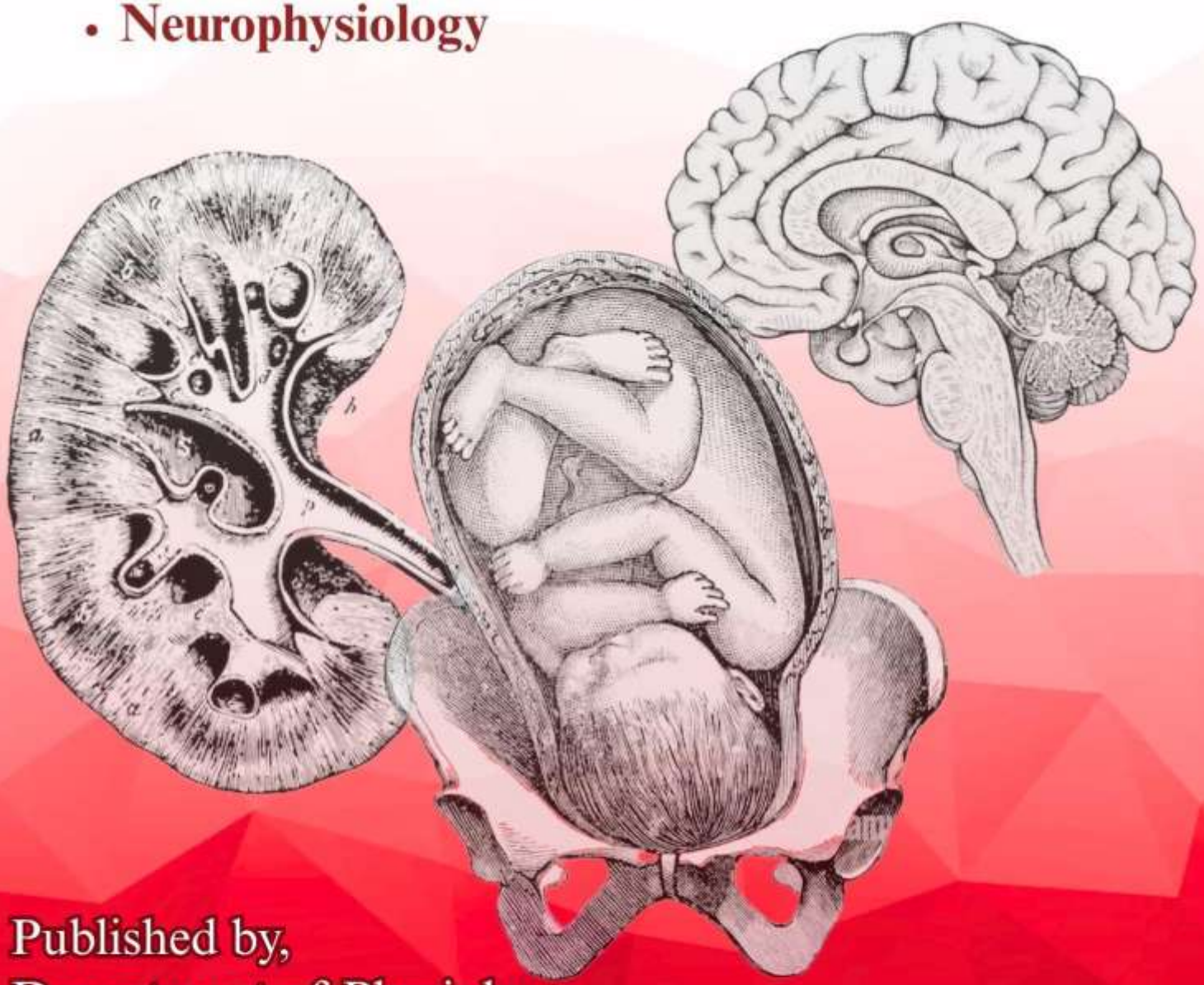
MASTERING PHYSIOLOGY
A Comprehensive Guide to MCQs, Essays, and OSPEs
Part III

Batch 1 & 2 - Semester 3 and 2nd MBBS

- **Renal Physiology**
- **Reproductive Physiology**
- **Neurophysiology**



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This book, including the multiple-choice questions (MCQs), answers, and rationales, is intended strictly for educational and examination review purposes for medical students. It is designed to reinforce learning and evaluate theoretical knowledge. It should not be treated as a clinical reference manual or used as a guide for real-world patient care, diagnosis, or treatment.

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Message from the Vice Chancellor

Dear Students,

It gives me great pleasure to extend my heartfelt congratulations and sincere appreciation to the Faculty of Medicine, Uva Wellassa University of Sri Lanka, and particularly to Senior Professor Muditha Vidanapathirana, Dean of the Faculty of Medicine, for their remarkable achievement in successfully publishing "Mastering Physiology – Part III: A Comprehensive Guide to MCQs, Essays & OSPEs."

This publication serves as an exceptional academic resource, offering considerable value not only to the MBBS undergraduates of Uva Wellassa University of Sri Lanka but also to medical students throughout the country.

I strongly encourage students to make the best use of the high-quality learning materials developed by the Faculty of Medicine. Resources such as this guide can greatly enhance the learning process, making studies more organized, productive, and rewarding.

I wish you every success in your future academic pursuits and professional careers.

Senior Professor Kolitha B. Wijesekara
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26.01.2026

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PHYSIOLOGY PRACTICE MCQ (T/F & SBR) QUESTIONS

1. Renal Physiology
2. Reproductive Physiology
3. Neurophysiology

Renal Physiology

Multiple Choice Questions

(1)True or False regarding the kidney and nephrons?

(A) A total of 1 million nephrons is present in a human.
(B) Nephrons are the functional units of the kidney.
(C) The loop of Henle establishes the corticomedullary osmotic gradient through countercurrent multiplication.
(D) Renin is secreted by the macula densa cells in response to increased sodium delivery.
(E) Glucose is reabsorbed in the nephron by passive diffusion alone.

(2)True or False regarding Glomerular filtration rate (GFR)?

(A) GFR is the volume of plasma filtered by all glomeruli per minute.
(B) GFR depends on renal blood flow alone and is independent of the properties of the filtration membrane.
(C) A decrease in plasma protein concentration leads to a decrease in GFR.
(D) Loss of the negative charge of the basement membrane favors the development of albuminuria.
(E) Afferent arteriolar constriction increases filtration fraction.

(3)True or False regarding renal clearance?

(A) It is the volume of plasma from which a substance is completely removed per unit time.
(B) Creatinine clearance is considered the gold standard for measuring GFR.
(C) Clearance of PAH is equal to renal blood flow.
(D) A rise in serum creatinine indicates acute renal failure.
(E) The kidneys receive approximately 20–25% of the cardiac output.

(4)True or False regarding tubular functions?

(A) Glucose is completely reabsorbed in the proximal tubule.
(B) Vasopressin increases urine osmolality by increasing water permeability of the collecting ducts.
(C) Osmotic diuresis occurs when solutes in the tubular fluid reduce water reabsorption.
(D) Loop diuretics acts by inhibiting Na^+–K^+–$2Cl^-$ transport in the thick ascending limb.
(E) Urine osmolality is increased in diabetes insipidus.

(5)True or False regarding acid-base physiology?

(A) Normal arterial blood pH is approximately 7.40.
(B) A small change in blood pH reflects a large change in hydrogen ion concentration.
(C) The lungs regulate H^+ homeostasis mainly by altering bicarbonate excretion.
(D) Renal excretion of hydrogen ions occurs primarily as titratable acid and ammonium.
(E) In metabolic acidosis, the primary compensatory response is an increase in alveolar ventilation.

(6)True or False regarding bladder function and micturition?

(A) The detrusor muscle of the bladder is composed of smooth muscle fibers.
(B) Micturition is initiated by stretch receptors located in the bladder wall.
(C) Parasympathetic nerve activity facilitates bladder filling by relaxing the detrusor muscle.
(D) The external urethral sphincter is under voluntary control and composed of skeletal muscle.
(E) Damage to the sacral segments of the spinal cord can impair the micturition reflex.

(7)True or False regarding assessment of renal function and urinalysis?

(A) The presence of red cell casts on urine microscopy suggests a glomerular cause of hematuria.
(B) Urine dipstick testing can reliably distinguish between hematuria and hemoglobinuria.
(C) Low urine specific gravity and urine osmolality indicate impaired renal concentrating ability.
(D) Proteinuria detected on dipstick testing is most commonly due to tubular dysfunction.
(E) Intravenous pyelography (IVP) primarily assesses renal endocrine function.

Single Best Response Questions

(8)A 62-year-old man presents with reduced urine output after two days of severe vomiting and diarrhea. He is hypotensive, and investigations show elevated urea and creatinine with no proteinuria. Renal ultrasound is normal.

What is the most likely physiological cause of the reduced glomerular filtration rate (GFR)?

(A) Increased plasma colloid osmotic pressure
(B) Loss of negative charge of the glomerular basement membrane
(C) Efferent arteriolar constriction reducing glomerular capillary pressure
(D) Increased Bowman's capsule pressure due to urinary obstruction
(E) Increased filtration coefficient due to glomerular membrane damage

(9)A 45-year-old man with early essential hypertension is started on an angiotensin-converting enzyme (ACE) inhibitor. Shortly after initiation, his renal blood flow increases, but his glomerular filtration rate (GFR) falls slightly.
Which change in renal arteriolar tone best explains this finding?

(A) Constriction of the afferent arteriole
(B) Dilation of the afferent arteriole
(C) Constriction of the efferent arteriole
(D) Dilation of the efferent arteriole
(E) Increased permeability of the glomerular filtration membrane

(10) A 25-year-old man presents with polyuria and polydipsia. Laboratory investigations show a very low urine osmolality despite normal plasma osmolality. Administration of desmopressin results in a marked increase in urine osmolality.

Which of the following is the most likely physiological mechanism responsible for the improvement in urine concentration after desmopressin?

(A) Increased Na^+–K^+–$2Cl^-$ reabsorption in the thick ascending limb
(B) Increased insertion of aquaporin-2 channels in the collecting ducts
(C) Reduced osmotic gradient in the renal medulla
(D) Decreased glomerular filtration rate
(E) Increased proximal tubular glucose reabsorption

(11) A 48-year-old man with long-standing poorly controlled diabetes mellitus presents with excessive urination and thirst. Laboratory investigations show high plasma glucose, glycosuria, and increased urine volume with moderately increased urine osmolality.

Which of the following is the most likely physiological mechanism responsible for his polyuria?

(A) Reduced action of vasopressin on the collecting ducts
(B) Decreased Na^+ reabsorption in the thick ascending limb
(C) Saturation of tubular glucose transporters reducing water reabsorption
(D) Increased glomerular filtration rate due to afferent arteriolar dilation
(E) Reduced medullary osmotic gradient due to loop diuretic action

(12) A 56-year-old man with severe diarrhea for 3 days presents with weakness and rapid breathing. Arterial blood gas analysis shows:

pH: 7.28
$PaCO_2$: 30 mmHg
HCO_3^-: 14 mmol/L

Which of the following best explains the observed change in $PaCO_2$?

(A) Primary respiratory alkalosis due to anxiety
(B) Renal retention of hydrogen ions
(C) Respiratory compensation for metabolic acidosis
(D) Impaired renal ammonium excretion
(E) Increased bicarbonate reabsorption in the proximal tubule

(13) A 28-year-old man presents with facial puffiness, cola-colored urine, and reduced urine output following a sore throat 2 weeks earlier. Urinalysis shows protein ++, numerous red blood cells, and red cell casts. Serum creatinine is mildly elevated. Renal ultrasound shows normal-sized kidneys with no obstruction.

Which of the following findings best explains the underlying renal dysfunction in this patient?

(A) Increased tubular secretion of creatinine
(B) Loss of concentrating ability due to tubular damage
(C) Increased permeability of the glomerular filtration membrane
(D) Obstruction to urine flow at the level of the ureter
(E) Reduced renal blood flow due to renal artery stenosis

Reproductive Physiology

Multiple Choice Questions

(14)True or False regarding sex determination and sexual differentiation?

(A) Sex chromosomes are the chromosomes that determine the genetic sex of an individual.
(B) The SRY gene codes for Müllerian inhibiting substance.
(C) Müllerian inhibiting substance is secreted by Sertoli cells of the developing testis.
(D) In the absence of testosterone, female internal genitalia develop by default.
(E) Development of male external genitalia from the bipotential external genitalia requires DHT.

(15)True or False regarding male reproductive physiology?

(A) The testis performs both exocrine and endocrine functions.
(B) Spermiogenesis is the transformation of spermatids into mature spermatozoa.
(C) Leydig cells secrete testosterone.
(D) The blood-testes barrier is formed by tight junctions between Sertoli cells.
(E) DHT is the principal androgen responsible for maintenance of spermatogenesis.

(16)True or False regarding puberty and adolescence?

(A) Puberty is the attainment of behavioral maturity.
(B) Secondary sexual characteristics develop due to sex steroid hormones.
(C) Increased leptin causes delayed puberty.
(D) Low GnRH secretion prevents reproductive maturation before puberty.
(E) True precocious puberty is GnRH-independent, unlike pseudo-precocious puberty.

(17)True or False regarding menstruation, ovarian cycle and menopause?

(A) Menstruation occurs due to the reduced concentration of progesterone.
(B) It is abnormal to have a cycle of 35 days in an adult.
(C) The LH surge during the mid-cycle triggers ovulation.
(D) Progesterone causes an increase in basal body temperature during the luteal phase.
(E) After menopause, ovarian estrogen production increases due to elevated FSH and LH levels.

(18)True or False regarding sexual desire and sexual response?

(A) Libido is primarily influenced by testosterone levels in both males and females.
(B) Penile erection is mainly mediated by sympathetic activity.
(C) Emission is mediated by parasympathetic stimulation.
(D) In females, orgasm is associated with rhythmic contractions of pelvic floor muscles and uterus.
(E) Ageing is associated with complete loss of sexual function in both males and females.

(19)True or False regarding fertilization, pregnancy, placenta, and lactation?

(A) The ovum remains viable for fertilization for approximately 24 hours after ovulation.
(B) Capacitation is the process by which the sperm penetrates the zona pellucida of the ovum.
(C) Human chorionic gonadotropin (hCG) maintains the corpus luteum during early pregnancy.
(D) Lower limb venous stasis in pregnancy is due to the enlarged uterus compressing the pelvic veins.
(E) High levels of estrogen and progesterone during pregnancy stimulate milk secretion.

(20)True or False regarding contraception and family planning?

(A) Family planning is the ability to determine the number and spacing of their children.
(B) The safe period method estimates the fertile window based on the timing of ovulation.
(C) Combined oral contraceptive pills primarily prevent pregnancy by inhibiting ovulation.
(D) Copper IUCDs prevent pregnancy mainly by suppressing pituitary gonadotropin secretion.
(E) Condoms provide protection against both pregnancy and sexually transmitted infections.

Single Best Response Questions

(21)A 32-year-old man presents to a fertility clinic with inability to conceive after 2 years of unprotected intercourse. Semen analysis reveals low sperm count, reduced motility, and normal semen volume. Hormonal evaluation shows normal FSH, normal LH, but low intratesticular testosterone levels. A testicular biopsy demonstrates intact seminiferous tubules with Sertoli cells present, but impaired spermatogenesis.

Which of the following is the most likely physiological explanation for his infertility?

(A) Failure of Sertoli cells to form the blood–testis barrier
(B) Reduced secretion of inhibin B leading to increased FSH
(C) Impaired Leydig cell testosterone production affecting spermatogenesis
(D) Defective conversion of testosterone to dihydrotestosterone in peripheral tissues
(E) Reduced seminal vesicle secretion resulting in abnormal seminal plasma composition

(22) A 7-year-old girl is brought to the pediatric clinic because of breast development and pubic hair noticed over the past 6 months. Her height velocity has increased, and bone age is advanced for her chronological age. Laboratory investigations show elevated LH levels that rise further after GnRH stimulation. Pelvic USS enlarged ovaries and uterus.

Which of the following best explains the underlying physiological mechanism responsible for this child's condition?

(A) Premature activation of the hypothalamic–pituitary–gonadal axis
(B) Excess adrenal androgen secretion independent of GnRH
(C) Increased sensitivity of peripheral estrogen receptors
(D) Delayed maturation of inhibitory neural pathways to GnRH neurons
(E) Autonomous ovarian estrogen secretion without pituitary involvement

(23) A 24-year-old woman with regular 28-day menstrual cycles wishes to delay her upcoming menstruation due to a planned religious event. Her last menstrual period began 14 days ago. She has no medical problems.

Which of the following best explains the physiological basis of delaying menstruation?

(A) Suppression of the mid-cycle LH surge to prevent ovulation
(B) Continuous administration of progesterone to prevent withdrawal bleeding
(C) Administration of oestrogen alone to stimulate endometrial proliferation
(D) Suppression of FSH to prevent follicular development
(E) Increasing prostaglandin synthesis in the endometrium

(24) A 52-year-old man with long-standing diabetes mellitus presents with difficulty achieving and maintaining an erection. He reports normal sexual desire. On examination, peripheral neuropathy is present.

Which of the following is the most likely mechanism responsible for his erectile dysfunction?

(A) Reduced testosterone production by Leydig cells
(B) Impaired parasympathetic-mediated vasodilation of penile arteries
(C) Failure of sympathetic stimulation during emission
(D) Increased prolactin secretion suppressing libido
(E) Psychological aversion to sexual activity

(25) A 26-year-old woman with a regular 28-day menstrual cycle has unprotected intercourse on day 13. Ovulation is expected on day 14. She asks about the likelihood of pregnancy.

Which of the following physiological factors most contributes to the possibility of fertilization in this situation?

(A) The ovum remains viable for 7 days after ovulation
(B) Sperm remain viable in the female reproductive tract for up to 3–5 days
(C) Implantation occurs immediately after fertilization
(D) hCG secretion occurs before fertilization
(E) The corpus luteum degenerates immediately after ovulation

(26) A 28-year-old woman requests a long-acting reversible contraceptive that can last several years without daily compliance. Which of the following methods best meets this requirement?

(A) Combined oral contraceptive pill
(B) Male condom
(C) Copper intrauterine contraceptive device (IUCD)
(D) Calendar (safe period) method
(E) Post-coital emergency contraception

Neurophysiology

Multiple Choice Questions

(27)True or False regarding sensory modalities, receptors, pathways and cortical processing?

(A) Sensory receptors are classified based on the type of stimulus they detect.
(B) A receptor potential is an all-or-none response similar to an action potential.
(C) Stimulus intensity is coded by AP frequency and number of recruited receptors.
(D) Fine touch and proprioception ascend mainly via the spinothalamic tract.
(E) Cortical reorganization after limb amputation contributes to phantom limb sensations.

(28)True or False regarding pain pathways, referred pain and modulation?

(A) Pain is considered a purely sensory experience without emotional components.
(B) Fast pain is transmitted mainly by Aδ fibers.
(C) Visceral pain is often poorly localized compared to somatic pain.
(D) Merging of visceral and somatic afferents onto the same 2nd-order neuron causes referred pain.
(E) Endorphins and enkephalins reduce pain transmission by inhibiting substance P release.

(29)True or False regarding voluntary and involuntary motor activity and motor cortex organization?

(A) Voluntary movements are initiated primarily in the motor cortex and require conscious control.
(B) Reflex movements such as the withdrawal reflex are examples of involuntary motor activity.
(C) The primary motor cortex is located in the precentral gyrus of the frontal lobe.
(D) The motor homunculus represents equal cortical areas for all body parts.
(E) The premotor cortex and supplementary motor area contribute to motor planning.

(30)True or False regarding sensory pathway lesions?

(A) A lesion of the dorsal columns causes loss of vibration and proprioception.
(B) The spinothalamic tract mainly carries fine touch and proprioception.
(C) Spinothalamic tract lesions cause loss of pain and temperature sensation.
(D) Dorsal column fibers cross in the spinal cord near the level of entry.
(E) Sensory cortex lesions may impair localization of sensory stimuli.

(31)True or False regarding descending motor tracts?

(A) Corticospinal tract is the main pathway for voluntary limb movement.
(B) Corticobulbar tract mainly controls motor nuclei of cranial nerves.
(C) Corticospinal fibers cross mainly in the spinal cord.
(D) Extrapyramidal tracts help regulate posture and muscle tone.
(E) Corticospinal tract lesions cause flaccid paralysis below the lesion.

(32)True or False regarding thermoregulation and body temperature?

(A) Humans are homeothermic and maintain a relatively constant core temperature.
(B) Normal core body temperature in adults is about 37°C.
(C) Radiation is the main method of heat gain during exercise.
(D) The hypothalamus acts as the main center for temperature regulation.
(E) Brown adipose tissue helps generate heat in infants.

(33)True or False regarding hypothalamic control of feeding and thirst?

(A) Suprachiasmatic nucleus regulates circadian rhythms.
(B) Ventromedial hypothalamus stimulates hunger.
(C) Ghrelin released from stomach increases appetite.
(D) Leptin from adipose tissue stimulates feeding.
(E) Hypothalamic osmoreceptors detect plasma osmolarity.

(34)True or False regarding descending motor pathways?

(A) Corticospinal tract controls voluntary skilled limb movements.
(B) Vestibulospinal tracts originate from vestibular nuclei in the brainstem.
(C) Corticospinal fibers mainly cross in the spinal cord.
(D) Reticulospinal tracts contribute to posture and muscle tone.
(E) Rubrospinal tract originates from the cerebellum.

(35)True or False regarding vision, retina and visual pathways?

(A) The fovea contains a high density of cones for visual acuity.
(B) The blind spot contains rods and no cones.
(C) Rods are responsible for color vision in bright light.
(D) Myopia occurs when image forms in front of the retina.
(E) Aqueous humor obstruction can increase intraocular pressure.

(36)True or False regarding hearing and vestibular physiology?

(A) Sound frequency determines loudness.
(B) Amplitude of sound waves determines the pitch of the sound.
(C) Organ of Corti is located in the semicircular canals.
(D) Weber test compares air conduction with bone conduction.
(E) Semicircular canals detect angular acceleration of the head.

(37)True or False regarding consciousness, EEG & sleep?

(A) Reticular activating system maintains wakefulness.
(B) Beta waves are seen during deep slow wave sleep.
(C) Non-REM sleep shows rapid eye movements and vivid dreams.
(D) Sleep cycle repeats about every 90 minutes in adults.
(E) Narcolepsy is characterized by sudden sleep attacks.

(38)True or False regarding CSF, BBB and ICP?

(A) CSF is mainly produced by the choroid plexus in ventricles.
(B) CSF protein concentration is higher than plasma.
(C) CSF is absorbed via arachnoid villi into venous sinuses.
(D) Blood-brain barrier allows free passage of all drugs.
(E) Raised ICP can reduce cerebral perfusion.

(39)True or False regarding smell and taste?

(A) Olfactory receptors are bipolar neurons in nasal epithelium.
(B) Olfactory pathway relays first in the thalamus before cortex.
(C) Taste buds are mainly located on tongue papillae.
(D) Bitter taste is mediated by ion channels directly.
(E) Olfactory nerve fibers pass through the cribriform plate.

(40)True or False regarding higher cortical functions and limbic system?

(A) Hippocampus is essential for memory consolidation.
(B) Broca's area is responsible for language comprehension.
(C) Left hemisphere is dominant for language in most people.
(D) Limbic system regulates emotion and motivation.
(E) Wernicke's area controls speech production.

Single Best Response Questions

(41)A patient sustains a right-sided lesion of the dorsal columns at T10. Which deficit is most likely below the level of the lesion?

(A) Loss of pain and temperature on the right side
(B) Loss of pain and temperature on the left side
(C) Loss of fine touch and proprioception on the right side
(D) Loss of fine touch and proprioception on the left side
(E) Bilateral loss of crude touch

(42)A 55-year-old man presents with central chest pain radiating to the left arm. ECG shows myocardial ischemia. The radiation of pain to the arm is best explained by,

(A) Direct spread of pain through sympathetic fibers to the arm
(B) Cortical misinterpretation due to separate thalamic nuclei
(C) Convergence of cardiac and somatic afferents in the spinal cord
(D) Increased activation of Aβ fibers
(E) Loss of descending inhibition

(43) A 60-year-old man develops difficulty initiating voluntary movements after a lesion in the premotor cortex. Which of the following best explains the primary role of this cortical region?

(A) Execution of muscle contraction
(B) Generation of motor plan before movement
(C) Maintenance of muscle tone through spinal reflexes
(D) Transmission of sensory information to the thalamus
(E) Coordination of balance and posture

(44) A 50-year-old man develops a right-sided spinal cord lesion at the T10 level after trauma. On examination, he has loss of vibration sense and joint position sense below the lesion on the same side, while pain and temperature are preserved.

Which sensory pathway is most likely damaged?

(A) Spinothalamic tract
(B) Dorsal column–medial lemniscus pathway
(C) Spinocerebellar tract
(D) Corticospinal tract
(E) Vestibulospinal tract

(45) A 60-year-old man develops weakness of the right arm and leg after a stroke affecting the left internal capsule. On examination, there is spasticity, increased reflexes, and a positive Babinski sign on the right side.

Which descending motor pathway is most likely damaged?

(A) Vestibulospinal tract
(B) Reticulospinal tract
(C) Corticospinal tract
(D) Rubrospinal tract
(E) Tectospinal tract

(46) A 10-year-old child develops fever due to a bacterial infection. His body temperature rises to 39°C. The increase in temperature occurs because pyrogens stimulate the production of prostaglandin E_2 in the hypothalamus, which raises the thermoregulatory set point.

Which of the following physiological responses is most likely to occur during the onset of fever?

(A) Peripheral vasodilation and sweating
(B) Peripheral vasoconstriction and shivering
(C) Increased sweating and decreased metabolism
(D) Reduced muscle tone and decreased heat production
(E) Immediate heat loss through radiation

(47) A 45-year-old man develops excessive hunger and weight gain after a hypothalamic lesion. Imaging shows damage to the ventromedial nucleus of the hypothalamus.

Which of the following best explains his symptoms?

(A) Loss of the hypothalamic thirst center
(B) Damage to the satiety center leading to hyperphagia
(C) Reduced secretion of ghrelin from the stomach
(D) Reduced activity of the lateral hypothalamic feeding center
(E) Increased leptin sensitivity

(48) A 58-year-old man develops weakness of the right arm and leg after a stroke affecting the left internal capsule. On examination, he has spasticity, hyperreflexia, and a positive Babinski sign on the right side.

Which descending pathway is most likely damaged?

(A) Vestibulospinal tract
(B) Reticulospinal tract
(C) Corticospinal tract
(D) Tectospinal tract
(E) Spinothalamic tract

(49) A 22-year-old student complains of difficulty seeing distant objects clearly, but near vision is normal. Examination shows that parallel rays of light are focused in front of the retina.

Which of the following best explains this condition?

(A) Reduced refractive power of the lens
(B) Shortened axial length of the eyeball
(C) Increased axial length of the eyeball
(D) Loss of rod function in the retina
(E) Damage to the optic nerve

(50) A 40-year-old man complains of reduced hearing in his right ear.
On examination:
Rinne test: Bone conduction > Air conduction (right ear)
Weber test: Sound lateralizes to the right ear

What is the most likely diagnosis?

(A) Sensorineural deafness in right ear
(B) Conductive deafness in right ear
(C) Sensorineural deafness in left ear
(D) Normal hearing
(E) Bilateral sensorineural deafness

(51) A 22-year-old student reports sudden daytime sleep episodes and brief loss of muscle tone when laughing. Night sleep is fragmented.

Which condition best explains this?

(A) Obstructive sleep apnoea
(B) Narcolepsy
(C) Somnambulism
(D) Insomnia
(E) REM sleep behavior disorder

(52) A 45-year-old man presents with headache, vomiting, and papilledema. Imaging shows ventricular dilation due to impaired CSF absorption.

Which structure is most likely affected?

(A) Choroid plexus
(B) Arachnoid villi
(C) Circle of Willis
(D) Blood-brain barrier
(E) Ependymal cells

(53) A 28-year-old man presents after a road traffic accident with loss of smell. He can still detect sweet and salty tastes but complains that food has "no flavor." Examination shows no facial nerve weakness. Imaging reveals a fracture involving the cribriform plate.

Which of the following best explains his symptoms?

(A) Loss of olfactory receptor input affecting flavor perception
(B) Damage to chorda tympani affecting anterior tongue taste
(C) Lesion of glossopharyngeal nerve affecting posterior taste
(D) Impaired ion channel function in taste receptor cells
(E) Loss of trigeminal nerve function affecting oral sensation

(54) A 58-year-old right-handed man develops difficulty speaking after a stroke. He understands spoken language but produces slow, effortful speech with incorrect word formation. Motor function is otherwise normal.

Which area is most likely affected?

(A) Wernicke's area
(B) Broca's area
(C) Hippocampus
(D) Prefrontal cortex
(E) Right parietal cortex

PHYSIOLOGY PRACTICE MCQ (T/F & SBR) ANSWERS

(1)

(A) **F** - Each human kidney contains approximately 1 million nephrons (range ~0.8–1.5 million). Nephron number is fixed at birth and declines gradually with age.

(B) **T -** Nephrons perform the essential renal processes: (1) Filtration (2) Reabsorption (3) Secretion (4) Excretion. Without nephrons, the kidney cannot regulate fluid, electrolytes, or waste removal.

(C) **T -** The descending limb is permeable to water but not solutes. The thick ascending limb actively reabsorbs Na^+, K^+, and Cl^- but is impermeable to water. This arrangement creates a progressively increasing osmotic gradient from cortex to medulla (countercurrent multiplication).

(D) **F** - Renin is secreted by juxtaglomerular (JG) cells, not macula densa cells. Increased NaCl delivery to the macula densa actually suppresses renin release. Decreased NaCl delivery → macula densa signals JG cells → ↑ renin secretion.

(E) **F** - Glucose is reabsorbed in the proximal convoluted tubule by: Secondary active transport via Na^+–glucose cotransporters (SGLT2 and SGLT1). It then exits the cell via facilitated diffusion (GLUT transporters). Passive diffusion alone is not sufficient.

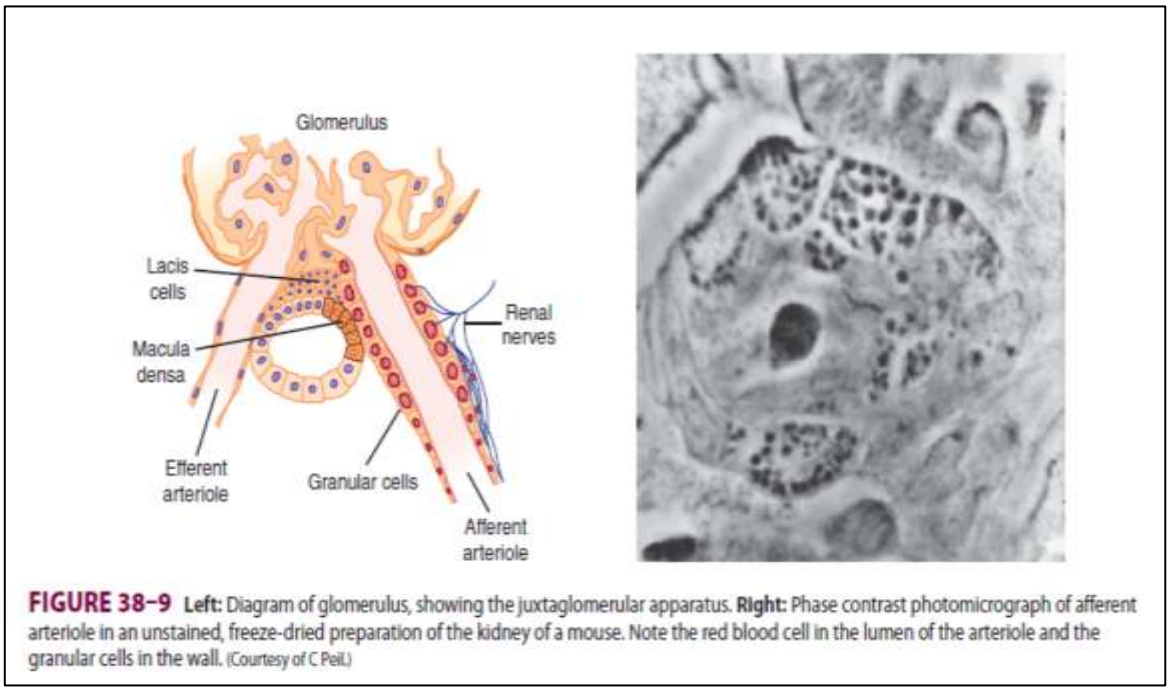

FIGURE 38–9 **Left:** Diagram of glomerulus, showing the juxtaglomerular apparatus. **Right:** Phase contrast photomicrograph of afferent arteriole in an unstained, freeze-dried preparation of the kidney of a mouse. Note the red blood cell in the lumen of the arteriole and the granular cells in the wall. (Courtesy of C Peil.)

Ganong's Review of Medical Physiology 24th Edition p.705

(2)

(A) **T -** GFR represents the total filtration rate of plasma across all functioning glomeruli per unit time. In a healthy adult, it is approximately 125 mL/min.

(B) **F** - GFR depends on: (1) Renal blood flow (2) Net filtration pressure (3) Filtration coefficient (Kf), which reflects the surface area and permeability of the glomerular filtration membrane. Changes in membrane integrity directly affect GFR.

(C) **F -** Plasma proteins contribute to plasma colloid osmotic pressure, which opposes filtration. A decrease in plasma protein concentration: (1) ↓ oncotic pressure (2) ↓ opposition to filtration (3) → increase in GFR

(D) **T -** The glomerular basement membrane normally has a negative charge that repels negatively charged proteins such as albumin. Loss of this charge increases permeability to albumin → albuminuria.
(E) **F -** Afferent arteriolar constriction: (1) ↓ renal blood flow (2) ↓ glomerular capillary pressure (3) ↓ GFR. Filtration fraction (GFR/RPF) therefore decreases, not increases.

TABLE 37–4 Factors affecting the GFR.

Changes in renal blood flow
Changes in glomerular capillary hydrostatic pressure
Changes in systemic blood pressure
Afferent or efferent arteriolar constriction
Changes in hydrostatic pressure in Bowman's capsule
Ureteral obstruction
Edema of kidney inside tight renal capsule
Changes in concentration of plasma proteins: dehydration, hypoproteinemia, etc (minor factors)
Changes in K_f
Changes in glomerular capillary permeability
Changes in effective filtration surface area

Ganong's Review of Medical Physiology 24th Edition p.681

(3)

(A) **T** - This is the definition of renal clearance. It represents a virtual volume of plasma cleared of a substance per minute.
(B) **F** - Inulin clearance is the gold standard. Creatinine clearance only approximates GFR and slightly overestimates it due to tubular secretion.
(C) **F** - PAH clearance estimates effective renal plasma flow (ERPF), not renal blood flow. Some PAH escapes excretion, so clearance is slightly less than actual RPF. Renal blood flow must be calculated using hematocrit.
(D) **F** - Serum creatinine may rise in chronic kidney disease, dehydration, or high muscle mass. It does not always indicate acute renal failure.
(E) **T** - Despite their small size, kidneys receive a large fraction of cardiac output to support filtration.

TABLE 37–2 Normal clearance values of different solutes.

Substance	Clearance (mL/min)
Glucose	0
Sodium	0.9
Chloride	1.3
Potassium	12
Phosphate	25
Urea	75
Inulin	125
Creatinine	140
PAH	560

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(4)

(A) **T** - Under normal conditions, all filtered glucose is reabsorbed in the proximal convoluted tubule via Na^+–glucose cotransporters, as long as the transport maximum is not exceeded.
(B) **T** - Vasopressin (ADH) increases insertion of aquaporin-2 channels in the collecting duct, enhancing water reabsorption and producing concentrated urine.
(C) **T** - Non-reabsorbed solutes (e.g., glucose, mannitol) retain water in the tubular lumen, leading to increased urine output.
(D) **T** - Loop diuretics (e.g., frusemide) block the NKCC2 cotransporter, reducing medullary hypertonicity and impairing urine concentration.
(E) **F** - In diabetes insipidus, lack of ADH action results in dilute urine with low osmolality.

TABLE 37–5 Transport proteins involved in the movement of Na^+ and Cl^- across the apical membranes of renal tubular cells.[a]

Site	Apical Transporter	Function
Proximal tubule	Na/glucose CT	Na^+ uptake, glucose uptake
	Na^+/P_i CT	Na^+ uptake, P_i uptake
	Na^+ amino acid CT	Na^+ uptake, amino acid uptake
	Na/lactate CT	Na^+ uptake, lactate uptake
	Na/H exchanger	Na^+ uptake, H^+ extrusion
	Cl/base exchanger	Cl^- uptake
Thick ascending limb	Na–K–2Cl CT	Na^+ uptake, Cl^- uptake, K^+ uptake
	Na/H exchanger	Na^+ uptake, H^+ extrusion
	K^+ channels	K^+ extrusion (recycling)
Distal convoluted tubule	NaCl CT	Na^+ uptake, Cl^- uptake
Collecting duct	Na^+ channel (ENaC)	Na^+ uptake

[a]Uptake indicates movement from tubular lumen to cell interior, extrusion is movement from cell interior to tubular lumen. CT, cotransporter; P_i, inorganic phosphate.

Data from Schnermann JB, Sayegh EI: *Kidney Physiology*. Lippincott-Raven, 1998.

Ganong's Review of Medical Physiology 24th Edition p.682

(5)

(A) **T -** Normal arterial blood pH is tightly regulated between 7.35 and 7.45, with a mean value of 7.40. This corresponds to a hydrogen ion concentration of about 40 nmol/L. Even small deviations from this range can significantly affect enzyme activity, membrane stability, and cellular metabolism, highlighting the importance of strict pH regulation.

(B) **T** - pH is a logarithmic measure of hydrogen ion concentration ($pH = -\log_{10}[H^+]$). Therefore, a change of 0.3 pH units represents a doubling or halving of H^+ concentration. For

example, a fall in pH from 7.40 to 7.10 nearly doubles the hydrogen ion concentration, making even minor pH changes physiologically significant.

(C) **F** - The lungs regulate acid–base balance by controlling the elimination of carbon dioxide (CO_2) through ventilation. CO_2 combines with water to form carbonic acid, which dissociates into H^+ and HCO_3^-. By increasing or decreasing ventilation, the lungs alter $PaCO_2$ and thus blood pH. Bicarbonate excretion and regeneration are renal functions, not pulmonary.

(D) **T** - The kidneys cannot excrete free hydrogen ions in large amounts due to urine pH limitations. Instead, H^+ is buffered and excreted mainly as titratable acid (H^+ buffered by phosphate) and ammonium (NH_4^+) formed from renal metabolism of glutamine. These mechanisms allow the kidneys to eliminate acid loads and generate new bicarbonate, playing a critical role in long-term acid–base regulation.

(E) **T** - In metabolic acidosis, the primary disturbance is a fall in plasma bicarbonate concentration. The body compensates by increasing alveolar ventilation (hyperventilation) to reduce $PaCO_2$, thereby lowering carbonic acid levels and partially correcting the pH. This respiratory compensation is rapid and is classically seen as Kussmaul breathing in severe metabolic acidosis.

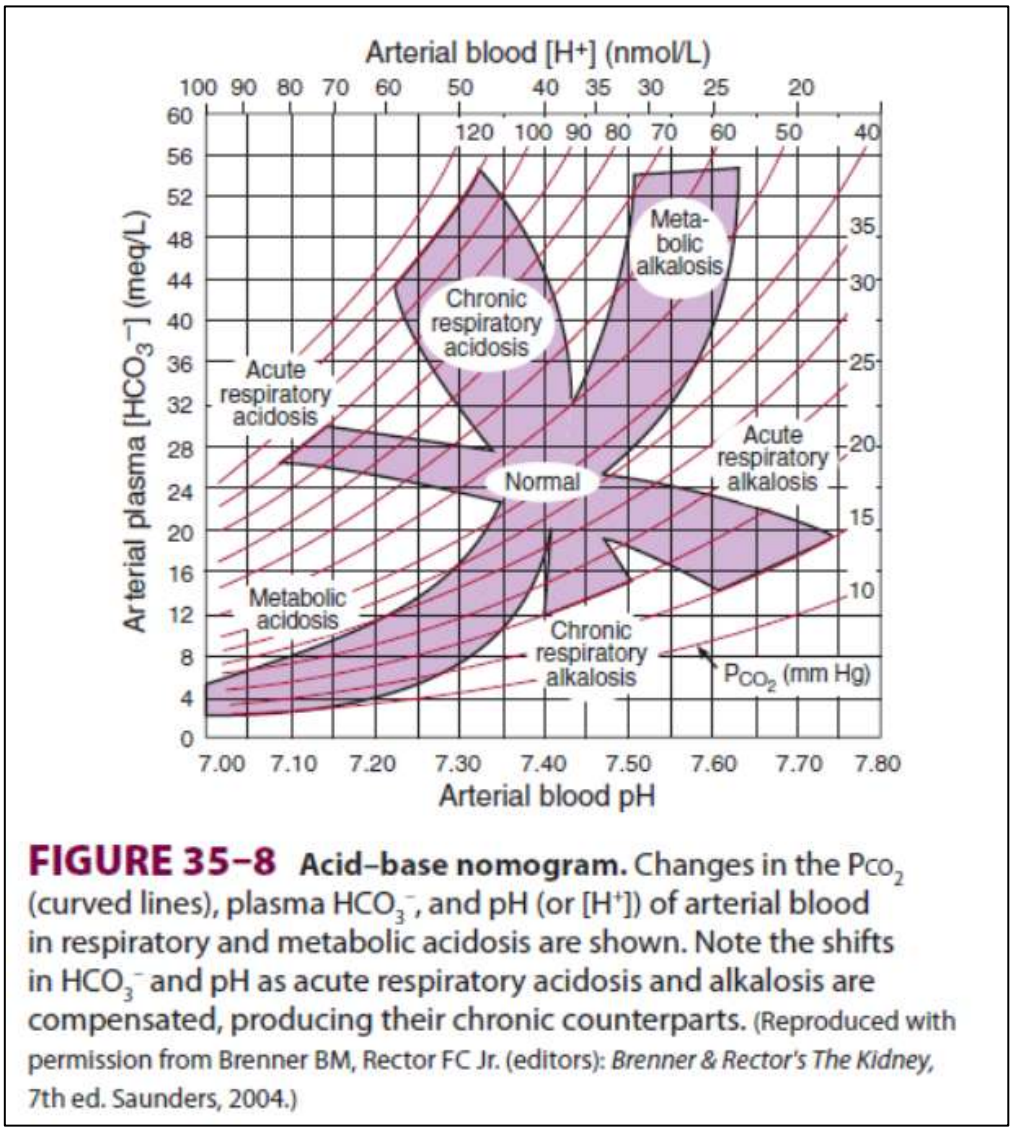

FIGURE 35–8 **Acid–base nomogram.** Changes in the P_{CO_2} (curved lines), plasma HCO_3^-, and pH (or $[H^+]$) of arterial blood in respiratory and metabolic acidosis are shown. Note the shifts in HCO_3^- and pH as acute respiratory acidosis and alkalosis are compensated, producing their chronic counterparts. (Reproduced with permission from Brenner BM, Rector FC Jr. (editors): *Brenner & Rector's The Kidney*, 7th ed. Saunders, 2004.)

Ganong's Review of Medical Physiology 24th Edition p. 647

(6)

(A) **T** - The detrusor muscle forms the main muscular wall of the urinary bladder and is composed of smooth muscle fibers arranged in multiple directions. This structure allows uniform contraction during micturition, generating sufficient pressure to expel urine.

(B) **T -** As the bladder fills, stretch receptors in the bladder wall are activated. These receptors send afferent impulses via pelvic nerves to the sacral spinal cord (S2–S4), initiating the micturition reflex. Increasing bladder volume increases the frequency of afferent firing, strengthening the urge to void.

(C) **F -** Parasympathetic activity promotes bladder emptying, not filling. Parasympathetic fibers (pelvic nerves, S2–S4) release acetylcholine, which causes contraction of the detrusor muscle and relaxation of the internal urethral sphincter. Bladder filling is facilitated mainly by sympathetic activity, which relaxes the detrusor muscle.

(D) **T -** The external urethral sphincter consists of skeletal muscle and is innervated by the pudendal nerve. It is under voluntary control, allowing conscious initiation or inhibition of micturition, which is essential for continence.

(E) **T -** The micturition reflex is integrated at the sacral spinal cord (S2–S4). Damage to these segments disrupts parasympathetic outflow and afferent sensory input, leading to impaired or absent reflex bladder contractions, resulting in conditions such as areflexic (flaccid) bladder.

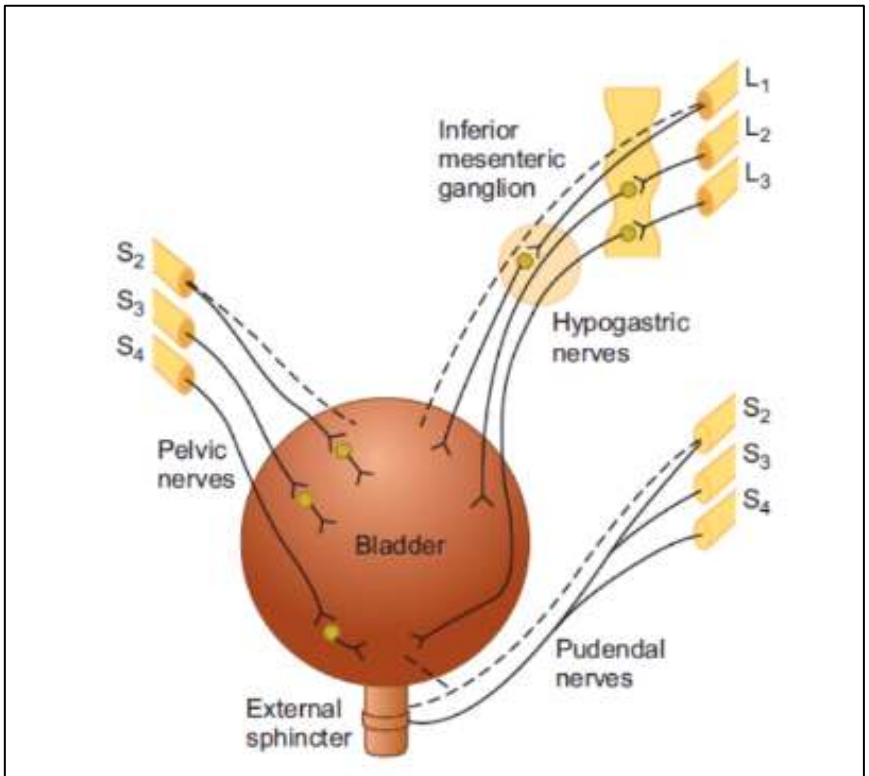

FIGURE 37–19 Innervation of the bladder. Dashed lines indicate sensory nerves. Parasympathetic innervation is shown at the left, sympathetic at the upper right, and somatic at the lower right.

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(7)

(A) **T -** Red blood cell (RBC) casts form when RBCs leak through a damaged glomerular filtration barrier and become trapped within Tamm–Horsfall protein in the renal tubules. Because casts are formed only within renal tubules, their presence indicates that bleeding originates within the kidney, most commonly from the glomeruli, as seen in conditions such as acute glomerulonephritis and nephritic syndrome.

(B) **F -** Urine dipstick testing for "blood" detects the heme moiety, which is present in intact red blood cells, free hemoglobin, and myoglobin. Therefore, a positive dipstick result cannot differentiate between hematuria and hemoglobinuria. Urine microscopy is required to identify intact RBCs and make this distinction.

(C) **T -** Urine specific gravity and urine osmolality both reflect the kidney's ability to concentrate or dilute urine. Persistently low values indicate that the kidneys are producing dilute urine. When this occurs inappropriately (e.g., despite dehydration), it suggests impaired concentrating ability, as seen in conditions such as diabetes insipidus, chronic kidney disease, or tubular dysfunction.

(D) **F -** Dipstick protein testing primarily detects albumin, a high–molecular-weight protein. The most common cause of albuminuria is glomerular damage, which increases permeability of the filtration membrane. Tubular proteinuria involves low–molecular-weight proteins and is usually not well detected by routine dipstick testing.

(E) **F -** Intravenous pyelography (IVP) is an imaging technique used to evaluate the anatomy and excretory function of the kidneys, ureters, and bladder. It is helpful in detecting obstruction, calculi, and structural abnormalities. Renal endocrine functions (e.g., erythropoietin or renin secretion) are assessed by laboratory tests, not imaging.

CLINICAL BOX 37–3

Proteinuria

In many renal diseases and in one benign condition, the permeability of the glomerular capillaries is increased, and protein is found in the urine in more than the usual trace amounts (**proteinuria**). Most of this protein is **albumin,** and the defect is commonly called albuminuria. The relation of charges on the glomerular membrane to albuminuria has been discussed above. The amount of protein in the urine may be very large, and especially in nephrosis, the urinary protein loss may exceed the rate at which the liver can synthesize plasma proteins. The resulting hypoproteinemia reduces the oncotic pressure, and the plasma volume declines, sometimes to dangerously low levels, while edema fluid accumulates in the tissues.

A benign condition that causes proteinuria is a poorly understood change in renal hemodynamics, which in some otherwise normal individuals, causes protein to appear in urine when they are in the standing position (**orthostatic albuminuria**). Urine formed when these individuals are lying down is protein-free.

Ganong's Review of Medical Physiology 24th Edition p. 693

(8)

Correct answer: A. Increased plasma colloid osmotic pressure opposing filtration

Explanation

This patient has features of pre-renal acute kidney injury:

- Severe vomiting and diarrhea → fluid loss
- Hypotension → reduced renal perfusion
- Raised urea and creatinine
- No proteinuria
- Normal renal ultrasound (rules out obstruction)

Physiological basis

Glomerular filtration rate (GFR) is determined by:

- Glomerular capillary hydrostatic pressure
- Bowman's capsule hydrostatic pressure
- Plasma colloid osmotic pressure
- Filtration coefficient (Kf)

In dehydration:

- Plasma volume decreases
- Plasma protein concentration increases
- Plasma colloid osmotic pressure rises
- This increased oncotic pressure opposes filtration across the glomerular capillary
- Result → reduced GFR

The intact filtration membrane explains the absence of proteinuria.

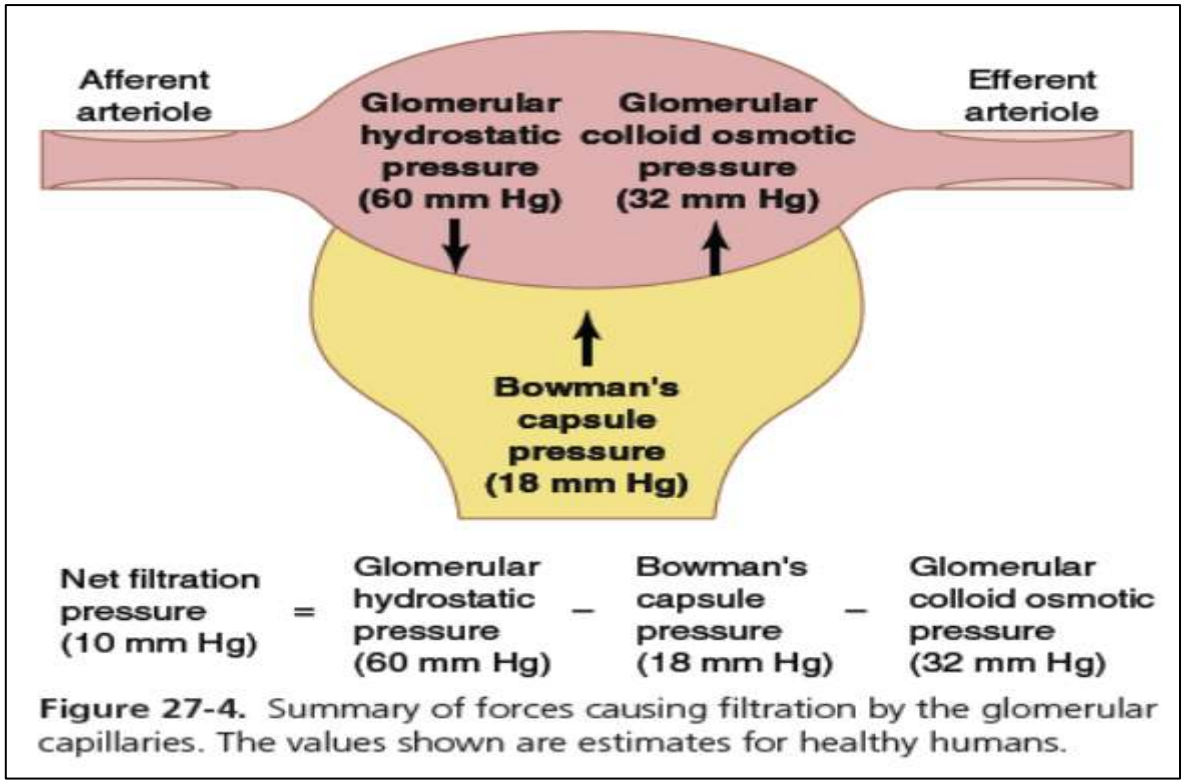


Figure 27-4. Summary of forces causing filtration by the glomerular capillaries. The values shown are estimates for healthy humans.

Guyton and Hall Textbook of Medical Physiology 14th edition p.333

(9)

Correct Answer: D. Dilation of the efferent arteriole

Explanation

Physiological basis

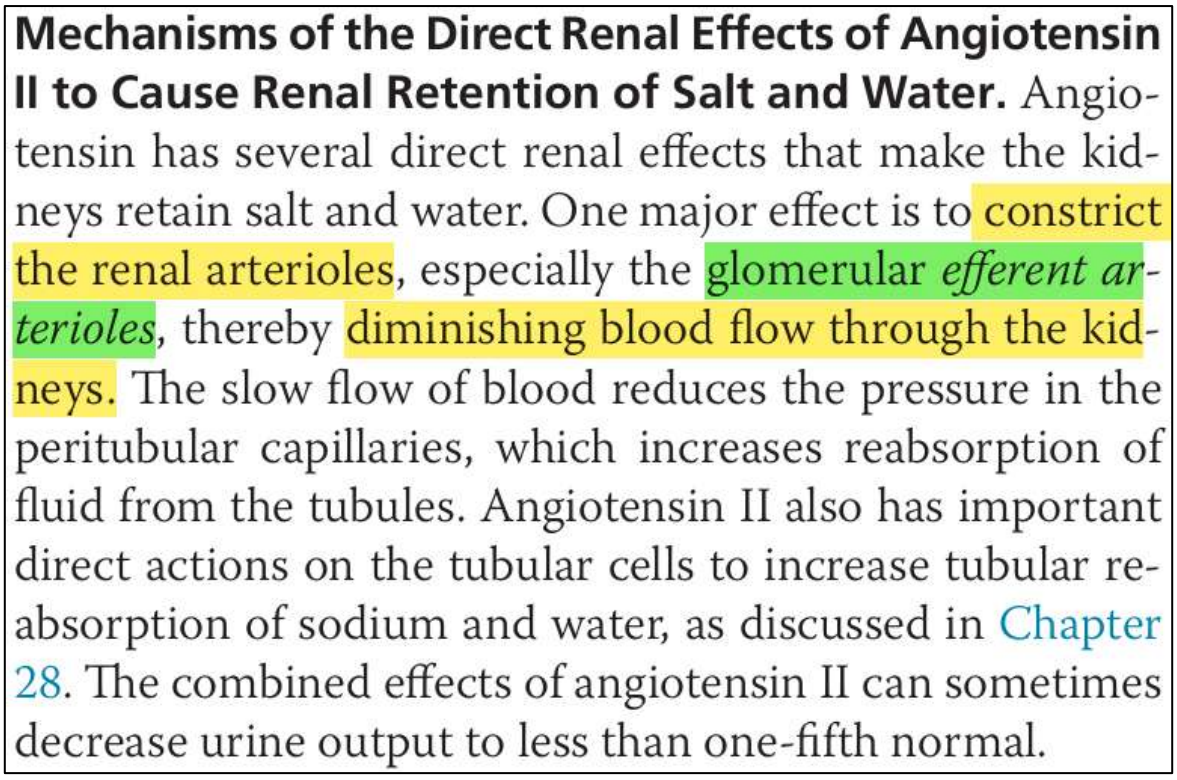
Angiotensin II preferentially causes efferent arteriolar constriction, which helps to:

- Maintain glomerular capillary hydrostatic pressure
- Preserve GFR, especially during reduced renal perfusion

ACE inhibitors block angiotensin II formation, leading to:

- Efferent arteriolar dilation
- Reduced glomerular capillary hydrostatic pressure
- Fall in GFR
- Increased renal blood flow
- Reduced filtration fraction

This explains the observed findings in this patient.



Mechanisms of the Direct Renal Effects of Angiotensin II to Cause Renal Retention of Salt and Water. Angiotensin has several direct renal effects that make the kidneys retain salt and water. One major effect is to constrict the renal arterioles, especially the glomerular *efferent arterioles*, thereby diminishing blood flow through the kidneys. The slow flow of blood reduces the pressure in the peritubular capillaries, which increases reabsorption of fluid from the tubules. Angiotensin II also has important direct actions on the tubular cells to increase tubular reabsorption of sodium and water, as discussed in Chapter 28. The combined effects of angiotensin II can sometimes decrease urine output to less than one-fifth normal.

Guyton and Hall Textbook of Medical Physiology 14th edition p.237

(10)

Correct answer: (B) Increased insertion of aquaporin-2 channels in the collecting ducts

This patient presents with polyuria, polydipsia, low urine osmolality, normal plasma osmolality, and a marked response to desmopressin, which is characteristic of central diabetes insipidus.

Desmopressin is a synthetic analogue of antidiuretic hormone (ADH/vasopressin). It acts on V_2 receptors located on the principal cells of the collecting ducts. Activation of these receptors increases intracellular cAMP, leading to:

- Insertion of aquaporin-2 (AQP2) water channels into the apical membrane
- Increased water permeability of the collecting duct
- Enhanced water reabsorption into the hyperosmotic medullary interstitium

Concentration of urine and rise in urine osmolality

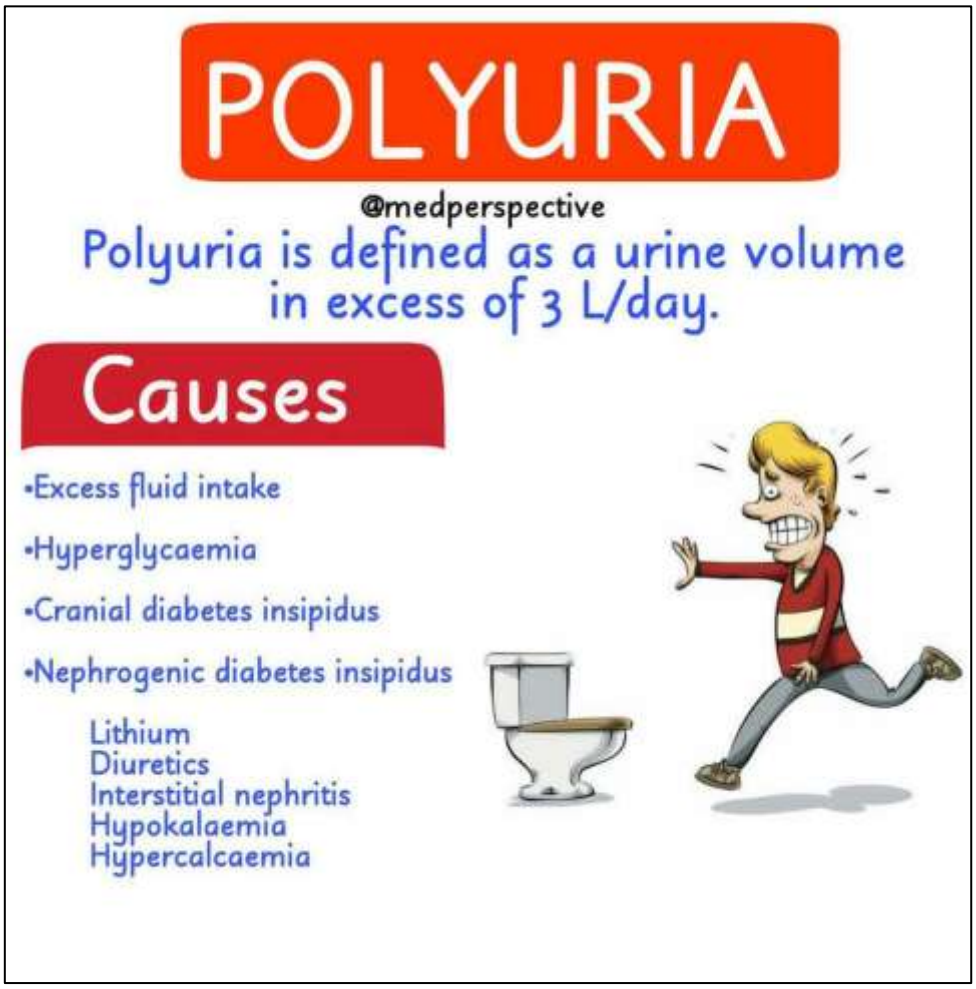
Diabetes insipidus is the syndrome that results when there is a vasopressin deficiency **(central diabetes insipidus)** or when the kidneys fail to respond to the hormone **(nephrogenic diabetes insipidus).**

Ganong's Review of Medical Physiology 24th Edition p. 700

(11)

Correct answer: (C) Saturation of tubular glucose transporters reducing water reabsorption

In uncontrolled diabetes mellitus, plasma glucose exceeds the renal threshold, saturating SGLT transporters in the proximal tubule. Excess glucose remains in the tubular lumen, acting as an osmotic agent that holds water in the tubules. This leads to osmotic diuresis, increased urine volume, and polyuria.



(12)

Correct answer: (C) Respiratory compensation for metabolic acidosis

This patient has had severe diarrhea for 3 days, which commonly causes loss of bicarbonate (HCO_3^-) from the gastrointestinal tract. This leads to a primary metabolic acidosis.

Stepwise interpretation of the ABG

pH = 7.28 → Acidemia

HCO_3^- = 14 mmol/L → Markedly reduced → primary metabolic acidosis

$PaCO_2$ = 30 mmHg → Lower than normal (≈40 mmHg)

In metabolic acidosis, the body attempts to restore pH by reducing $PaCO_2$. This is achieved through increased alveolar ventilation (hyperventilation), which removes more CO_2. Since CO_2 is in equilibrium with carbonic acid, lowering $PaCO_2$ reduces hydrogen ion concentration and partially corrects the acidosis.

This compensatory mechanism is rapid and mediated by peripheral and central chemoreceptors responding to increased H^+ concentration.

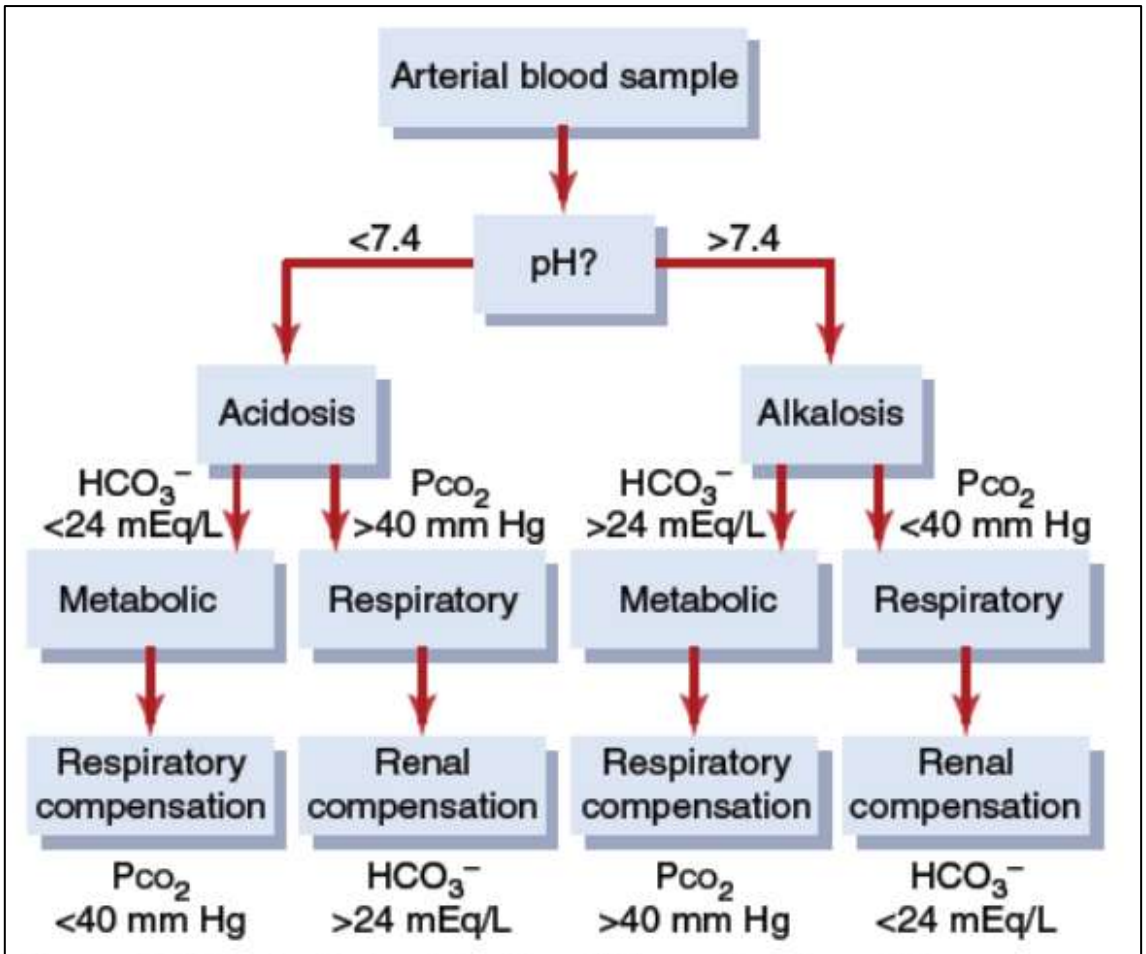


Figure 31-10. Analysis of simple acid–base disorders. If the compensatory responses are markedly different from those shown at the bottom of the figure, one should suspect a mixed acid–base disorder.

Guyton and Hall Textbook of Medical Physiology 14th Edition p. 418

(13)

Correct answer: (C) Increased permeability of the glomerular filtration membrane

This patient's presentation is classical for acute nephritic syndrome, most likely post-streptococcal glomerulonephritis.

Key clinical and investigation clues

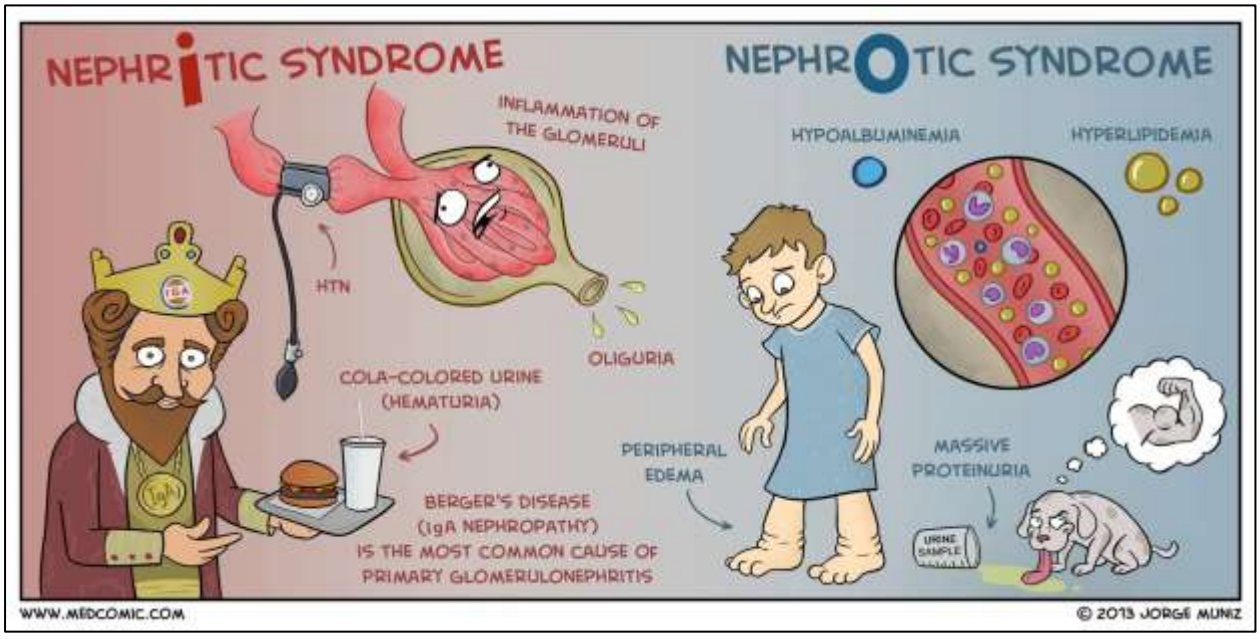
- Cola-colored urine → suggests glomerular hematuria
- Proteinuria → indicates damage to the glomerular filtration barrier
- Red cell casts → highly specific for glomerular origin of hematuria
- Mildly elevated creatinine → reduced glomerular filtration rate (GFR)
- Normal renal ultrasound → excludes obstructive or chronic structural disease

Pathophysiological basis

The glomerular filtration membrane (endothelium, basement membrane, and podocytes) normally restricts the passage of cells and proteins. In glomerulonephritis:

- Inflammation damages this barrier
- Permeability to proteins and red blood cells increases
- RBCs enter the tubules and form RBC casts
- GFR falls due to reduced effective filtration surface

This directly explains both the urinalysis findings and the reduced renal function.



(14)

(A) **T -** Sex chromosomes (X and Y) determine genetic sex at fertilization. Individuals with 46,XY are genetic males, while those with 46,XX are genetic females. Genetic sex is the first step in sex determination and precedes gonadal and phenotypic sex differentiation.

(B) **F -** The SRY (Sex-determining Region of the Y chromosome) gene codes for the testis-determining factor (TDF), a transcription factor that initiates differentiation of the primitive gonad into a testis. Müllerian inhibiting substance (MIS), also known as anti-Müllerian hormone (AMH), is produced later by Sertoli cells and is not coded by the SRY gene.

(C) **T -** During early fetal life, Sertoli cells of the developing testes secrete Müllerian inhibiting substance (MIS/AMH). MIS causes regression of the Müllerian (paramesonephric) ducts, which would otherwise develop into the uterus, fallopian tubes, and upper vagina.
(D) **T** - Female internal genitalia develop in the absence of testosterone. Without testosterone, the Wolffian (mesonephric) ducts regress, while the Müllerian ducts persist and differentiate into the female internal reproductive organs. This process does not require ovarian hormones during early development and is therefore considered the default pathway.
(E) **T** - Male external genitalia (penis, scrotum, and prostate) develop from bipotential external genital structures under the influence of dihydrotestosterone (DHT). DHT is formed from testosterone by 5α-reductase. Deficiency of DHT or 5α-reductase results in undervirilized or ambiguous external genitalia despite normal testosterone levels.

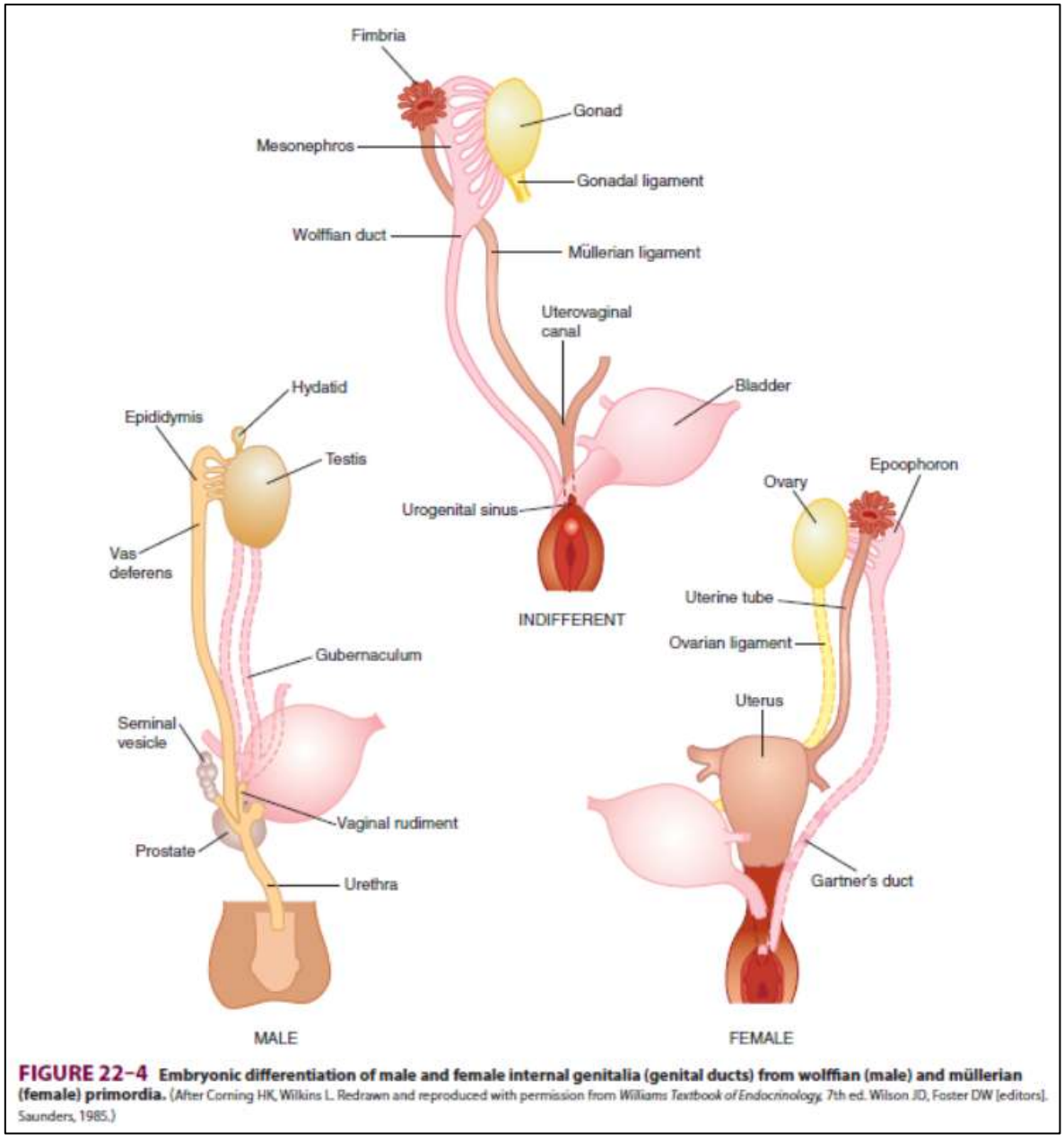


FIGURE 22–4 Embryonic differentiation of male and female internal genitalia (genital ducts) from wolffian (male) and müllerian (female) primordia. (After Corning HK, Wilkins L. Redrawn and reproduced with permission from *Williams Textbook of Endocrinology*, 7th ed. Wilson JD, Foster DW [editors]. Saunders, 1985.)

Ganong's Review of Medical Physiology 24th Edition p. 394

(15)

(A) **T -** The exocrine function of the testis is the production of spermatozoa through spermatogenesis in the seminiferous tubules. The endocrine function involves secretion of hormones, mainly testosterone by Leydig cells and inhibin B by Sertoli cells. These hormones regulate spermatogenesis, secondary sexual characteristics, and feedback control of the hypothalamic–pituitary–gonadal axis.

(B) **T -** Spermiogenesis is the final phase of spermatogenesis, during which haploid spermatids undergo morphological differentiation into mature spermatozoa. This includes formation of the acrosome, condensation of the nucleus, development of the flagellum, and shedding of excess cytoplasm. No cell division occurs during this stage.

(C) **T -** Leydig cells, located in the interstitial tissue between seminiferous tubules, synthesize and secrete testosterone under stimulation by luteinizing hormone (LH). Testosterone is essential for spermatogenesis, development of male internal genitalia, secondary sexual characteristics, libido, and anabolic effects on muscle and bone.

(D) **T -** The blood–testis barrier is formed by tight junctions (zonula occludens) between adjacent Sertoli cells. It divides the seminiferous tubule into basal and adluminal compartments, protecting developing germ cells from immune attack and creating a specialized microenvironment necessary for meiosis and spermatid development.

(E) **F -** The principal androgen responsible for maintenance of spermatogenesis is testosterone, not dihydrotestosterone (DHT). High intratubular testosterone levels, maintained by androgen-binding protein (ABP) from Sertoli cells, are essential for spermatogenesis.

DHT mainly acts on external genitalia, prostate, and secondary sexual characteristics, and plays a minimal role in spermatogenesis itself.

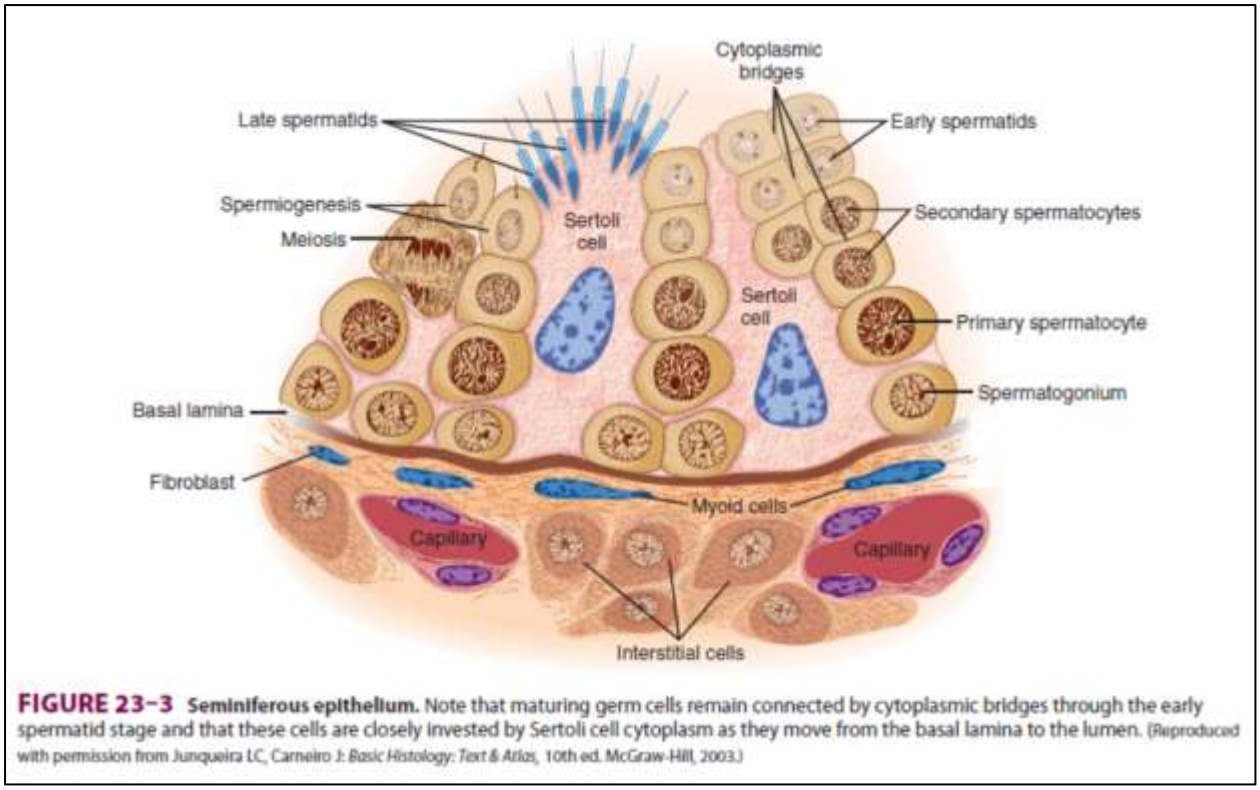


FIGURE 23–3 Seminiferous epithelium. Note that maturing germ cells remain connected by cytoplasmic bridges through the early spermatid stage and that these cells are closely invested by Sertoli cell cytoplasm as they move from the basal lamina to the lumen. (Reproduced with permission from Junqueira LC, Carneiro J: *Basic Histology: Text & Atlas*, 10th ed. McGraw-Hill, 2003.)

Ganong's Review of Medical Physiology 24th Edition p. 421

(16)

(A) **F -** Puberty refers to biological and sexual maturation leading to reproductive capability. Behavioral and emotional maturity develops during adolescence, not puberty alone.
(B) **T** - Sex steroid hormones—testosterone in males and estrogen in females—are responsible for the development of secondary sexual characteristics such as breast development, voice change, body hair, and body fat distribution.
(C) **F -** Leptin, secreted by adipose tissue, acts as a permissive signal for the onset of puberty. Low leptin levels (e.g., malnutrition) are associated with delayed puberty, while adequate or increased leptin facilitates pubertal onset.
(D) **T -** During the prepubertal period, GnRH secretion is suppressed, leading to low LH and FSH levels. This prevents activation of the gonads and delays reproductive maturation until puberty.
(E) **F -** True precocious puberty is GnRH-dependent, caused by early activation of the hypothalamic–pituitary–gonadal axis.
Pseudo-precocious puberty is GnRH-independent, due to excess sex steroids from peripheral sources (e.g., adrenal or gonadal tumors).

TABLE 22–2 Classification of the causes of precocious sexual development in humans.

True precocious puberty
Constitutional
Cerebral: Disorders involving posterior hypothalamus
Tumors
Infections
Developmental abnormalities
Gonadotropin-independent precocity
Precocious pseudopuberty (no spermatogenesis or ovarian development)
Adrenal
Congenital virilizing adrenal hyperplasia
Androgen-secreting tumors (in males)
Estrogen-secreting tumors (in females)
Gonadal
Leydig cell tumors of testis
Granulosa cell tumors of ovary
Miscellaneous

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(17)

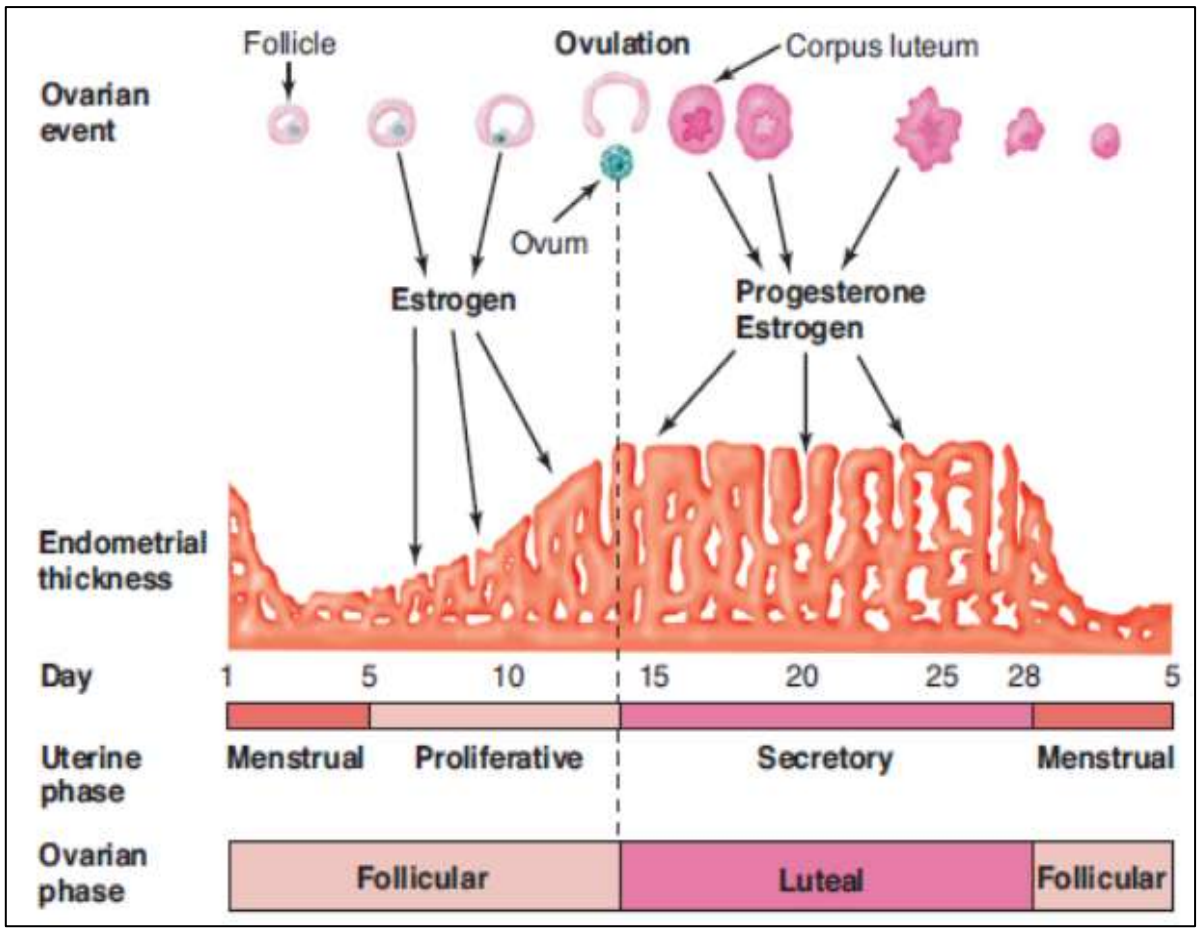
(A) **T -** Menstruation occurs when the corpus luteum regresses, leading to a fall in progesterone. Progesterone withdrawal causes shedding of the functional layer of the endometrium.

(B) **F** - In adult women, menstrual cycles between 21–35 days are considered normal.

(C) **T -** A surge in LH, induced by sustained high oestrogen levels (positive feedback), triggers ovulation.

(D) **T -** Progesterone has a thermogenic effect, increasing basal body temperature after ovulation.

(E) **F -** After menopause, ovarian follicular depletion leads to markedly reduced estrogen production despite elevated FSH and LH levels.



Ganong's Review of Medical Physiology 24th Edition p. 403

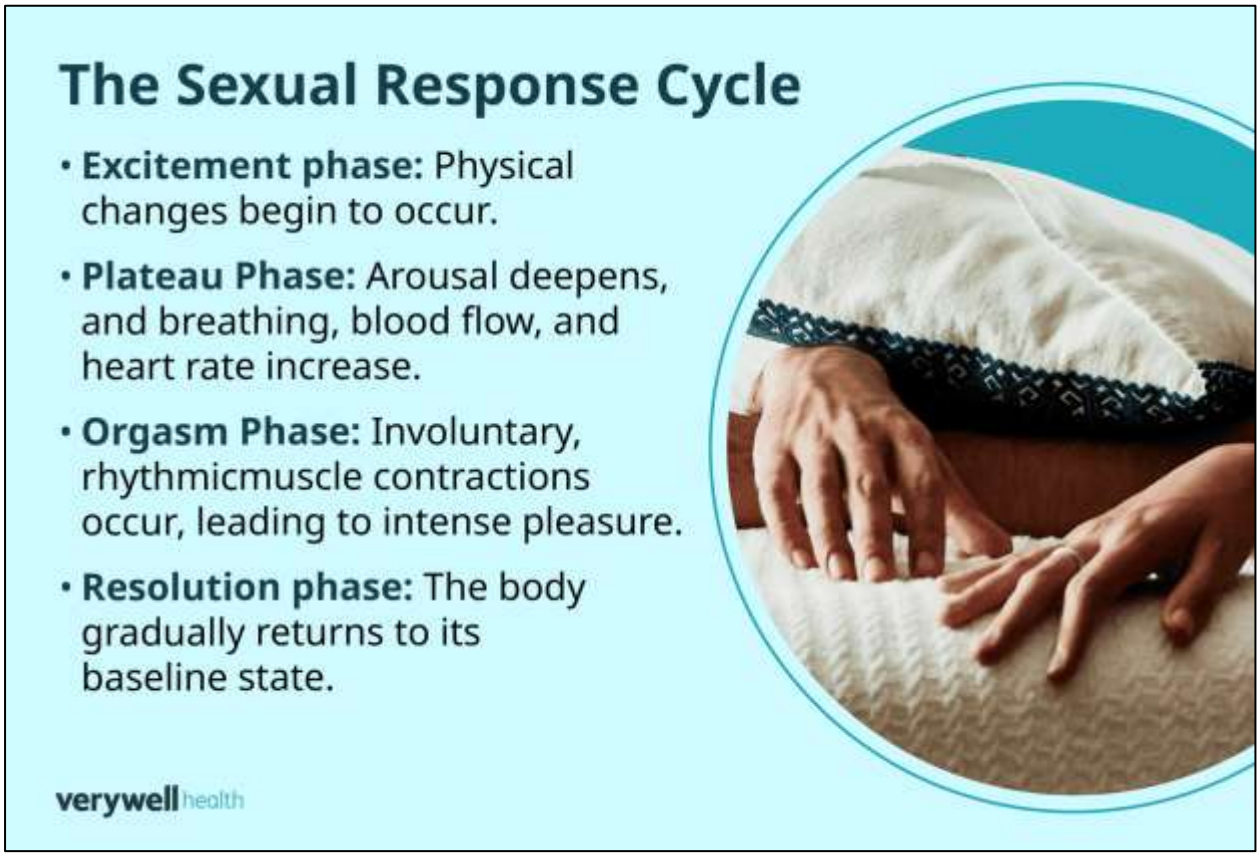
(18)

(A) **T -** Testosterone plays a major role in sexual desire in both men and women, although psychological, social, and hormonal factors also contribute.

(B) **F -** Erection is mediated by parasympathetic activity (S2–S4), which causes nitric oxide–induced vasodilation of penile arteries. Sympathetic activity is involved in emission and ejaculation.

(C) **F -** Emission is mediated by sympathetic stimulation, which causes contraction of the vas deferens and seminal vesicles to move semen into the urethra.

(D) **T -** Orgasm involves rhythmic contractions of pelvic floor muscles and uterine smooth muscle due to autonomic and somatic reflexes.
(E) **F -** Although sexual response may decline with age (e.g., delayed erection, vaginal dryness), complete loss of sexual function is not a normal consequence of ageing.



(19)

(A) **T -** The ovum is viable for about 12–24 hours after ovulation in the upper female reproductive tract.
(B) **F -** Capacitation is the functional maturation of sperm within the female reproductive tract that enables it to undergo the acrosome reaction.
Penetration of the zona pellucida occurs during the acrosome reaction, when enzymes are released.
(C) **T -** hCG, secreted by the syncytiotrophoblast, acts like LH and maintains the corpus luteum, ensuring continued progesterone production in early pregnancy.
(D) **T -** The gravid uterus compresses pelvic veins and the inferior vena cava, leading to venous pooling, varicose veins, and increased risk of thrombosis.
(E) **F -** Although prolactin levels are high during pregnancy, estrogen and progesterone inhibit milk secretion. Lactation begins after delivery when these hormone levels fall.

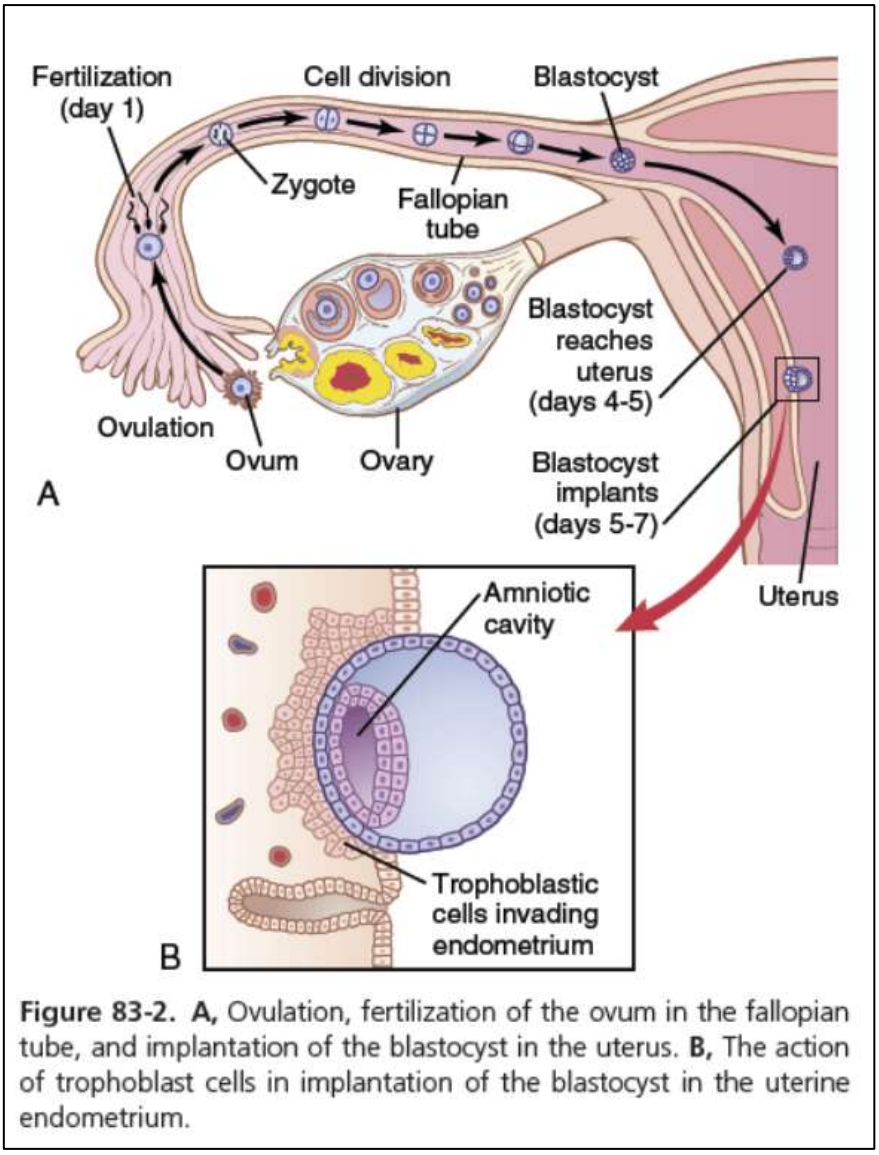


Figure 83-2. A, Ovulation, fertilization of the ovum in the fallopian tube, and implantation of the blastocyst in the uterus. **B,** The action of trophoblast cells in implantation of the blastocyst in the uterine endometrium.

Guyton and Hall Textbook of Medical Physiology p. 1046

(20)

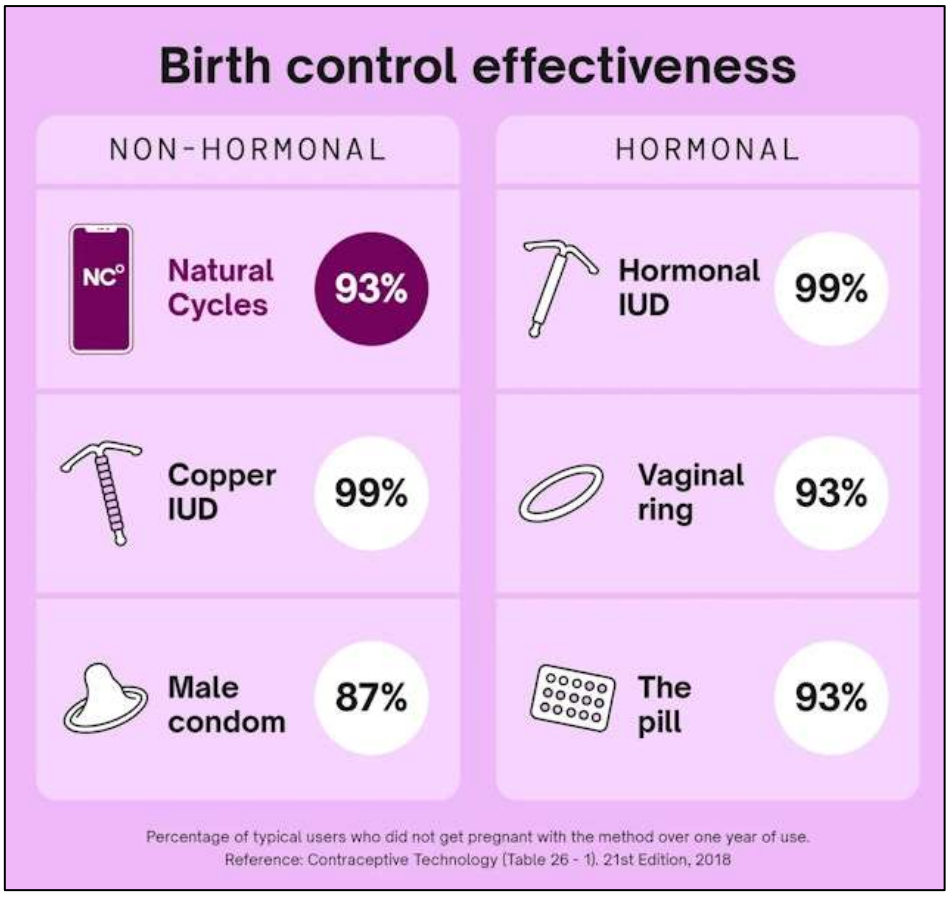
(A) **T -** Family planning refers to the voluntary control of fertility, allowing individuals or couples to decide the number of children and the spacing between pregnancies using contraceptive methods.

(B) **T -** The safe period (calendar/rhythm) method predicts the fertile window around ovulation. Since ovulation typically occurs ~14 days before the next menstruation, intercourse is avoided during the days when sperm and ovum may be viable.

(C) **T -** Combined pills contain estrogen + progesterone, which suppress GnRH, FSH, and LH release, preventing the LH surge and ovulation. They also thicken cervical mucus and alter the endometrium.

(D) **F -** Copper IUCDs do not act hormonally. They work by causing a local inflammatory reaction in the uterus, and copper ions are toxic to sperm, impairing sperm motility and fertilization.

(E) **T -** Condoms act as a barrier method, preventing sperm from entering the female reproductive tract and reducing transmission of STIs such as HIV, gonorrhea, and chlamydia.



(21)

Correct Answer: C. Impaired Leydig cell testosterone production affecting spermatogenesis

Leydig cells, under the influence of LH, produce testosterone.

High intratesticular testosterone concentration is essential for normal spermatogenesis within the seminiferous tubules.

Even if circulating testosterone and gonadotropins appear normal, reduced local testosterone levels can impair sperm production.

Sertoli cells support spermatogenesis but depend on testosterone for normal function.

DHT is more important for external genitalia and prostate, not for spermatogenesis.

Normal semen volume suggests intact accessory gland function.

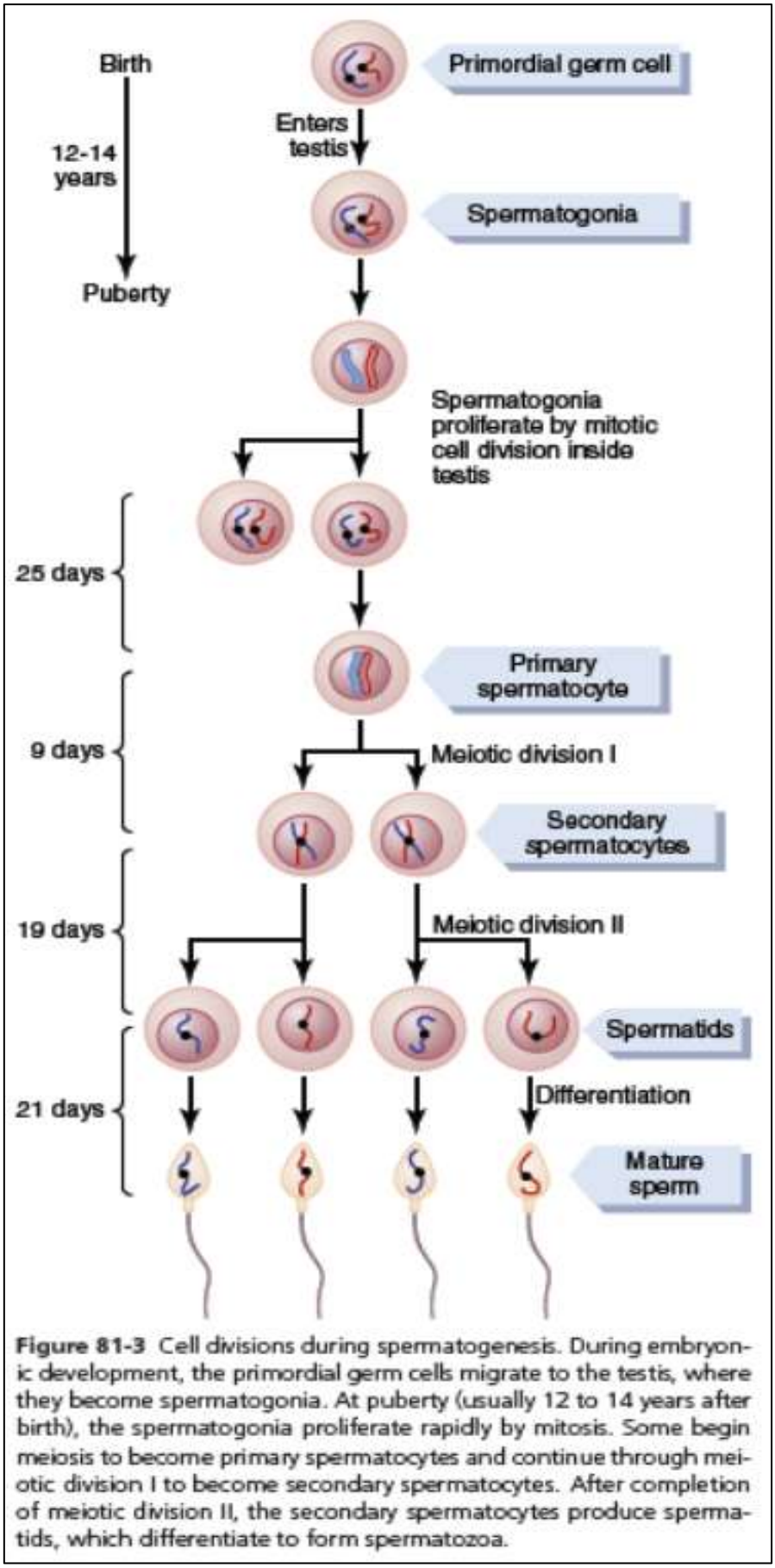


Figure 81-3 Cell divisions during spermatogenesis. During embryonic development, the primordial germ cells migrate to the testis, where they become spermatogonia. At puberty (usually 12 to 14 years after birth), the spermatogonia proliferate rapidly by mitosis. Some begin meiosis to become primary spermatocytes and continue through meiotic division I to become secondary spermatocytes. After completion of meiotic division II, the secondary spermatocytes produce spermatids, which differentiate to form spermatozoa.

Guyton and Hall Textbook of Medical Physiology 14th Edition p. 1012

(22)

Correct Answer: A. Premature activation of the hypothalamic–pituitary–gonadal axis

The child shows features of true (central) precocious puberty: early secondary sexual characteristics, advanced bone age, and increased growth velocity.

True precocious puberty results from early activation of the hypothalamic–pituitary–gonadal (HPG) axis.

Elevated LH that increases further after GnRH stimulation confirms a GnRH-dependent mechanism.

Enlargement of ovaries and uterus reflects estrogen-mediated maturation.

In contrast, pseudo-precocious puberty is GnRH-independent and shows suppressed LH response to GnRH.

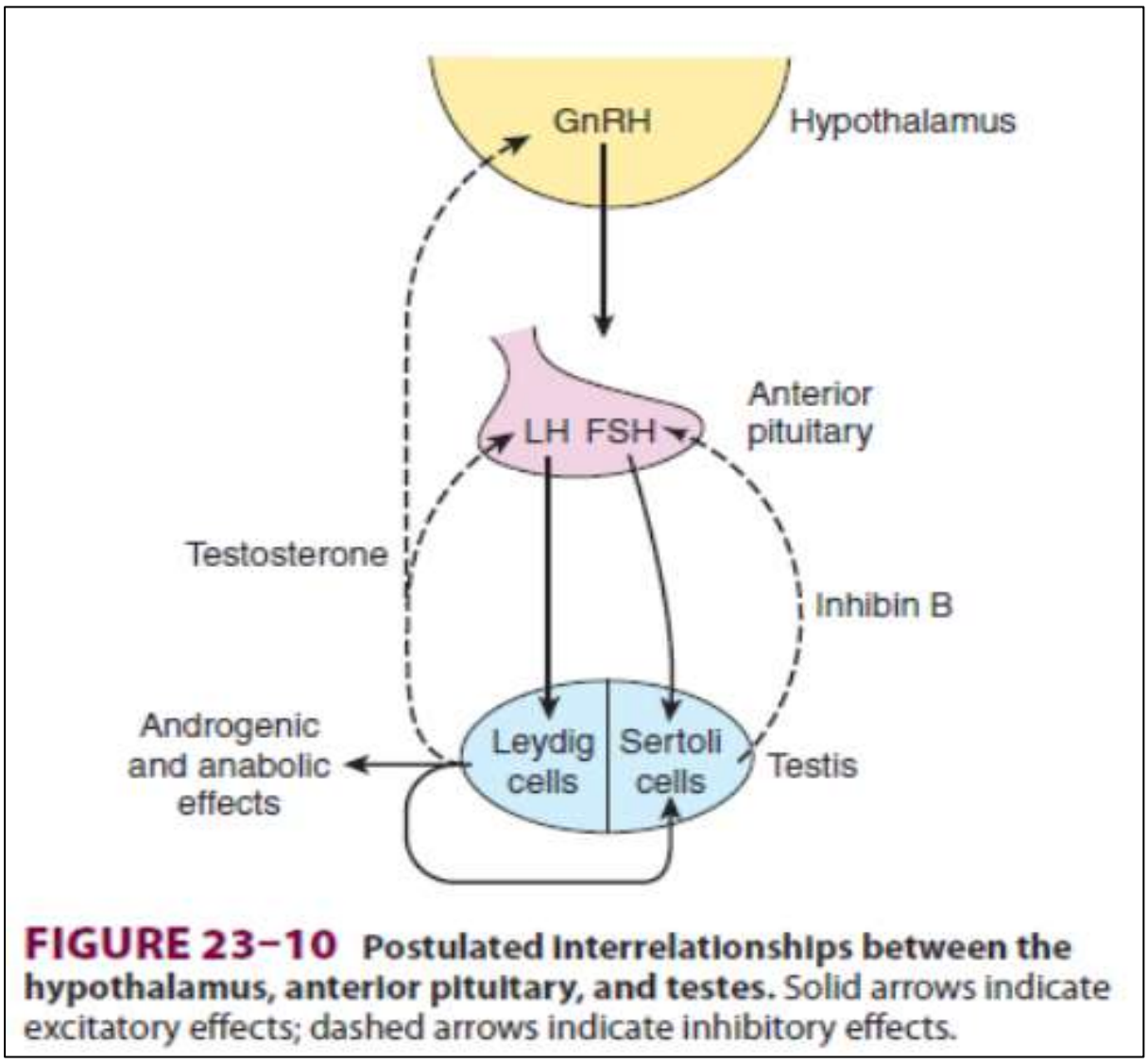


FIGURE 23–10 Postulated interrelationships between the hypothalamus, anterior pituitary, and testes. Solid arrows indicate excitatory effects; dashed arrows indicate inhibitory effects.

Ganong's Review of Medical Physiology 24th Edition p. 427

(23)

Correct Answer: B. Continuous administration of progesterone to prevent withdrawal bleeding

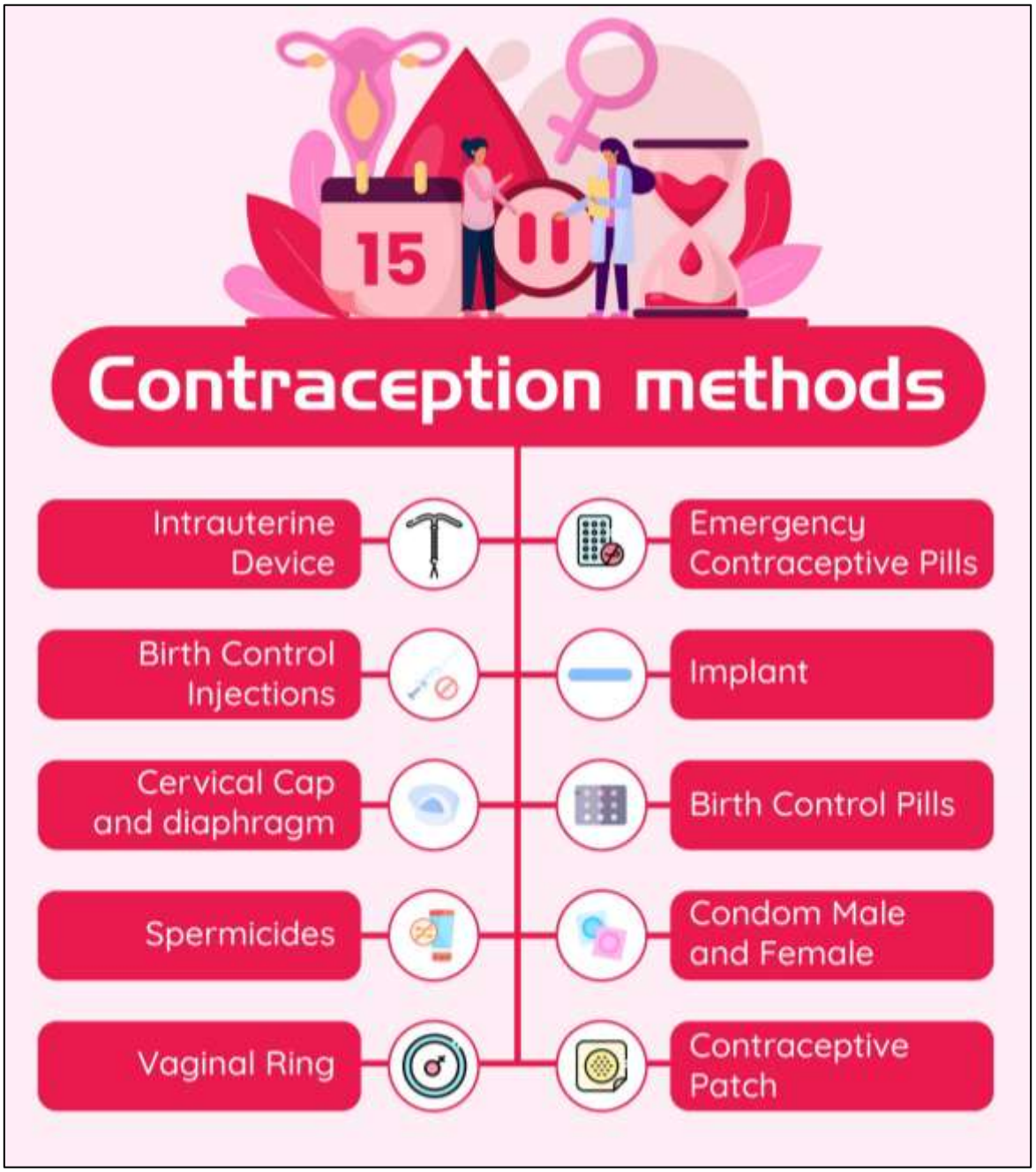
Menstruation occurs due to withdrawal of progesterone following regression of the corpus luteum.

Progesterone maintains the secretory endometrium.

If progesterone levels are maintained (e.g., by hormonal therapy), the endometrium does not shed.

Therefore, continuous progesterone administration delays menstruation.

Bleeding occurs only after progesterone withdrawal.



(24)

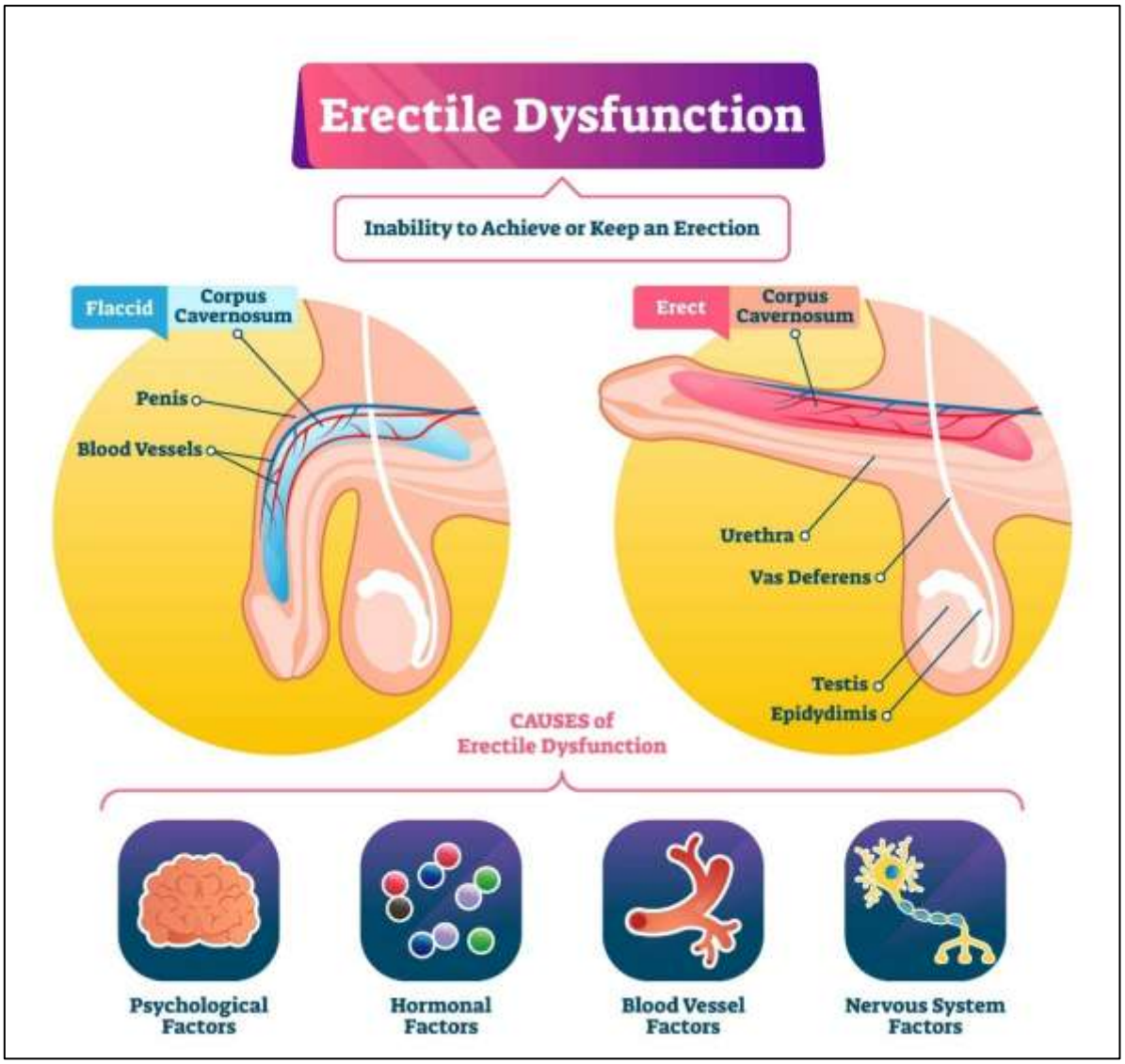
Correct Answer: B. Impaired parasympathetic-mediated vasodilation of penile arteries

Erection is mediated by parasympathetic stimulation (S2–S4).

Nitric oxide release causes vasodilation and increased blood flow to the corpora cavernosa.

Diabetes can cause autonomic neuropathy → impaired parasympathetic function → erectile dysfunction.

Normal libido suggests testosterone levels are likely adequate.



(25)

Correct answer: B. Sperm remain viable in the female reproductive tract for up to 3–5 days

Sperm survive 3–5 days, allowing fertilization if intercourse occurs before ovulation.

Ovum survives only ~24 hours.

Implantation occurs 6–7 days after fertilization.

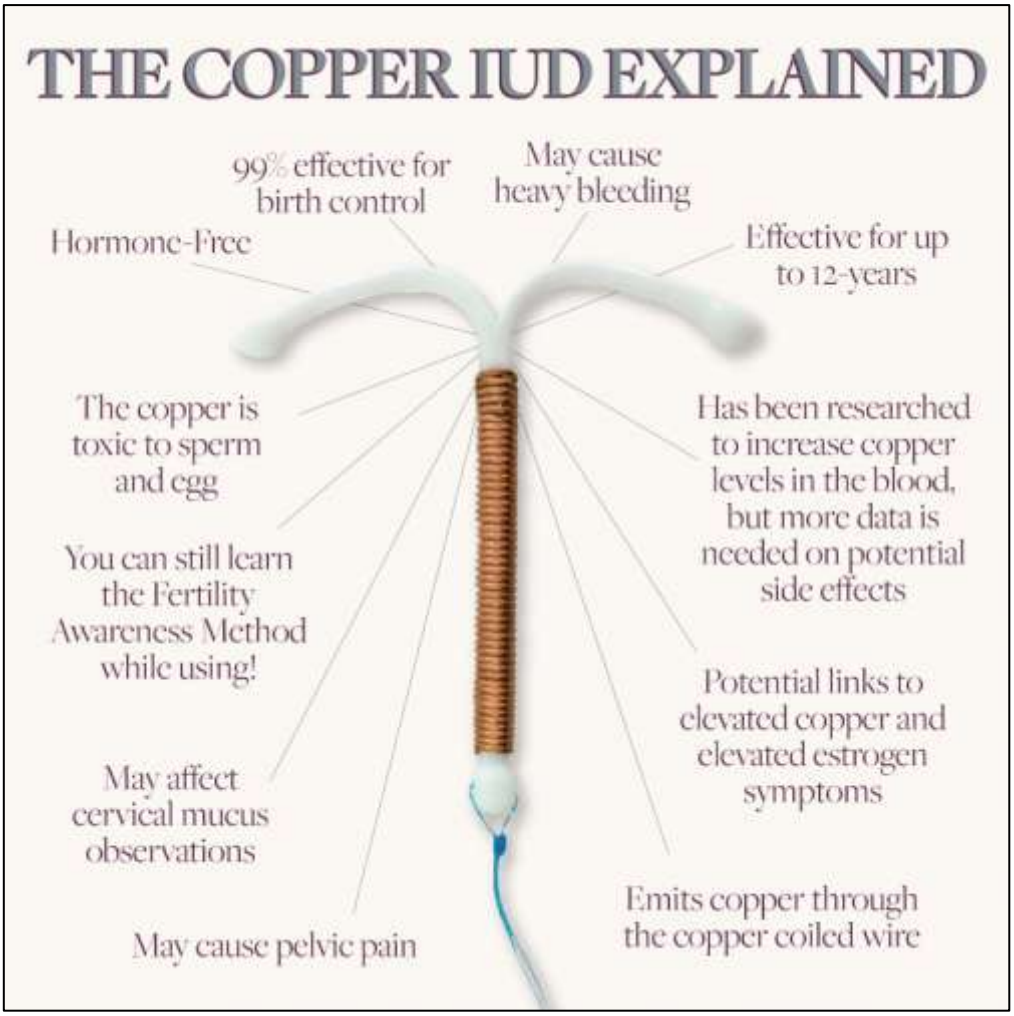
hCG is secreted after implantation.
Corpus luteum persists during luteal phase and longer if pregnancy occurs.



(26)

Correct Answer: (C) Copper intrauterine contraceptive device (IUCD)

Copper IUCDs are long-acting reversible contraceptives (LARC) that can remain effective for 5–10 years. They prevent fertilization mainly by creating a local inflammatory reaction toxic to sperm and ova and impairing sperm motility.



(27)

(A) **T -** Sensory receptors are commonly classified by the type of stimulus they detect (e.g., mechanoreceptors, thermoreceptors, nociceptors, photoreceptors).

(B) **F -** A receptor potential is graded, not all-or-none. Its amplitude varies with stimulus intensity, unlike an action potential.

(C) **T -** Stimulus intensity is encoded by frequency of action potentials and recruitment of additional receptors/afferent fibers.

(D) **F -** Fine touch and proprioception ascend mainly via the dorsal column–medial lemniscus pathway, not the spinothalamic tract (which carries pain, temperature, and crude touch).

(E) **T -** After limb amputation, cortical plasticity/reorganization in the sensory cortex contributes to phantom limb sensations.

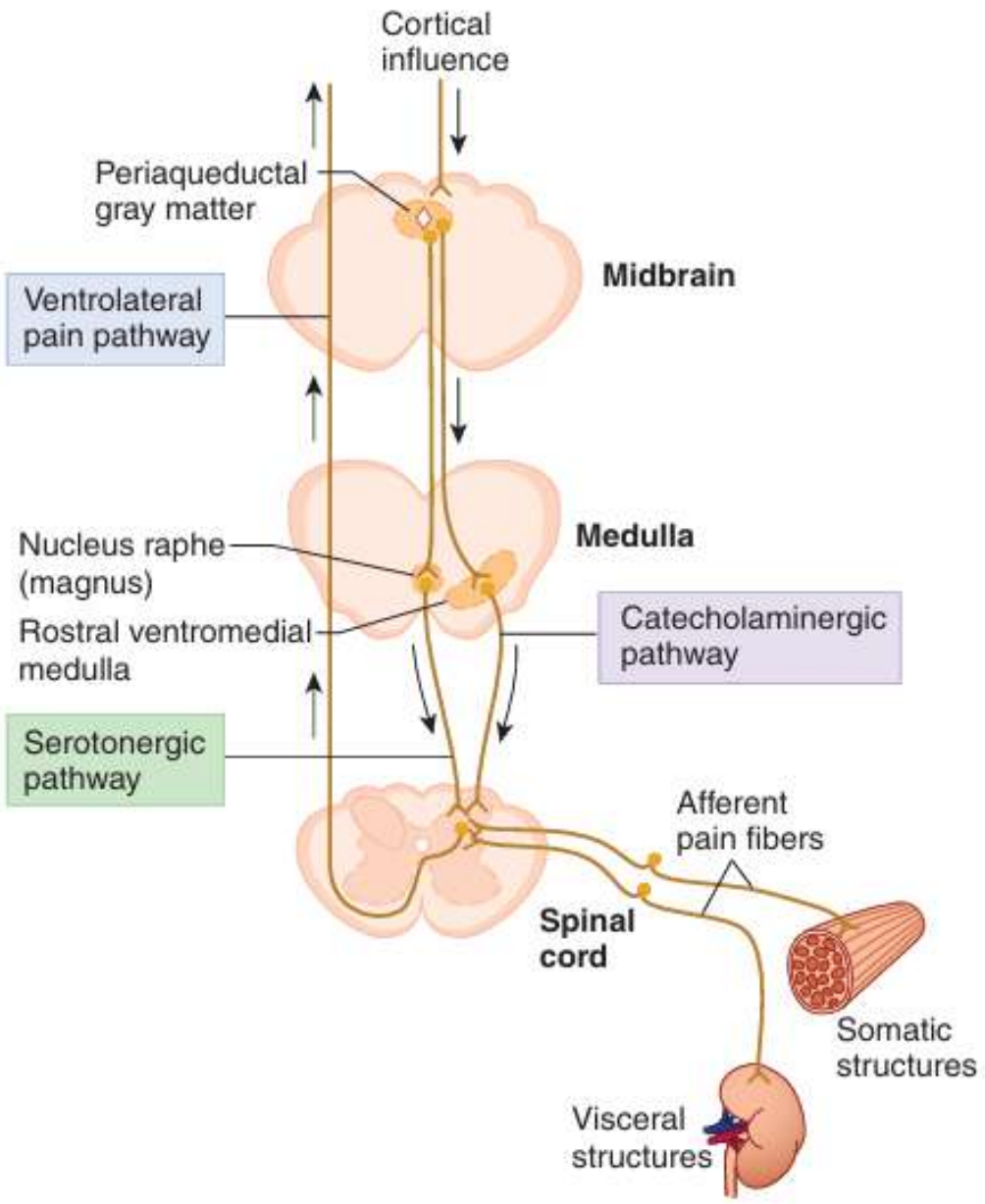


FIGURE 8–6 Schematic illustration of the convergence-projection theory for referred pain and descending pathways involved in pain control. The basis for referred pain may be convergence of somatic and visceral pain fibers on the same second-order neurons in the dorsal horn of the spinal cord that project higher brain regions. The periaqueductal gray (PAG) is a part of a descending pathway that includes serotonergic neurons in the nucleus raphé magnus and catecholaminergic neurons in the rostral ventromedial medulla to modulate pain transmission by inhibition of primary afferent transmission in the dorsal horn. (Courtesy of Al Basbaum.)

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(28)

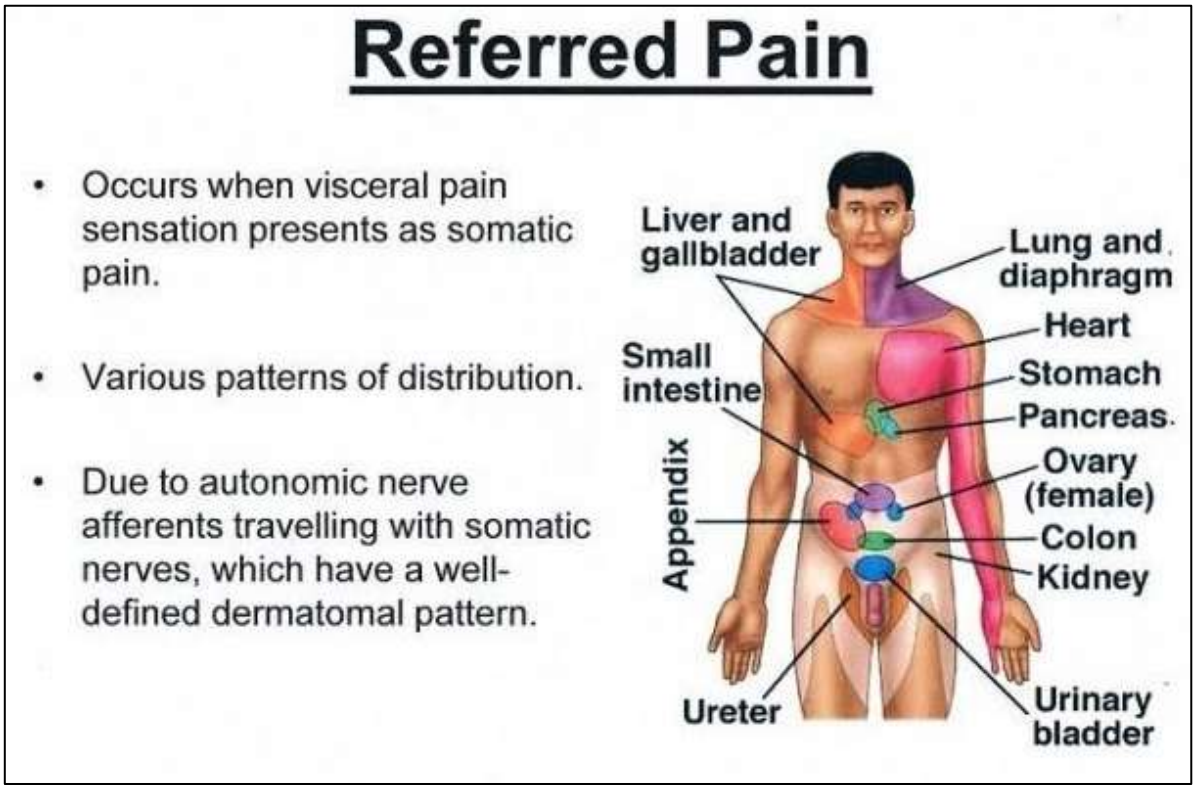
(A) **F -** Pain has both sensory and emotional (affective) components. Emotional processing occurs via limbic system connections.

(B) **T -** Aδ fibers are thinly myelinated and conduct fast, sharp, well-localized pain.

(C) **T -** Visceral organs have fewer nociceptors and diffuse central representation, so pain is dull and poorly localized.

(D) **T -** This is the convergence–projection theory, where visceral and somatic afferents converge on the same spinal neurons, leading the brain to misinterpret visceral pain as somatic.

(E) **T -** These endogenous opioids act presynaptically in the dorsal horn to inhibit substance P release, reducing nociceptive transmission.



(29)

(A) **T -** Voluntary movements originate mainly in the primary motor cortex and associated motor areas and involve conscious intention.

(B) **T -** Reflexes are automatic responses mediated mainly at the spinal cord or brainstem level without conscious control.

(C) **T -** The primary motor cortex (M1) lies in the precentral gyrus and controls voluntary muscle activity.

(D) **F -** Cortical representation is not equal; body parts requiring fine motor control (e.g., hands, face) occupy larger cortical areas.

(E) **T -** These areas are involved in planning, sequencing, and preparing movements before execution by the primary motor cortex.

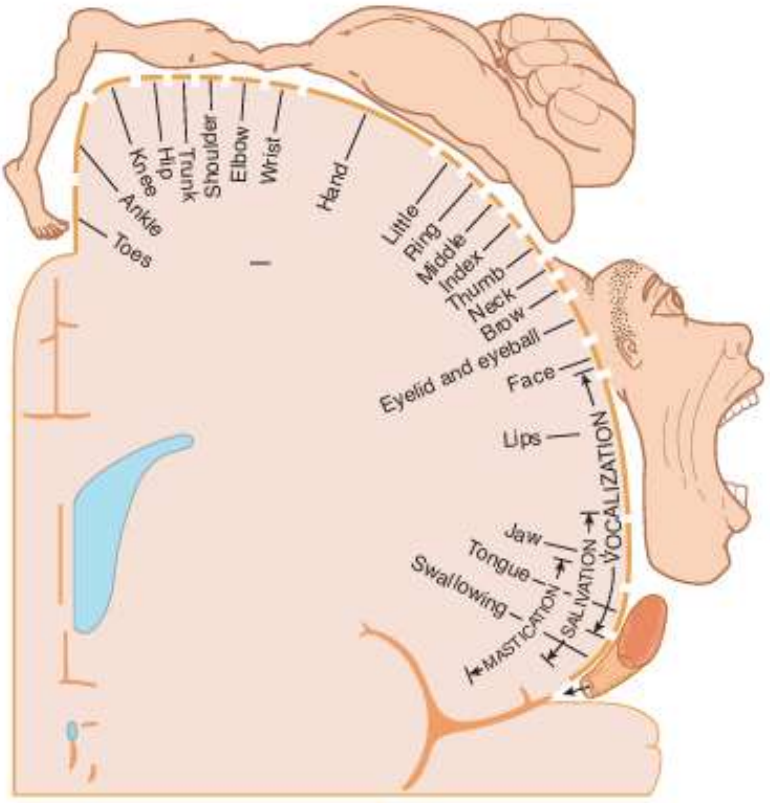


FIGURE 12–8 Motor homunculus. The figure represents, on a coronal section of the precentral gyrus, the location of the cortical representation of the various parts. The size of the various parts is proportional to the cortical area devoted to them. Compare with Figure 8–9 which shows the sensory homunculus. (Reproduced with permission from Penfield W, Rasmussen G: *The Cerebral Cortex of Man*. Macmillan, 1950.)

Ganong's Review of Medical Physiology 24th Edition p.248

(30)

(A) **T -** The dorsal column–medial lemniscus pathway carries vibration, fine touch, and proprioception, so lesions here cause loss of these modalities below the lesion.

(B) **F -** The spinothalamic tract carries pain, temperature, and crude touch, not fine touch or proprioception.

(C) **T -** These sensations are transmitted mainly through the spinothalamic (anterolateral) pathway.

(D) **F -** Dorsal column fibers ascend ipsilaterally in the spinal cord and decussate in the medulla (internal arcuate fibers).

(E) **T -** The primary somatosensory cortex is important for interpreting and localizing sensory input, so lesions can impair stimulus localization.

Site of abnormality	Functional defect	Tract affected
At the level of the lesion (1)	Ipsilateral flaccid paralysis (LMN)	Corticospinal
	Ipsilateral loss of vibration and proprioception	Dorsal column
Below the level of the lesion (2)	Ipsilateral spastic paralysis (UMN)	Corticospinal
1-2 levels below the lesion (3)	Contralateral loss of pain/temperature	Lateral spinothalamic

(31)

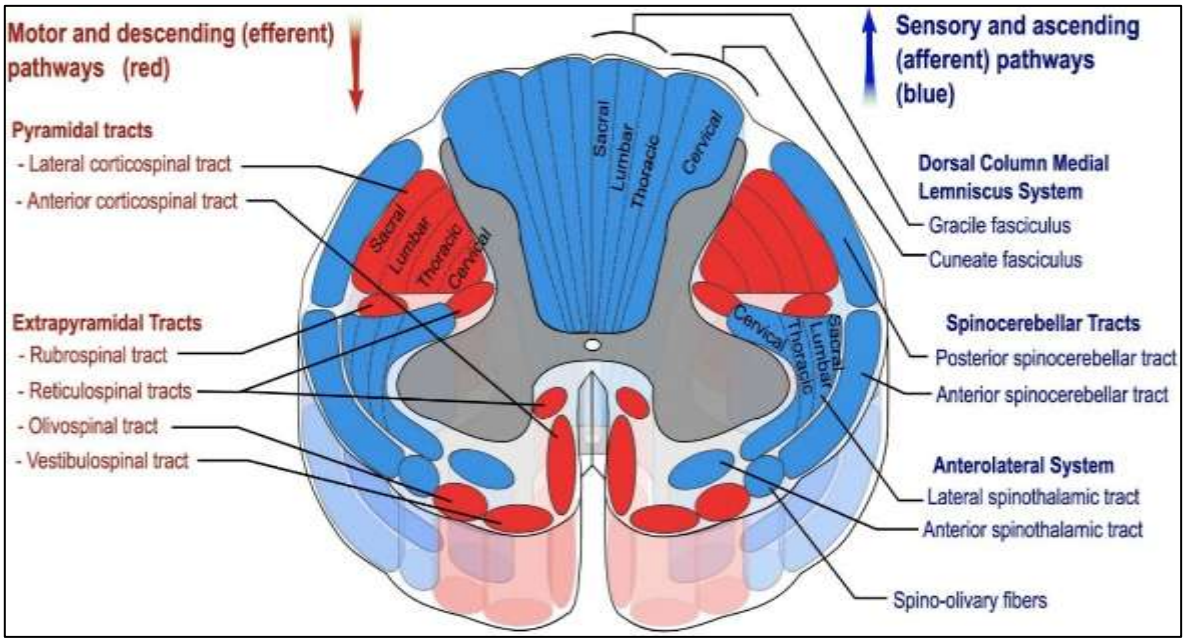
(A) **T -** It is the principal pyramidal pathway controlling voluntary movements, especially fine distal limb movements.

(B) **T -** It carries impulses from the motor cortex to motor nuclei in the brainstem that control muscles of the face, head, and neck.

(C) **F -** About 85–90% of corticospinal fibers decussate in the medullary pyramids (pyramidal decussation), not in the spinal cord.

(D) **T** - Pathways such as reticulospinal, vestibulospinal, rubrospinal, and tectospinal tracts help maintain posture, tone, and automatic movements.

(E) **F -** Upper motor neuron lesions typically cause spastic paralysis, hyperreflexia, and a positive Babinski sign (after the initial spinal shock phase).



(32)

(A) **T -** Humans are homeothermic, meaning they maintain a stable internal body temperature despite environmental changes.
(B) **T -** The average normal core temperature is around 37°C, typically ranging 36.5–37.5°C.
(C) **F -** Radiation mainly causes heat loss, not heat gain. During exercise, metabolic activity in muscles is the main source of heat production.
(D) **T -** The hypothalamus functions as the thermoregulatory center, integrating signals from peripheral and central thermoreceptors.
(E) **T -** Brown fat produces heat through non-shivering thermogenesis, which is important in newborns and infants.

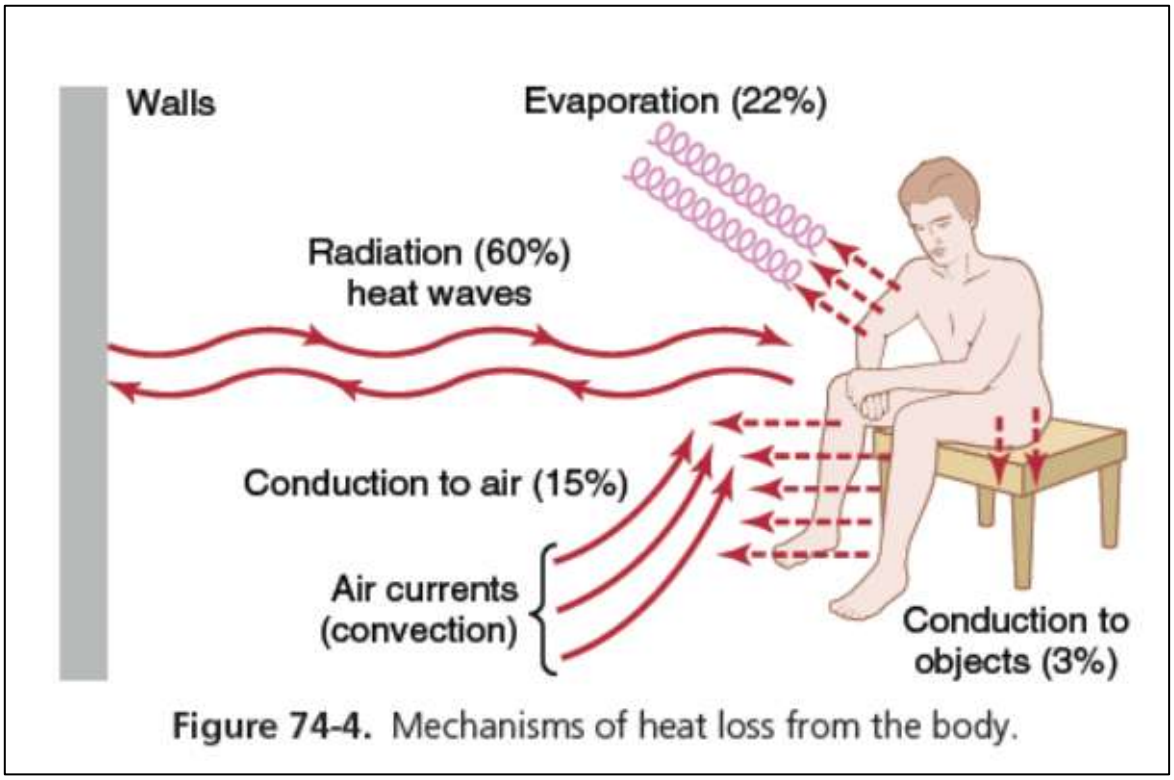


Figure 74-4. Mechanisms of heat loss from the body.

Guyton and Hall Textbook of Medical Physiology 14th Edition p. 903

(33)

(A) **T -** The suprachiasmatic nucleus (SCN) of the hypothalamus is the body's biological clock, regulating circadian rhythms.
(B) **F -** The ventromedial hypothalamus is the satiety center; its activation suppresses food intake.
(C) **T -** Ghrelin, secreted mainly by the stomach, stimulates the hypothalamic feeding centers and increases appetite.
(D) **F -** Leptin suppresses appetite by acting on hypothalamic neurons and promoting satiety.
(E) **T -** Osmoreceptors in the hypothalamus detect changes in plasma osmolarity and help regulate thirst and ADH secretion.

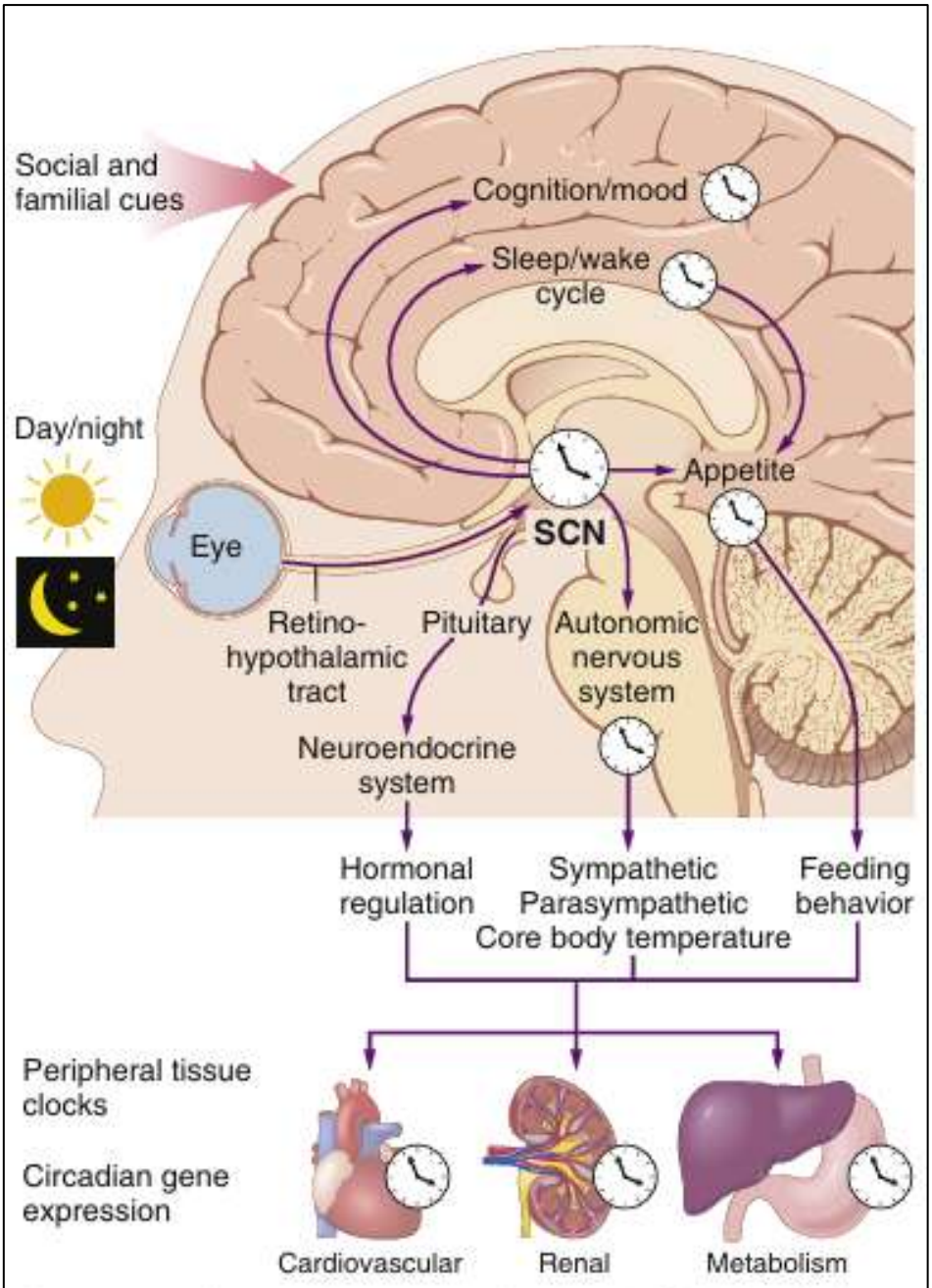


Figure 59-8 The suprachiasmatic nucleus (SCN) of the hypothalamus serves as a "master clock" for many physiological, mental, and behavioral activities. The SCN receives direct innervation from the retina via the retinohypothalamic tract (RHT) to entrain its activity to day–night cycles. SCN neurons project to various brain centers, which contain local circadian clocks that direct feeding–fasting, sleep–wakefulness, autonomic and neuroendocrine circadian rhythms. These systemic cues synchronize local molecular clocks in peripheral tissues, and these local clocks then direct circadian gene expression that regulates physiological rhythms, including those related to mental alertness and cognition, cardiovascular regulation, metabolism, and renal function.

Guyton and Hall Textbook of Medical Physiology 14th Edition p. 707

(34)

(A) **T -** The corticospinal tract (pyramidal tract) is the main descending pathway responsible for voluntary motor control, particularly fine and skilled movements of distal limb muscles such as finger movements and precise hand coordination. It originates mainly from the primary motor cortex (area 4) and descends through the internal capsule, brainstem, and spinal cord to synapse with lower motor neurons.

(B) **T -** The vestibulospinal tracts arise from the vestibular nuclei in the medulla and pons. These pathways are part of the extrapyramidal system and are important for:

- Maintaining posture
- Stabilizing the head and body
- Facilitating extensor muscle activity to maintain balance

They integrate information from the vestibular apparatus of the inner ear.

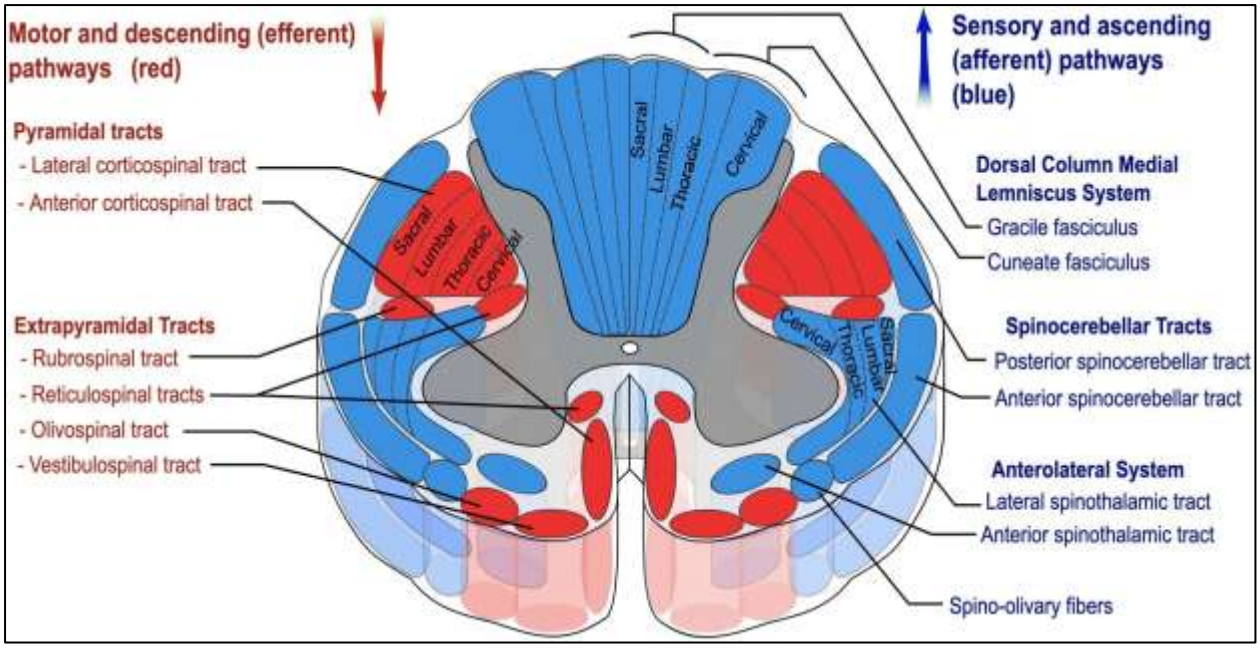
(C) **F -** Most corticospinal fibers (about 85–90%) cross at the pyramidal decussation in the lower medulla, not in the spinal cord. After crossing, they descend as the lateral corticospinal tract on the opposite side. A smaller portion continues ipsilaterally as the anterior corticospinal tract, which may cross near the level of termination in the spinal cord.

(D) **T** - The reticulospinal tracts arise from the reticular formation in the brainstem and play an important role in:

- Regulating muscle tone
- Maintaining posture
- Modulating spinal reflexes
- Coordinating automatic movements such as walking

They are part of the extrapyramidal motor system.

(E) **F -** The rubrospinal tract originates from the red nucleus in the midbrain, not from the cerebellum. It receives input from the motor cortex and cerebellum and then projects to the spinal cord. The tract mainly influences flexor muscle activity, particularly in the upper limbs, although its role in humans is relatively minor compared to the corticospinal tract.



(35)

(A) **T -** The fovea centralis is packed with cones, giving maximum visual acuity and color vision.

(B) **F -** The blind spot (optic disc) has no photoreceptors at all (no rods or cones).

(C) **F -** Rods function in dim light and do not detect color; cones mediate color vision.

(D) **T -** In myopia, light focuses anterior to the retina, usually due to increased axial length.

(E) **T -** Impaired drainage of aqueous humor leads to raised intraocular pressure, contributing to glaucoma.

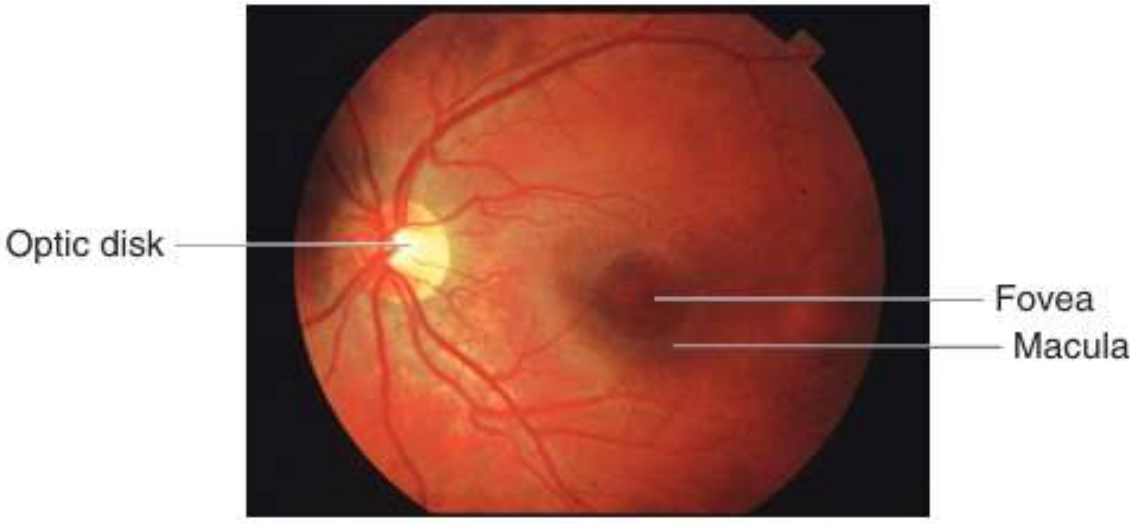


FIGURE 9–3 The fundus of the eye in a healthy human as seen through the ophthalmoscope. The fundus of the eye refers to the interior surface of the eye, opposite the lens, and includes the retina, optic disc, macula and fovea, and posterior pole. Optic nerve fibers leave the eyeball at the optic disc to form the optic nerve. The arteries, arterioles, and veins in the superficial layers of the retina near its vitreous surface can be seen through the ophthalmoscope. (Courtesy of Dr AJ Weber, Michigan State University.)

(36)

(A) **F -** Frequency determines pitch, not loudness.

(B) **F -** Amplitude determines loudness, not pitch.

(C) **F -** It is located in the cochlea (scala media).

(D) **F -** That is the Rinne test; Weber checks lateralization.

(E) **T -** They detect rotational (angular) movements.

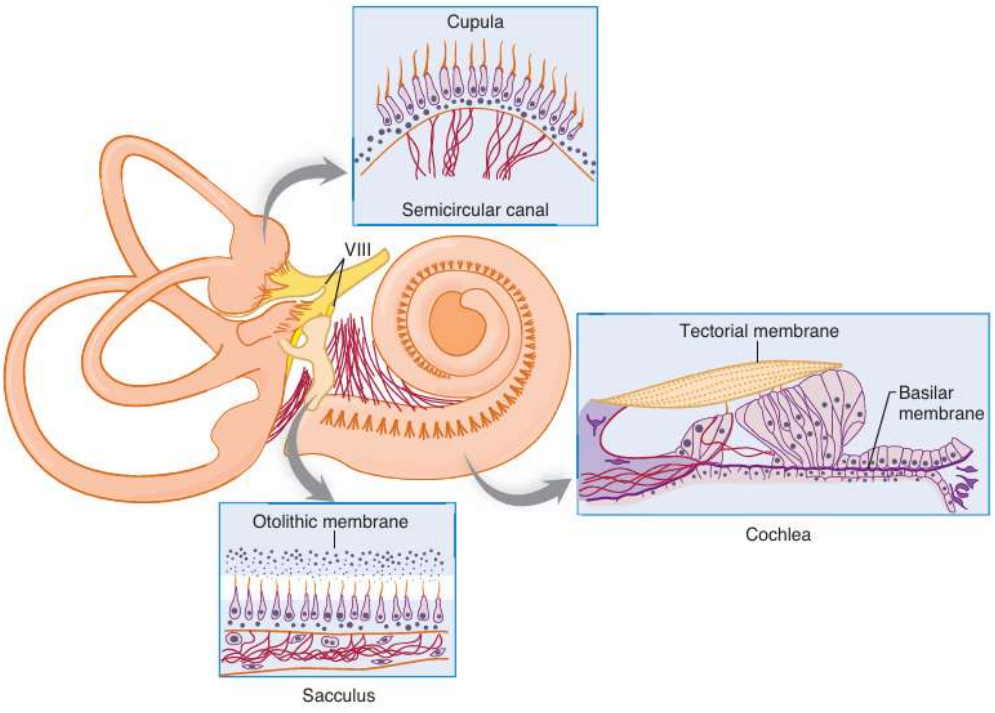


FIGURE 10–3 Schematic of the human inner ear showing the membranous labyrinth with enlargements of the structures in which hair cells are embedded. The membranous labyrinth is suspended in perilymph and filled with K^+-rich endolymph, which bathes the receptors. Hair cells (darkened for emphasis) occur in different arrays characteristic of the receptor organs. The three semicircular canals are sensitive to angular accelerations that deflect the gelatinous cupula and associated hair cells. In the cochlea, hair cells spiral along the basilar membrane in the organ of Corti. Airborne sounds set the eardrum in motion, which is conveyed to the cochlea by bones of the middle ear. This flexes the membrane up and down. Hair cells in the organ of Corti are stimulated by shearing motion. The otolithic organs (saccule and utricle) are sensitive to linear acceleration in vertical and horizontal planes. Hair cells are attached to the otolithic membrane. VIII, eighth cranial nerve, with auditory and vestibular divisions. (Adapted with permission from Hudspeth AJ: How the ear's works work. Nature 1989;341(6241):397–404.)

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(37)

(A) **T -** ARAS is essential for arousal and consciousness.
(B) **F -** Deep sleep shows delta waves, not beta waves.
(C) **F -** These are features of REM sleep, not NREM.
(D) **T -** Normal cycle ≈ 90 minutes.
(E) **T -** Classic feature, often with cataplexy.

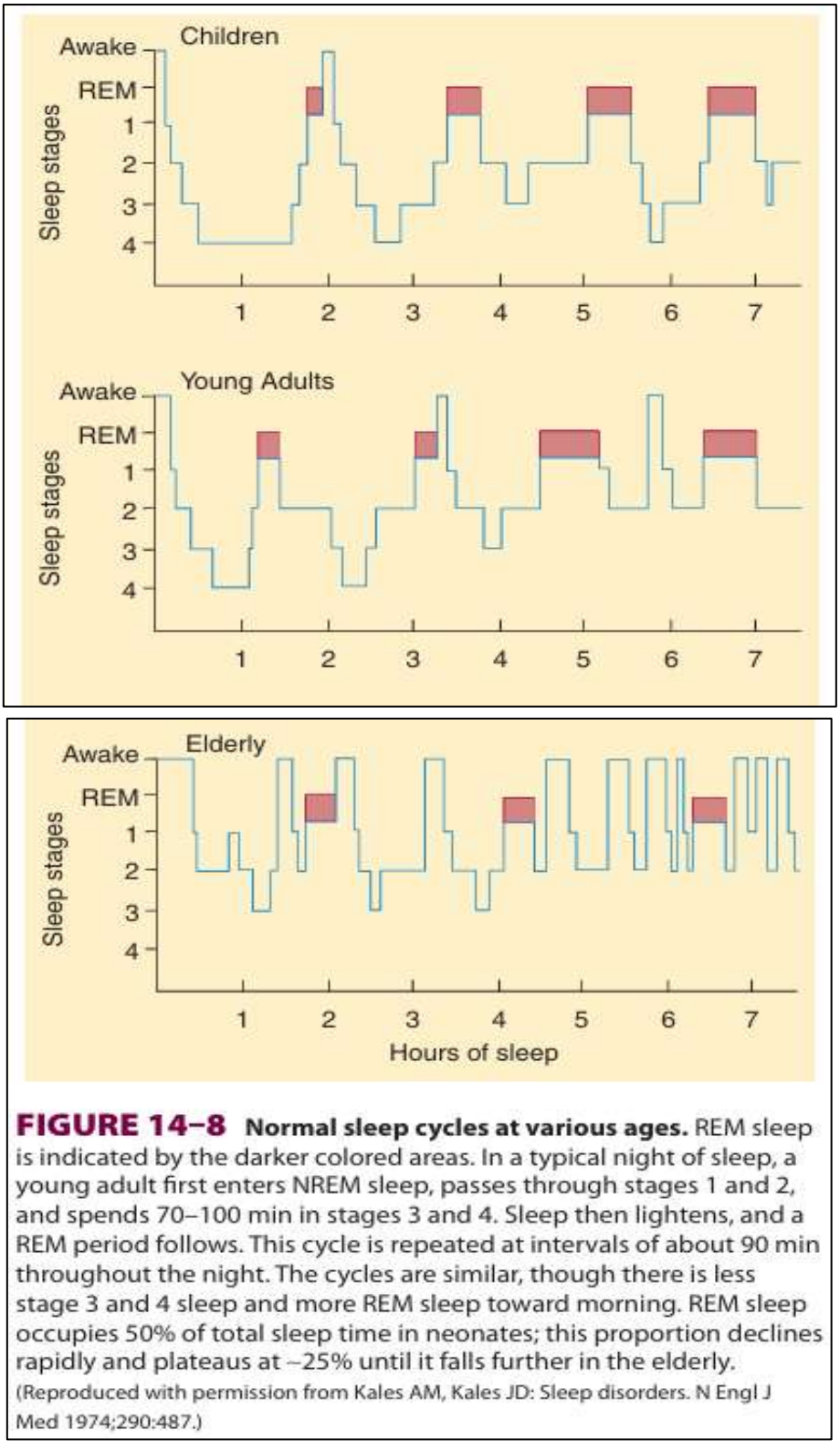
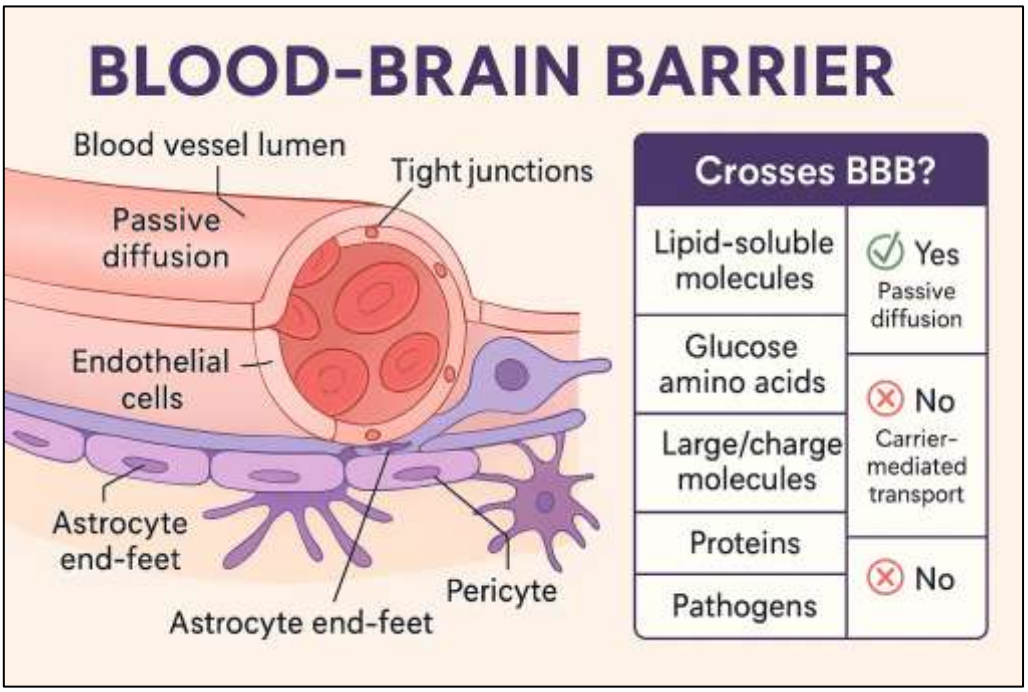


FIGURE 14–8 Normal sleep cycles at various ages. REM sleep is indicated by the darker colored areas. In a typical night of sleep, a young adult first enters NREM sleep, passes through stages 1 and 2, and spends 70–100 min in stages 3 and 4. Sleep then lightens, and a REM period follows. This cycle is repeated at intervals of about 90 min throughout the night. The cycles are similar, though there is less stage 3 and 4 sleep and more REM sleep toward morning. REM sleep occupies 50% of total sleep time in neonates; this proportion declines rapidly and plateaus at ~25% until it falls further in the elderly.
(Reproduced with permission from Kales AM, Kales JD: Sleep disorders. N Engl J Med 1974;290:487.)

(38)

(A) **T -** Choroid plexus is the main site of CSF production.
(B) **F -** CSF has much lower protein than plasma.
(C) **T -** CSF drains via arachnoid villi → dural sinuses.
(D) **F -** BBB restricts many substances; only lipid-soluble cross easily.
(E) **T -** ↑ICP → ↓ cerebral perfusion → risk of ischemia.



(39)

(A) **T -** Olfactory receptors are bipolar neurons in olfactory epithelium.
(B) **F -** Olfactory pathway bypasses thalamus initially → cortex directly.
(C) **T -** Taste buds are mainly in fungiform, foliate, circumvallate papillae.
(D) **F -** Bitter taste uses GPCRs (second messenger), not ion channels.
(E) **T -** Olfactory fibers pass via cribriform plate to olfactory bulb.

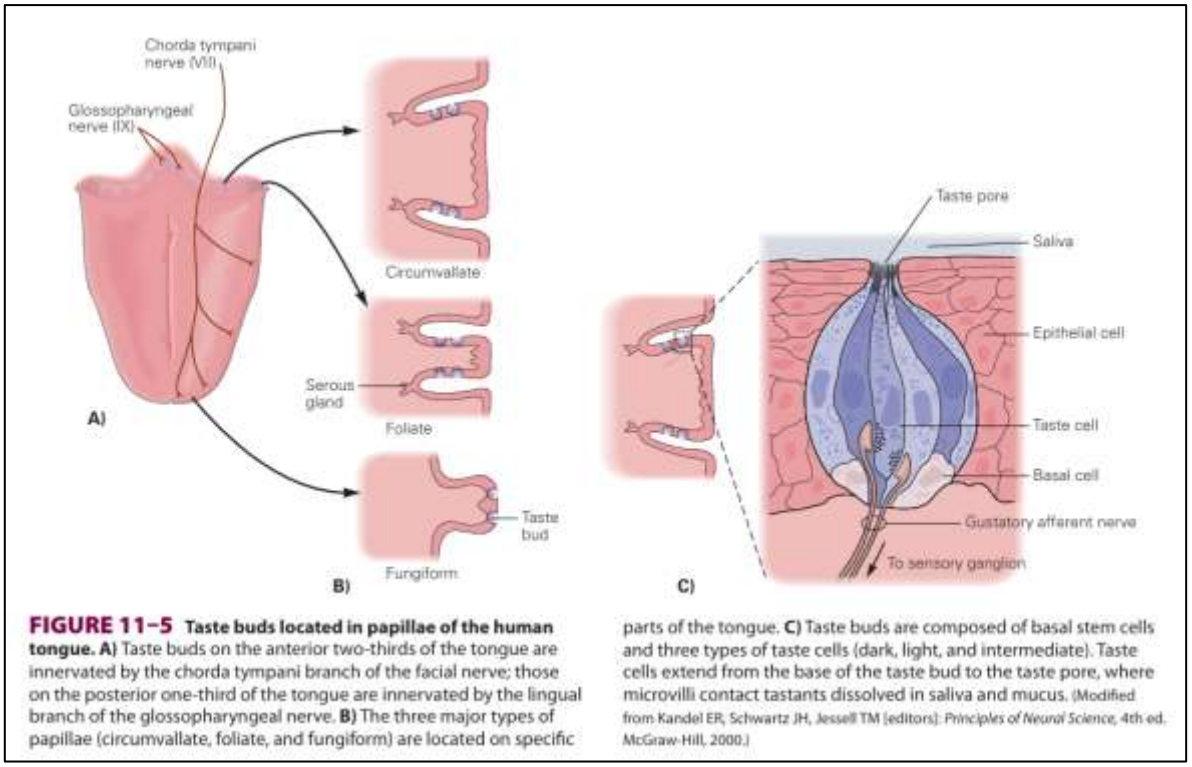


FIGURE 11–5 Taste buds located in papillae of the human tongue. A) Taste buds on the anterior two-thirds of the tongue are innervated by the chorda tympani branch of the facial nerve; those on the posterior one-third of the tongue are innervated by the lingual branch of the glossopharyngeal nerve. **B)** The three major types of papillae (circumvallate, foliate, and fungiform) are located on specific parts of the tongue. **C)** Taste buds are composed of basal stem cells and three types of taste cells (dark, light, and intermediate). Taste cells extend from the base of the taste bud to the taste pore, where microvilli contact tastants dissolved in saliva and mucus. (Modified from Kandel ER, Schwartz JH, Jessell TM (editors): *Principles of Neural Science*, 4th ed. McGraw-Hill, 2000.)

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(40)

(A) **T**
(B) **F -** speech production
(C) **T**
(D) **T**
(E) **F –** Language comprehension

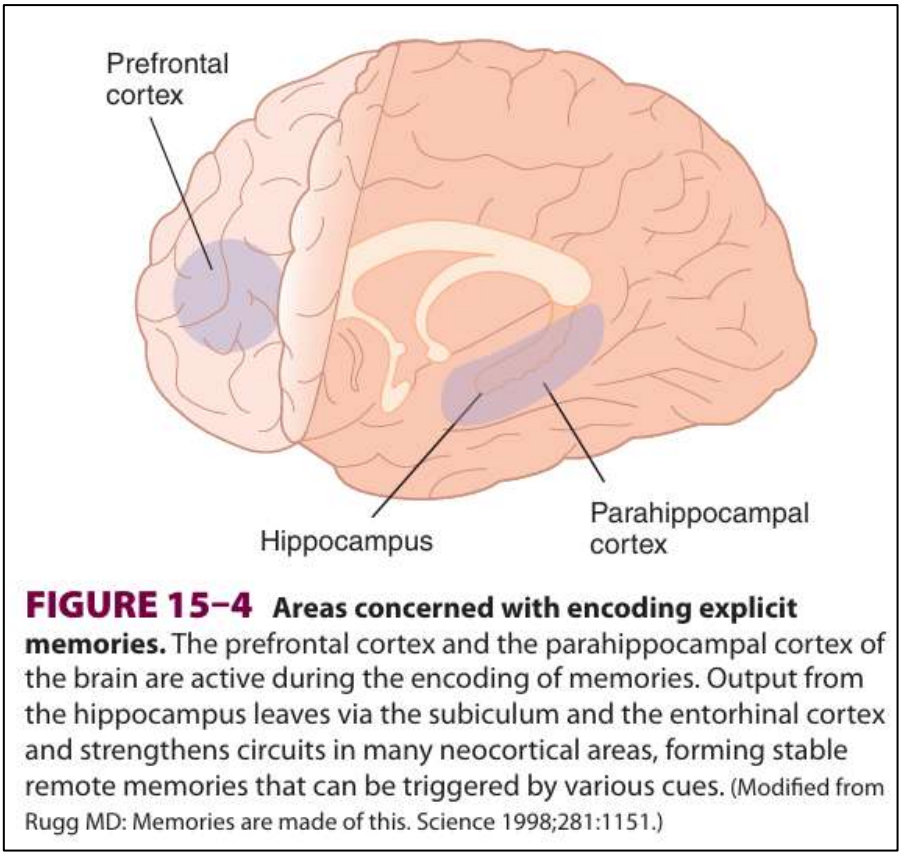

FIGURE 15–4 Areas concerned with encoding explicit memories. The prefrontal cortex and the parahippocampal cortex of the brain are active during the encoding of memories. Output from the hippocampus leaves via the subiculum and the entorhinal cortex and strengthens circuits in many neocortical areas, forming stable remote memories that can be triggered by various cues. (Modified from Rugg MD: Memories are made of this. Science 1998;281:1151.)

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(41)

Correct answer: (C) Loss of fine touch and proprioception on the right side

The dorsal column–medial lemniscus (DCML) pathway carries:

- Fine touch
- Vibration
- Proprioception

Key anatomical point:

- Fibers in the dorsal columns ascend ipsilaterally in the spinal cord.
- They cross (decussate) in the medulla at the level of the internal arcuate fibers.

Therefore:

2. A right-sided lesion at T10 affects right dorsal column fibers before they cross.
3. This produces ipsilateral (right-sided) loss of fine touch and proprioception below the lesion.

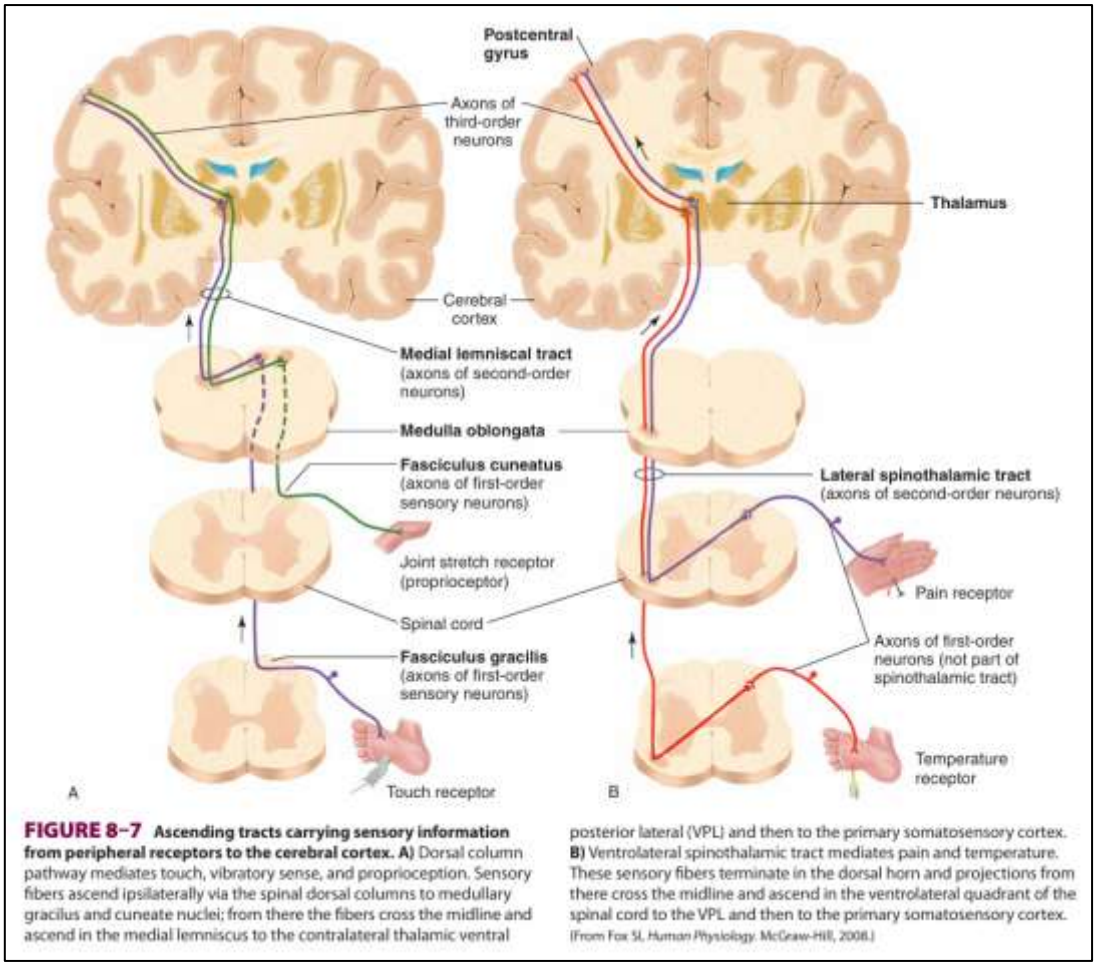


FIGURE 8–7 **Ascending tracts carrying sensory information from peripheral receptors to the cerebral cortex. A)** Dorsal column pathway mediates touch, vibratory sense, and proprioception. Sensory fibers ascend ipsilaterally via the spinal dorsal columns to medullary gracilus and cuneate nuclei; from there the fibers cross the midline and ascend in the medial lemniscus to the contralateral thalamic ventral posterior lateral (VPL) and then to the primary somatosensory cortex. **B)** Ventrolateral spinothalamic tract mediates pain and temperature. These sensory fibers terminate in the dorsal horn and projections from there cross the midline and ascend in the ventrolateral quadrant of the spinal cord to the VPL and then to the primary somatosensory cortex. (From Fox SI, *Human Physiology*. McGraw-Hill, 2008.)

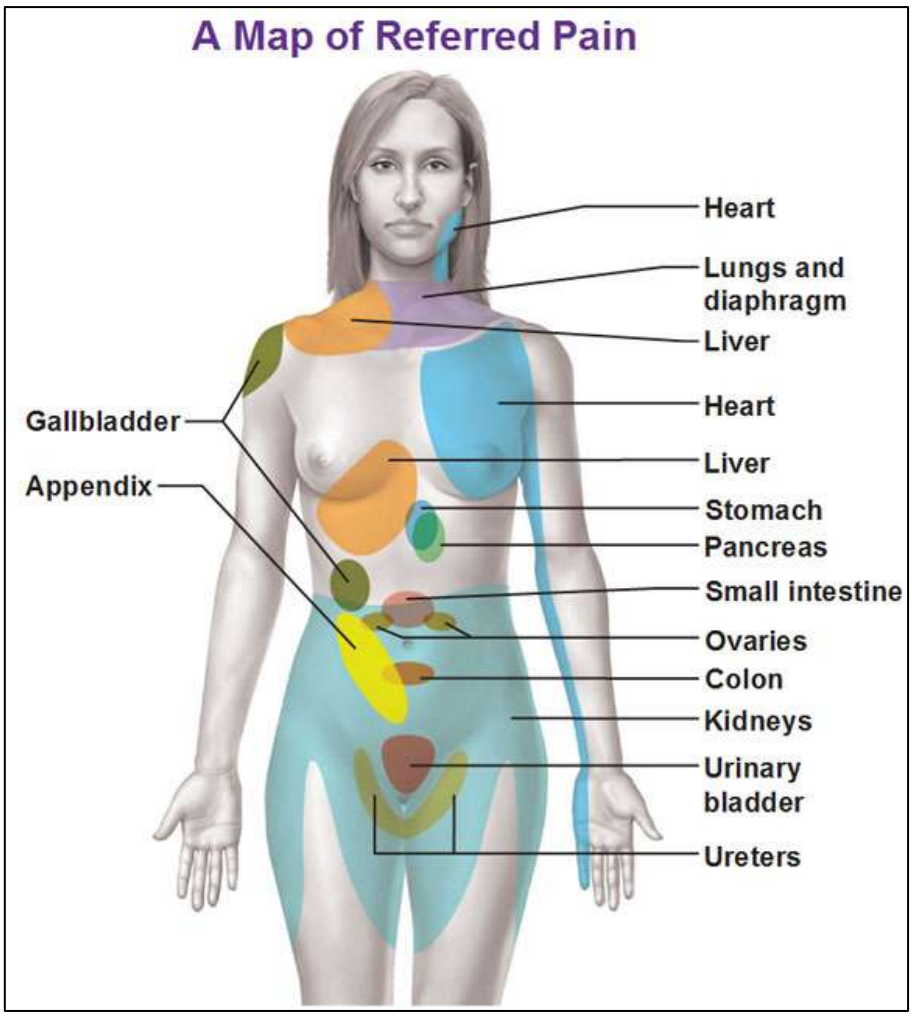
Ganong's Review of Medical Physiology 24th Edition p.178

(42)

Correct answer: (C) Convergence of cardiac and somatic afferents in the spinal cord

Referred pain in myocardial ischemia occurs because visceral afferent fibers from the heart (T1–T5 spinal segments) converge on the same second-order neurons in the dorsal horn as somatic afferents from the left arm and chest wall.

The brain is more accustomed to interpreting signals from somatic structures, so the visceral pain is mislocalized to the arm or chest wall. This is known as the convergence–projection mechanism of referred pain.



(43)

Correct Answer: (B) Generation of motor plan before movement

The premotor cortex and supplementary motor area are involved in planning and programming voluntary movements before they are executed by the primary motor cortex (M1). They integrate sensory information and previous experience to generate the motor plan.

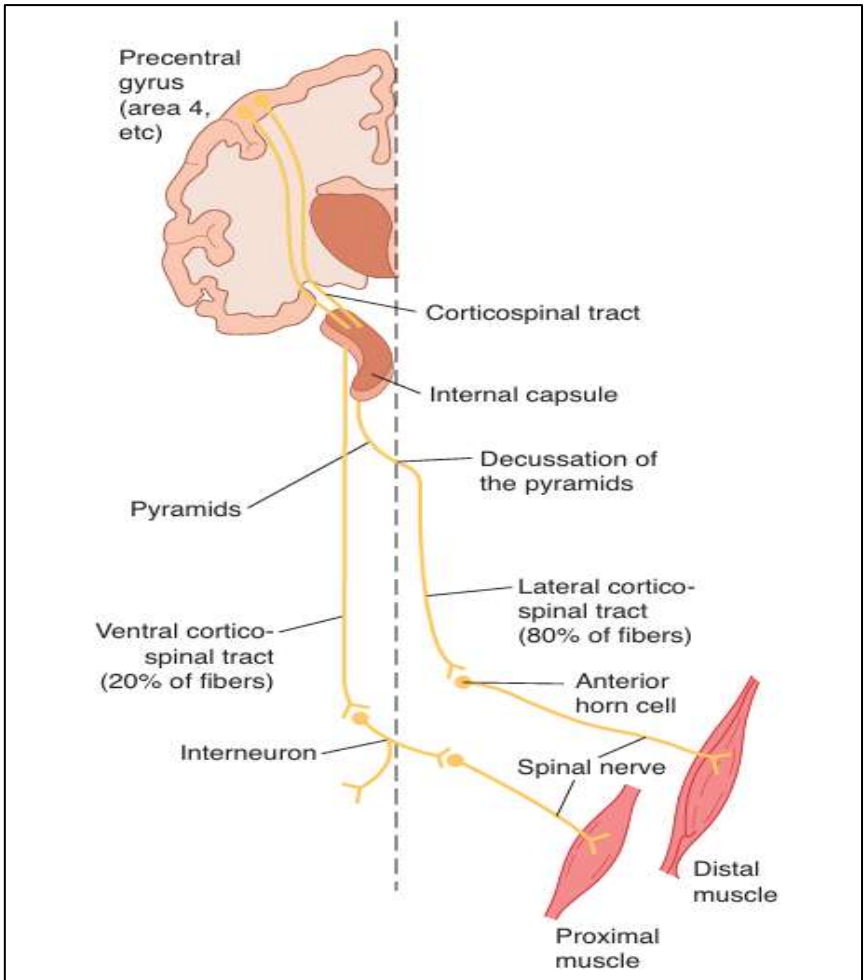


FIGURE 12–10 The corticospinal tracts. This tract originates in the precentral gyrus and passes through the internal capsule. Most fibers decussate in the pyramids and descend in the lateral white matter of the spinal cord to form the lateral division of the tract which can make monosynaptic connections with spinal motor neurons. The ventral division of the tract remains uncrossed until reaching the spinal cord where axons terminate on spinal interneurons antecedent to motor neurons.

Ganong's Review of Medical Physiology 24th Edition p.250

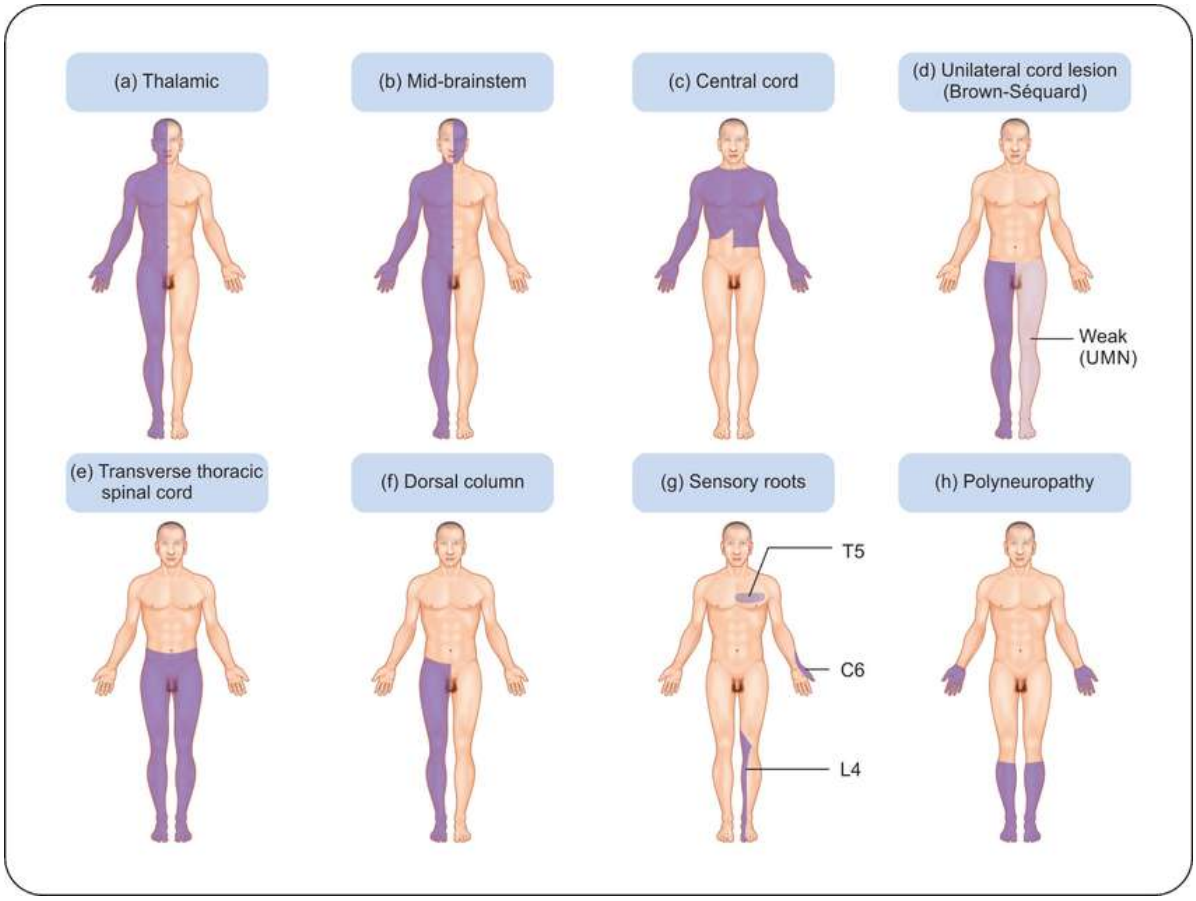
(44)

Correct Answer: (B) Dorsal column–medial lemniscus pathway

The dorsal column–medial lemniscus pathway carries fine touch, vibration, and proprioception.

These fibers ascend ipsilaterally in the spinal cord and cross in the medulla, so a right-sided spinal lesion causes right-sided loss of these modalities below the lesion.

Pain and temperature remain intact because they travel in the spinothalamic tract, which is not affected in this scenario.



Pattern of sensory abnormalities. Principal patterns of loss of sensation. (a) Thalamic lesion: sensory loss throughout opposite side (rare). (b) Brainstem lesion: contralateral sensory loss below face and ipsilateral loss on face. (c) Central cord lesion, e.g., syrinx: 'suspended' areas of loss, often asymmetrical and 'dissociated' , i.e. pain and temperature loss but light touch intact. (d) Hemisection of cord/unilateral cord lesion = Brown-Séquard syndrome: contralateral spinothalamic (pain and temperature) loss with ipsilateral weakness and dorsal column loss below lesion. (e) Transverse cord lesion: loss of all modalitiesm, including motor, below lesion. (f) Dorsal column lesion, e.g., MS: loss of proprioception, vibration and light touch. (g) Individual sensory root lesions, e.g., C6, T5, L4. (h) Polyneuropathy: distal sensory loss

(45)

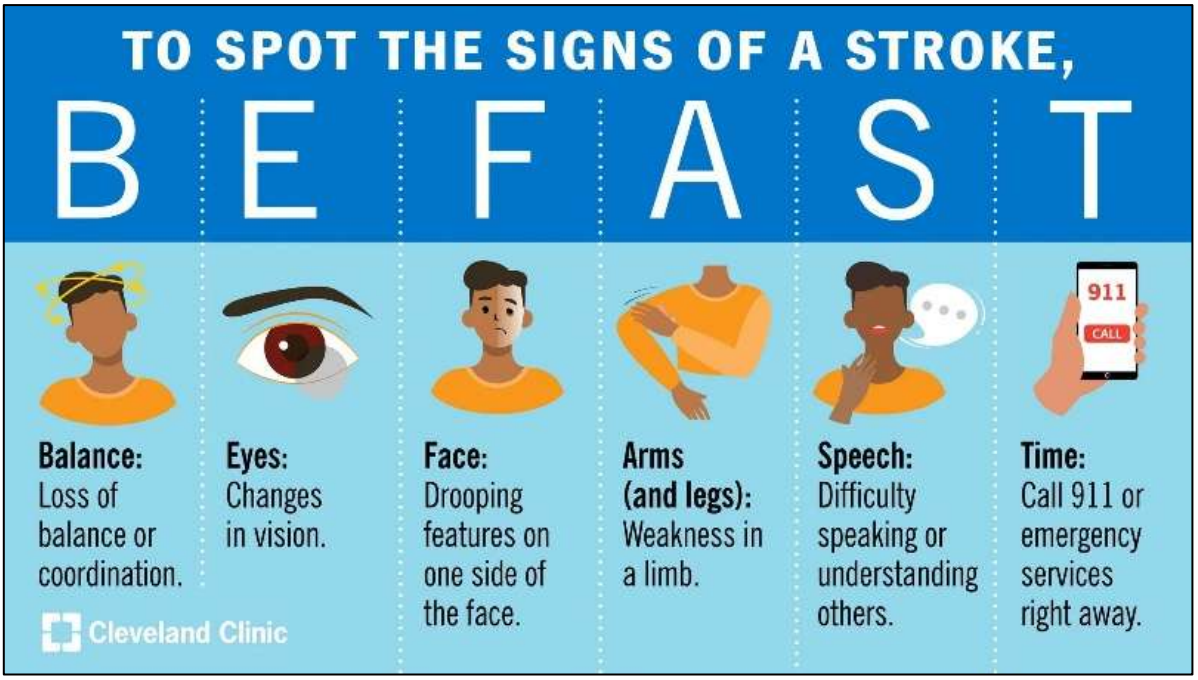
Correct Answer: (C) Corticospinal tract

The corticospinal tract (pyramidal tract) is the main pathway for voluntary control of limb movements.

Damage to this tract produces upper motor neuron signs, including:

- Contralateral weakness
- Spasticity
- Hyperreflexia
- Babinski sign

This occurs because corticospinal fibers decussate in the medullary pyramids, so a left-sided brain lesion produces right-sided deficits.



(46)

Correct Answer: (B) Peripheral vasoconstriction and shivering

When the hypothalamic set point increases during fever, the body perceives the current temperature as too low. To reach the new set point, the body activates heat-producing and heat-conserving mechanisms, including:

- Peripheral vasoconstriction → reduces heat loss
- Shivering → increases heat production
- Increased metabolic rate

Sweating and vasodilation occur later when the fever breaks and the set point returns to normal.

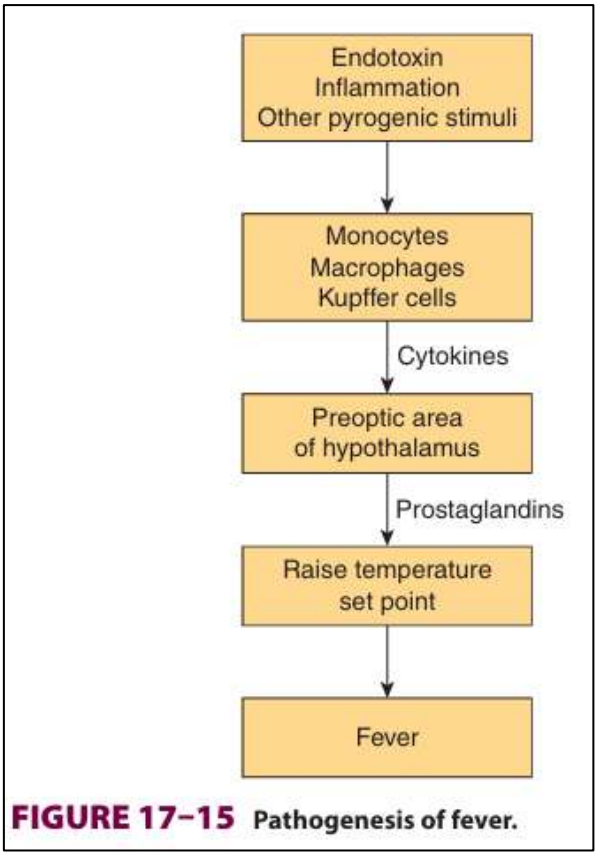


FIGURE 17–15 **Pathogenesis of fever.**

Ganong's Review of Medical Physiology 24th Edition p. 320

(47)

Correct Answer: (B) Damage to the satiety center leading to hyperphagia

The ventromedial nucleus of the hypothalamus acts as the satiety center.

Lesions in this region cause:

- Hyperphagia (excessive eating)
- Obesity

In contrast, lesions of the lateral hypothalamus (feeding center) cause loss of appetite and weight loss.

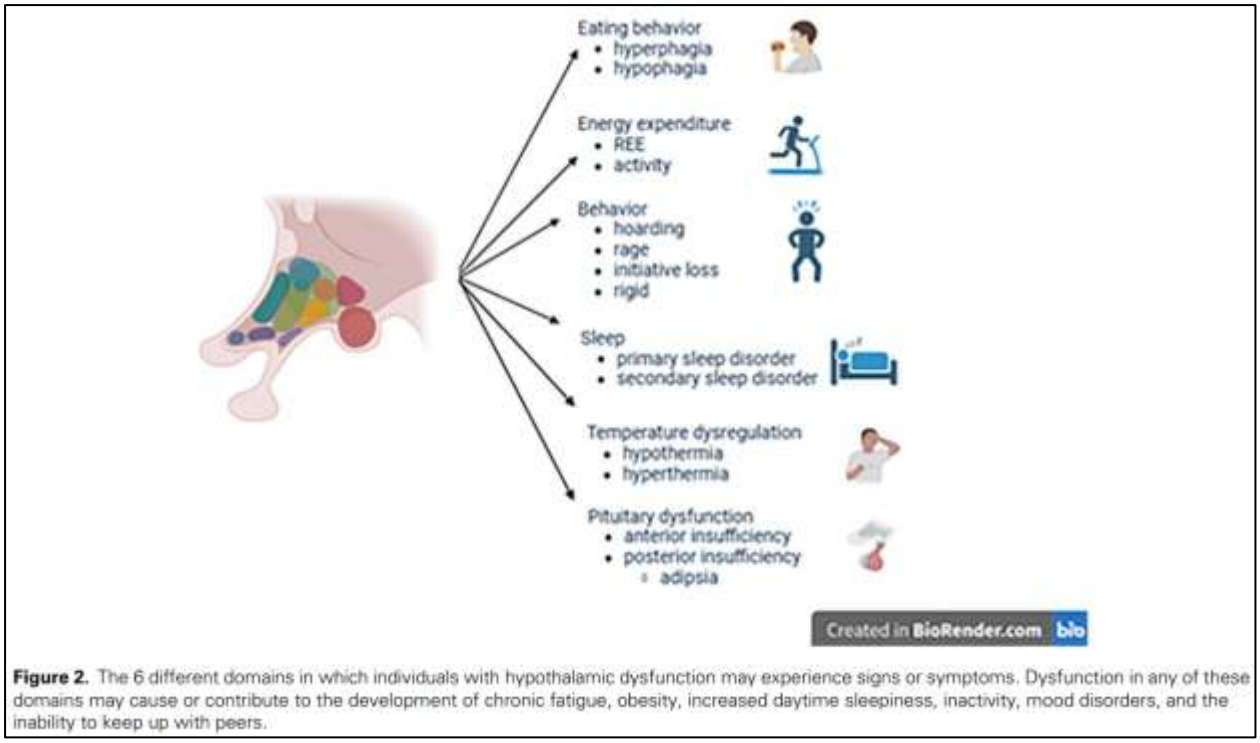


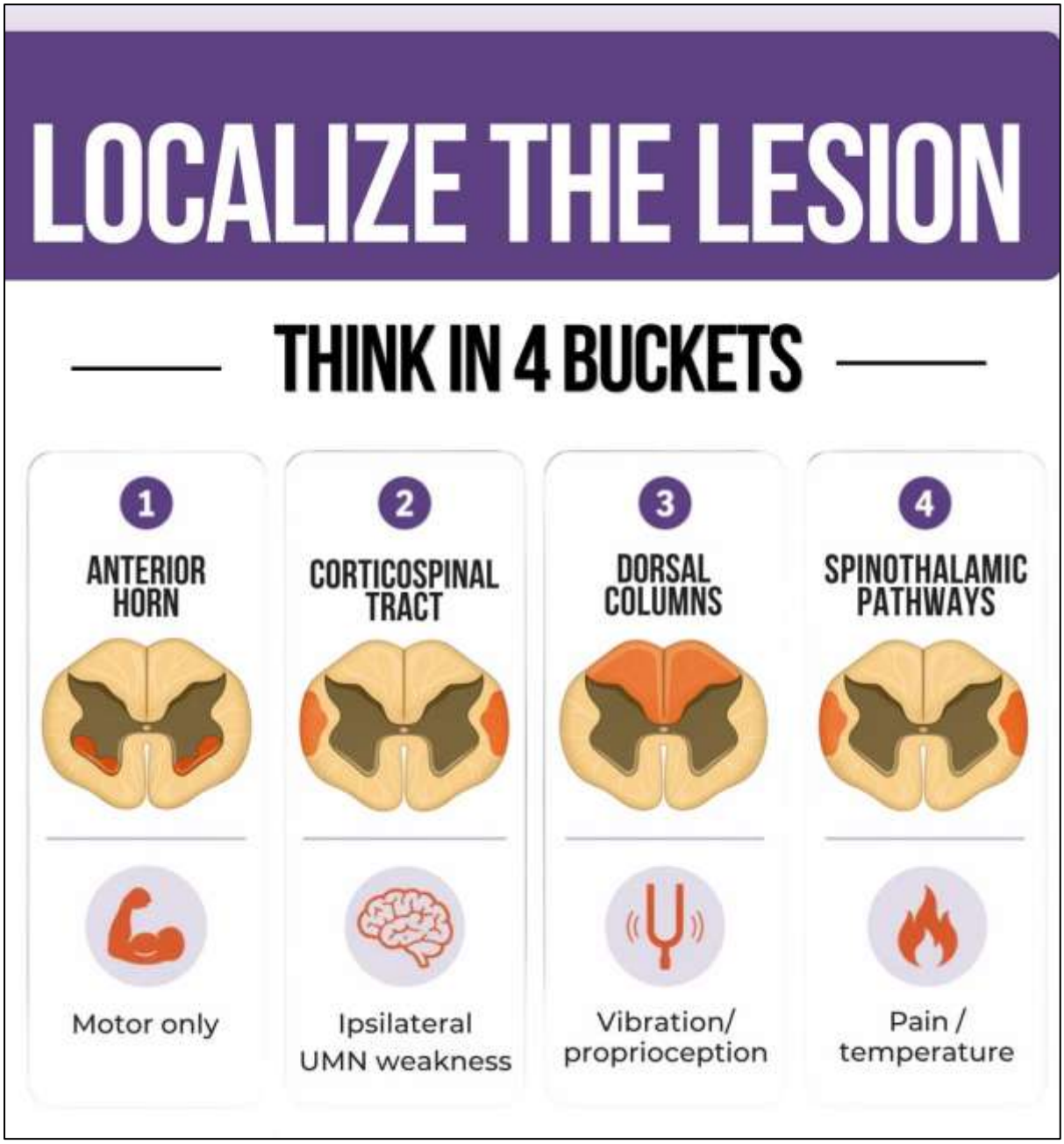
Figure 2. The 6 different domains in which individuals with hypothalamic dysfunction may experience signs or symptoms. Dysfunction in any of these domains may cause or contribute to the development of chronic fatigue, obesity, increased daytime sleepiness, inactivity, mood disorders, and the inability to keep up with peers.

(48)

Correct Answer: (C) Corticospinal tract

The corticospinal tract is the main pathway for voluntary motor control of the limbs. Damage to this pathway above the level of decussation produces contralateral upper motor neuron signs, including:

- Weakness or paralysis
- Spasticity
- Hyperreflexia
- Positive Babinski sign.

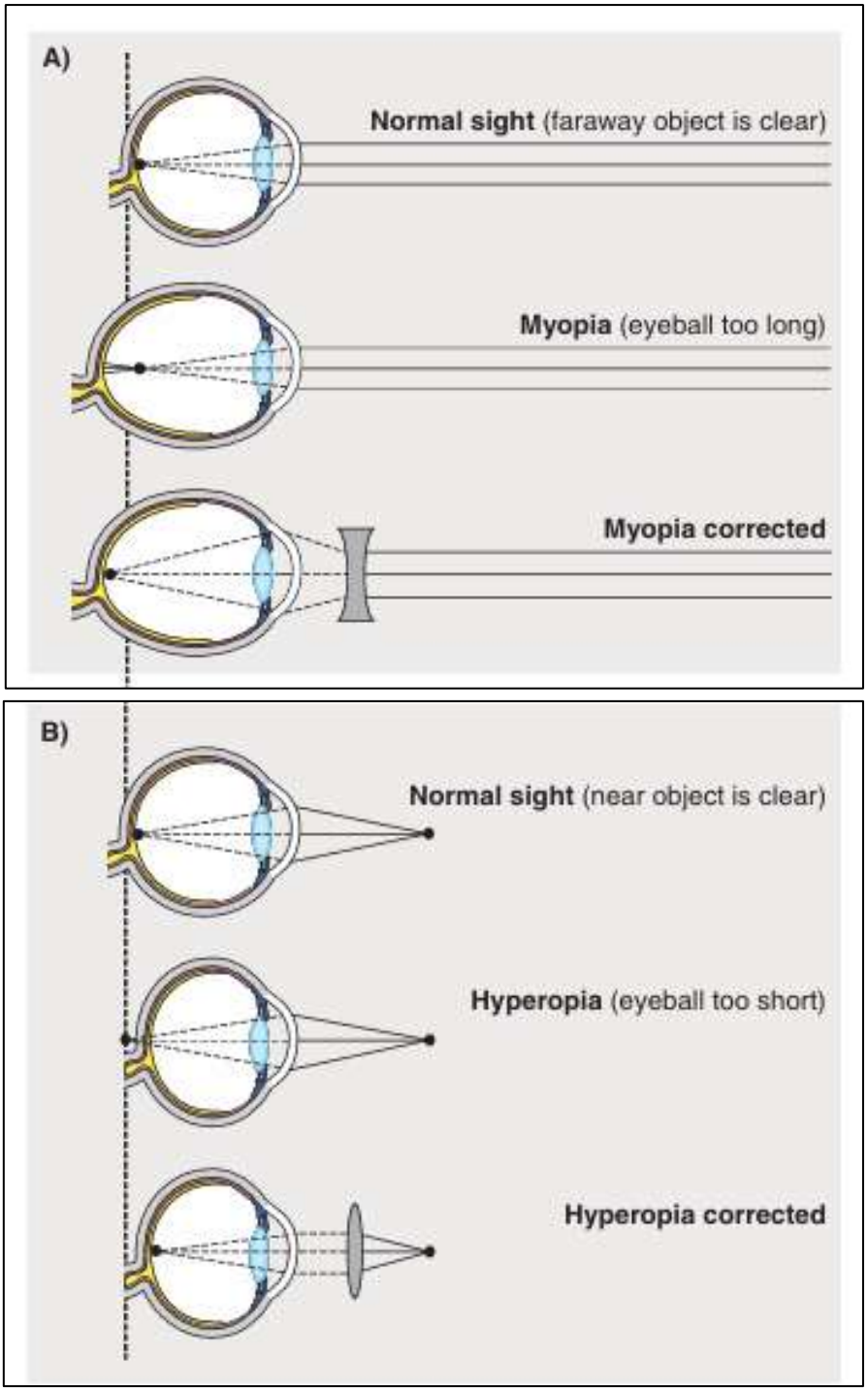


(49)

Correct Answer: (C) Increased axial length of the eyeball

This is myopia (short-sightedness):

- Light rays focus in front of the retina
- Usually due to increased axial length or excessive refractive power
- Corrected using concave (diverging) lenses



Ganong's Review of Medical Physiology 24th Edition p. 198

(50)

Correct Answer: (B) Conductive deafness in right ear

- Rinne negative (BC > AC) → suggests conductive hearing loss
- Weber lateralizes to affected ear → confirms conductive deafness

So, both findings point to conductive hearing loss in the right ear.

TABLE 10–1 Common tests with a tuning fork to distinguish between sensorineural and conduction deafness.

	Weber	Rinne	Schwabach
Method	Base of vibrating tuning fork placed on vertex of skull	Base of vibrating tuning fork placed on mastoid process until subject no longer hears it, then held in air next to ear	Bone conduction of patient compared with that of normal subject.
Normal	Hears equally on both sides.	Hears vibration in air after bone conduction is over	
Conduction deafness (one ear)	Sound louder in diseased ear because masking effect of environmental noise is absent on diseased side	Vibrations in air not heard after bone conduction is over	Bone conduction better than normal (conduction defect excludes masking noise)
Sensorineural deafness (one ear)	Sound louder in normal ear	Vibration heard in air after bone conduction is over, as long as nerve deafness is partial	Bone conduction worse than normal

Ganong's Review of Medical Physiology 24th Edition p. 211

(51)

Correct Answer: (B) Narcolepsy

Classic features = sleep attacks + cataplexy + disturbed nocturnal sleep, due to dysfunction of hypothalamic orexin (hypocretin) system.



(52)

Correct Answer: (B) Arachnoid villi

- CSF is absorbed via arachnoid villi into dural venous sinuses
- Impairment → communicating hydrocephalus
- Leads to raised ICP → headache, vomiting, papilledema

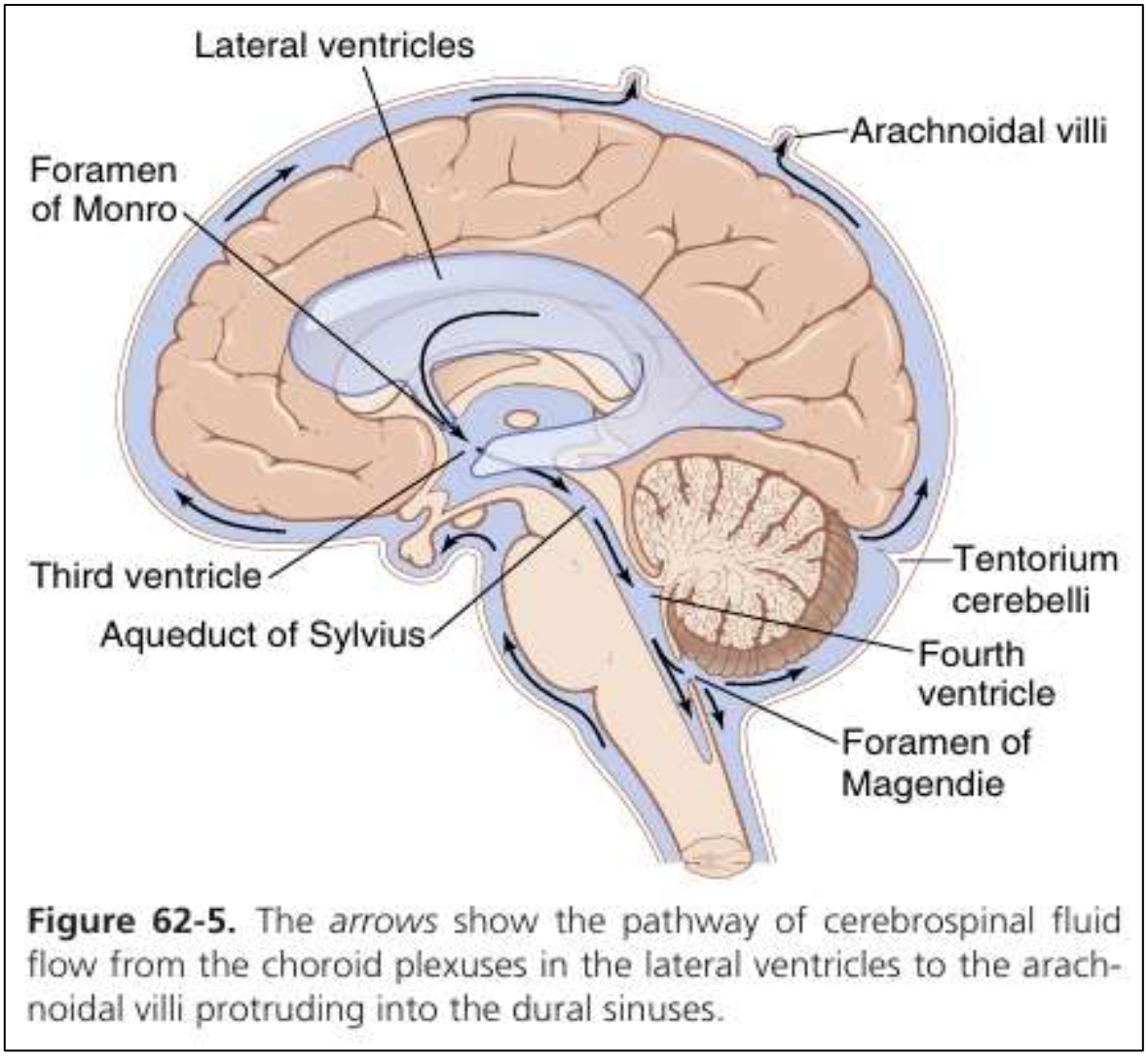


Figure 62-5. The *arrows* show the pathway of cerebrospinal fluid flow from the choroid plexuses in the lateral ventricles to the arachnoidal villi protruding into the dural sinuses.

Guyton and Hall Textbook of Medical Physiology 14th Edition

(53)

Correct Answer: (A) Loss of olfactory receptor input affecting flavor perception

- Flavor = taste + smell, with smell contributing a major component
- Cribriform plate injury → damage to olfactory nerve fibers → anosmia
- Basic tastes (sweet, salty, sour, bitter, umami) remain intact
- But loss of smell → reduced flavor perception

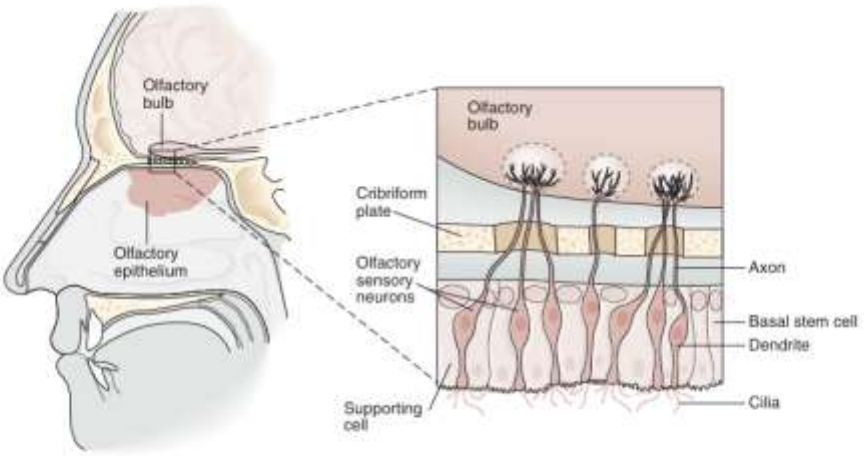


FIGURE 11–1 Structure of the olfactory epithelium. There are three cell types: olfactory sensory neurons, supporting (sustentacular) cells, and basal stem cells at the base of the epithelium. Each olfactory sensory neuron has a dendrite that projects to the epithelial surface. Numerous cilia protrude into the mucus layer lining the nasal lumen. Odorants bind to specific odorant receptors on the cilia and initiate a cascade of events leading to generation of action potentials in the sensory axon. Each olfactory sensory neuron has a single axon that projects to the olfactory bulb, a small ovoid structure that rests on the cribriform plate of the ethmoid bone. (From Kandel ER, Schwartz JH, Jessell TM [editors]: *Principles of Neural Science*, 4th ed. McGraw-Hill, 2000.)

Ganong's Review of Medical Physiology 24th Edition p. 218

(54)

Correct Answer: B. Broca's area

- Broca's area (dominant frontal lobe): motor speech → lesion → *expressive aphasia*
- Wernicke's area: comprehension → lesion → *receptive aphasia*
- Lateralization: language is usually in the left hemisphere in right-handed individuals
- Limbic system (hippocampus): memory, not speech production

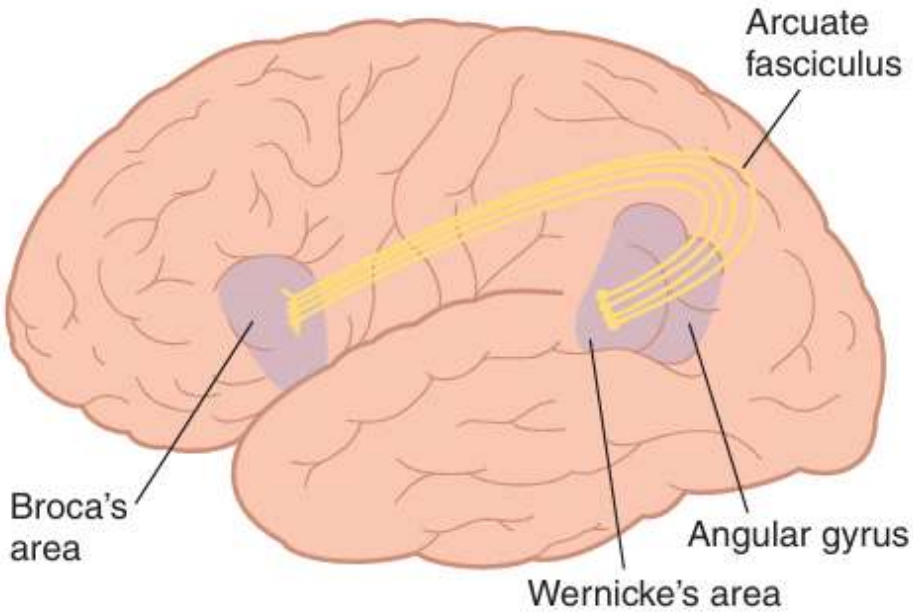


FIGURE 15–7 Location of some of the areas in the categorical hemisphere that are concerned with language functions. Wernicke's area is in the posterior end of the superior temporal gyrus and is concerned with comprehension of auditory and visual information. It projects via the arcuate fasciculus to Broca's area in the frontal lobe. Broca's area processes information received from Wernicke's area into a detailed and coordinated pattern for vocalization and then projects the pattern via a speech articulation area in the insula to the motor cortex, which initiates the appropriate movements of the lips, tongue, and larynx to produce speech.

Ganong's Review of Medical Physiology p. 293

PHYSIOLOGY SGD & TUTE QUESTIONS & ANSWERS

GFR and Tubular Functions

(1) Furosemide (a loop diuretic) was prescribed together with oral KCl to a patient who had generalize oedema. KCl was given to prevent furosemide induced hypokalaemia. His urine output increased and oedema reduced gradually.

(1.1) Explain the effect of furosemide on urine volume. (30 marks)

Furosemide is a loop diuretic that acts mainly on the thick ascending limb of the loop of Henle. - 3

Mechanism

- Normally, the Na^+-K^+-$2Cl^-$ cotransporter (NKCC2) reabsorbs sodium, potassium, and chloride from the tubular fluid into the renal tubular cells. - 3
- Furosemide inhibits NKCC2, preventing the reabsorption of these ions. - 3
- As a result, large amounts of Na^+ and Cl^- remain in the tubular fluid. - 3
- Water follows these solutes by osmosis and remains in the nephron rather than being reabsorbed into the blood. - 3

Effect on urine volume

- Increased excretion of sodium and chloride (natriuresis). - 3
- Increased water excretion (diuresis). - 3
- Reduced medullary osmotic gradient, which decreases water reabsorption in the collecting ducts. - 3
- Consequently, a large volume of dilute urine is produced. - 3

Therefore, furosemide markedly increases urine volume by inhibiting sodium chloride reabsorption in the thick ascending limb, causing increased excretion of water. - 3

(1.2) Explain how treatment with furosemide-leads to hypokalaemia. (30 marks)

Hypokalaemia refers to a decrease in plasma potassium concentration.

Mechanism

1. Reduced potassium reabsorption
   - By inhibiting the NKCC2 transporter, furosemide reduces potassium uptake from the tubular lumen. - 3
2. Increased sodium delivery to the distal nephron
   - More sodium reaches the distal convoluted tubule and collecting duct. - 3
3. Increased potassium secretion
   - Principal cells in the collecting duct reabsorb the excess sodium through epithelial sodium channels (ENaC). - 3
   - To maintain electrical neutrality, potassium is secreted into the tubular fluid and lost in urine. - 3
4. Activation of the renin–angiotensin–aldosterone system (RAAS)
   - Diuresis causes mild reduction in extracellular fluid volume. - 3
   - This stimulates aldosterone secretion. - 3
   - Aldosterone increases sodium reabsorption and potassium secretion in the collecting ducts. - 3

Result

- Increased urinary potassium loss (kaliuresis). - 3
- Progressive reduction in plasma potassium concentration. - 3

Therefore, furosemide causes hypokalaemia by increasing urinary potassium excretion through increased distal sodium delivery and aldosterone-mediated potassium secretion. - 3

(1.3) Explain how treatment with furosemide reduces oedema. (40 marks)

Oedema is the excessive accumulation of fluid in the interstitial spaces. - 3

Step 1: Increased excretion of sodium and water

- Furosemide inhibits sodium and chloride reabsorption in the loop of Henle. - 2
- Large amounts of sodium and water are excreted in urine. - 2

Step 2: Reduction of extracellular fluid volume

- Loss of sodium and water decreases: - 2
  - Plasma volume - 2
  - Extracellular fluid volume - 2

Step 3: Reduction of capillary hydrostatic pressure

- Decreased plasma volume lowers venous return and blood volume. - 3
- Capillary hydrostatic pressure falls. - 2
- Less fluid is pushed from capillaries into the interstitial tissues. - 2

Step 4: Movement of oedema fluid back into circulation

- As capillary hydrostatic pressure decreases, fluid accumulated in the interstitial spaces moves back into the capillaries. - 3
- This fluid is then transported to the kidneys and excreted in urine. - 2

Step 5: Progressive resolution of oedema

- Continued diuresis gradually removes excess extracellular fluid. - 2
- Tissue swelling decreases and oedema resolves. - 2

Additional benefit

- Furosemide also causes venodilation, which reduces venous pressure and further decreases fluid accumulation in tissues. - 3

Result

- Excess interstitial fluid is mobilized and excreted. - 3
- Generalized oedema gradually diminishes. - 3

Therefore, furosemide reduces oedema by promoting sodium and water loss, decreasing extracellular fluid volume and capillary hydrostatic pressure, which allows excess interstitial fluid to return to the circulation and be excreted by the kidneys. - 2

(2)

(2.1) What is the renal clearance of a substance? (10 marks)

Renal clearance is the volume of plasma that is completely cleared of a substance by the kidneys per unit time (usually expressed in mL/min). - 2

It indicates the efficiency with which the kidneys remove a substance from the blood. - 1

Formula

$$Clearance\ (C) = \frac{U \times V}{P}$$ - 1

Where:

- U = concentration of the substance in urine - 1
- V = urine flow rate (mL/min) - 1
- P = concentration of the substance in plasma - 1

Significance

- Used to assess kidney function. - 2
- Helps determine whether a substance is filtered, reabsorbed, or secreted by the renal tubules. - 1

(2.2)

(2.2.1) Describe the mechanism of water absorption in the proximal tubule (30 marks)

Approximately 65–70% of filtered water is reabsorbed in the proximal tubule. - 2

Mechanism

1. Active sodium reabsorption
   - Sodium is actively transported from tubular cells into the interstitial fluid by the Na^+/K^+-ATPase pump on the basolateral membrane. - 2
   - This lowers intracellular sodium concentration. - 1
   - Sodium enters the tubular cells from the lumen through various transporters. - 2
2. Creation of osmotic gradient
   - Reabsorption of sodium and other solutes increases the osmolarity of the interstitial fluid surrounding the tubule. - 2
   - The tubular fluid becomes relatively less concentrated. - 2
3. Water follows by osmosis
   - Water moves from the tubular lumen into the interstitial fluid down the osmotic gradient. - 2
   - Water movement occurs through:
     - Transcellular pathway via Aquaporin-1 channels - 2
     - Paracellular pathway through tight junctions between cells - 2
4. Uptake into peritubular capillaries
   - Reabsorbed water enters the peritubular capillaries due to:
     - Low capillary hydrostatic pressure - 2
     - High plasma colloid osmotic pressure -2

Characteristics

- Water reabsorption in the proximal tubule is obligatory. - 2
- It occurs automatically with solute reabsorption. - 2
- It is not regulated by hormones. - 1

Result

- About two-thirds of filtered water is reabsorbed in the proximal tubule. - 2
- Tubular fluid remains nearly isotonic with plasma. - 2

(2.2.2) Describe the regulation and mechanisms of water absorption in the collecting duct (40 marks)

The collecting duct is the major site for regulated water reabsorption. - 2

Mechanism of water absorption

1. Role of ADH (Antidiuretic Hormone)

- ADH is synthesized in the hypothalamus and released from the posterior pituitary. - 1
- It acts mainly on principal cells of the collecting duct. - 1

2. ADH receptor activation

- ADH binds to V_2 receptors on the basolateral membrane of principal cells. - 2
- This activates adenylate cyclase and increases intracellular cAMP. - 1

3. Insertion of Aquaporin-2 channels

- Increased cAMP promotes insertion of Aquaporin-2 (AQP2) channels into the luminal membrane. - 2
- Water permeability of the collecting duct increases markedly. - 1

4. Water movement

- Water moves from the tubular lumen into the cells through AQP2 channels. - 2
- Water then exits through Aquaporin-3 and Aquaporin-4 channels on the basolateral membrane. - 2
- Water enters the hyperosmotic renal medulla and then the blood. - 2

Regulation of water absorption

A. Increased ADH secretion

ADH secretion increases when:

i. Plasma osmolarity rises - 3

- Osmoreceptors in the hypothalamus detect increased osmolarity. - 1
- ADH release increases. - 1
- More water is reabsorbed. - 1
- Urine becomes concentrated. - 1

ii. Blood volume or blood pressure falls - 3

- Baroreceptors in the carotid sinus, aortic arch, and atria are stimulated. - 1
- ADH secretion increases. - 1
- Water conservation helps restore blood volume. - 1

B. Decreased ADH secretion

ADH secretion decreases when:

- Plasma osmolarity falls. - 1
- Blood volume increases. - 1

This reduces water permeability of the collecting duct and produces a large volume of dilute urine. - 2

Importance of the medullary osmotic gradient

- The hyperosmotic renal medulla, created by:
  - Countercurrent multiplication - 1
  - Urea recycling - 1
- Provides the osmotic force required for water reabsorption. - 2

Result

- Water reabsorption in the collecting duct varies according to body needs. - 2
- It allows production of either concentrated or dilute urine. - 1

(2.3) Explain the physiological basis for using PAH to measure the renal blood flow (20 marks)

PAH (Para-aminohippuric acid) is used to estimate renal plasma flow (RPF) and thereby renal blood flow. - 2

Physiological basis

1. Free filtration

- PAH is freely filtered at the glomerulus. - 2

2. Tubular secretion

(1) PAH that remains in the peritubular capillary blood is actively secreted into the proximal tubule. - 2

(2) Nearly all PAH entering the kidney is removed from the plasma in a single pass. - 2

3. Almost complete extraction

- About 90% of PAH reaching the kidneys is excreted in urine. - 2
- Therefore, PAH clearance approximates the amount of plasma flowing through the kidneys. - 2

PAH clearance

$$C = \frac{U \times V}{P}$$ - 2

This gives the effective renal plasma flow (ERPF).- 2

Calculation of renal blood flow

$$RBF = \frac{RPF}{1 - Haematocrit}$$ - 2

Where:

- RBF = Renal Blood Flow
- RPF = Renal Plasma Flow
- Hematocrit = Fraction of blood occupied by red blood cells

Conclusion

PAH is used to measure renal blood flow because it is freely filtered and extensively secreted by the renal tubules, resulting in nearly complete removal from renal plasma during a single passage through the kidneys.

Therefore, PAH clearance provides an estimate of renal plasma flow, from which renal blood flow can be calculated. - 2

Sexual Differentiation and Puberty

(1) A newborn is brought to the pediatric unit with ambiguous external genitalia. Chromosomal analysis reveals a 46, XY karyotype. Imaging shows absence of uterus and fallopian tubes, and the gonads are located in the inguinal canal. Hormonal evaluation later reveals low levels of dihydrotestosterone (DHT).

(1.1) Explain how male and female gonads develop from the primitive gonads. (40 marks)

Primitive (indifferent) gonad – 10 marks

- Forms from the genital (gonadal) ridge – 2
- Which is a condensation of tissue near the adrenal gland – 2
- Two parts; cortex and medulla – 2
- Presence of bipotential gonad until ~6 weeks – 2
- Ability to differentiate into testis or ovary – 2

Male gonadal development (46, XY) – 20 marks

- Presence of Y chromosome – 3
- SRY (sex-determining region of Y chromosome) gene on short arm of Y chromosome – 2
- Transcription factor for MIS (müllerian inhibiting substance) – 2
- During 7th – 8th weeks – 2
- Cortex regresses – 2
- Medulla turns into testes – 3
- Formation of Sertoli cells – 1
- Sertoli cells secrete MIS – 1
- Development of Leydig cells – 2
- Leydig cells secrete testosterone – 2

Female gonadal development (46, XX) – 10 marks

- Absence of Y chromosome / SRY gene – 2
- Medulla regresses – 2
- Cortex turns into ovaries – 3

No hormone production in fetal life in ovaries – 3

(1.2) Briefly explain;

(1.2.1) How the male and female internal genitalia development is regulated. (15 marks)

Male internal genitalia – 8 marks

- Development from Wolffian (mesonephric) ducts – 2
- Testosterone maintains Wolffian ducts – 2
- MIS inhibits müllerian duct growth – 2
- Formation of epididymis, vas deferens, seminal vesicles – 2

Female internal genitalia – 7 marks

- Regression of Wolffian ducts due to absence of testosterone – 2
- Müllerian duct persistence – 2
- Absence of MIS – 2

  Formation of uterus, fallopian tubes, upper vagina – 1

(1.2.2) How the male and female external genitalia development is regulated. (15 marks)

- Presence of bipotential external genitalia – 3
- Conversion of testosterone to DHT by 5α-reductase – 3
- In 7th-8th weeks – 2
- Role of DHT in development of penis, scrotum, prostate – 3
- Female external genitalia develop in absence of DHT – 2
- Formation of clitoris, labia majora and minora – 2

(1.3) Briefly outline the abnormality in sexual differentiation in this case. (30 marks)

Identification of disorder – 8 marks

- Correct diagnosis: 5α-reductase deficiency – 6
- Classified as disorder of sexual differentiation – 2

Evidence from the case – 12 marks

- 46, XY karyotype – 2
- Presence of testes in inguinal canal – 2
- Absence of uterus and fallopian tubes (MIS action intact) – 3
- Low DHT levels – 3
- Ambiguous external genitalia – 2

Pathophysiology – 10 marks

- Deficiency of 5α-reductase enzyme – 4
- Failure of conversion of testosterone to DHT – 3
- Normal male internal genitalia development – 2

  Undervirilized external genitalia – 1

(2) A 13-year-old girl is brought to the clinic by her parents because she has not yet attained menarche and has minimal breast development. She is shorter than her peers and has a history of poor nutritional intake. Her parents are concerned about delayed pubertal development.

(2.1) Define puberty. (20 marks)

The period when

- the endocrine – 4
- and the gametogenic functions of the gonads – 4
- have first developed to the point where reproduction is possible – 4
- Boys at age 8-13 years – 4
- Girls at age 9-14 years – 4

(2.2) List the secondary sexual characteristics,

(2.2.1) Males (10 marks)

(2 mark each; any 5)

- Enlargement of testes
- Enlargement of penis
- Growth of facial hair
- Growth of axillary hair
- Growth of pubic hair
- Deepening of voice
- Laryngeal enlargement (Adam's apple)
- Increase in muscle mass
- Broadening of shoulders
- Growth spurt

(2.2.2) Females (10 marks)

(2 mark each; any 5)

- Breast development
- Growth of pubic hair
- Growth of axillary hair
- Onset of menarche
- Widening of pelvis
- Increase in subcutaneous fat
- Female body contour development
- Growth spurt
- Maturation of uterus and ovaries
- Development of areola and nipple pigmentation

(2.3) List the factors affecting puberty (20 marks)

(4 marks each; any 5)

- Genetic factors
- Nutritional status and body fat

- General health and chronic illness
- Socioeconomic status
- Environmental factors (climate, altitude)
- Psychological stress
- Endocrine disorders (thyroid, pituitary)

(2.4) Briefly outline the physiological basis of the above patient's condition. (40 marks)

Identification of condition – 5 marks

- Delayed puberty – 5

Role of nutrition – 15 marks

- Poor nutritional intake → low body fat – 5
- Reduced leptin secretion – 5
- Leptin required for GnRH pulse initiation – 5

Hypothalamic–pituitary–gonadal axis suppression – 15 marks

- Reduced GnRH pulsatility – 5
- Decreased LH and FSH secretion – 5
- Reduced ovarian estrogen production – 5

Clinical correlation – 5 marks

- Minimal breast development due to low estrogen – 3
  Delayed menarche – 2

Female Reproductive System

(1)

(1.1) State two clinical features that indicate ovulation has occurred in a woman (20 marks)

- Rise in basal body temperature (≈0.3–0.5°C after ovulation)
  - Due to thermogenic effect of progesterone
- Mid-cycle (Mittelschmerz) pain
  - Due to follicular rupture
- Changes in cervical mucus
  - Becomes thin, watery, stretchable (spinnbarkeit) before ovulation
  - Fern pattern on drying
- Serum progesterone elevation in luteal phase
- Detection of LH surge (urinary LH kits)

10 marks per each for any two well explained.

(1.2) Outline the endometrial changes that occur during a 28-day menstrual cycle. (30 marks)

A. Menstrual phase (Day 1–4/5) – 5 marks
   - Shedding of functional layer – 2
   - Spiral artery constriction – 1
   - Bleeding due to progesterone withdrawal – 2

B. Proliferative phase (Day 5–14) – 10 marks
   (Oestrogen dominant)
   - Regeneration of functional layer – 3
   - Straight tubular glands – 1
   - Increased stromal cellularity – 2
   - Spiral arteries lengthen – 2
   - Endometrial thickness increases – 2

C. Secretory phase (Day 15–28) – 15 marks
   (Progesterone dominant)
   - Glands become tortuous & coiled – 3
   - Glycogen-rich secretions – 1
   - Stromal edema – 2
   - Further spiral artery development – 3
   - Preparation for implantation – 3
   - Premenstrual ischemic changes if no fertilization – 3

(1.3) Explain the changes that would be observed in the levels of FSH, LH, estrogen and progesterone in a menopaused woman.

- Ovarian changes – 5 marks
  - Follicular depletion – 2
  - No ovulation – 3

- Hormonal levels – 10 marks
    - ↓ Estrogen – 2
    - ↓ Progesterone – 2
    - ↑ FSH (markedly increased) – 3
    - ↑ LH (increased) – 3
- Physiological basis – 5 marks
    - Loss of negative feedback on hypothalamus & pituitary

(2)

(2.1) Draw a schematic diagram to show the feedback regulation of the hypothalamic pituitary-ovarian axis (40 marks)

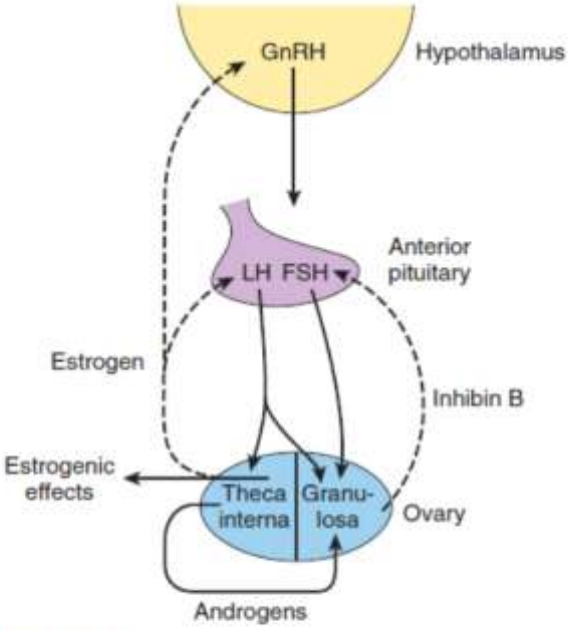


FIGURE 22–21 Feedback regulation of ovarian function. The cells of the theca interna provide androgens to the granulosa cells, and theca cells also produce the circulating estrogens that inhibit the secretion of GnRH, LH, and FSH. Inhibin from the granulosa cells inhibits FSH secretion. LH regulates the thecal cells, whereas the granulosa cells are regulated by both LH and FSH. The dashed arrows indicate inhibitory effects and the solid arrows stimulatory effects.

- Diagram components – 20 marks
  - Hypothalamus → GnRH (pulsatile) – 6
  - Anterior pituitary → FSH & LH – 7
  - Ovary → Estrogen & Progesterone – 7
- Feedback mechanisms – 20 marks
  - Negative feedback (low-moderate estrogen, progesterone) – 10
  - Positive feedback (sustained high estrogen → LH surge → ovulation) – 10

(2.2) A 25-year-old female athlete complained of amenorrhea for the last six months. Her pregnancy test was negative. Investigations showed that her plasma LH, FSH and estradiol levels were low, while plasma prolactin level was normal.

(2.2.1) What is the most likely cause for her amenorrhoea? (20 marks)

Functional hypothalamic amenorrhea due to excessive exercise / stress (hypogonadotropic hypogonadism). – 20

(2.2.2) State the physiological basis of your answer in 2.2.1. (30 marks)

Excessive exercise → energy deficit – 5

↓ Leptin / ↑ stress hormones – 5

Suppression of GnRH pulse generator – 10

↓ LH & FSH secretion – 5 marks

↓ Estradiol → failure of ovulation → amenorrhea – 5

(2.2.3) State one treatment strategy to regularize her menstrual cycle. (10 marks)

Any one of the following: 10 marks

- Reduce exercise intensity
- Increase caloric intake
- Restore normal BMI
- Pulsatile GnRH therapy
- Combined hormonal therapy

Sensory System

(1) Write short notes on following,

(1.1) Two point discrimination (25 marks)

Ability to identify two touch stimuli applied at the same time separately - 4
Receptors are touch receptors - 3
Impulses travel via A beta fibres - 4
Depends on the receptor density in the area - 3
In fingers, higher number of receptors - 4
Therefore two-point discrimination is better on fingers than on back - 3
Lateral inhibition is useful – receptors at the peripheral edge of the stimulus is inhibited compared to the stimuli coming from the centre - 4

(1.2) Sensory receptor adaptation (25 marks)

When a stimulus with constant strength is applied to a receptor over a prolonged time - 4
Decline in frequency of discharge over time - 4
2 main categories – slowly adapting, rapidly adapting - 4
Slowly adapting – merkel and ruffini – nociceptors, proprioceptors - 4
Rapidly adapting – Meissner and pacinican – eg light touch, pressure - 4
Significance /importance – some sensations can be distracting - 5

(1.3) Receptor potential (25 marks)

Convert stimuli to signals - 4
Each has an adequate stimulus – repond to lower threshold - 4
Convert mechanical energy to electrical response - 4
Develop receptor potential - 3
Change in receptor membrane, depolarization - 3
Firing level is reached, action potential is generated - 3
Produced in the 1st node of Ranvier - 4

(1.4) Sensory coding (25 marks)

Conversion of receptor stimulus into a recognizable sensation - 5
Code for four basic qualities –
modality - 5
Location - 5
Intensity - 5
Duration - 5

Motor System

(1)

(1.1) Describe the pathway of signals from the motor cortex to the bicep muscle when you perform a bicep flexion. (50 marks)

Origin of pathway (10 marks)

- Upper motor neurons arise from primary motor cortex (precentral gyrus, area 4). (4)
- Also contributions from premotor and supplementary motor areas. (3)
- Neurons are pyramidal cells (Betz cells). (3)

Course through cerebrum (10 marks)

- Fibers descend through corona radiata. (5)
- Then pass through the posterior limb of internal capsule. (5)

Course through brainstem (10 marks)

- Pass through crus cerebri of midbrain. (3)
- Descend through pons. (3)
- Form pyramids of the medulla. (4)

Decussation and spinal cord pathway (10 marks)

- About 85–90% cross at pyramidal decussation in the lower medulla. (5)
- Continue as the lateral corticospinal tract in the spinal cord. (5)

Synapse and activation of muscle (10 marks)

- Upper motor neuron synapses with lower motor neuron in anterior horn at C5–C6 segments. (4)
- Lower motor neuron exits via ventral root. (2)
- Travels through musculocutaneous nerve. (2)
- Releases acetylcholine at neuromuscular junction → biceps contraction. (2)

(1.2) List the extrapyramidal tracts and briefly mention their functions. (30 marks)

Vestibulospinal tract (7 marks)

- Origin: vestibular nuclei (2)
- Function: posture, balance, facilitation of extensor muscles (5)

Reticulospinal tract (7 marks)

- Origin: reticular formation (2)
- Function: regulation of muscle tone, posture, reflex modulation (5)

Rubrospinal tract (7 marks)

- Origin: red nucleus in midbrain (2)
- Function: facilitates flexor muscles of upper limbs (5)

Tectospinal tract (7 marks)

- Origin: superior colliculus (2)
- Function: reflex head and neck movements toward visual stimuli (5)

General role of extrapyramidal system (2 marks)

- Coordination of automatic movements, posture and muscle tone.

(1.3) Explain the terms upper motor and lower motor neurons. (20 marks)

Upper motor neuron (10 marks)

- Neurons that originate in motor cortex or brainstem. (3)
- Descend to synapse with lower motor neurons in spinal cord or cranial nerve nuclei. (4)
- Responsible for voluntary motor control. (3)

Lower motor neuron (10 marks)

- Neurons located in anterior horn of spinal cord or cranial nerve motor nuclei. (4)
- Axons leave CNS to directly innervate skeletal muscle. (4)
- Final common pathway for muscle contraction. (2)

(2) A patient who had a neurological injury 5 weeks ago shows diminished bicep jerks and exaggerated triceps jerks on both sides. He also experiences periodic involuntary emptying of urinary bladder without his awareness.

(2.1) State the most likely site of the lesion. (10 marks)

Lesion of the spinal cord between C5 and C7 segments (around C6 level).

Marking

- Cervical spinal cord lesion (5)
- Between biceps (C5–C6) and triceps (C7–C8) reflex levels (5)

(2.2) List the neurological signs that you would expect in the upper limbs of this patient. (10 marks)

Any relevant upper motor neuron signs below the lesion:

- Weakness/paralysis of voluntary movements (2)
- Spasticity (2)
- Hyperreflexia (2)
- Positive Babinski sign (2)
- Loss of fine voluntary movements (2)

(2.3) Explain the physiological basis of the following in this patient

(2.3.1) Reduced biceps jerks and exaggerated triceps jerks. (50 marks)

Biceps reflex (C5–C6) reduction (25 marks)

- Reflex arc involves C5–C6 spinal segments. (5)
- Lesion damages LMN or reflex arc at that level. (10)
- Loss of motor neuron activity to biceps reduces reflex. (10)

Triceps reflex exaggeration (C7–C8) (25 marks)

- Triceps reflex mediated by C7–C8 segments. (5)
- Reflex arc below lesion remains intact. (5)
- Loss of descending inhibitory corticospinal control. (10)
- Leads to hyperreflexia and exaggerated reflexes. (5)

(2.3.2) Periodic involuntary emptying of the bladder. (30 marks)

Normal control (10 marks)

- Micturition controlled by pontine micturition center and cortical control. (5)
- Descending pathways regulate spinal micturition reflex. (5)

Effect of spinal cord lesion (10 marks)

- Loss of voluntary cortical control over bladder reflex. (5)
- Spinal reflex becomes autonomous. (5)

Result (10 marks)

- Development of automatic (reflex) bladder. (5)
- Causes periodic involuntary emptying of urine. (5)

Involuntary Motor Activity

(1) Reflex arcs are neural pathways that mediate rapid responses in human body.

(1.1) Describe what a synapse is. (10 marks)

specialized junction/transmission site - 5

from presynaptic cell to post synaptic cell (excitable cell – neuron/muscle) - 3

typically neurotransmitters relay the signal (chemical/electrical signal transmission) - 2

(1.2) Give an example each for the following two reflex pathways (20 marks)

(1.2.1) Monosynaptic reflex

stretch reflex - 10

(1.2.2) Polysynaptic reflex

withdrawal reflex - 10

(1.3) Compare and contrast monosynaptic reflex pathway and polysynaptic reflex pathway using two labelled diagrams (50 marks)

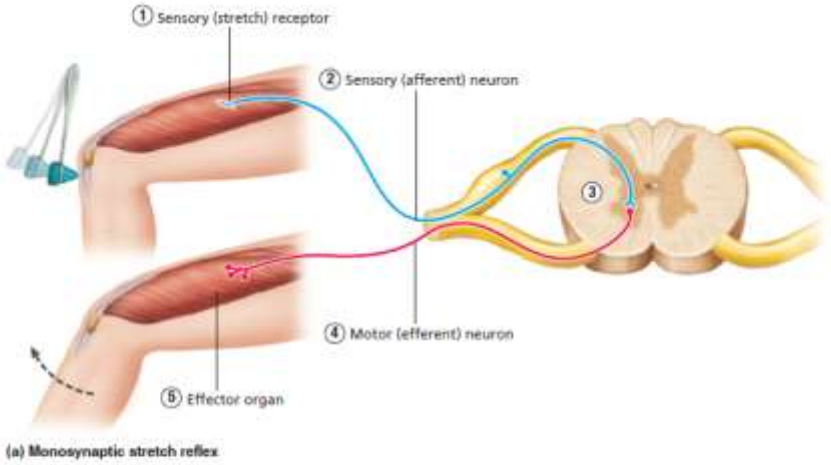


Figure 12.11 Types of reflex arcs. (a) A monosynaptic reflex arc has two neurons and a single synapse. (b) A polysynaptic reflex arc has more than two neurons (in this case, three) and therefore has at least two synapses. The five components of a reflex arc are indicated by number.

Diagram – stimulus - 1, receptor - 1, sensory neuron - 2, spinal cord, (interneuron) - 2, motor neuron - 2, effector - 2
In monosynaptic reflex, two neurons participate. In polysynaptic reflexes 3 or more neurons participate. - 5
In both reflex arcs, Sensory organ detects the external stimulus. - 5
Afferent neuron (sensory) carries nerve impulse to the central nervous system. - 5
In polysynaptic reflex, it synapses with intermediate neurons within the CNS. - 5
In monosynaptic reflex, it synapses with alpha and gamma motor neurons of the same muscle at the spinal cord. - 5
In both arcs, then motor impulse is carried out via efferent neuron. - 3
Response is exhibit by effectors (muscle, gland) - 2
Monosynaptic reflex can be faster than polysynaptic reflex - 5
Polysynaptic reflexes can involve multiple muscles whereas monosynaptic reflex usually involves one muscle - 5

(1.4) List two examples for following clinical signs

(1.4.1) Diminished motor reflexes (10 marks)

Peripheral neuropathy (e.g., diabetic neuropathy) - 5
Guillain-Barré syndrome - 5

(1.4.2) Exaggerated motor reflexes (10 marks)

Upper motor neuron lesion (e.g., stroke affecting corticospinal tract) - 5
Spinal cord injury above reflex level - 5

(2)

(2.1) Briefly describe the function of basal ganglia. (50 marks)

3 functional loops – 2
Motor - 1, associative – 1 and limbic - 1
Regulation of voluntary movement - 5
Planning of a movement – cognitive component - 5
Initiation and smooth execution of movement - 5
Prevents unwanted movements - 5
Posture and muscle tone:
Maintains appropriate muscle tone during movement / unconscious movements - 5
Maintains posture - 2
Has inhibitory effect on spinal reflex - 3
Motor learning: Involved in procedural learning (e.g., riding a bicycle) - 5
Emotional aspects of movement - 5
Also has a role in arousal mechanism through its connection with reticular formation - 5

(2.2) What are the two main types of disorders that arise due to diseases in basal ganglia? (20 marks)

Hypokinetic disorders – Reduced movement - 10
Hyperkinetic disorders – Excessive involuntary movements - 10

(2.3) Name one disease of basal ganglia and mention two clinical features seen in this disease condition. (30 marks)

Parkinson's disease - 10
1. Resting tremor
2. Rigidity (cogwheel rigidity/ led pipe rigidity)
3. Bradykinesia (slowness of movement) (any 2 = 5 each)

Physiology of Pain

(1) Explain the physiological basis of the following;

(1.1) Irritation of the diaphragm presents as shoulder tip pain. (25 marks)

Physiological Basis: Referred Pain

Referred pain occurs when pain from a visceral structure is perceived in a somatic region sharing the same spinal segments. - 5

Neural Pathway

- Diaphragm is innervated by the Phrenic nerve - 5
- Pain fibers travel to spinal cord segments C3–C5 - 5

Mechanism

- Somatic sensory input from the shoulder (C3–C5 dermatomes) and visceral afferents from the diaphragm converge on the same second-order neurons - 3
- Brain cannot distinguish visceral origin → misinterprets pain as coming from somatic region - 4

This is explained by the Convergence Projection Theory - 3

(1.2) Transcutaneous Electrical Nerve Stimulation (TENS) relieves pain. (25 marks)

Physiological Basis: Gate Control Theory of Pain

TENS works by modulating pain transmission at the spinal cord level. - 5

Mechanism

- Electrical stimulation activates large diameter Aβ fibers - 5
- These fibers:
    - Excite inhibitory interneurons in the substantia gelatinosa (lamina II) - 3
    - Inhibit transmission from Aδ and C pain fibers - 2

Effect on Pain Pathway

- Inhibits second-order neurons in Spinothalamic tract - 3
- “Closes the gate” to nociceptive signals - 2

Theory

Explained by Gate Control Theory - 3

Additional Mechanism

- May stimulate release of endogenous opioids (endorphins) - 2

(1.3) Opioids are used to manage acute severe pain. (25 marks)

Physiological Basis: Endogenous Opioid System

Opioids mimic natural pain-inhibiting substances in the body. - 5

Receptors

- μ (mu), κ (kappa), δ (delta) receptors in:
    - Brain - 2
    - Spinal cord (especially dorsal horn) - 2

Mechanisms of Action

1. Presynaptic inhibition

- Decrease Ca^{2+} influx - 2
- ↓ Release of neurotransmitters (e.g., substance P, glutamate) - 2

2. Postsynaptic inhibition

- Increase K^+ efflux → hyperpolarization - 2
- ↓ Excitability of second-order neurons - 2

3. Activation of descending inhibitory pathways

- From:
    - Periaqueductal gray (PAG) - 2
    - Nucleus raphe magnus - 2

Enhances inhibitory signals to spinal cord - 2

Effect on Pain Pathway

- Suppresses transmission in Spinothalamic tract - 2

(1.4) Loss of pain in cape-like distribution in syringomyelia (25 marks)

Physiological Basis: Selective Damage to Crossing Pain Fibers

Syringomyelia involves formation of a cavity within the spinal cord. - 2

Structure Involved

- Central canal expansion damages:
    - Anterior white commissure - 3

Mechanism

- Pain and temperature fibers:
    - Enter spinal cord - 3
    - Cross to opposite side within 1–2 segments via anterior white commissure - 3
- These crossing fibers are selectively damaged – 2

Result

- Bilateral loss of:
    - Pain - 2
    - Temperature - 2
- At affected dermatomes (commonly C5–T1) - 2

Produces “cape-like distribution” over shoulders and upper limbs - 2

Preserved Modalities

Fine touch, vibration, proprioception remain intact - 4

(because dorsal column is unaffected)

Hearing and Vestibular System

(1) A 45-year-old man presents with progressive hearing loss in his right ear. On examination:
Rinne test: Bone conduction > Air conduction (right ear)
Weber test: Sound lateralizes to the right ear

(1.1) Explain the pathway of sound transmission from the external ear to the cochlea. (25 marks)

External ear (5 marks)
- Pinna collects sound (2)
- External auditory canal directs sound to TM (3)

Middle ear (10 marks)
- Tympanic membrane vibrates (3)
- Ossicles: malleus → incus → stapes (4)
- Amplification of sound (3)

Inner ear entry (10 marks)
- Stapes moves oval window (3)
- Pressure waves in perilymph (scala vestibuli) (3)
- Transmission to scala media via basilar membrane (4)

(1.2) Explain how sound waves are converted into neural signals in the organ of Corti. (25 marks)

Basilar membrane movement (5 marks)
- Sound causes vibration → displacement of basilar membrane

Hair cell deflection (5 marks)
- Stereocilia bend against tectorial membrane

Ionic mechanism (10 marks)
- Opening of mechanically gated K^+ channels (5)
- Depolarization → Ca^{2+} influx → neurotransmitter release (5)

Neural signal generation (5 marks)
- Activation of cochlear nerve fibers

(1.3) Outline the central auditory pathway from cochlea to auditory cortex. (25 marks)
- Cochlear nerve → cochlear nuclei (5)
- Bilateral projection via superior olivary complex (5)
- Ascends via lateral lemniscus (5)
- Synapse in inferior colliculus (5)
- → Medial geniculate body → auditory cortex (temporal lobe) (5)

(1.4) Using the clinical findings above, justify the type of hearing loss and explain the physiological basis. (25 marks)

Type of hearing loss (10 marks)

- Conductive hearing loss (right ear) (5)
- Rinne: BC > AC (5)

Weber interpretation (5 marks)

- Lateralizes to affected ear in conductive loss (5)

Physiological basis (10 marks)

- Impaired sound conduction in external/middle ear (5)
- Bone conduction bypasses defect → appears better (5)

(2) A 30-year-old woman presents with severe vertigo, nausea, and involuntary eye movements (nystagmus) when she turns her head quickly. She also reports imbalance while walking.

(2.1) Explain how movement of endolymph leads to generation of nerve impulses. (30 marks)

Stimulus (5 marks)

- Head movement → endolymph displacement

Mechanical transduction (10 marks)

- Deflection of cupula (semicircular canals) or otoliths (5)
- Bending of hair cells (5)

Ionic mechanism (10 marks)

- Opening of K^+ channels → depolarization (5)
- Neurotransmitter release → vestibular nerve firing (5)

Direction sensitivity (5 marks)

- Different responses depending on direction of movement

(2.2) Outline the major vestibular pathways and their connections. (30 marks)

- Vestibular nerve → vestibular nuclei (8th nerve) (5)
- Connections to cerebellum (coordination) (5)
- To ocular motor nuclei (III, IV, VI) (5)
- Via MLF for eye movements (5)
- To spinal cord (vestibulospinal tracts) (5)
- To thalamus → cortex (perception) (5)

(2.3) Explain the physiological basis of: (40 marks)

(2.3.1) Nystagmus

- Rhythmic eye movement: slow + fast phase (5)
- Due to imbalance of vestibular inputs (5)
- Involves VOR via MLF and ocular nuclei (5)
- Fast phase direction defines nystagmus (5)

(2.3.2) Vertigo

- Illusion of movement (5)
- Caused by asymmetric vestibular input (5)
- Mismatch between visual, vestibular, proprioceptive inputs (5)
- Leads to nausea, imbalance (5)

Sleep, EEG and ICH

(1) Electroencephalogram is a recording of the electrical activity in brain. It can be used to identify stages of sleep-wake cycle.

(1.1) What are the different stages of sleep? (5 marks)

Non REM – stage 1, stage 2, stage 3, stage 4 (N3)
REM sleep
1 mark each

(1.2) Describe the EEG patterns expected in these different stages. (15 marks)

Non REM
Stage 1 (transition from wakefulness to sleep) – theta rhythm (4-7Hz) - 3
Stage 2 – sleep spindles (7-15Hz), K complexes - 3
Stage 3 – high amplitude delta rhythm (0.5-4Hz) - 3
Stage 4 – rhythmic slow waves - 3
REM sleep – rapid, low voltage waves, irregular beta waves, pontogeniculo occipital spikes - 3

(1.3) Briefly describe the distribution of sleep stages in a typical night of sleep. (20 marks)

First enters non REM sleep – 2
passes through 4 stages – 2
then sleep lightens and enters REM sleep - 4
Cycle is repeated at intervals of 90 minutes - 4
Towards morning less time in stage 3 and 4, more time in REM sleep - 4
4-6 REM periods per night - 4

(1.4) Describe the EEG waves observed in awake people (30 marks)

Alpha waves - 5

- when awake but at rest with mind wandering and eyes closed (8-13Hz) - 5
- most marked in parietal and occipital lobes, associated with decreased levels of attention - 5

Beta waves - 5

- irregular, 13-30Hz low voltage waves - 5
- produced by mental concentration. - 5

(1.5) Describe the role of suprachiasmatic nuclei in regulating the sleep wake cycle (30 marks)

Suprachiasmatic nuclei receive info about light-dark cycle via retinohypothalamic pathway - 5
When light falls on retina, the signals are conducted to SCN - 5
It increases GABA, which inhibit neurons in hypothalamic PVN - 5

It reduces the activity of Sympathetic preganglionic neurons in spinal intermediolateral nucleaus - 5
Which inhibit superior cervical ganglion that supply the pineal gland - 5
Reducing melatonin release - 5

(2) A 22-year-old male is brought to the emergency department after a high-speed motor vehicle accident. He was initially conscious but became progressively drowsy over the next hour. On examination, his Glasgow Coma Scale (GCS) score is 10. His right pupil is dilated and sluggishly reactive to light. A CT scan of the head reveals an epidural hematoma.

(2.1) State Monre-Kellie principle (20 marks)

cranial vault is an enclosed space with limited volume - 5
and the contents within this space exist in a state of dynamic balance - 5
sum of volumes of brain, CSF, and intracranial blood is constant - 5
and that an increase in one will result in a corresponding decrease in one or both of the other two - 5

(2.2) List three main components inside the cranial vault described by this principle (15 marks)

Brain tissue, CSF, blood
5 each

(2.3) What is the cause of increased intracranial pressure in this patient? (10 marks)

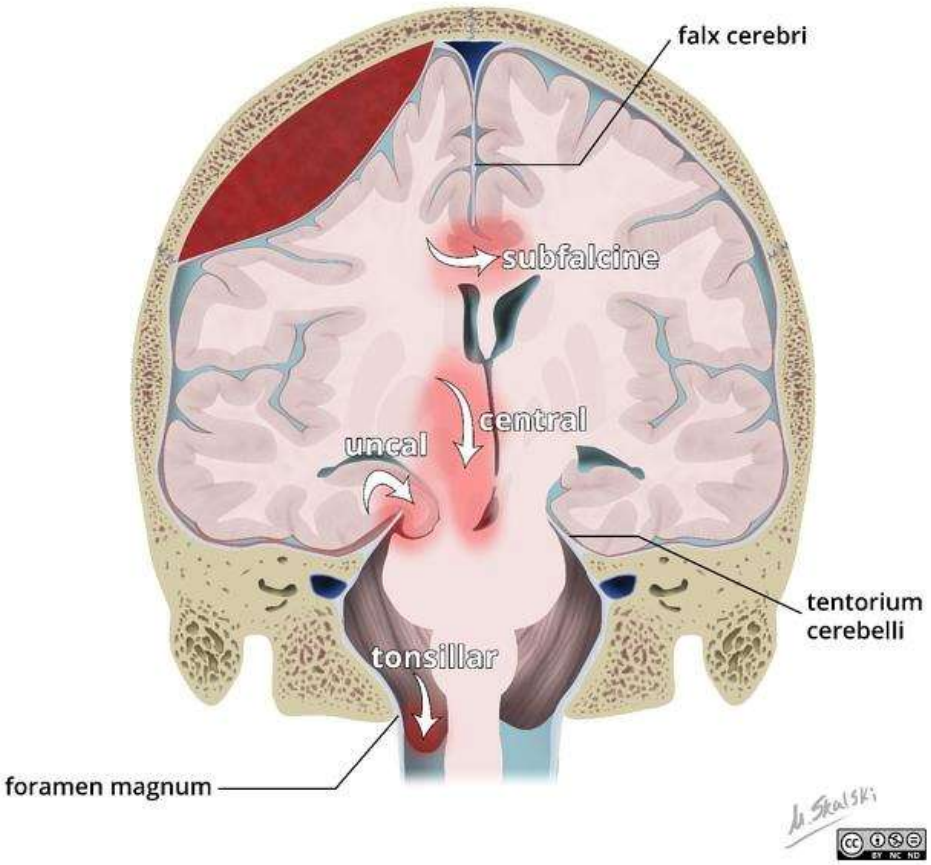
Expanding hematoma - 10

(2.4) Describe the consequences of raised intracranial pressure. (25 marks)

Cerebral vessels are compressed - 5
Effective perfusion pressure is decreased - 5
Therefore, cerebral blood flow is decreased - 5
Risk of brain herniation - 5
Pressure on brain structures - 5

(2.5) Describe the reason for this patient's pupil being dilated. (30 marks)

Compression of oculomotor nerve - 15
Due to uncal herniation - 15


falx cerebri
subfalcine
central
uncal
tentorium
cerebelli
tonsillar
foramen magnum

Neurophysiology

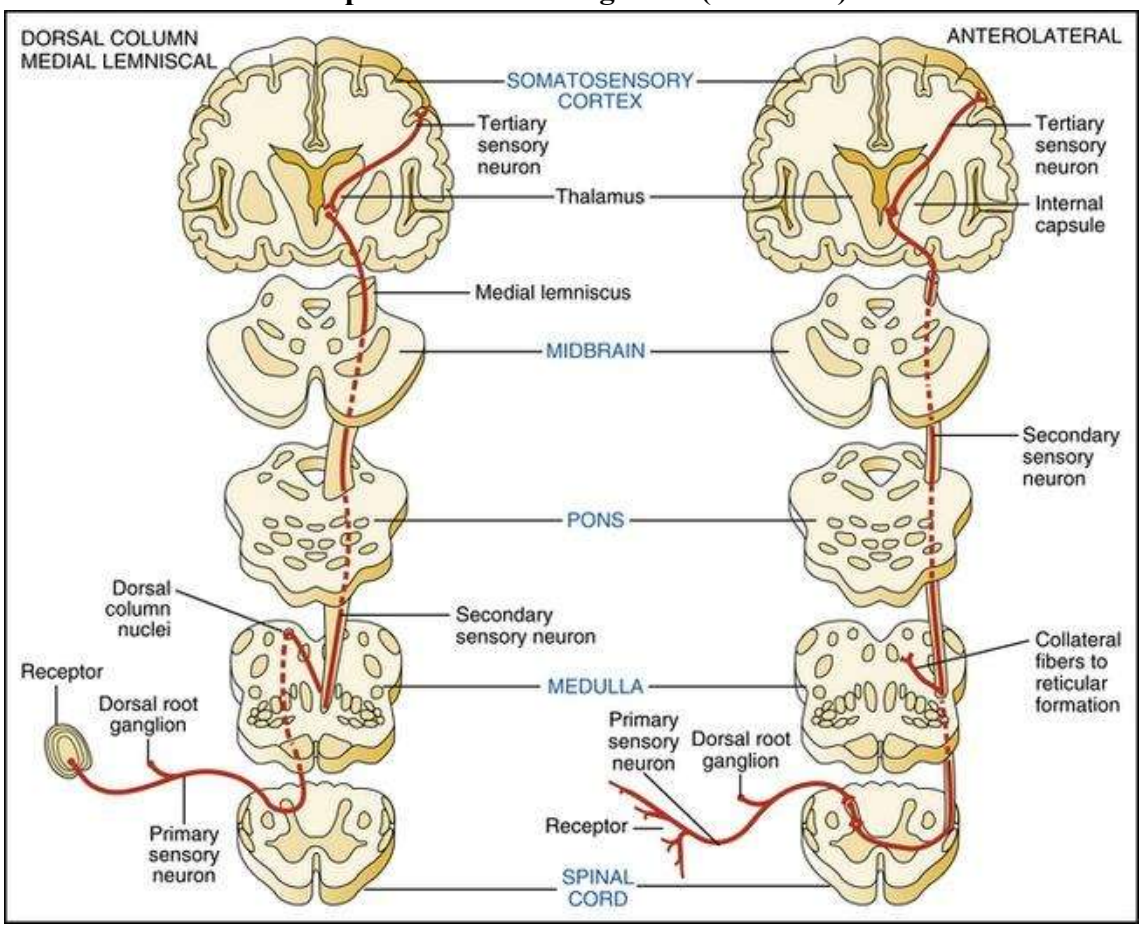
(1)

(1.1) What are the two main ascending tracts that carry the sensory information from peripheral receptors to cerebral cortex? (20 marks)

Dorsal column – medial lemniscus pathway - 10

Spinothalamic tract (anterolateral pathway) - 10

(1.2) Draw the two tracts in separate labelled diagrams. (20 marks)



10 marks for each pathway

(1.3) Using the drawn diagrams describe the sensory abnormalities expected in the following situation and its physiological basis,

(1.3.1) In syringomyelia where there is a cavity formation within spinal cord (20 marks)

Pain & temperature loss - 4

Bilateral/cape-like distribution - 4

Crossing fibers affected - 4

Location: anterior white commissure - 4

DCML spared - 4

(1.3.2) Right hemi section of the spinal cord at T10 level (20 marks)

Ipsilateral DCM loss - 4
Contralateral pain & temperature loss, Upper limbs are spared - 4
Segmental offset (1–2 levels below) - 4
DCML decussation in medulla - 4
Spinothalamic early crossing - 4

(1.3.3) Ischemic infarction in left lateral medulla oblongata (lateral medullary syndrome) (20 marks)

Ipsilateral facial pain/temp loss - 4
Contralateral body pain/temp loss - 4
Identification of trigeminal involvement - 4
Spinothalamic tract involvement - 4
DCML spared (medial) - 4

(2) Explain the physiological basis of the following,

(2.1) A patient presented with bitemporal hemianopia is found to have a pituitary tumour. (25 marks)

- Bitemporal hemianopia correctly stated – 3
- Loss of peripheral visual fields – 2
- optic chiasma identified – 3
- Nasal retinal fibres cross at chiasma – 3
- Temporal retinal fibres remain uncrossed – 2
- Pituitary gland located inferior to chiasma – 2
- Tumour compresses central chiasma – 3
- Affects crossing nasal fibres – 3
- Nasal retina carries temporal visual field – 2
- Bilateral temporal field loss explained – 2

(2.2) When a person walks from a room with a bright light to a dark room, he cannot immediately see the objects in the dark room clearly. (25 marks)

- Temporary inability to see in dark – 3
- Rods responsible for dim light vision – 3
- Cones function in bright light – 2
- Rhodopsin bleaching in bright light – 3
- Low initial rod sensitivity after entering dark – 2
- Regeneration of rhodopsin – 4
- Increased retinal sensitivity over time – 3
- Rod dominance in dark – 2
- Time course (minutes) – 2
- Role of Vitamin A (optional detail) – 1

(2.3) People develop presbyopia as they age. (25 marks)

A. Presbyopia

- Inability to focus on near objects – 3
- Age-related condition – 2

B. Normal accommodation (10 marks)

- ciliary muscle contraction – 2
- Zonular fibres relax – 2
- Lens becomes more convex – 3
- Increased refractive power – 3

C. Physiological basis of presbyopia (10 marks)

- Lens elasticity decreases – 4
- Lens becomes rigid – 3
- Reduced ability to increase curvature – 2
- Near point recedes – 1

(2.4) When a beam of light directed to right eye, both pupils in the left and right eyes constrict. (25 marks)

Pupillary light reflex

- Both pupils constrict – 3
- Direct and consensual reflex mentioned – 2

Afferent pathway (8 marks)

- Retina → optic nerve – 2
- Optic chiasma → optic tract – 2
- Pretectal nucleus in midbrain – 2
- Bilateral projection – 2

Efferent pathway (8 marks)

- Edinger-Westphal nucleus – 2
- Oculomotor nerve (CN III) – 2
- Ciliary ganglion – 2
- Sphincter pupillae muscle – 2

Physiological basis of consensual reflex (4 marks)

- Bilateral innervation from pretectal nuclei – 2
- Activation of both Edinger-Westphal nuclei – 2

PHYSIOLOGY
CAT-3
MOCK PAPERS & ANSWERS

2022/2023 (1st Batch)
CAT-3 Mock Exam

CAT-3 (BATCH 1) MOCK MCQS

MULTIPLE CHOICE QUESTIONS
Time: 1 hour

This paper consists of 10 True or False type questions and 10 Single Best Answer type questions.

(1) True or False regarding glomerular filtration and renal blood flow?
(A) Glomerular filtrate contains all the solutes, electrolytes and proteins in the same concentration as plasma
(B) Glomerular filtration of 90mL/min can be normal
(C) Tubular glomerular feedback maintains the constancy of the load delivered to the distal tubule
(D) Autoregulation of renal blood flow is present in denervated kidneys
(E) Edema of kidney inside tight renal capsule can increase glomerular filtration rate

(2) True or False regarding renal clearance?
(A) Renal clearance is a measure of renal function
(B) Inulin is considered the ideal glomerular marker because all filtered inulin is reabsorbed by the tubule
(C) 24-hour creatinine clearance is more often measured in clinical setting than inulin clearance because creatinine clearance is a more accurate representation of GFR
(D) Para aminohippuric acid is suitable to determine renal plasma flow
(E) In order to calculate the renal clearance of substance X, all the measurements required are urine flow and concentration of X in urine

(3) True or False regarding the H+ homeostasis?
(A) H+ excretion at proximal convoluted tubule takes place via an antiport
(B) H+ secretion in distal convoluted tubule and collecting ducts is regulated by aldosterone
(C) In chronic acidosis, NH3 formation is increased due to increased glutaminase activity
(D) When the plasma HCO3- concentration decreases below normal range, the urine become more acidic
(E) Carbonic anhydrase catalyzes the formation of H2CO3

(4) True or False sexual differentiation?
(A) Presence or absence of X chromosome determine the sex of an individual
(B) Barr bodies are typically present in males
(C) At the very early period of gestation, an embryo has both male and female primodial genital tracts
(D) In female embryos, wolffian ducts develop into uterus and fallopian tubes
(E) In Klinefelter syndrome, testes is present

(5) True or False regarding male reproductive system?

(A) Sertoli cells produce a fructose rich fluid that nourishes spermatozoa
(B) Ideal temperature for spermatogenesis is 36 degrees Celsius
(C) 60% of the semen composition comes from prostate gland
(D) Ejaculation is mediated by parasympathetic nervous system
(E) PSA (prostate specific antigen) is used as a screening test for prostate cancer

(6) True or False regarding female reproductive system?

(A) Oestrogen enhance the activity of cilia in fallopian tubes
(B) Progesterone promotes secretory changes in uterine endometrium in follicular phase
(C) Menstrual flow has clots due to presence of fibrinolysin
(D) Women undergoing menopause can experience vaginal dryness
(E) In women, relaxin hormone facilitates delivery

(7) True or False regarding physiology of pain?

(A) Fast pain sensations are conducted by C fibres
(B) The basis of referred pain is convergence of somatic and visceral pain fibres on the same second order neurons in the dorsal horn of the spinal cord
(C) Enkephalin is an endogenous opioid peptide
(D) Local anesthetics block voltage gated K+ channels on the nerve membrane
(E) Stress induced analgesia occurs due to release of norepinephrine in amygdala

(8) True or False regarding the vestibular system and equilibrium?

(A) Saccule detect horizontal linear acceleration
(B) Semi circular canals detest rotational acceleration of the head
(C) Basilar migraine is a cause for central vestibular disorder
(D) Labyrinth righting reflex is initiated by tilting of the head
(E) Nystagmus at rest can be observed in some healthy individuals

(9) True or False regarding EEG and sleep?

(A) Narcolepsy is difficulty in initiating or maintaining sleep several times a week
(B) Ascending arousal system is comprised of monoaminergic, cholinergic and histaminergic neurons
(C) Majority of the rhythms in EEG are alpha when alert
(D) REM sleep occupies 50% of total sleep time in grown adult
(E) Partial seizures are subdivided into simple and complex

(10) True or False regarding hypothalamic functions and higher functions?

(A) Hypothalamus has a role in regulating sexual behaviour
(B) Orexin is important in switching between sleep and wakefulness
(C) Ghrelin stimulate orexigenic neurons in hypothalamus
(D) Implicit memories are always associated with awareness
(E) Lesions in Broca area cause expressive aphasia

Question number 11 to 20 are Single Best Response (SBR) type. Select the best response to each question.

(11) A 65-year-old man with long-standing hypertension is started on a new medication that acts on the thick ascending limb of the loop of Henle. After one week, he reports muscle cramps and generalized weakness.

Which of the following is the most likely reason for his symptoms?

(A) Rhabdomyolysis due to statin therapy
(B) Medication induced hypokalemia
(C) Dehydration due to excessive fluid loss
(D) Medication induced hyperkalemia
(E) Hyponatremia due to SIADH

(12) A 28-year-old woman underwent spinal anesthesia for a minor surgery. After the surgery was over and she was sent back to the ward she experienced difficulty in passing urine.

Which neural pathway is most likely impaired?

(A) Sympathetic fibers from T11–L2
(B) Parasympathetic fibers from S2–S4
(C) Somatic motor fibers in the pudendal nerve
(D) Afferent fibers in the pelvic splanchnic nerves
(E) Hypogastric nerve motor fibers

(13) A 55-year-old man with a history of long-standing hypertension and type 2 diabetes mellitus has been under regular follow-up for chronic kidney disease (CKD). Over the past 6 months, he has experienced worsening fatigue and mild ankle swelling. His blood tests reveal that his serum creatinine level has doubled compared to his previous measurement 6 months ago. He has not had any major changes in muscle mass or protein intake. Urinalysis shows moderate proteinuria.

What is the best physiological explanation for the rise in his serum creatinine?

(A) Decreased tubular secretion of creatinine
(B) Increased glomerular filtration rate (GFR)
(C) Decreased glomerular filtration rate (GFR)
(D) Increased creatinine reabsorption
(E) Increased creatinine production

(14) A 15-year-old boy is brought to the pediatric endocrinology clinic by his parents because they are concerned that he has not yet shown any signs of puberty, while his peers have already started developing facial hair and deepening voices. His growth chart shows that his height is at the 50th percentile for his age, but he appears younger than his classmates. He has no significant past medical history and there is no family history of delayed puberty. On physical examination, he has small testes and minimal pubic hair. Laboratory investigations reveal low serum testosterone levels. Further hormonal testing shows that both follicle-stimulating hormone (FSH) and luteinizing hormone (LH) levels are below the normal range for his age.

Which of the following is the most likely cause of his delayed puberty?

(A) Testicular failure (primary hypogonadism)
(B) Klinefelter syndrome
(C) Pituitary or hypothalamic dysfunction (hypogonadotropic hypogonadism)
(D) Androgen insensitivity syndrome
(E) Precocious puberty

(15) A 28-year-old woman, who is approximately 7 weeks pregnant based on her last menstrual period, presents to the obstetric clinic with mild lower abdominal discomfort and vaginal spotting for two days. She has no significant past medical history and this is her first pregnancy. On examination, her vital signs are stable and there is no significant tenderness or signs of ectopic pregnancy. A transvaginal ultrasound shows a viable intrauterine pregnancy with a fetal heartbeat present. Laboratory investigations reveal that her serum progesterone level is lower than expected for this stage of pregnancy. Her doctor explains that if progesterone levels continue to fall, there is a risk of pregnancy loss due to failure to maintain the endometrial lining. Supplemental progesterone therapy is discussed.

Which of the following structures is primarily responsible for producing progesterone necessary to maintain the pregnancy at this early stage?

(A) Trophoblast cells of the early placenta
(B) Maternal adrenal cortex
(C) Corpus luteum maintained by hCG
(D) Hypothalamic-pituitary axis
(E) Decidual cells of the endometrium

(16) A 32-year-old man presents to the neurology clinic with progressive numbness in both upper limbs. He reports that he frequently burns his hands without realizing it but notices light touch and pressure normally. On examination, there is a bilateral loss of pain and temperature sensation in a cape-like distribution over the shoulders, upper arms, and upper back. However, joint position sense and vibration sense are preserved in the same areas. Motor strength in the upper limbs is mildly reduced, and there is some muscle wasting in the small muscles of the hands. An MRI of the cervical spinal cord shows a fluid-filled cavity within the central canal extending over several segments.

Which of the following neural structures is most likely affected to cause the patient's specific pattern of sensory loss?

(A) Dorsal columns (fasciculus gracilis and cuneatus)
(B) Lateral corticospinal tracts
(C) Anterior white commissure (crossing spinothalamic fibers)
(D) Vestibulospinal tracts
(E) Dorsal spinocerebellar tracts

(17) A 64-year-old man is brought to the emergency department because he suddenly developed weakness in his right arm and right leg while having breakfast. On examination, he is alert and oriented but has marked weakness and spasticity in the right upper and lower limbs. There is increased muscle tone and hyperreflexia with a positive Babinski sign on the right side. Sensory examination reveals no significant loss of pain, temperature, or vibration sensation on either side. Cranial nerves are intact, with no facial weakness or speech difficulty. An urgent brain CT scan shows an area of infarction in the left cerebral hemisphere.

Which of the following structures is most likely affected to explain this patient's pattern of motor deficits?

(A) Lower motor neurons of the cervical and lumbar spinal cord
(B) Dorsal root ganglion
(C) Posterior horn of the spinal cord gray matter
(D) Upper motor neuron fibers in the internal capsule (corticospinal tract)
(E) Spinothalamic tract in the lateral spinal cord

(18) A 60-year-old man has resting tremor, muscle rigidity, and bradykinesia. Which neurotransmitter imbalance explains his condition?

(A) Increased dopamine in the striatum
(B) Decreased dopamine in the striatum
(C) Increased acetylcholine in the motor cortex
(D) Increased serotonin in the basal ganglia
(E) Increased norepinephrine in the substantia nigra

(19) A 34-year-old man presents to the ophthalmology clinic because he has been bumping into objects on one side and has difficulty seeing people approaching from his right side. He first noticed the problem a few weeks ago but thought it was due to fatigue. His past medical history is unremarkable. Visual acuity is normal in both eyes. Fundoscopic examination shows healthy optic discs bilaterally with no signs of papilledema. Visual field testing reveals a loss of vision in the right temporal (lateral) field and the left nasal (medial) field. Pupillary light reflexes are normal and symmetric. An MRI of the brain is ordered to localize the lesion.

Which of the following structures is most likely affected to explain this pattern of visual loss?

(A) Right optic nerve
(B) Left optic nerve
(C) Optic chiasm
(D) Right optic tract
(E) Right lateral geniculate body

(20) A 32-year-old woman and her 35-year-old husband come to the family planning clinic to discuss contraception options. They have two children, aged 4 and 2, and do not plan to have any more children for at least 5 years but are not ready for permanent sterilization. The woman does not smoke, has no significant medical history, and is not currently breastfeeding. She reports heavy menstrual bleeding and iron deficiency anemia, for which she takes oral iron supplements. She prefers to avoid daily pills because she often forgets to take them. Her husband is open to sharing contraceptive responsibility.

Which of the following would be the most appropriate contraceptive option for this couple at this time?

(A) Combined oral contraceptive pill (COCP)
(B) Copper intrauterine device (IUD)
(C) Levonorgestrel-releasing intrauterine system (LNG-IUS, e.g., Mirena)
(D) Male condom alone
(E) Female sterilization (tubal ligation)

CAT-3 (BATCH 1) MOCK MCQ ANSWERS

(1) FTTTF

(2) TFFTF

(3) TTTTT

(4) FFTFT

(5) TFFFT

(6) TFFTT

(7) FTTFT

(8) FTTTF

(9) FTFFT

(10) TTTFT

(11) B

(12) B

(13) C

(14) C

(15) C

(16) C

(17) D

(18) B

(19) D

(20) C

CAT-3 (BATCH 1) MOCK ESSAY

(1) A 25-year-old man visits the ENT clinic complaining of reduced hearing in his right ear following a recent episode of otitis media. Another 40-year-old man presents with gradual bilateral hearing loss, which he attributes to many years of working in a noisy factory environment.

(1.1) Classify the type of hearing loss in each patient and justify your answer.

(a) Patient with recent otitis media (5 marks)

(b) Patient with occupational noise exposure (5 marks)

(1.2) Describe the normal physiology of hearing from sound wave entry to perception in the auditory cortex (40 marks)

(1.3) Compare and contrast the pathophysiology, causes, clinical features, and audiological findings of conductive versus sensorineural hearing loss. (25 marks)

(1.4) Describe how Rinne's and Weber's tuning fork tests are used to differentiate between conductive and sensorineural hearing loss. (25 marks)

(2) Write the physiological basis of the following scenarios

(2.1) A person is deprived of water for 24 hours but maintains near-normal plasma osmolarity. (30 marks)

(2.2) A patient with severe blood loss shows an increase in renin secretion and aldosterone levels. (40 marks)

(2.3) A diabetic patient has excessive urination with glucose detected in the urine (30 marks)

CAT-3 (BATCH 1) MOCK ESSAY ANSWERS

(1) A 25-year-old man visits the ENT clinic complaining of reduced hearing in his right ear following a recent episode of otitis media. Another 40-year-old man presents with gradual bilateral hearing loss, which he attributes to many years of working in a noisy factory environment.

(1.1) Classify the type of hearing loss in each patient and justify your answer.

(a) Patient with recent otitis media (5 marks)

Point	Marks
Conductive hearing loss identified	2
Otitis media affects middle ear sound transmission	2
Inner ear and auditory nerve usually intact	1

(b) Patient with occupational noise exposure (5 marks)

Point	Marks
Sensorineural hearing loss identified	2
Chronic noise damages cochlear hair cells	2
Usually bilateral and progressive	1

(1.2) Describe the normal physiology of hearing from sound wave entry to perception in the auditory cortex (40 marks)

Normal Physiology of Hearing (40 marks)

Point	Marks
Sound waves enter external auditory canal	3
Tympanic membrane vibrates	3
Vibration transmitted through malleus, incus and stapes	4
Stapes movement at oval window	4
Pressure waves generated in cochlear fluids	4
Basilar membrane vibrates	4
Hair cells of organ of Corti bend against tectorial membrane	5
Receptor potentials generated	3
Action potentials generated in cochlear nerve	3

Point	Marks
Transmission through auditory pathway (brainstem → thalamus)	4
Perception in primary auditory cortex (temporal lobe)	3

(1.3) Compare and contrast the pathophysiology, causes, clinical features, and audiological findings of conductive versus sensorineural hearing loss. (25 marks)

Pathophysiology – 8 marks

Conductive	Marks
Defect in sound conduction through external/middle ear	4

Sensorineural	Marks
Damage to cochlea, hair cells or auditory nerve	4

Causes (6 Marks)

Any three each

- Conductive
- Ear wax
- Otitis media
- Tympanic membrane perforation
- Otosclerosis

Sensorineural

- Presbycusis
- Noise exposure
- Ototoxic drugs
- Acoustic neuroma

(1 mark each)

Clinical Features – 5 marks

Feature	Marks
Conductive hearing loss: patient hears better in quiet environment	2
Sensorineural hearing loss: difficulty understanding speech, especially in noise	3

Audiological Findings – 6 marks

Finding	Marks
Air conduction reduced more than bone conduction in conductive loss	3
Both air and bone conduction reduced in sensorineural loss	3

(1.4) Describe how Rinne's and Weber's tuning fork tests are used to differentiate between conductive and sensorineural hearing loss. (25 marks)

- Rinne's test – 12 marks

Point	Marks
Compare air conduction (AC) with bone conduction (BC)	3
Normal: AC > BC	3
Conductive deafness: BC > AC (negative Rinne)	3
Sensorineural deafness: AC > BC but both reduced	3

- Weber's test – 13 marks

Point	Marks
Tuning fork placed on forehead/vertex	3
Normal: sound heard equally in both ears	3
Conductive deafness: lateralizes to affected ear	4
Sensorineural deafness: lateralizes to normal ear	3

(2) Write the physiological basis of the following scenarios

(2.1) A person is deprived of water for 24 hours but maintains near-normal plasma osmolarity. (30 marks)

- Increased plasma osmolarity stimulating hypothalamic osmoreceptors (5 marks)
- Increased secretion of antidiuretic hormone (ADH) from posterior pituitary (5 marks)
- Increased water reabsorption in late distal tubules and collecting ducts via insertion of aquaporin2 channels (10 marks)
- Reduced urine volume and increased urine osmolarity to conserve body water (5 marks)

(2.2) A patient with severe blood loss shows an increase in renin secretion and aldosterone levels. (40 marks)

- Explanation of decreased blood volume and arterial pressure stimulating juxtaglomerular cells to secrete renin: intra renal baroreceptor mechanism, sensor in macula densa, sympathetic activity, circulating catcholamines – (10 marks)
- Conversion of angiotensinogen to angiotensin I, then to angiotensin II by ACE (5 marks)
- Angiotensin II causing vasoconstriction and stimulating aldosterone secretion from adrenal cortex (5 marks) - Aldosterone increasing sodium and therefore water reabsorption in distal tubules and collecting ducts (10 marks)
- Net effect: restoration of ECF volume and blood pressure (5 marks)

(2.3) A diabetic patient has excessive urination with glucose detected in the urine (30 marks)

- Persistent hyperglycemia exceeds renal threshold → glucose appears in filtrate (10 marks)
- Glucose remains in the tubule because transport maximum (Tm) of glucose reabsorption is exceeded (5 marks)
- Unreabsorbed glucose acts as an osmotic agent, holding water in tubule → osmotic diuresis (10 marks)
- Results in polyuria, dehydration, and compensatory polydipsia (5 marks)

CAT-3 (BATCH 1) MOCK OSPE

(1) A 60-year-old man with a history of chronic obstructive pulmonary disease (COPD) presents with fatigue and confusion. On examination, he is drowsy and has shallow breathing. His arterial blood gas (ABG) results are as follows:

- pH: 7.32
- pCO_2: 60 mmHg
- HCO_3^-: 30 mEq/L
- Serum K^+: 5.1 mEq/L

(1.1) What is the primary acid-base disorder seen in this patient?
(1.2) What is the most likely cause of this disorder?
(1.3) Name one renal mechanism that compensates for this acid-base disturbance.
(1.4) Name one complication this patient can develop due to an electrolyte imbalance?

(2) Match the diuretic with correct mechanism of action

- A – ethanol
- B – Mannitol
- C – Caffeine
- D – Spironolactone

(2.1) Decrease tubular reabsorption of Na+ and increase GFR
(2.2) Increase vasopressin secretion
(2.3) Inhibit Na+, K+ exchange in collecting ducts
(2.4) Produce osmotic diuresis

(3) Following are two clinical features of a patient presented to Out Patient Department with generalized itching of the body.

A.



B

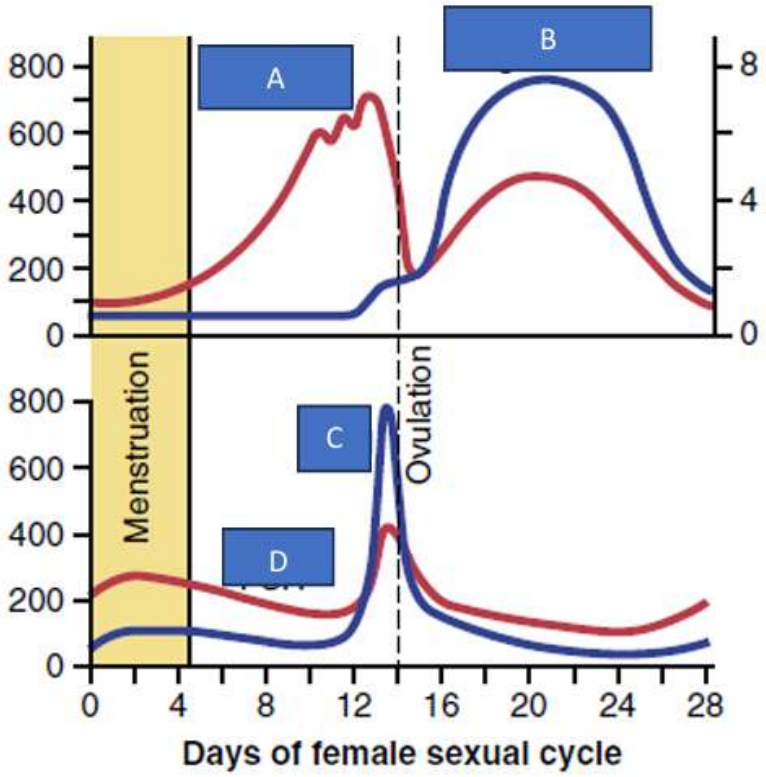


(3.1) Name A and B

(3.2) What is the reason for the abnormal urine colour?

(3.3) Name one possible cause for the development of these two features in this patient.

(4)



(4.1) Name the curves

A –

B –

C –

D –

(4.2) Female sexual cycles cease and female sexual hormones diminish by the age of 50. What is term used to call this phenomenon?

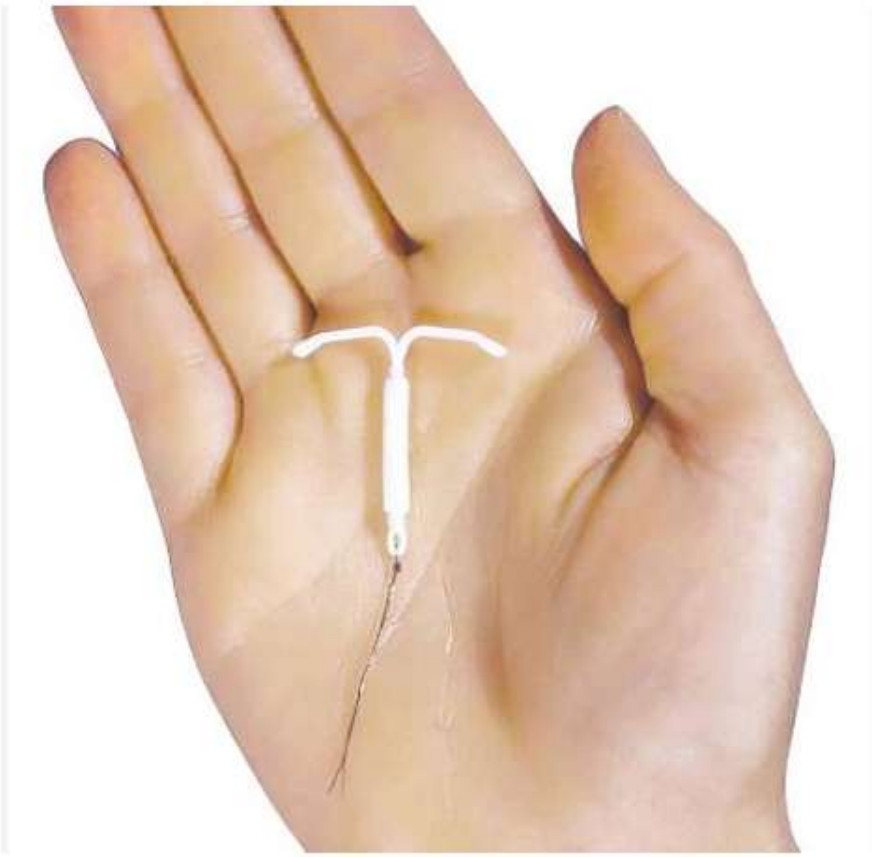
(4.3) Name one symptom of this pheonomenon.

(5) Given below is a pregnancy test kit.



(5.1) What is the hormone used in this test?
(5.2) What is the main function of the above-mentioned hormone?
(5.3) Name the site of secretion of the above-mentioned hormone
(5.4) What is the ideal time period for this test?

(6)



(6.1) Identify the device
(6.2) How does it prevent conception?
(6.3) Name one contra indication for the use of this device

(7)

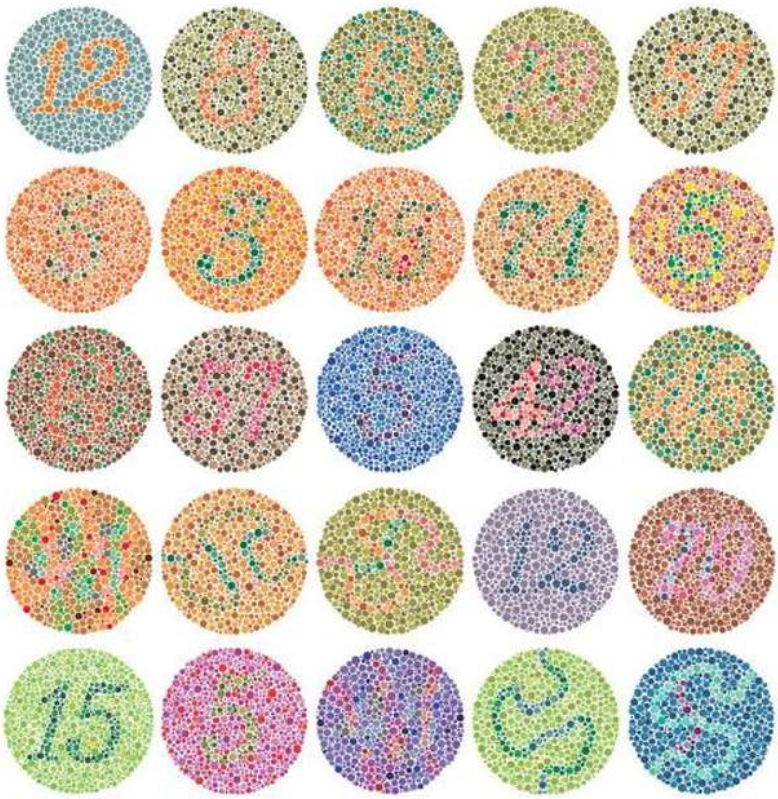


(7.1) What is the two clinical features depicted in the photograph?

(7.2) This patient also has anhidrosis. What is the most likely condition he is having?

(7.3) What is the cause for this condition?

(8)



(8.1) What is the name of this chart?

(8.2) What is the use of this chart?

(8.3) What is the inheritance pattern of the condition which gives abnormal test results for this chart?

(9)



(9.1) What is the sign elicited here?
(9.2) What is the normal response for this?
(9.3) What is the abnormal response?
(9.4) What does abnormal response indicate?

(10) Examine the cranial nerves 3,4 and 6 of this patient.

CAT-3 (BATCH 1) MOCK OSPE ANSWERS

(1)

ABG Report

- pH: 7.32
- pCO_2: 60 mmHg
- HCO_3^-: 30 mEq/L
- Serum K^+: 5.1 mEq/L

(1.1) Respiratory acidosis (partially compensated/chronic respiratory acidosis).

(1.2) Hypoventilation with CO_2 retention due to COPD.

(1.3) Increased reabsorption of bicarbonate (HCO_3^-) by the kidneys.
(Alternative: Increased H^+ secretion as NH_4^+ or titratable acid.)

(1.4) Cardiac arrhythmias due to hyperkalemia.

(2)

(2.1) C – Caffeine

(2.2) A – Ethanol (Actually ethanol inhibits ADH secretion; likely a typo in question)

(2.3) D – Spironolactone

(2.4) B – Mannitol

(3)

A. 

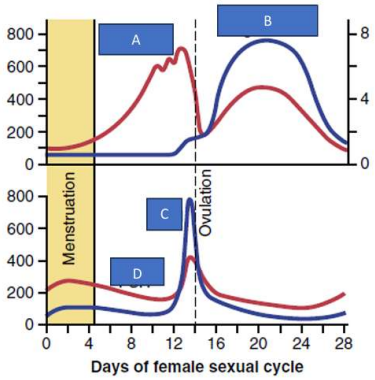
B 

(3.1) A – Jaundice (icterus)
B – Dark-colored urine

(3.2) Presence of conjugated bilirubin in urine (bilirubinuria).

(3.3) Obstructive jaundice due to gallstones.
(Other acceptable answers: hepatitis, pancreatic carcinoma, cholestasis.)

(4)



(4.1) A – Estrogen
B – Progesterone
C – LH (Luteinizing Hormone)
D – FSH (Follicle Stimulating Hormone)

(4.2) Menopause

(4.3) Hot flushes (hot flashes)
(Other acceptable answers: mood changes, vaginal dryness, insomnia.)

(5)



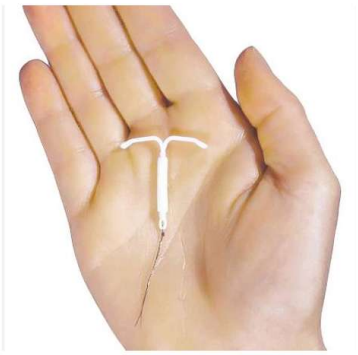
(5.1) Human Chorionic Gonadotropin (hCG)

(5.2) Maintains the corpus luteum during early pregnancy.

(5.3) After the first missed menstrual period (approximately 1–2 weeks after conception).

(5.4) Syncytiotrophoblast of the placenta.

(6)



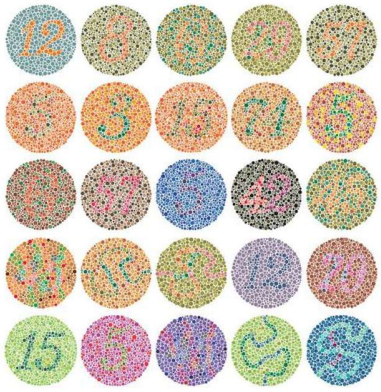
(6.1) Intrauterine Contraceptive Device (IUCD/Copper-T)
(6.2) Produces a local inflammatory reaction that impairs sperm motility and fertilization.
(6.3) Pelvic inflammatory disease (PID).
(Other acceptable answers: pregnancy, unexplained vaginal bleeding, cervical cancer.)

(7)



(7.1) Ptosis and miosis
(7.2) Horner syndrome
(7.3) Interruption of the sympathetic pathway to the eye.
Examples:
- Pancoast tumor
- Cervical sympathetic chain lesion
- Carotid artery dissection

(8)



(8.1) Ishihara Chart
(8.2) Testing for color vision defects (especially red-green color blindness).
(8.3) X-linked recessive inheritance.

(9)



(9.1) Babinski sign (Plantar reflex).
(9.2) Plantar flexion (downward movement) of the toes.
(9.3) Dorsiflexion of the great toe with fanning of the other toes.
(9.4) Upper Motor Neuron (UMN) lesion / corticospinal tract lesion.

(10) Cranial Nerve III – Oculomotor

- Inspect for ptosis.
- Assess pupil size and light reflex.
- Test eye movements.

Cranial Nerve IV – Trochlear

- Ask patient to look down and medially.
- Tests superior oblique muscle.

Cranial Nerve VI – Abducens

- Ask patient to look laterally.
- Tests lateral rectus muscle.

Procedure

- Ask patient to keep head still.
- Move finger in an "H" pattern.
- Observe eye movements and look for diplopia or nystagmus.
- Assess convergence and pupillary reactions.

Normal finding: Full conjugate eye movements in all directions without diplopia or nystagmus.

2023/2024 (2nd Batch)
CAT-3 Mock Exam

CAT-3 (BATCH 2) MOCK MCQS

MULTIPLE CHOICE QUESTIONS
Time: 1 hour

This paper consists of 10 True or False type questions and 10 Single Best Answer type questions.

(1) Regarding GFR,

(A) It is defined by the amount of plasma filtered by nephrons of one kidney per unit time
(B) Glomerular filtration coefficient increases with constriction of efferent arterioles
(C) The colloid pressure in the Bowman's capsule and the hydrostatic pressure inside the glomerulus act as driving forces for the filtration of plasma
(D) Creatinine clearance can be used to measure GFR with 100% accuracy
(E) Increased sodium concentration entering the distal tubule causes decreased GFR

(2) Regarding tubular function,

(A) Glucose is reabsorbed by sodium-glucose cotransporter in the distal convoluted tubules
(B) A high protein diet can increase the kidney's ability to concentrate urine
(C) The most amount of water is reabsorbed in the descending limb of loop of Henle
(D) Potassium is excreted in the distal convoluted tubules under the influence of aldosterone
(E) In healthy individuals, protein is absent in routine testing

(3) Regarding bladder function and micturition,

(A) The detrusor muscle is innervated by parasympathetic fibers from the pelvic nerves
(B) The internal urethral sphincter is composed of skeletal muscle under voluntary control
(C) Micturition reflex is initiated when the bladder volume is about 150 ml
(D) The micturition reflex is initiated by stretch receptors in the bladder wall
(E) Voluntary inhibition of micturition involves the pontine micturition center and cerebral cortex

(4) Regarding menstrual cycle,

(A) During the follicular phase, rising FSH stimulates growth of ovarian follicles
(B) The luteal phase is characterized by low progesterone and high levels of LH
(C) Estrogen level is constant throughout the cycle
(D) In menopause, a rise in FSH and LH can be seen
(E) Ovulation is triggered by a drop in LH and FSH

(5) Which of the following are causes for true precocious puberty?

(A) Androgen secreting tumors
(B) Constitutional precocious puberty
(C) Developmental abnormalities
(D) Congenital adrenal hyperplasia
(E) Hypothalamic harmatoma

(6) Regarding fertilization,

(A) Sperm undergo capacitation which increases membrane fluidity and motility
(B) The acrosome reaction is triggered by binding of sperm to the oocyte plasma membrane
(C) Cortical granule exocytosis in the oocyte prevents polyspermy
(D) The oocyte completes meiosis II only after sperm entry
(E) Sperm entry is accompanied by a rapid rise in oocyte intracellular calcium, initiating activation

(7) Regarding sensory receptors and pathways,

(A) Warm sensitive spots are more abundant than cold sensitive spots
(B) Muscle spindles are slow-adapting receptors
(C) The conduction velocity of nerve fibers from proprioceptors are faster than that of pain receptors
(D) The dorsal column of the spinal cord carries signals from pain and temperature receptors
(E) The primary somatosensory cortex is located in the precentral gyrus

(8) Which of the following occurs when your eye is focusing on a near object?

(A) Constriction of the pupil
(B) Contraction of the medial rectus muscle
(C) Relaxation of the ciliary muscles
(D) Thinning of the lens
(E) Activation of parasympathetic fibers in the oculomotor nerve

(9) Regarding descending tracts,

(A) The vestibulospinal tract facilitates extensor muscle tone for posture and balance
(B) The reticulospinal tract is primarily involved in transmitting pain and temperature sensations
(C) The rubrospinal tract facilitate the flexor activity of the upper limb
(D) The tectospinal tract coordinates the reflex head turning to visual and auditory stimuli
(E) The corticospinal tract is responsible for voluntary control of skilled movements

(10) Regarding cerebrospinal fluid (CSF),

(A) It is produced mainly in the choroid plexus in ventricles
(B) The protein content in CSF is higher compared to plasma
(C) The glucose concentration in CSF is similar to that of plasma
(D) Papilledema is an early manifestation of increased intracranial pressure (ICP)
(E) Raised ICP leads to decreased cerebral perfusion pressure (CPP)

Single Best Response Questions

(1) A 65-year-old man presents with oliguria following severe dehydration due to prolonged diarrhea. Laboratory investigations are performed to determine the cause of his acute kidney injury.

Which of the following findings most strongly suggests an intrinsic renal cause rather than prerenal cause?

(A) Fractional excretion of sodium (FENa) <1%
(B) Urine osmolality >500 mOsm/kg
(C) Urine sodium concentration >40 mEq/L
(D) Fractional excretion of urea (FEUrea) <35%
(E) Urine specific gravity > 1.020

(2) A 58-year-old man with a long history of chronic kidney disease (CKD) presents with fatigue and shortness of breath. Arterial blood gas (ABG) results are as follows

pH	**7.28**
pCO_2	**30 mmHg**
HCO_3^-	**14 mEq/l**

Which of the following best describes the acid-base disorder in this patient?

(A) Metabolic acidosis with respiratory compensation
(B) Metabolic alkalosis with partial respiratory compensation
(C) Respiratory acidosis with metabolic compensation
(D) Mixed metabolic and respiratory acidosis
(E) Respiratory alkalosis with metabolic compensation

(3) A 68-year-old man with long-standing hypertension and diabetic nephropathy is started on enalapril, an angiotensin-converting enzyme inhibitor (ACEI). Two weeks later, his serum creatinine is noted to have increased.

Which of the following best explains the rise in serum creatinine following initiation of enalapril?

(A) Decreased constriction of the afferent arteriole reduces renal plasma flow
(B) Dilation of the efferent arteriole reduces glomerular capillary hydrostatic pressure
(C) Constriction of the efferent arteriole increases glomerular filtration rate
(D) Increased aldosterone release causes sodium and water retention
(E) Increased sympathetic tone raises renal vascular resistance

(4) A 22-year-old woman presents to the clinic 72 hours after unprotected sexual intercourse and requests emergency contraception. She has no significant medical history.

Which of the following is the most appropriate emergency contraceptive method at this time?

(A) Levonorgestrel 1.5 mg single dose
(B) Depot medroxyprogesterone acetate injection
(C) Combined oral contraceptive "Yuzpe" regimen
(D) Copper intrauterine device (IUD) insertion
(E) Tamoxifen

(5) A 16-year-old girl presents with primary amenorrhea (not attained menarche) and lack of secondary sexual characteristics. Physical examination reveals short stature, a webbed neck, and widely spaced nipples. Karyotyping shows 45,XO.

Which of the following is the most likely cause of her sexual development abnormality?

(A) Androgen insensitivity syndrome
(B) Turner syndrome
(C) Congenital adrenal hyperplasia
(D) Klinefelter syndrome
(E) 5-α reductase deficiency

(6) Which of following statements correctly describes a normal physiological change during pregnancy?

(A) Decrease in stroke volume
(B) Decreased tidal volume
(C) Increased blood albumin levels
(D) Increased blood flow to the liver
(E) Increased GFR

(7) A 62-year-old man had a stroke and now has slow, broken speech. He understands what others say but has difficulty expressing himself.

Which of the following best describes his condition?

(A) Wenicke's aphasia
(B) Broca's aphasia
(C) Conduction aphasia
(D) Global aphasia
(E) Transcortical sensory aphasia

(8) A 68-year-old man presents with resting tremor, bradykinesia, and muscle rigidity. On examination, his facial expression is reduced and his gait is shuffling.

Which of the following neurotransmitter is most decreased in this ccondition?

(A) Acetylcholine
(B) Serotonin
(C) Gamma-aminobutyric acid (GABA)
(D) Dopamine
(E) Glutamate

(9) A 64-year-old man with long-standing type II diabetes presents with numbness and tingling in both hands and feet, best described as a "glove and stocking" type of sensory loss.

Which of the following is the most likely cause of his condition?

(A) Chronic hyperglycemia causing peripheral nerve damage
(B) Vitamin B12 deficiency due to poor diet
(C) Compression of peripheral nerves at multiple levels
(D) Alcohol-induced degeneration of posterior columns
(E) Autoimmune demyelination of peripheral nerves

(10) A 35-year-old man falls from a height and sustains a spinal cord injury at the T12 level. Several weeks later, he reports that he is unable to voluntarily initiate urination, but his bladder empties automatically whenever it becomes full.

Which of the following best explains his current bladder dysfunction?

(A) Damage to pontine micturition center causing urinary retention
(B) Loss of parasympathetic innervation to the detrusor muscle
(C) Destruction of the external urethral sphincter motor neurons in the pudendal nerve
(D) Loss of voluntary control over the autonomous micturition reflex
(E) Overactivity of sympathetic pathways maintaining internal sphincter tone

CAT-3 (BATCH 2) MOCK MCQ ANSWERS

(1)

(A) False – GFR is defined as the volume of plasma filtered by all nephrons of both kidneys per unit time, not just one
(B) False – constriction of efferent arterioles increases glomerular hydrostatic pressure but does not increase the filtration coefficient (Kf). Kf depends on surface area and permeability of the glomerular membrane, not arteriole tone
(C) True – opposing forces are the hydrostatic pressure in the Bowman's capsule and the colloid osmotic pressure in glomerular capillaries
(D) False – creatinine slightly overestimates GFR as some amount is secreted by renal tubules. Inulin clearance is the gold standard for 100% accurate GFR measurement
(E) True – this is known as tubuloglomerular feedback

(2)

(A) False – glucose is reabsorbed by sodium-glucose cotransporters (SGLT2 and SGLT1) in the proximal convoluted tubule, not the distal convoluted tubule
(B) True – a high protein diet increases urea production, which contributes to the medullary osmotic gradient. This enhances the kidney's ability to concentrate urine
(C) False – the majority of water reabsorption occurs in the proximal convoluted tubules, not in the loop of Henle
(D) True – aldosterone acts on the principal cells of late distal tubule and collecting ducts, promoting sodium reabsorption and potassium secretion
(E) True

(3)

(A) True – parasympathetic (pelvic nerve) stimulation causes detrusor contraction
(B) False – internal urethral sphincter is composed of smooth muscle (involuntary); the external urethral sphincter is skeletal and voluntary
(C) False – the first sensation of bladder filling occurs around 150 ml, but the micturition reflex is initiated when bladder volume reaches about 300-400 ml in adults
(D) True – afferent impulses carried via pelvic nerves to the sacral spinal cord, initiating the micturition reflex
(E) True

(4)

(A) True
(B) False – the luteal phase is characterized by high progesterone and moderate estrogen, with low FSH and LH due to negative feedback from progesterone
(C) False – there is rise of estrogen levels during follicular phase (estradiol), peak right before ovulation, moderate levels during luteal phase
(D) True – due to loss of ovarian follicles which causes low estrogen and progesterone which removes negative feedback mechanism on the pituitary
(E) False – ovulation is triggered by a surge in LH, not a drop

(5)

(A) False – causes precocious pseudopuberty
(B) True
(C) True
(D) False – causes precocious pseudopuberty
(E) True – by stimulating GnRH secretion

True (central) precocious puberty occurs due to an early but otherwise normal pubertal pattern of gonadotropin secretion from the pituitary Eg:- constitutional, cerebral, tumors and infections of the hypothalamus, development abnormalities

Precocious pseudopuberty (peripheral) is early development of secondary sexual characteristics without gametogenesis. It is caused by abnormal exposure to androgens or estrogens in males and females respectively. Eg:- congenital adrenal hyperplasia, androgen/estrogen secreting tumors, Leydig cell tumors of the testis, granulosa cell tumors of the ovary

(6)

(A) True
(B) False – the acrosome reaction is triggered by binding to the zona pellucida, not directly the oocyte plasma membrane
(C) True
(D) True
(E) True – it triggers release of cortical granules by exocytosis

(7)

(A) False – cold sensitive spots are more numerous than warm sensitive spots (about 4-10 times more)
(B) True – it is needed to maintain posture
(C) True – proprioceptors use Aα fibers with a conduction velocity of 70-120 m/s. Pain receptors use two types of fibers, Aδ fibers (with a conduction velocity of 12-30 m/s) and C fibers (with a conduction velocity of 0.5-2 m/s)
(D) False – pain and temperature is carried via the ventrolateral (spinothalamic) tract. The dorsal column carries fine touch, vibration and proprioception
(E) False – primary somatosensory cortex is located in the postcentral gyrus of the parietal lobe. The precentral gyrus is the motor cortex

(8)

(A) True
(B) True
(C) False
(D) False
(E) True

When focusing on a near object, the eye undergoes accommodation convergence (near response) reflex which involves three responses (1) accommodation (the lens becomes more convex) (2) pupillary constriction (reduces the amount of light entering the eye) (3) convergence (both eyes turn medially on the same near object. All three processes are mediated by parasympathetic fibers in the oculomotor nerve (CN III)

(9)

(A) True – vestibulospinal tract originates from the vestibular nuclei and enhances extensor muscle tone, maintaining posture and balance in response to signals from the vestibular apparatus
(B) False – the reticulospinal tract is responsible for facilitation of extensors (medial reticulospinal tract) and inhibition of extensors and facilitation of flexors (lateral reticulospinal tract) which is responsible for posture and locomotion
(C) True – the rubrospinal tract arises from the red nucleus in the midbrain, excites the flexor muscles and inhibits the extensors, mainly influencing upper limb movement
(D) True – the tectospinal arises from the superior and inferior colliculi, mediating reflex turning of head and eyes towards visual or auditory stimuli
(E) True

(10)

(A) True

(B) False – the protein concentration in CSF is < 0.5 g/L (virtually free of protein) where as in plasma, the protein concentration is ~60-80 g/L

(C) False – the normal glucose concentration in CSF is usually ~2/3 of that in plasma

(D) False – the early manifestations of raised ICP are Headache (often worse in morning, aggravated by coughing/straining), nausea, vomiting (projectile), altered mental status (irritability, drowsiness). Late manifestations are Papilledema (swelling of optic disc), Cushing's triad (hypertension, bradycardia, irregular respirations), pupillary changes (dilated, fixed), decreased level of consciousness, posturing (decorticate/decerebrate).

(E) True – CPP = MAP – ICP

SINGLE BEST RESPONSE QUESTIONS

(1) The causes for acute renal failure can be categorized as prerenal, renal and post renal causes. The following investigation findings help us differentiate whether the lesion is prerenal or renal.

Measurement	Prerenal	Renal
Spot urine Na	<20 mEq/l	>40 mEq/l
FENa	<1%	>2%
FEUrea	<35%	>50%
Urine osmolality	>500 mOsm/kg	300-400 mOsm/kg
U/P osmolality	>1.5	1-1.3

Answer – C

(2) ↓ pH – acidemia
↓ HCO_3^- - primary metabolic cause
↓ pCO_2 – compensatory respiratory alkalosis (hyperventilation)
This pattern is suggestive of metabolic acidosis due to reduced acid excretion in chronic kidney disease
Answer – A

(3) Angiotensin II normally constricts the efferent arteriole more than the afferent, helping maintain glomerular filtration pressure, especially when renal perfusion is low. ACEI block angiotensin II formation, leading to efferent arteriolar dilation, drop in glomerular hydrostatic pressure, and hence a reduced GFR. This explains the mild rise in serum creatinine seen after ACEI, particularly in patients with renal artery stenosis or CKD
Answer – B

(4) This patient is presenting after 72 hours after unprotected sexual intercourse. The best method is using Cu-IUD as it is effective up to 5 days after unprotected intercourse. Levonorgestrel 1.5 mg single dose and the "Yuzpe" regimen is only effective up to 72 hours. So, they are unreliable here. Depot medroxyprogesterone acetate is not used as an emergency contraceptive. Tamoxifen is a selective estrogen receptor modulator used to treat breast cancer. It has no role in emergency contraception.
Answer – D

(5) This clinical picture is typical for Turner syndrome. The karyotyping in Turner syndrome is 45,XO. In these patients, gonadal dysgenesis occurs leading to failure of ovarian development.
In androgen insensitivity syndrome, the karyotyping is 46,XY. They present with female external genitalia, normal breast development and absent uterus.

In congenital adrenal hyperplasia, there is a deficiency in the enzyme 21-hydroxylase which is important for the production of cortisol. Lack of cortisol leads to stimulation of pituitary to produce ACTH, which drives overproduction of adrenal androgens. The karyotyping is 46,XX. They present with virilization of external genitalia.
In Klinefelter syndrome, the karyotyping is 47,XXY. They present with a male phenotype, small testis and gynecomastia
In 5-α reductase deficiency, the karyotyping is 46,XY. They present with undervirilized male genitalia at birth, masculinization at puberty
Answer - B

(6) In pregnancy, the stroke volume is increased (by 30%) contributing a higher cardiac output
Tidal volume is increased from 500-700 ml due to progesterone stimulating respiration
The blood albumin level decreases during pregnancy due to hemodilution
There is no significant change in blood flow to the liver during pregnancy
GFR is increased by about 40-50% due to increased renal plasma flow
Answer – E

(7) Broca's aphasia occurs due to damage in the inferior frontal gyrus of the dominant (usually left) hemisphere. The key features seen are (1) non-fluent, effortful, broken speech (2) good comprehension (3) poor repetition (4) patient is aware of the deficit
In Wernicke's aphasia, speech is fluent but nonsensical and comprehension is poor. The lesion is in the superior temporal gyrus
In conduction aphasia, fluent speech with good comprehension is seen but poor repetition is there. The lesion is in the arcuate fasciculus (connection between Broca's and Wernicke's areas)
In global aphasia, severe impairment in both comprehension and expression is seen. Lesion involves both Broca's and Wernicke's areas
In transcortical sensory aphasia, the presentation is similar to Wernicke's aphasia but repetition is preserved. Lesion is in the tempo-parietal region around the Wernicke's area
Answer – B

(8) This presentation is seen in Parkinson's disease. It is caused by degeneration of dopaminergic neurons in the substantia nigra pars compacta of the basal ganglia. This leads to reduced dopamine in the striatum (caudate nucleus and putamen). The resulting imbalance between dopamine and acetylcholine causes (1) resting tremor (pill-rolling) (2) bradykinesia (3) muscle rigidity (cogwheel rigidity) (4) postural instability
Answer – D

(9) This patient has a long-standing history of type II diabetes. So, the most likely cause for this type of sensory deficit is diabetic polyneuropathy. Diabetic polyneuropathy is a symmetrical, distal sensorimotor neuropathy caused by chronic hyperglycemia leading to (1) metabolic injury to neurons (2) microangiopathy of vasa nervorum leading to nerve ischemia. The result is a "glove and stocking" pattern of sensory loss, often with burning pain or tingling.
In vitamin B12 deficiency, posterior column is involved leading to impaired vibration and proprioception
Compression neuropathies are more focal rather than symmetrical
Alcoholic neuropathy is possible but the patient does not have a history of alcohol consumption
In autoimmune demyelination, the presentation is acute and the lesion is ascending in nature (starting from the legs then going up)
Answer – A

(10) The micturition reflex is coordinated by the sacral spinal cord (S2-S4) and modulated by pontine and cortical higher centers. A spinal cord lesion above the sacral segments, in this case T12, interrupts the descending control but spinal reflex pathways remain intact. After spinal shock resolves, the bladder empties reflexively when full causing reflex (automatic) bladder. The patient cannot voluntarily initiate or inhibit urination, but micturition still occurs due to local reflex activity.
Pontine center damage causes incoordination, not isolated reflex activity.
Parasympathetic fibers (S2-S4) are intact here.
Pudendal motor neurons are in sacral cord – not injured in T12 lesion
Sympathetic overactivity causes retention, not reflex voiding
Answer - D

CAT-3 (BATCH 2) MOCK ESSAY

(1)

(1.1) Define the term “glomerular filtration rate” (GFR)

(10 marks)

(1.2) List for determinants of GFR in a healthy adult

(20 marks)

(1.3) A 53-year-old male was admitted to the hospital for elevation of his kidney functions. A 24-hour urine collection was done, and a sample of blood was obtained. Her serum creatinine was 2 mg/dl, urine creatinine was 90 mg/dl, and his urine output volume was 2880 ml/day

(1.3.1) Calculate GFR

(30 marks)

(1.3.2) Explain the advantages and disadvantages of using creatinine for determination of GFR

(40 marks)

(2) Explain the physiological basis of the following observations

(2.1) A young girl who had difficulty in reading letters written in the whiteboard in the classroom was tested for vision. Snellen chart reading was 6/18 on both eyes. Near vision was normal. Her reading improved after wearing biconcave glasses

(50 marks)

(2.2) When Weber test was performed on a patient with unilateral conductive hearing loss, sound was heard better in the affected ear

(50 marks)

CAT-3 (BATCH 2) MOCK ESSAY ANSWERS

(1)

(1.1) Define the term "glomerular filtration rate" (GFR) (10 marks)

The amount of plasma filtered by all the nephrons of both the kidneys per unit time. (10 marks)

(1.2) List for determinants of GFR in a healthy adult (20 marks)

- The Starling forces
  - Hydrostatic pressure difference across the glomerular capillaries and the Bowman's space (2.5 marks)
  - Osmotic pressure difference across the glomerular capillaries and the Bowman's space. (2.5 marks)
- Surface area of the glomerular capillary membrane. (5 marks)
- Permeability of the glomerular capillary membrane. (5 marks)
- Renal blood flow. (5 marks)

(1.3) A 53-year-old male was admitted to the hospital for elevation of his kidney functions. A 24-hour urine collection was done, and a sample of blood was obtained. Her serum creatinine was 2 mg/dl, urine creatinine was 90 mg/dl, and his urine output volume was 2880 ml/day

(1.3.1) Calculate GFR (30 marks)

GFR = Creatinine clearance (10 marks)

$$GFR = \frac{Ucr \times V}{Pcr}$$

(10 marks)

$$\frac{90\,\frac{mg}{dl} \times 2880\ ml}{2\,\frac{mg}{dl}} \times \frac{1}{(24 \times 60)min}$$

90 ml/min (10 marks)

(1.3.2) Explain the advantages and disadvantages of using creatinine for determination of GFR (40 marks)

Advantages

- Creatinine is a nitrogenous waste product from the breakdown of creatinine phosphate in muscle (2 marks)
- As it is a natural product, it does not need to be administered orally or via injection (4 marks)
- Convenient compared to substances like radioactive iothalamate or inulin (2 marks)
- Freely filtered at the glomerular filtration membrane (3 marks)
- Almost completely cleared from the body (3 marks)

- Not reabsorbed in the proximal convoluted tubule or elsewhere in the nephron leading to higher accuracy than substances subject to reabsorption (4 marks)
- Creatinine levels are mostly dependent on muscle mass and a less affected by other factors (2 marks)

Disadvantages

- Small amount is secreted actively in the proximal tubule. So slight overestimation of GFR which requires correction (5 marks)
- Serum creatinine depends on muscle mass, so values can vary with
    - Age
    - Sex
    - Pathologies affecting muscle (Eg, malnutrition, rhabdomyolysis) (5 marks)
- Not completely cleared (like PAH). So cannot be used to estimate renal blood flow (5 marks)

Clinically, creatinine is used to estimate changes in GFR rather than obtain precise GFR values (5 marks)

(2) Explain the physiological basis of the following observations

(2.1) A young girl who had difficulty in reading letters written in the whiteboard in the classroom was tested for vision. Snellen chart reading was 6/18 on both eyes. Near vision was normal. Her reading improved after wearing biconcave glasses (50 marks)

- Visual acuity is the shortest distance between 2 points by which they can be perceived as 2 separate points (4 marks)
- There are 2 tests for acuity
  - Jaeger chart for near vision (3 marks)
  - Snellen chart for distant vision (3 marks)
- The reading is given as a ratio, which is d/D (4 marks)
- d – the distance at which the letters can be read by the patient (3 marks)
- D – the distance at which they can be read by a normal eye (3 marks)
- Since the person's ratio is 6/18, she can read letters at 6 m which are usually readable at 18 m by a normal eye (4 marks)
- This condition is called myopia (5 marks)
- The light rays coming from distant objects are focused in front of the retina (4 marks)
- This condition is usually due to
  - too long eye ball or (4 marks)
  - too much refractive power in the lens (4 marks)
- This can be corrected using a concave lens (5 marks)
- The excessive refractive power can be neutralized by placing a concave spherical lens in front of the eye which will diverge rays (4 marks)

(2.2) When Weber test was performed on a patient with unilateral conductive hearing loss, sound was heard better in the affected ear (50 marks)

- The weber test is a screening test for hearing (6 marks)
- Performed with a tuning fork (5 marks)
- It can detect unilateral conductive hearing loss and unilateral sensorineural hearing loss (6 marks)
- A patient with a unilateral conductive hearing loss would hear the tuning fork loudest in the affected ear (6 marks)
- This is because the ear with the conductive hearing loss is only receiving input from bone conduction and no air conduction (5 marks)
- The conduction problem of the middle ear (incus, malleus, stapes) masks the ambient noise from the room (5 marks)
- The well-functioning inner ear picks the sound up via the bones of the skull, causing it to be perceived as a louder sound in affected ear (6 marks)
- Therefore, sound is perceived as louder in that ear (5 marks)
- The unaffected ear receives other background noises via air conduction as well. Therefore, it is perceived as a comparatively less loud sound (6 marks)

CAT-3 (BATCH 2) MOCK OSPE

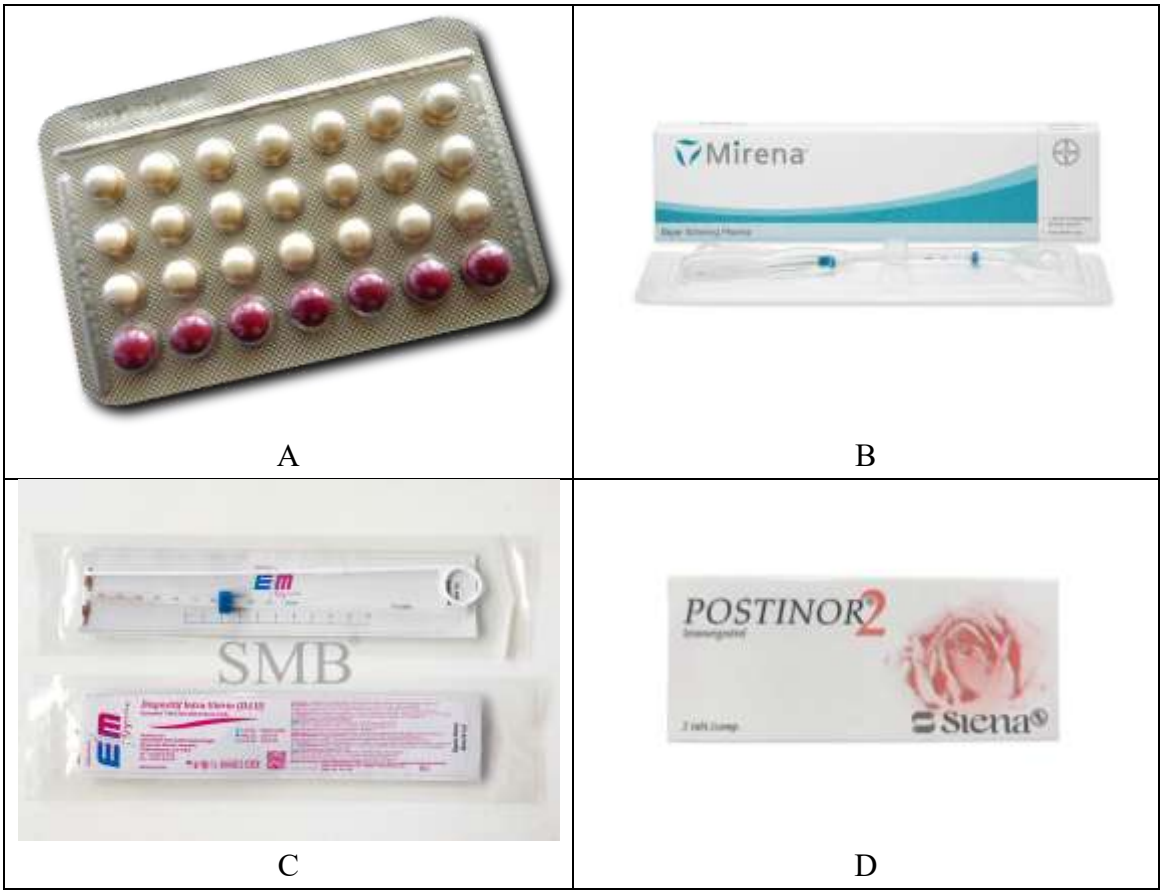
(1) This is a urine sample taken from a patient.



(1.1) What constituent gives this color change in urine? (04 marks)

(1.2) State 02 causes for the above constituent to be in urine (06 marks)

(2)



A B C D

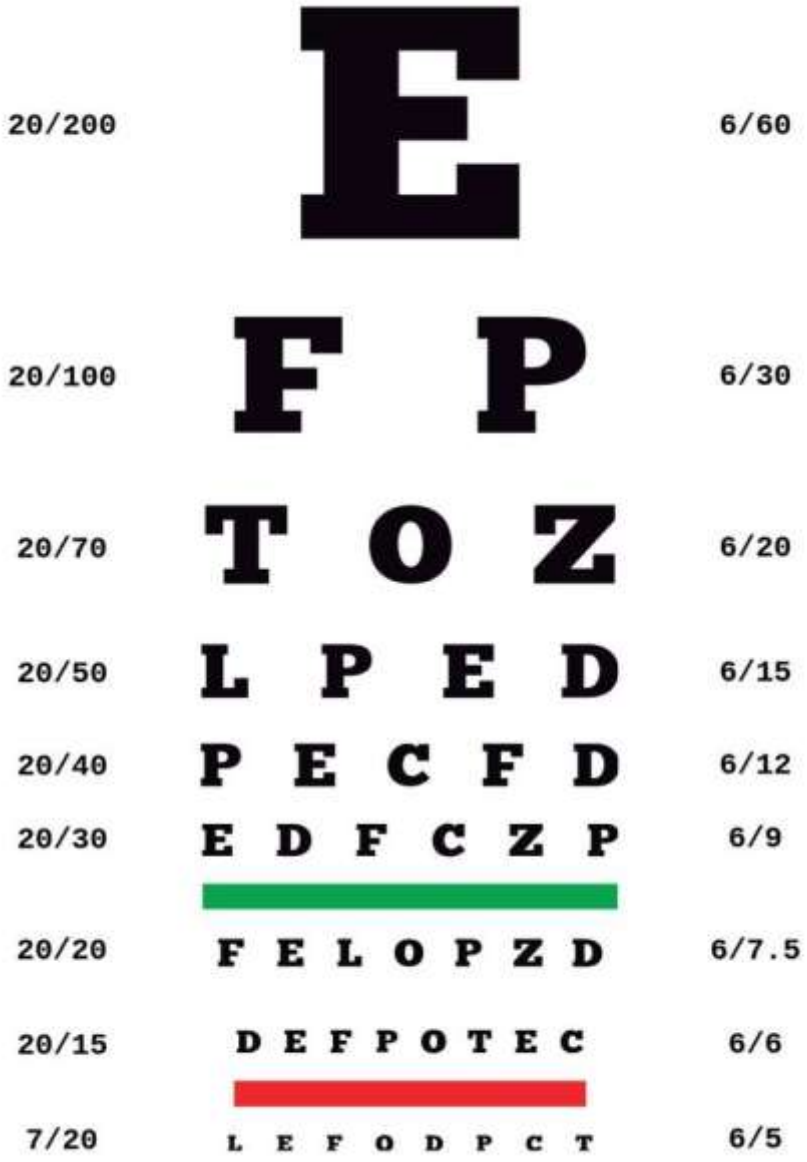
(2.1) Identify A, B, C and D (04 marks)
(2.2) Name 2 uses of A (02 marks)
(2.3) What are the instructions given before using D? (04 marks)

(3)

Parameter	Value
Seminal volume	2.0 ml
Sperm concentration	11 million/ml
Total motility	45%
Normal forms	3%

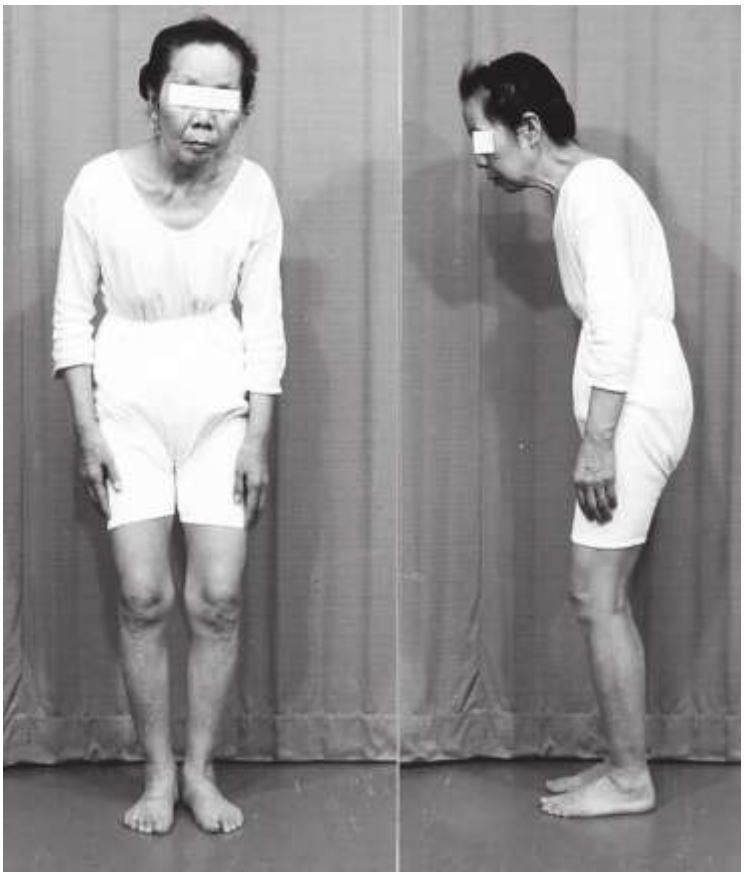
(3.1) What is the minimum duration of abstinence from sexual intercourse for sample collection for seminal fluid analysis (SFA)? (04 marks)
(3.2) Interpret the give SFA (06 marks)

(4)



(4.1) What is this chart called? (02 marks)
(4.2) The patient can only see up to the 3rd row. Interpret this finding (04 marks)
(4.3) What should this patient do to correct this abnormality? (04 marks)

(5) This is a picture of a 65-year-old patient with tremors at rest, reduced movements and rigidity.



(5.1) What is the condition she has? (04 marks)

(5.2) What is the neurotransmitter involved? (03 marks)

(5.3) What is the type of gait which can be observed in this patient? (03 marks)

(6)

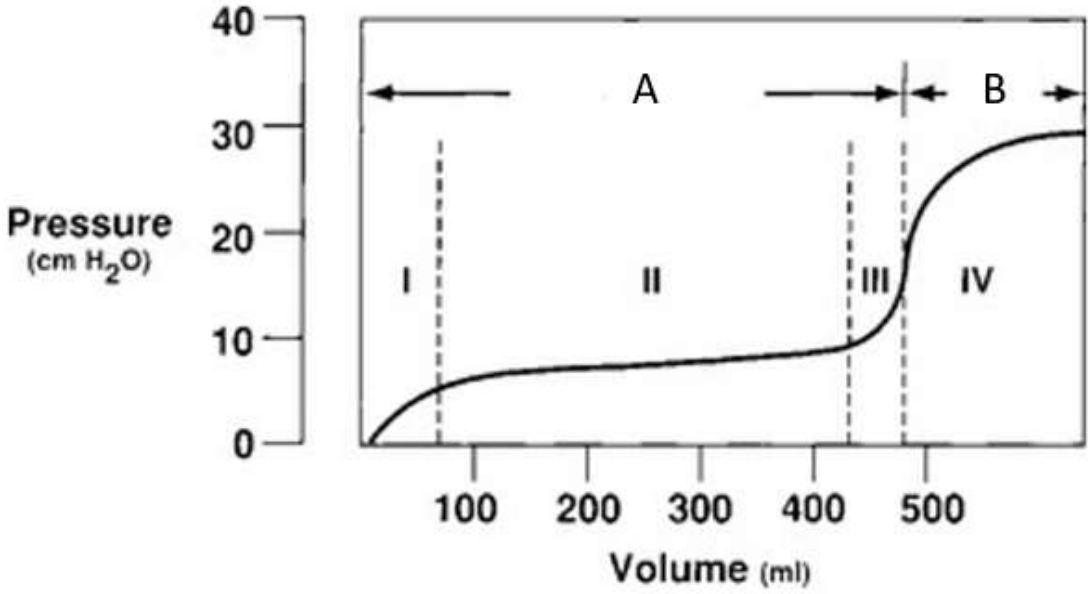


(6.1) What is the nerve palsy seen in this patient? (04 marks)

(6.2) What type of lesion is this? (04 marks)

(6.3) Which sensation is diminished in a patient with this nerve palsy? (02 marks)

(7) A cystometrogram is given here.



(7.1) Identify A and B phases (06 marks)
(7.2) At which volume of bladder do we start to feel the urge to urinate? (02 marks)
(7.3) What are the higher centers for voluntary control of micturition? (02 marks)

(8) A 24-year-old man presents with deep, rapid breathing and dehydration following uncontrolled diabetes mellitus.

pH	7.28
PaCO2	32 mmHg
HCO3-	15 mEq/L

(8.1) Interpret the acid-base disorder in the given ABG (06 marks)
(8.2) State one reason why metabolic acidosis occurs in kidney failure (04 marks)

(9)



(9.1) What is the clinical sign seen here? (04 marks)

(9.2) What nerve is injured? (04 marks)

(9.3) What is the investigation that can be done to identify the nerve involved? (02 marks)

(10) Live Station

Demonstrate how you would assess the visual fields of a patient using the confrontation method. (10 marks)

CAT-3 (BATCH 2) MOCK OSPE ANSWERS

(1)



(1.1) Red blood cells/Myoglobin/Blood (04 marks)

(1.2) Any 2 conditions causing glomerular or non-glomerular hematuria (03 each)
glomerular – nephrotic syndrome, nephritic syndrome, HSP etc. (2) non-glomerular – urinary tract stones, urinary tract infections
If myoglobin; Rhabdomyolysis, Major injury (crush injuries, burns), severe overexertion, intense exercise, infections

(2)

 A	 B
 C	 D

(2.1) A – combined oral contraceptive pills, B – Levonorgestrel intrauterine device, C – copper intrauterine device, D – Emergency Contraceptive Pills
(01 each)

(2.2) Contraception, for irregular menstrual cycle (01 each)

(2.3) Best results achieved if taken within 72 hours of unprotected sex (02 marks). Take 1 tablet (01 mark) and the 2nd in 12 hours (01 mark)

(3)

Parameter	Value
Seminal volume	2.0 ml
Sperm concentration	11 million/ml
Total motility	45%
Normal forms	3%

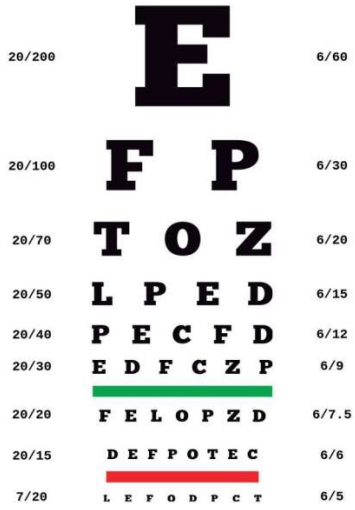
(3.1) 3 days (04 marks)

(3.2) Sperm count low – oligozoospermia (03 marks), normal forms low – teratozoospermia (03 marks)

or

oligo-teratozoospermia (06 marks)

(4)

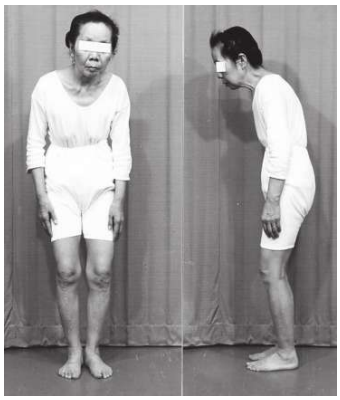


(4.1) Snellen chart (02 marks)

(4.2) d/D = 6/20, they can see the text at 6 m (20 ft) while a person with normal vision can see the text at 20 m (100 ft) / their visual acuity is 6/20 (04 marks)

(4.3) Wear spectacles with biconcave lenses (04 marks)

(5)



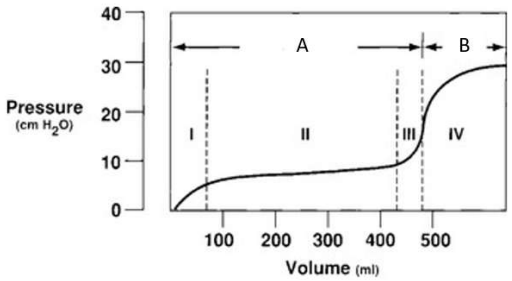
(5.1) Parkinson's disease (04 marks)
(5.2) Dopamine (03 marks)
(5.3) Festinant gait/shuffling gait (03 marks)

(6)



(6.1) Facial nerve palsy (04 marks)
(6.2) Lower motor neuron type (04 marks)
(6.3) Taste sensation of the anterior 2/3 of the tongue (02 marks)

(7)



(7.1) A – filling phase, B – voiding phase (03 each)
(7.2) 150 – 200 ml (02 marks)
(7.3) Pontine and cortical centers (02 marks)

(8)

pH	7.28
PaCO2	32 mmHg
HCO3-	15 mEq/L

(8.1) Partially compensated (02 marks) metabolic (02 marks) acidosis (02 marks)
(8.2) failure to excrete H+ (02 marks) and to regenerate HCO3- (02 marks)

(9)



(9.1) Wrist drop (04 marks)
(9.2) Radial nerve (04 marks)
(9.3) Nerve conduction studies and electromyography (02 marks for one of these)

(10) The student should do the following;

- Introduce themselves, confirm identity, explain what is going to be done and gain consent
- Patient positioning – ~1 meter away, patient's eye level same as themselves
- Ask patient to look at your face and comment on any difficulties seeing
- Ask patient to close or cover one eye and look directly across your opposite eye, you should cover also cover the other eye
- Hold your hands out and bring an extended finger in from the periphery towards the centre of the visual field.
- The testing finger is always kept in the plane exactly halfway between yourself and the patient.
- Wiggle your fingertip and ask the patient to point to it when they first see it. If the patient fails to notice your finger when it is clearly visible to you, their field is reduced in that area.
- Test all four quadrants separately
- Once finished, thank the patient
- Explain the findings

PHYSIOLOGY CONTINUOUS ASSESSMENT-3

2022/2023 (1st Batch)
CAT-3
Papers & Answers

CAT-3 (BATCH 1) MCQ PAPER

Question numbers 01 to 10 are True or False type questions. Mark your answer for each of the 5 responses (A to E)

(1) True or False regarding kidney?

(A) Fluid filtered to the Bowmen's capsule is isotonic.
(B) In a healthy individual GFR plays a more important role than the amount of reabsorption in determining the urine volume.
(C) It has more cortical nephrons than medullary nephrons.
(D) Juxtaglomerular apparatus secretes erythropoietin.
(E) Medullary nephrons are more important than cortical nephrons in the generation of osmotic gradient from cortex to medulla.

(2) True or False regarding the renal clearance?

(A) Renal clearance is the volume of plasma completely cleared of a substance by the kidneys per minute.
(B) Renal clearance is calculated using the plasma, urine concentrations of a substance and urine flow rate.
(C) Renal clearance of a substance is less than GFR if it is reabsorbed in renal tubules.
(D) Renal clearance of PAH is less than GFR.
(E) Renal clearance of creatinine is increased in acute kidney injury.

(3) Which of the following findings in a routine urinalysis is correctly matched with its clinical significance?

(A)	Glucose	– Seen in diabetic ketoacidosis only
(B)	Leukocytes	– Seen in Fanconi's syndrome
(C)	Nitrites	– Indicative of viral urinary tract infection
(D)	Proteinuria	– Suggestive of glomerular disease
(E)	Specific gravity >1.010	– Indicates inability to concentrate urine

(4) True or False regarding sexual differentiation?

(A) In 5 alpha reductase deficiency at birth, the baby has ovaries and male external genitalia.
(B) In testicular feminization syndrome, menstruation does not occur.
(C) In true hermaphroditism there is genetic constitution of one sex and the genitalia of another.
(D) Sertoli cells secrete Mullerian inhibiting factor.
(E) SRY gene is required for the development of ovaries.

(5) True or False regarding physiological changes of pregnancy?

(A) Decreased cardiac output due to reduced stroke volume.
(B) Increased systemic vascular resistance mediated by estrogen.
(C) Left axis deviation in ECG.
(D) Mild respiratory alkalosis due to hyperventilation.
(E) Relaxation of ureters due to progesterone.

(6) True or False regarding Fertilization, Pregnancy, and Parturition?

(A) Before fertilization, sperm must undergo capacitation in the male reproductive tract.
(B) During early labor, the number of oxytocin receptors in the myometrium significantly increases.
(C) During parturition, progesterone is primarily responsible for the uterine contractions.
(D) Fertilization typically occurs in the ampulla of the fallopian tube.
(E) Placenta secretes human chorionic gonadotropin (hCG).

(7) True or False regarding thermoreceptors?

(A) Activity of cool receptors gradually increases when the temperature is reduced from 40°C to 0°C.
(B) Cold-sensitive spots are more abundant than warm-sensitive spots on the skin.
(C) Extremes of temperatures induce pain rather than cold or warm sensations.
(D) Innocuous warm sensation is carried via myelinated nerve fibres.
(E) Warm receptors show the highest rate of discharge around 45°C.

(8) True or False regarding sensory nerve abnormalities?

(A) Dorsal column lesion causes loss of proprioception.
(B) Pain and temperature sensations are lost in syringomyelia.
(C) Peroneal nerve lesion at the ankle causes tarsal tunnel syndrome.
(D) Sensory loss in a dermatomal pattern is caused by a specific spinal nerve root lesion.
(E) Sensory stroke causes loss of pain sensation of the opposite side of the body.

(9) Lesions in which of the following sites are correctly matched with their clinical presentations?

(A)	Caudate nucleus	– Chorea
(B)	Cerebellum	– Stamping gait
(C)	Putamen	– Athetosis
(D)	Substantia nigra	– Parkinsonism
(E)	Subthalamic nucleus	– Hemiballismus

(10) True or False regarding EEG and sleep?

(A) Alpha blocking is seen in normal individuals.
(B) Alpha waves are due to thalamic activity.
(C) Delta waves are seen during stage II sleep.
(D) Dreams occur during REM sleep.
(E) Sleep spindles are seen in stage I Non-REM sleep.

Single Best Response (SBR)

(11) pH of the tubular fluid in the proximal convoluted tubule (PCT) remains relatively unchanged despite secretion of large amount of H+ into it.

What is the best explanation for this relatively unchanged pH of the proximal tubular fluid?

(A) Almost all the secreted H+ are reabsorbed in the PCT.
(B) Ammonia buffer is active in the PCT.
(C) PCT cells are very active as they have a large number of mitochondria.
(D) Plenty of HCO3- is available in the PCT to buffer all the secreted H+.
(E) Tubular fluid flow rate in the PCT is higher than in any other part of the nephron.

(12) A 38-year-old mother begins breastfeeding her 5-day-old baby. The baby latches on properly and begins to suckle.

Which of the following is the most likely maternal physiological response to suckling?

(A) Increase in hypothalamic dopamine release.
(B) Increase in luteinizing hormone-releasing hormone.
(C) Increase in oestrogen concentration.
(D) Increase in posterior pituitary oxytocin secretion.
(E) Increase in progesterone concentration.

(13) When CSF is obtained by lumbar puncture, a venous blood sample is also obtained to measure its glucose concentration.

What is the best explanation for simultaneous assessment of blood glucose?

(A) Cells in the CSF utilize glucose until CSF is being assessed in the laboratory.
(B) Glucose is actively secreted from blood into CSF during formation of CSF.
(C) High blood glucose will have an osmotic effect on cells in the CSF.
(D) Interpretation of CSF glucose report requires blood glucose concentration.
(E) Lumbar puncture is contraindicated if the patient is hypoglycaemic.

(14) Gently rubbing the skin of an injured area relieves pain.

Which of the following best explains this observation?

(A) Gate control theory
(B) Inhibition of C fibres carrying pain
(C) Inhibition of pain receptors on the skin
(D) Lateral inhibition
(E) Stimulation of Aδ fibres carrying pain

(15) A 7-year-old girl is brought to the paediatric clinic by her mother because of concerns about early breast development and pubic hair growth that started about 6 months ago. On examination, she has Tanner stage III breast development and coarse pubic hair. Her height is above the 95th percentile for her age. No signs of virilization are noted. Bone age assessment shows advancement by 2 years compared to her chronological age. An ultrasound of the pelvis reveals an enlarged uterus and ovaries with multiple follicles.

Which of the following is the most likely cause for this presentation?

(A) Adrenal tumour
(B) Congenital virilizing adrenal hyperplasia
(C) Granulose cell tumour of ovaries
(D) Hypothalamic tumour
(E) Oestrogen-secreting tumour

(16) A 16-year-old girl is brought to the clinic because of excessive urination and constant thirst for the past month. She also complains of feeling more tired than usual. Her fasting blood glucose is measured at 320 mg/dL (normal: 70–110 mg/dL). Urinalysis shows a large amount of glucose in the urine.

Which of the following best explains the presence of glucose in her urine?

(A) Glucose is actively secreted into the urine by the distal tubules.
(B) High blood glucose caused microvascular changes in glomeruli.
(C) The filtered glucose load has exceeded the transport maximum.
(D) The renal threshold for glucose has lowered.
(E) There is a defect in the glomerular filtration barrier allowing glucose to leak into urine.

(17) A 45-year-old construction worker sustained a fall two months ago, resulting in a penetrating injury to his spinal cord. Now he presents to the clinic with the following findings below the lesion.
Right leg: Weakness, increased muscle tone, hyperreflexia, and a positive Babinski sign. He also has loss of vibration and proprioception in this leg.
Left leg: Intact motor strength and normal reflexes. However, he reports a loss of pain and temperature sensation in this leg.

Which of the following neurological lesions is the most likely cause of the above clinical features?

(A) Damage to the left side spinothalamic track
(B) Damage to the right side of the dorsal column
(C) Damage to the rubrospinal track.
(D) Right side hemi section of the thoracic spinal cord
(E) Right side upper motor neuron lesion

(18) A 55-year-old female presents to an eye clinic complaining of progressive difficulty seeing things to her sides over the past six months. She states, "It feels like I'm looking through a tunnel." On examination, visual acuity is 20/20 in both eyes. Visual field testing reveals a loss of vision in the outer half of her both visual fields.

Which of the following visual defects is most consistent with her presentation?

(A) Central scotoma
(B) Cortical blindness
(C) Heteronymous bitemporal hemianopia
(D) Left homonymous hemianopia
(E) Right homonymous hemianopia

(19) A 28-year-old male presents to a clinic complaining of excessive daytime sleepiness for the past two years. He describes an irresistible urge to sleep, often occurring in monotonous situations like meetings or while driving. He reports several episodes where he suddenly loses muscle tone, leading to a brief collapse without loss of consciousness.

Which of the following is the most likely diagnosis?

(A) Fatigue
(B) Narcolepsy
(C) Obstructive Sleep Apnoea
(D) Parasomnia
(E) Sleep walking

(20) A 68-year-old man presents with progressive memory loss and his family reports that he no longer notices the smell of burnt food or flowers. Neurological exam reveals no focal deficits. Considering both memory impairment and olfactory dysfunction, which brain region is most likely to be affected?

(A) Amygdala
(B) Entorhinal cortex
(C) Hippocampus
(D) Olfactory bulb
(E) Orbitofrontal cortex

CAT-3 (BATCH 1) MCQ PAPER ANSWERS

(1) TFTFT

(2) TTTFF

(3) FFFTF

(4) FTFTF

(5) FFTTT

(6) FTFTT

(7) FTTFT

(8) TTFTT

(9) TFTTT

(10) TTFTF

(11) D

(12) D

(13) D

(14) A

(15) D

(16) C

(17) D

(18) C

(19) B

(20) B

CAT-3 (BATCH 1) STRUCTURED ESSAY (SEQ) PAPER

(1) Sensory receptors convert specific forms of energy into action potentials in sensory neurons.

(1.1) List five (05) different types of sensory receptors that are involved in sensing different forms of sensations. (Do not consider special senses from cranial nerves). (15 marks)

(1.2) Explain the difference between rapidly adapting receptors and slowly adapting receptors. (20 marks)

(1.3) Define the term 'adequate stimulus' in relation to a sensory receptor. (15 marks)

(1.4) Explain how lateral inhibition helps in two-point discrimination. (20 marks)

(1.5) Name the two (02) main somatosensory pathways in the spinal cord. (20 marks)

(1.6) State the main difference between carrying impulses in a myelinated nerve and an unmyelinated nerve. (10 marks)

(2) Once sperm enter the female reproductive tract, a sequence of physiological events occur, culminating in implantation.

(2.1) Name six (06) key events that occur from the entry of sperm into the female reproductive tract up to implantation. (30 marks)

(2.2) Capacitation is the process of priming the sperm for fertilization.

(2.2.1) Define the term capacitation. (10 marks)

(2.2.2) List four (04) key features or changes that occur during capacitation. (20 marks)

(2.3) Describe the key steps involved in the process of fertilization. (25 marks)

(2.4) Explain the role of corpus luteum in the maintenance of early pregnancy. (15 marks)

CAT-3 (BATCH 1) SEQ PAPER ANSWERS

(1) Sensory receptors convert specific forms of energy into action potentials in sensory neurons.

(1.1) List five (05) different types of sensory receptors that are involved in sensing different forms of sensations. (Do not consider special senses from cranial nerves). (15 marks)

Award 3 marks each (any five)

Receptor Type	Marks
Mechanoreceptors	3
Thermoreceptors	3
Nociceptors	3
Chemoreceptors	3
Proprioceptors	3
Baroreceptors	3
Osmoreceptors	3

(1.2) Explain the difference between rapidly adapting receptors and slowly adapting receptors. (20 marks)

Feature	Rapidly Adapting	Slowly Adapting	Marks
Response to stimulus	Respond mainly at onset/offset	Respond throughout stimulus	5
Adaptation rate	Fast	Slow	5
Function	Detect changes/movement	Detect continuous intensity	5
Example	Pacinian corpuscle	Merkel disc, muscle spindle	5

(1.3) Define the term ‘adequate stimulus’ in relation to a sensory receptor. (15 marks)

Point	Marks
Specific form of energy/stimulus	5
To which receptor is most sensitive	5
Produces response at lowest threshold/intensity	5

(1.4) Explain how lateral inhibition helps in two-point discrimination. (20 marks)

Point	Marks
Stimulated receptor activates central pathway	4
Adjacent neurons inhibited by inhibitory interneurons	4
Surrounding sensory activity suppressed	4
Sharper contrast between stimulated and adjacent areas	4
Improves localization and two-point discrimination	4

(1.5) Name the two (02) main somatosensory pathways in the spinal cord. (20 marks)

Pathway	Marks
Dorsal column–medial lemniscal pathway	10
Anterolateral (spinothalamic) pathway	10

(1.6) State the main difference between carrying impulses in a myelinated nerve and an unmyelinated nerve. (10 marks)

Point	Marks
Myelinated nerves conduct by saltatory conduction	4
Impulses jump between nodes of Ranvier	2
Unmyelinated nerves conduct continuously along membrane	2
Myelinated conduction is much faster	2

(2) Once sperm enter the female reproductive tract, a sequence of physiological events occur, culminating in implantation.

(2.1) Name six (06) key events that occur from the entry of sperm into the female reproductive tract up to implantation. (30 marks)

Award 5 marks each

- Capacitation
- Acrosome reaction
- Fertilization
- Formation of zygote
- Cleavage divisions
- Morula formation
- Blastocyst formation
- Implantation

(Any six correct events)

(2.2) Capacitation is the process of priming the sperm for fertilization.

(2.2.1) Define the term capacitation. (10 marks)

Point	**Marks**
Functional maturation of sperm	4
Occurs in female reproductive tract	3
Enables sperm to fertilize ovum	3

(2.2.2) List four (04) key features or changes that occur during capacitation. (20 marks)

Award 5 marks each

Any four:

Change	**Marks**
Removal of cholesterol from sperm membrane	5
Increased membrane fluidity	5
Increased permeability to calcium ions	5
Increased motility (hyperactivation)	5
Increased ability to undergo acrosome reaction	5
Exposure of receptors needed for zona pellucida binding	5

(2.3) Describe the key steps involved in the process of fertilization. (25 marks)

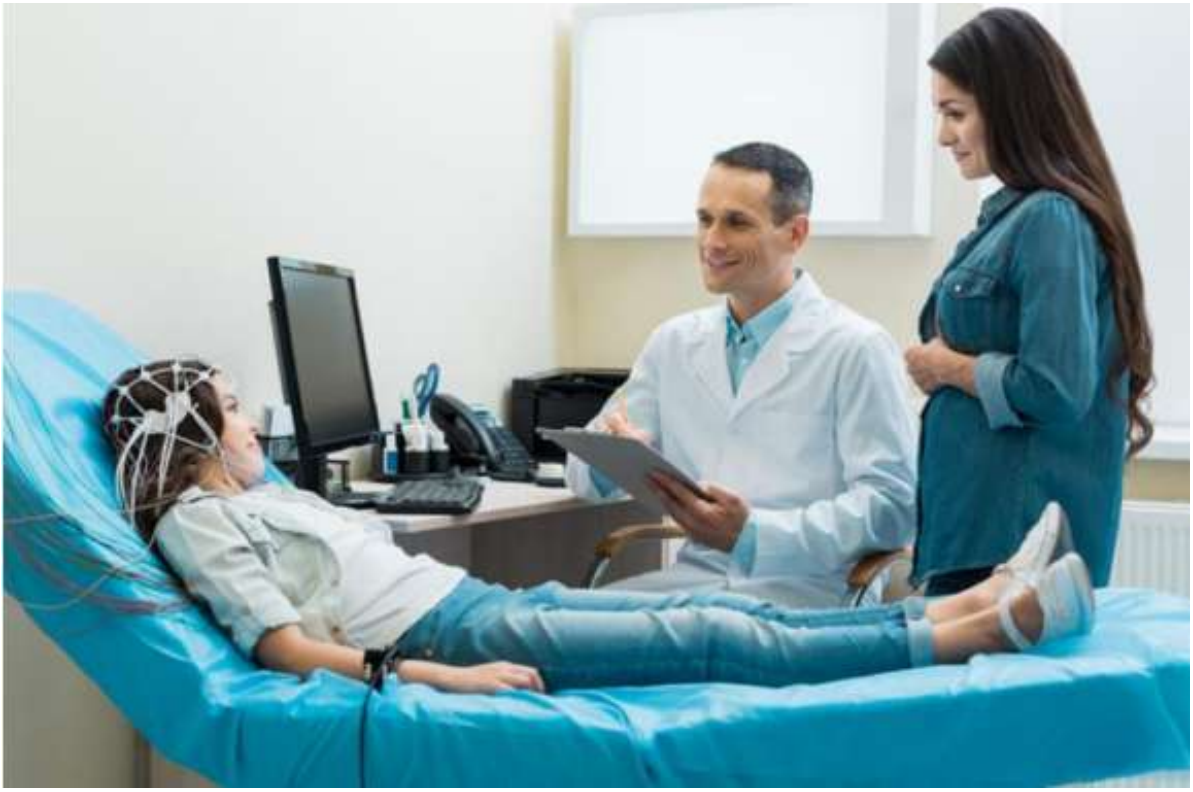
Point	Marks
Capacitated sperm reaches ovum	3
Sperm binds zona pellucida	4
Acrosome reaction occurs	4
Penetration of zona pellucida	4
Fusion of sperm and oocyte membranes	4
Cortical reaction prevents polyspermy	3
Fusion of male and female pronuclei (syngamy)	3

(2.4) Explain the role of corpus luteum in the maintenance of early pregnancy. (15 marks)

Point	Marks
Corpus luteum secretes progesterone	4
Progesterone maintains endometrium	4
Prevents menstruation/endometrial shedding	3
Suppresses uterine contractions	2
Maintained by hCG during early pregnancy	2

CAT-3 (BATCH 1) OSPE QUESTIONS

(1)



(1.1) What is being recorded in this person? (2 marks)

(1.2) State the four types of waves that can be recorded using this method. (6 marks)

(1.3) State two neurological diseases that can be diagnosed using this method. (2 marks)

(2) Eye movements are being tested in a patient in the following situations:

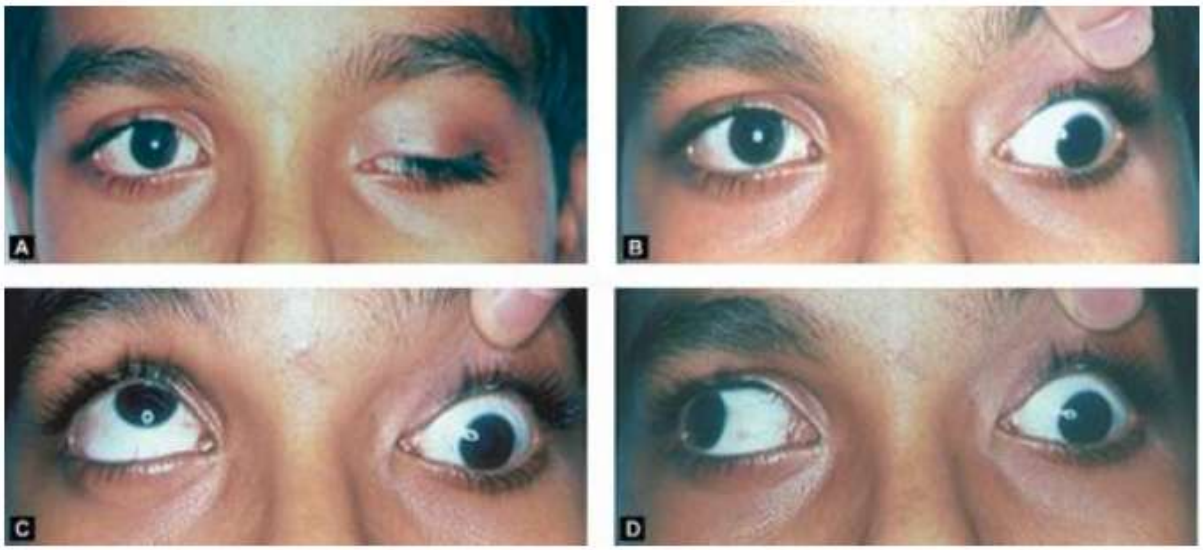
A – Patient is looking straight ahead.

B – Patient is looking straight ahead with the left eye lid held open

C – Patient is looking upward.

D – Patient is looking to the right.

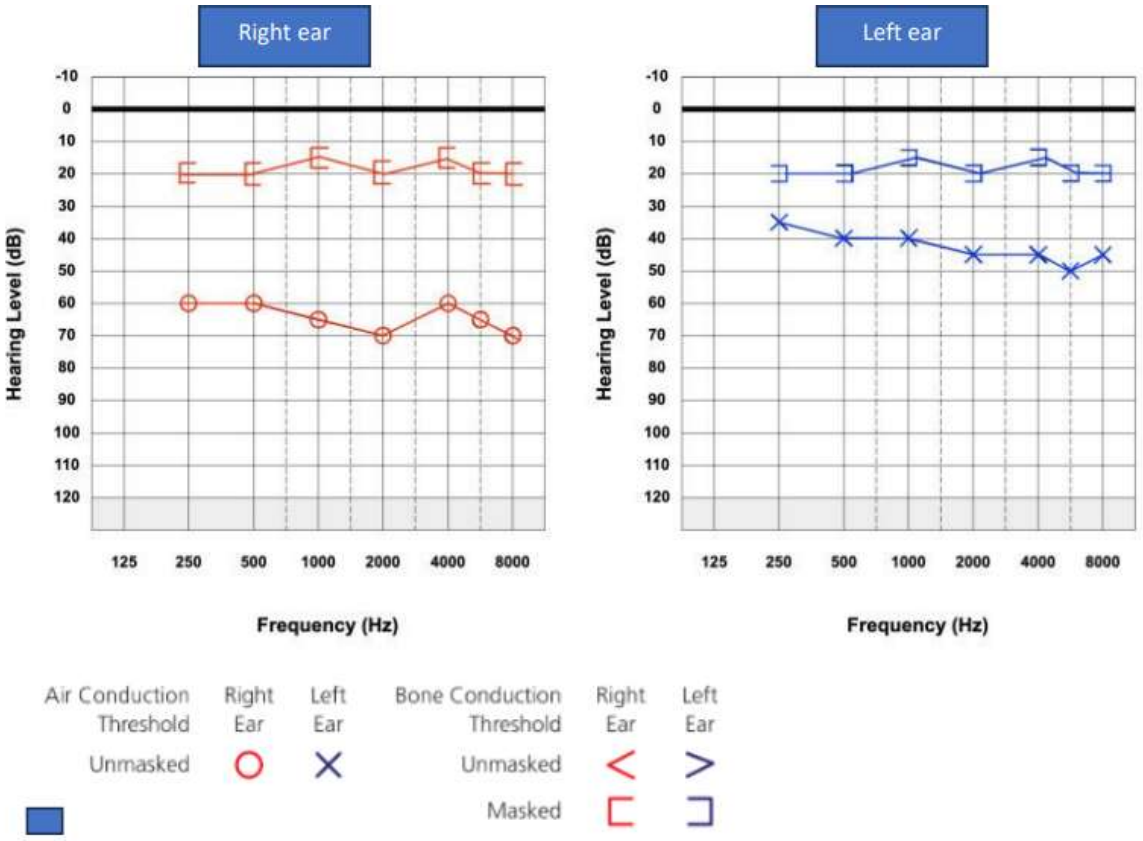
Observe the pictures carefully and answer the questions below.



(2.1) Identify four abnormal physical signs in this patient (6 marks)

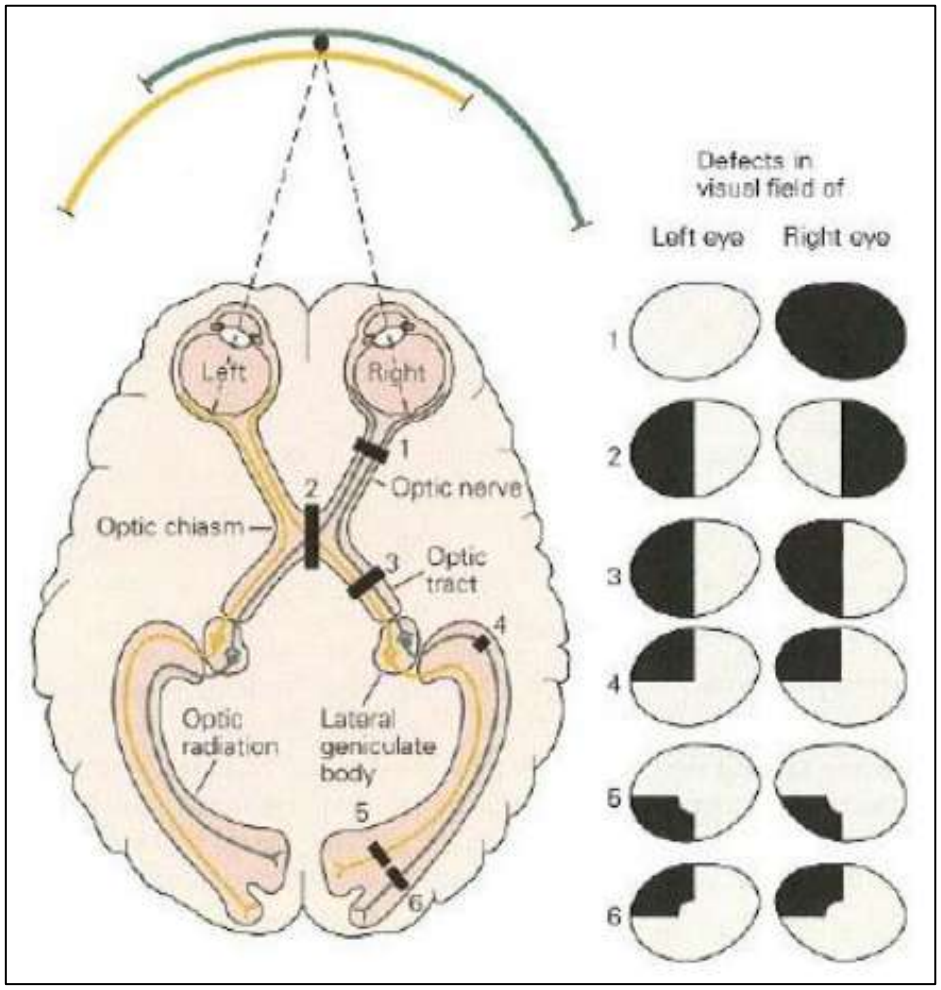
(2.2) What is the most likely diagnosis? (4 marks)

(3) A 50 – year- old male presents with reduced hearing, Audiometry was performed.



(3.1) Identify the type of hearing loss shown in the audiogram (4 marks)
(3.2) Provide reasons for your answer in 3.1 (3 marks)
(3.3) What are the hearing lossthresholds in the left and right ears (3 marks)

(4)



(4.1) Identify the visual field defects labeled as 2,3, and 5 (6 marks)

(4.2) Briefly explain the anatomical basis for the for the visual field defect at site 4 (4 marks)

(5) For each description given below, choose the single most appropriate contraception option.

A



B



C



D



1.A woman who wishes to wait for 2 years after her first childbirth before becoming pregnant again.

2.A newly married couple who wishes to delay pregnancy for 6 months.

3.A woman with pelvic inflammatory disease.

4.A woman who needs protection against sexually transmitted diseases (STDs).

(6) You are provided with a seminal fluid analysis report of a 32- year-old male undergoing evaluation for infertility.

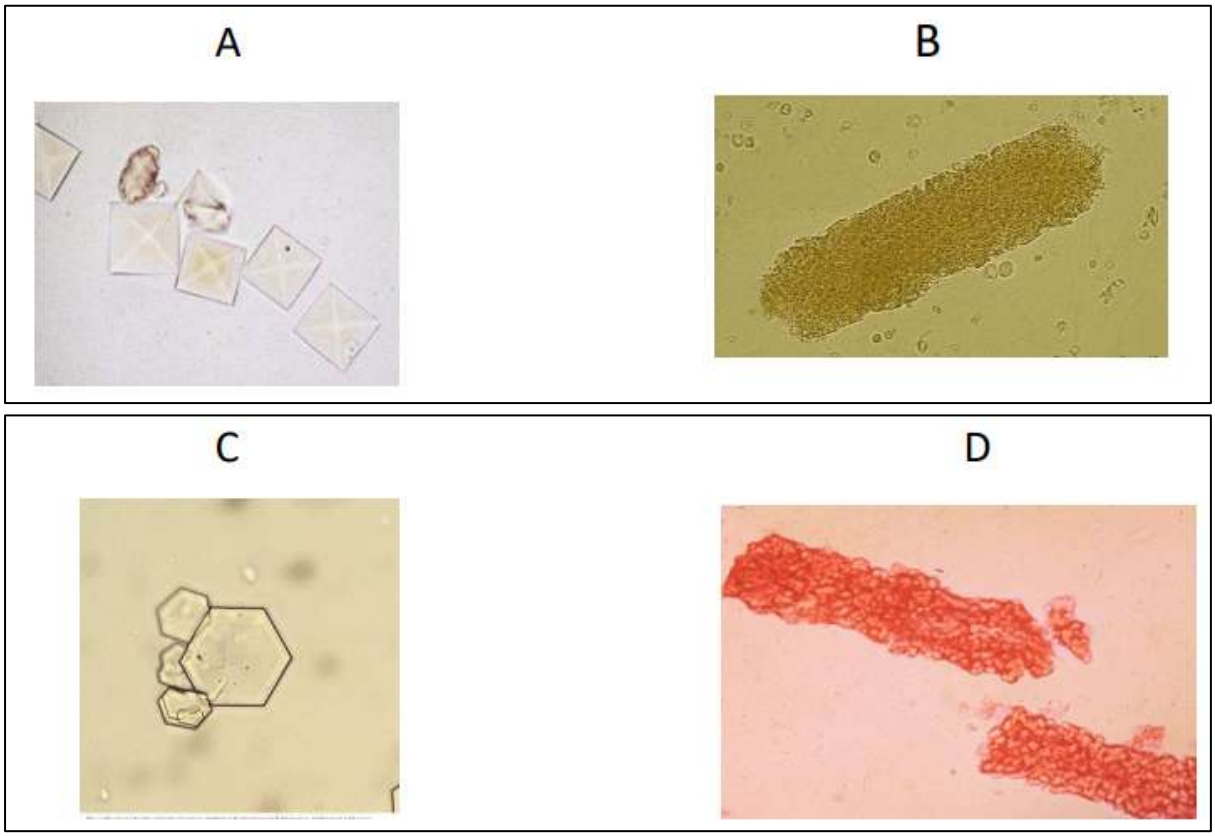
SEMEN ANALYSIS

PARAMETER	RESULT	WHO REFERENCE RANGE
Volume	1.2 mL	≥ 1,5 mL
Sperm concentration	8 million/mL	≥ 15 million/mL
Total motility	30% progressive	≥ 40% total; ≥32% progressive
Morphology (normal)	2%	≥ 4% (strict criteria)
pH	7.4	≥ 7,2
Liquefaction time	30 minutes	≤ 60 minutes

(6.1) Identify 4 abnormalities in this report (8 marks)

(6.2) Mention two possible causes for the abnormalities observed in this patient. (2 marks)

(7) You are provided with four microscopic images of urine sediment. Observe them carefully and answer the following questions



(7.1) Identify A, B, C and D. (6 marks)

(7.2) State the clinical significance of each of the identified findings. (4 marks)

(8) A patient undergoing renal function assessment has the following laboratory results:
Concentration of substance X in urine 60 mg/dL
Volume of urine excreted per minute- 1.5 mL/min
Concentration of substance X in plasma 2 mg/dL

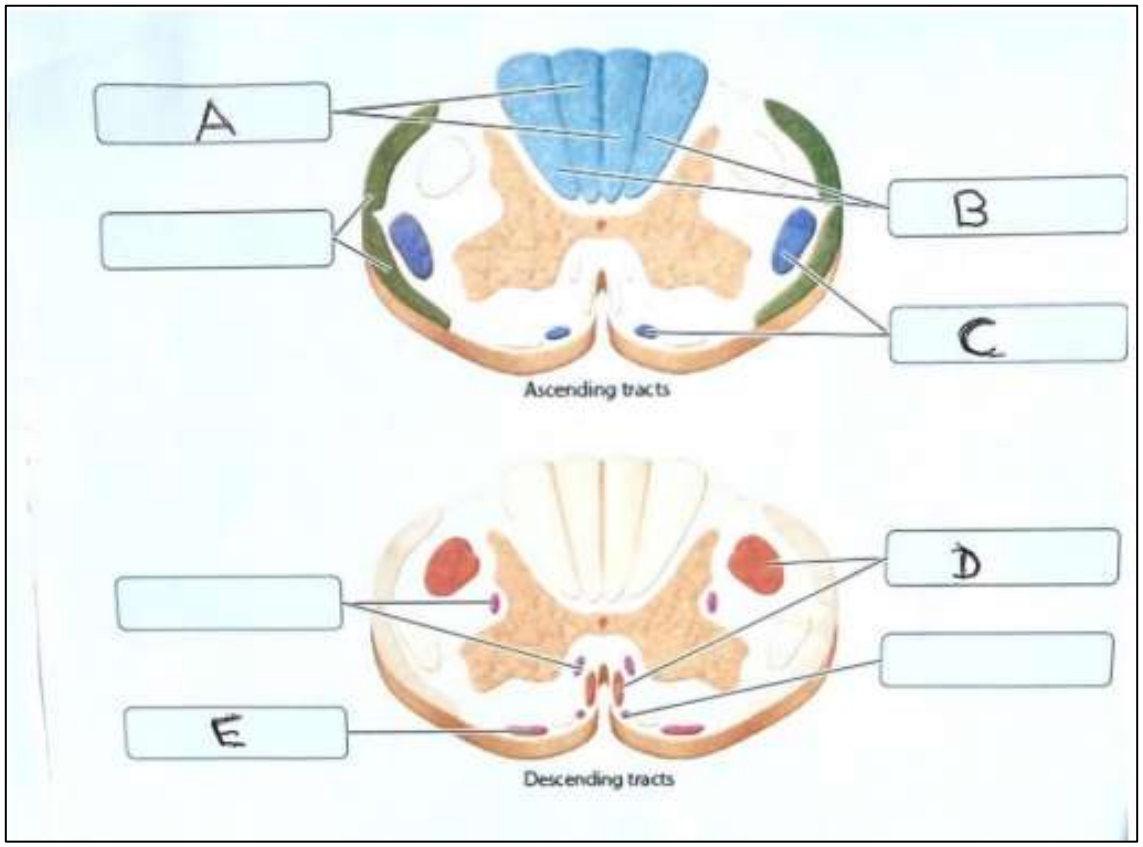
(8.1) Calculate the renal clearance of substance X (6 marks)

(8.2) Name one substance that is commonly used to estimate:

(a) Glomerular filtration rate (GFR)

(b) Renal plasma flow (RPF) (4 marks)

(9) Carefully observe the provided diagram of ascending and descending tracts of the spinal cord



(9.1) Name the spinal tracts labeled A to E in the diagram (5marks)

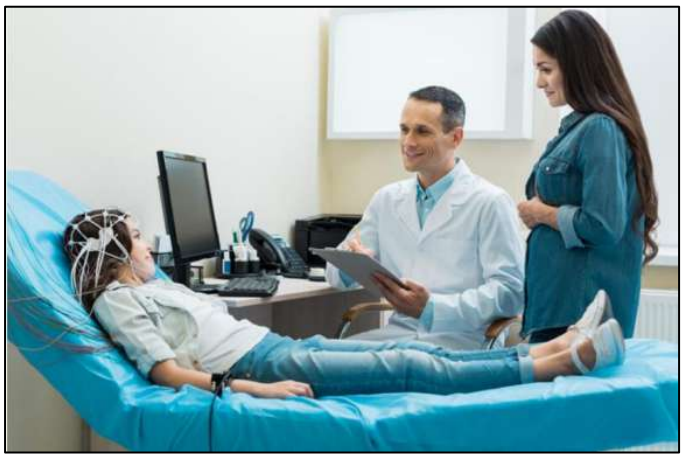
(9.2) Match the following clinical presentations with the most likely tract involved (A-E) (5 marks)

Clinical Presentation	Tract Letter
1 Loss of balance, falls, postural instability and possible vertigo	.....
2. Loss of proprioception and vibration from the upper limbs	.....
3. Spastic paralysis of ipsilateral limbs below the lesion	.....

(10) You are provided with two tuning forks. Select the appropriate tuning fork and asses the patient's hearing. Interpret your results.

CAT-3 (BATCH 1) OSPE ANSWERS

(1)

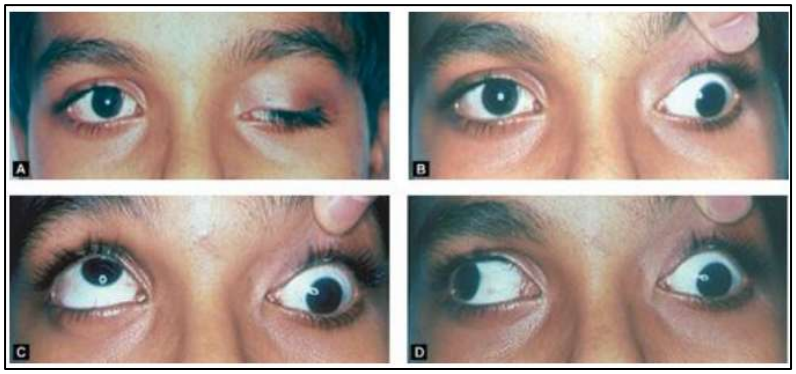


(1.1) EEG (02 marks)

(1.2) Alpha, Beta. Theta, and Delta (1.5*4 = 06 marks)

(1.3) Epilepsy, brain tumor, encephalopathy (1*2 = 02 marks)

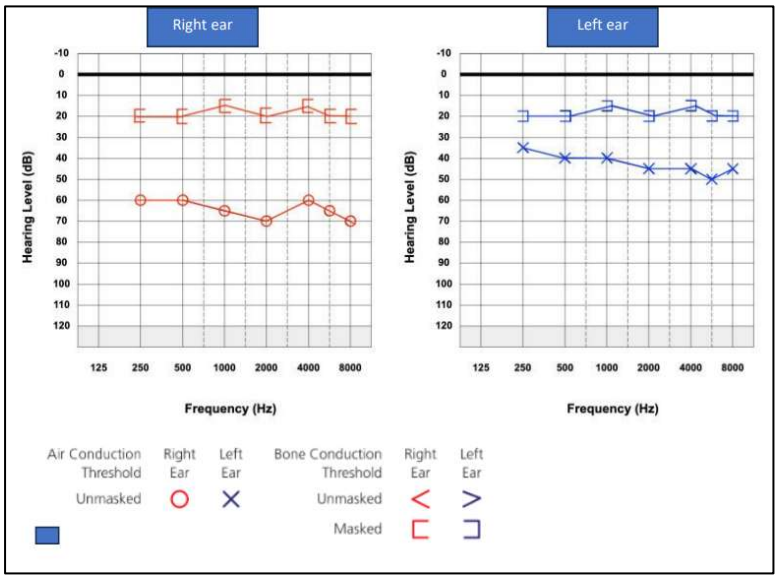
(2)



(2.1) Left complete ptosis, lateral strabismus/deviation of the eye ball/paralysis of left superior rectus muscle/paralysis of left medial rectus (1.5*4 = 06 marks)

(2.2) Left complete third nerve (oculomotor nerve) palsy (2 marks for the correct side) (2+2 = 04 marks)

(3)

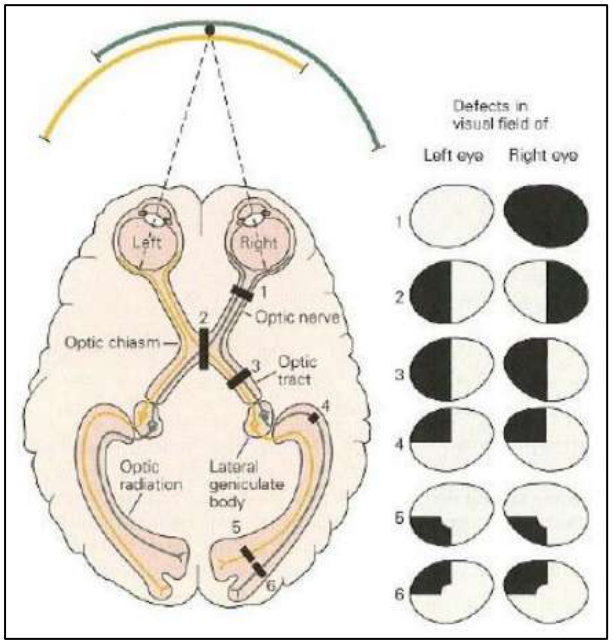


(3.1) Bilateral conductive hearing loss (bilateral 2 marks conductive hearing loss 2 marks)

(3.2) Air conduction threshold is increased but bone conduction is normal in both ears/increased air bone gap in the audiogram in both sides (03 marks)

(3.3) Right ear – 60 dB, Left ear – 40 dB (1.5*2 = 03 marks)

(4)



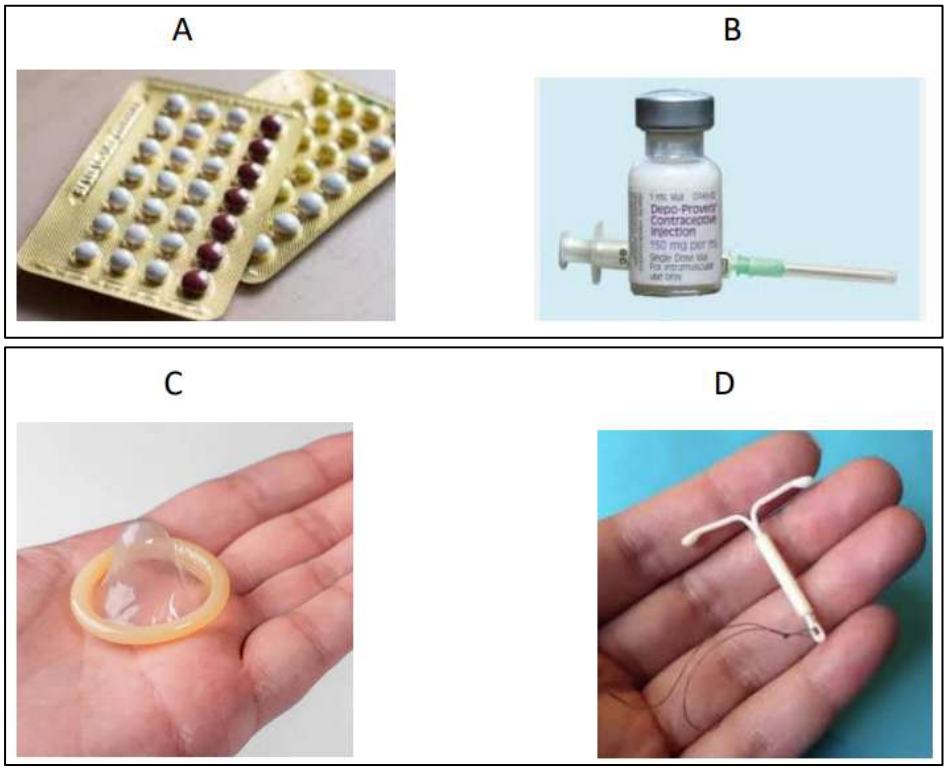
(4.1) 2 – Bitemporal hemianopia

3 – Left homonymous hemianopia

5 – Left homonymous hemianopia with macular sparing (2*3 = 06 marks)

(4.2) This occurs because of lesion in right side (contralateral) temporal lobe fibers/optic radiation (Meyer's loop) causing left superior quadrantic visual field loss. (04 marks)

(5)



1. B 2. A 3. A 4. C

(6)

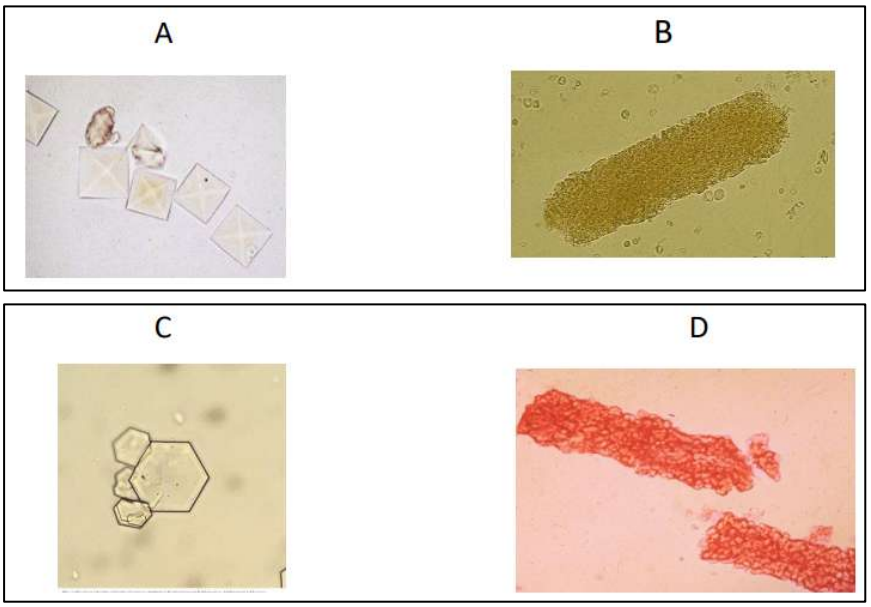
SEMEN ANALYSIS

PARAMETER	RESULT	WHO REFERENCE RANGE
Volume	1.2 mL	≥ 1,5 mL
Sperm concentration	8 million/mL	≥ 15 million/mL
Total motility	30% progressive	≥ 40% total; ≥32% progressive
Morphology (normal)	2%	≥ 4% (strict criteria)
pH	7.4	≥ 7,2
Liquefaction time	30 minutes	≤ 60 minutes

(6.1) Lower semen volume, low sperm count/concentration, abnormal morphology, reduced motility (2*4 = 08 marks)

(6.2) Hypogonadism or hormone imbalance
Infection or inflammation of the reproductive tract (e.g. Prostatitis, orchitis)
Obstruction of seminal vesicles or ejaculatory ducts (for low volume)
Environmental or lifestyle factors (e.g. Smoking, alcohol, heat exposure, toxins) (two of these) (1*2 = 02 marks)

(7)



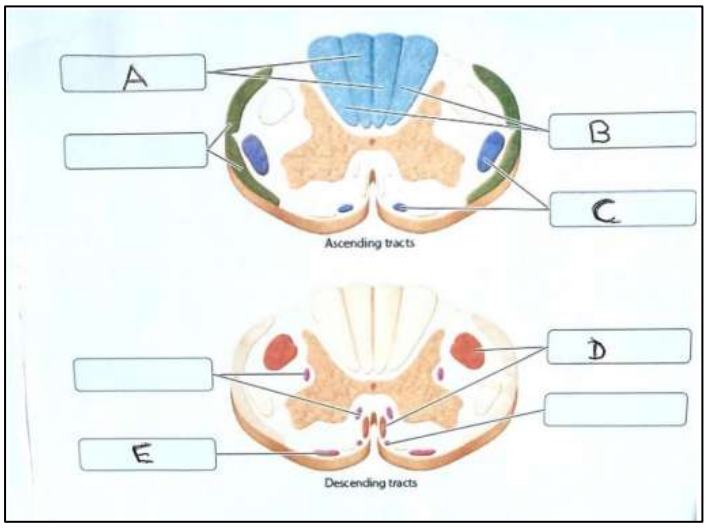
A - Calcium oxalate - common in oxalate renal stones or ethylene glycol poisoning
B – Granular cast - suggest CKD or ATN
C – Cystine crystals - seen in cystinuria
D – Red cell cast - indicative of glomerulonephritis/vasculitis/severe malignant hypertension (1.5*4 = 06 marks)

(8) Lab results:
Concentration of substance X in urine 60 mg/dL
Volume of urine excreted per minute- 1.5 mL/min
Concentration of substance X in plasma 2 mg/dL

(8.1) Clearance (Cx) = (U*V)/P (01 mark)
Clearance = (60*1.5)/2 = 90/2 = 45 ml/min
(05 marks: 1 for substitution, 4 for correct working and answer)

(8.2)
(a) Inulin or Creatinine for GFR
(b) Para-aminohippuric acid (PAH) for RPF (02 marks each)

(9)



(9.1) A – Fasciculus gracilis (posterior column)
B – Fasciculus cuneatus (posterior column)
C – Spinothalamic tracts/Anterolateral systems/anterior and lateral spinothalamic tracts
D – Corticospinal tracts/pyramidal tracts/lateral and anterior corticospinal tract
E – Vestibulospinal tract (1*5 = 05 marks)

(9.2) 1 – E 2 – B/A 3 – D (05 marks)

(10) Live station – hearing assessment

2023/2024 (2nd Batch)
CAT-3
Papers & Answers

CAT-3 (BATCH 2) MCQ PAPER

Question numbers 01 to 10 are True or False type questions. Mark your answer for each of the 5 responses (A to E)

(1) True or False regarding inulin and creatinine clearance?

(A) Creatinine clearance equals GFR.
(B) Creatinine is freely filtered and partially reabsorbed.
(C) Creatinine is slightly secreted by renal tubules.
(D) Inulin is metabolized in the body.
(E) Inulin is neither secreted nor reabsorbed.

(2) True or False regarding renal tubular functions?

(A) Aquaporin-1 channels are regulated by vasopressin.
(B) Glucose is reabsorbed by a secondary active transport mechanism.
(C) In the proximal convoluted tubule, Na^+ is actively transported from the lumen into tubular epithelial cells.
(D) Na^+ reabsorption in the collecting duct is regulated by aldosterone.
(E) Urea contributes to the osmotic gradient in the medullary pyramids.

(3) True or False regarding acute physiological changes in a person who has lost a large amount of blood (acute haemorrhage)?

(A) ADH secretion is stimulated.
(B) Plasma Na^+ concentration remains unchanged.
(C) The renin–angiotensin–aldosterone system (RAAS) is inhibited.
(D) There is a negative Na+ balance.
(E) There is a positive water balance.

(4) True or False regarding the urinary bladder

(A) Stretch receptors are activated as bladder volume increases.
(B) The "guarding reflex" helps maintain urinary continence.
(C) The external urethral sphincter is innervated by the pudendal nerve.
(D) The flaccid (atonic) bladder occurs due to loss of cortical inhibition.
(E) The initial slight rise in pressure in a cystometrogram indicates bladder compliance.

(5) True or False regarding sexual differentiation in a person with XXY genotype?

(A) External genitalia are ambiguous.
(B) Medulla of the primitive gonads regresses.
(C) Müllerian ducts regress.
(D) There is impaired spermatogenesis.
(E) XXY genotype is caused by nondisjunction of sex chromosomes.

(6) True or False regarding the control of testicular function?

(A) Activins inhibit FSH secretion from the anterior pituitary.
(B) FSH stimulates the secretion of androgen-binding protein (ABP).
(C) Inhibin exerts negative feedback on FSH secretion at the anterior pituitary.
(D) LH stimulates Leydig cells to produce testosterone.
(E) Testosterone increases FSH secretion from the anterior pituitary.

(7) True or False regarding the erection?

(A) It is initiated by dilation of penile arterioles.
(B) It is terminated by sympathetic vasoconstrictor impulses to the penile arterioles.
(C) Nitric oxide-induced increase of cGMP causes penile vasodilation.
(D) Stimulation of nervi erigentes causes penile erection.
(E) Phosphodiesterase-5 (PDE-5) inhibitors reduce cGMP levels.

(8) True or False regarding peripheral nerve abnormalities?

(A) Common peroneal nerve lesion produces foot drop.
(B) Glove and stocking sensory loss is seen in polyneuropathies.
(C) Sciatic nerve compression causes meralgia paraesthetica.
(D) Sensory nerve abnormalities produce paraesthesia.
(E) Syringomyelia causes loss of proprioception before loss of temperature sensation.

(9) True or False regarding EEG and sleep?

(A) Beta waves are seen during REM sleep.
(B) GABA is mainly responsible for slow wave sleep.
(C) Nightmares are seen during REM sleep.
(D) Sleepwalking occurs during slow wave sleep.
(E) Theta waves are seen during stage 3 NREM sleep.

(10) True or False regarding CSF?

(A) Astrocytes play a critical role in the maintenance of blood brain barrier properties.
(B) Choroid plexuses absorb CSF.
(C) CSF has significantly higher glucose concentration than that of plasma.
(D) Rate of CSF formation is decreased in cerebral oedema.
(E) Neutrophils in CSF is a normal finding

Questions 11 to 20 are Single Best Response (SBR) type. Select the best response to each question.

(11) A 28-year-old woman at 32 weeks of pregnancy reports breathing more deeply than usual but is not in distress.

Compared to her non-pregnant state, what is the most likely Arterial Blood Gas (ABG) finding?

(A) Compensated respiratory acidosis.
(B) Compensated respiratory alkalosis.
(C) Normal acid–base balance with very low PO_2
(D) Pure metabolic acidosis.
(E) Uncompensated metabolic alkalosis.

(12) A 28-year-old healthy male experiences increased heart rate, blood pressure, and muscle tension during sexual activity. These changes continue to intensify just before orgasm.

Which phase of the sexual response cycle best explains this stage?

(A) Excitement phase
(B) Orgasm phase
(C) Plateau phase
(D) Refractory phase
(E) Resolution phase

(13) Before fertilization, sperm must undergo a process called capacitation in the female reproductive tract.

What is the main physiological effect of capacitation?

(A) Completion of second meiotic division
(B) Exocytosis of cortical granules
(C) Hardening of the ovum's zona pellucida
(D) Hyperactivated motility
(E) Synthesis of proteolytic enzymes in the acrosome

(14) A 52-year-old teacher, presents to a well-woman clinic with a 14-month history of amenorrhea, associated with frequent hot flushes and disturbed sleep.

Which of the following hormonal patterns is the physiological hallmark of her current condition?

(A) Markedly decreased progesterone
(B) Markedly elevated circulating estrogen
(C) Markedly elevated Follicle-Stimulating Hormone (FSH)
(D) Markedly elevated Luteinizing Hormone (LH)
(E) Undetectable Gonadotropin-Releasing Hormone (GnRH)

(15) A 15-year-old girl presents with delayed onset of menarche. She has a very low body mass index, and physical examination shows minimal subcutaneous fat and delayed secondary sexual characteristics. There is no evidence of systemic disease.

Which of the following statements best explains the delay in onset of menarche in this patient?

(A) Decreased androgen levels
(B) Increased cortisol levels
(C) Low body fat enhancing pituitary sensitivity to GnRH
(D) Reduced body fat leading to decreased levels of leptin
(E) Undernutrition-induced decreased estrogen production

(16) A 58-year-old man with a 10-year history of diabetes presents with a 6-month history of numbness and burning sensation in both feet. He describes it as "walking on cotton wool." Recently, similar symptoms have started in his fingertips.

Which of the following is the most likely cause for his symptoms?

(A) Brainstem disease
(B) Dorsal column disease
(C) Lower motor neuron lesion
(D) Peripheral neuropathy
(E) Thoracic spinal cord disease

(17) A 68-year-old man presents with sudden loss of vision on the right side of his visual field. While reading, he notices that the right half of the page is missing. Pupillary light reflexes are normal in both eyes. Vision in the left visual field is intact.

Which site in the visual pathway is most likely affected?

(A) Left optic radiation
(B) Left optic tract
(C) Optic chiasma
(D) Right optic tract
(E) Right primary visual cortex

(18) A 54-year-old male with a BMI of 34 is brought to the clinic by his wife. She reports that he snores loudly and frequently "stops breathing" for several seconds during sleep, followed by a loud gasp.

Which of the following is the most likely cause of his symptoms?

(A) Fatigue
(B) Narcolepsy
(C) Obstructive sleep apnoea
(D) Parasomnia
(E) Sleepwalking

(19) A 68-year-old man is brought by his family due to progressive memory loss over the past year. They also report that he is unable to recognize familiar smells such as food and perfume. On further questioning, he has difficulty recalling recent events. There are no significant motor deficits.

Which of the following is the most likely anatomical site responsible for his olfactory deficit?

(A) Orbitofrontal cortex
(B) Amygdala
(C) Entorhinal cortex
(D) Hippocampus
(E) Thalamus

(20) A 62-year-old man presents with progressive difficulty in walking. He reports that he needs to watch his feet while walking and often loses balance when walking in dim light.
On examination:
Gait is stamping Romberg test is positive
Vibration and joint position sense are reduced in both lower limbs Muscle strength in the lower limbs is normal

What is the most likely physiological explanation for this gait abnormality?

(A) Abnormal inputs from the vestibular apparatus
(B) Damage to cerebellar vermis
(C) Damage to the common peroneal nerve
(D) Damage to the visual cortex
(E) Impaired proprioceptive input

CAT-3 (BATCH 2) MCQ PAPER ANSWERS

(1) FFTFT

(2) FTFTT

(3) TTFFF

(4) TTTFF

(5) FFTTT

(6) FTTTF

(7) TTTTF

(8) TTFTF

(9) TTTTF

(10) TFFTF

(11) B

(12) C

(13) D

(14) C

(15) D

(16) D

(17) A

(18) C

(19) C

(20) E

CAT-3 (BATCH 2) STRUCTURED ESSAY (SEQ) PAPER

(1) Explain the physiological basis of following.
  (1.1) Para-aminohippuric acid (PAH) is used to estimate renal plasma flow. (25 marks)
  (1.2) Counter-current mechanisms enable the formation of concentrated urine. (25marks)
  (1.3) FSH and LH levels are elevated in a male with primary hypogonadism (25 marks)
  (1.4) Serum progesterone rises moderately and then remains relatively constant during pregnancy (25 marks)

(2) Explain the physiological basis of the following observations.
  (2.1) Damage to the right thalamus causes loss of sensation on the left side of the body and severe pain (25 marks)
  (2.2) In conductive deafness, Weber’s test lateralizes the sound to the affected ear. (25marks)
  (2.3) Bradykinesia in a patient with Parkinson's disease (25 marks)
  (2.4) When a person enters a dark room after being exposed to bright sunlight, vision remains impaired for approximately 20 minutes. (25 marks)

CAT-3 (BATCH 2) SEQ PAPER ANSWERS

(1) Explain the physiological basis of following.

(1.1) Para-aminohippuric acid (PAH) is used to estimate renal plasma flow. (25 marks)

Point	Marks
PAH is freely filtered at the glomerulus	4
PAH not filtered is actively secreted by proximal tubules	4
Nearly all PAH entering kidneys is removed in one circulation	5
Amount excreted ≈ amount delivered in renal plasma	4
PAH clearance approximates effective renal plasma flow (ERPF)	4
Therefore PAH is used to estimate renal plasma flow	4

(1.2) Counter-current mechanisms enable the formation of concentrated urine. (25 marks)

Point	Marks
Loop of Henle acts as counter-current multiplier	4
Thick ascending limb actively transports NaCl into medulla	4
Ascending limb impermeable to water	3
Hyperosmotic medullary interstitium created	4
Vasa recta acts as counter-current exchanger	3
Medullary gradient preserved/prevents washout	3
ADH increases water reabsorption from collecting ducts	2
Concentrated urine produced	2

(1.3) FSH and LH levels are elevated in a male with primary hypogonadism (25 marks)

Point	Marks
Primary hypogonadism = testicular failure	4
Reduced testosterone production by Leydig cells	4
Reduced negative feedback on hypothalamus	4

Point	Marks
Increased GnRH secretion	3
Increased LH secretion	3
Sertoli cell dysfunction/reduced inhibin	3
Reduced inhibition of FSH secretion	2
Elevated LH and FSH result	2

(1.4) Serum progesterone rises moderately and then remains relatively constant during pregnancy (25 marks)

Point	Marks
Corpus luteum secretes progesterone in early pregnancy	4
hCG maintains corpus luteum	4
Progesterone levels rise during first trimester	4
Placenta becomes major source (luteo-placental shift)	5
Placenta continuously synthesizes progesterone	4
Sustained secretion maintains relatively constant high level	4

(2) Explain the physiological basis of the following observations.

(2.1) Damage to the right thalamus causes loss of sensation on the left side of the body and severe pain (25 marks)

Point	Marks
Thalamus is major sensory relay station	4
Somatosensory pathways relay through thalamus	4
Most sensory pathways cross to opposite side before thalamus	5
Right thalamus receives sensations from left side of body	4
Lesion interrupts sensory transmission	4
Contralateral sensory loss results	2
Abnormal thalamic activity may cause thalamic pain syndrome	2

(2.2) In conductive deafness, Weber's test lateralizes the sound to the affected ear. (25 marks)

Point	Marks
Tuning fork placed on forehead/vertex	3
Sound transmitted by bone conduction to both cochleae	4
Conductive deafness affects external/middle ear transmission	4
Environmental sounds are reduced in affected ear	5
Reduced masking effect occurs	4
Bone-conducted sound perceived louder in affected ear	3
Sound lateralizes to affected ear	2

(2.3) Bradykinesia in a patient with Parkinson's disease (25 marks)

Point	Marks
Degeneration of substantia nigra pars compacta	5
Reduced dopamine production	4
Reduced stimulation of direct pathway	4
Increased activity of indirect pathway	4

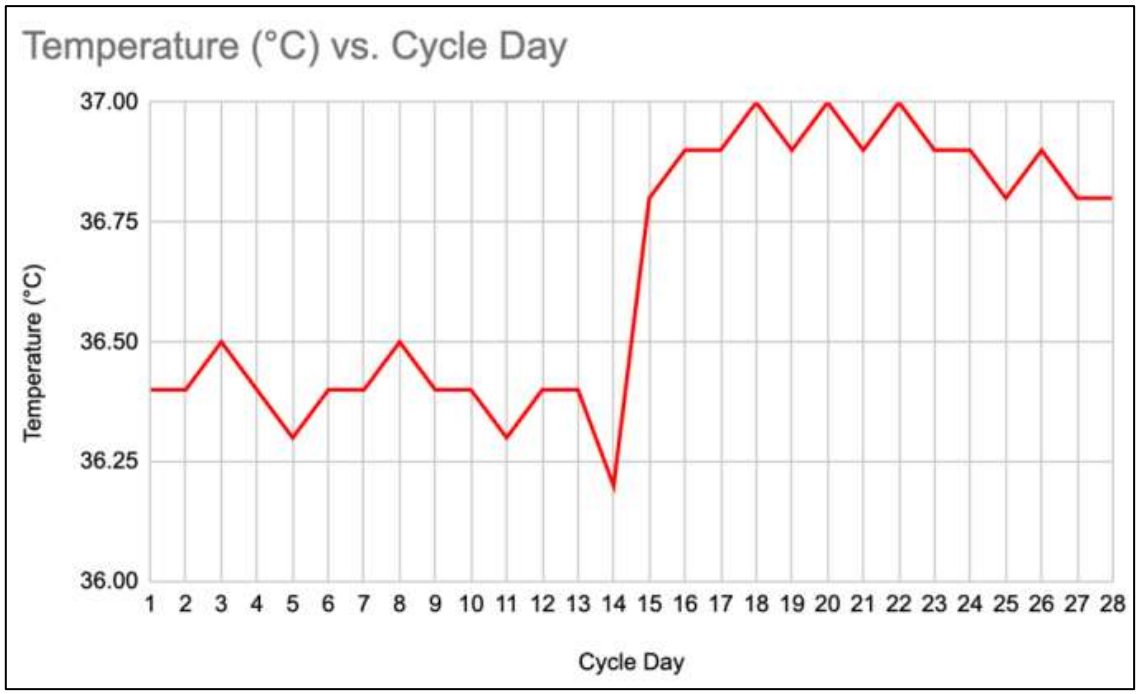
Point	Marks
Increased inhibitory output from basal ganglia	3
Reduced thalamic stimulation of motor cortex	3
Slow initiation and execution of movement (bradykinesia)	2

(2.4) When a person enters a dark room after being exposed to bright sunlight, vision remains impaired for approximately 20 minutes. (25 marks)

Point	Marks
Bright light causes bleaching of visual pigments	4
Rhodopsin in rods is extensively bleached	5
Rods responsible for dim-light vision	4
Rhodopsin must be regenerated	4
Regeneration requires retinal and opsin recombination	3
Rod sensitivity gradually increases (dark adaptation)	3
Full adaptation takes approximately 20–30 minutes	2

CAT-3 (BATCH 2) OSPE QUESTIONS

(1) Biphasic Basal Body Temperature (BBT) chart over a 28-day menstrual cycle

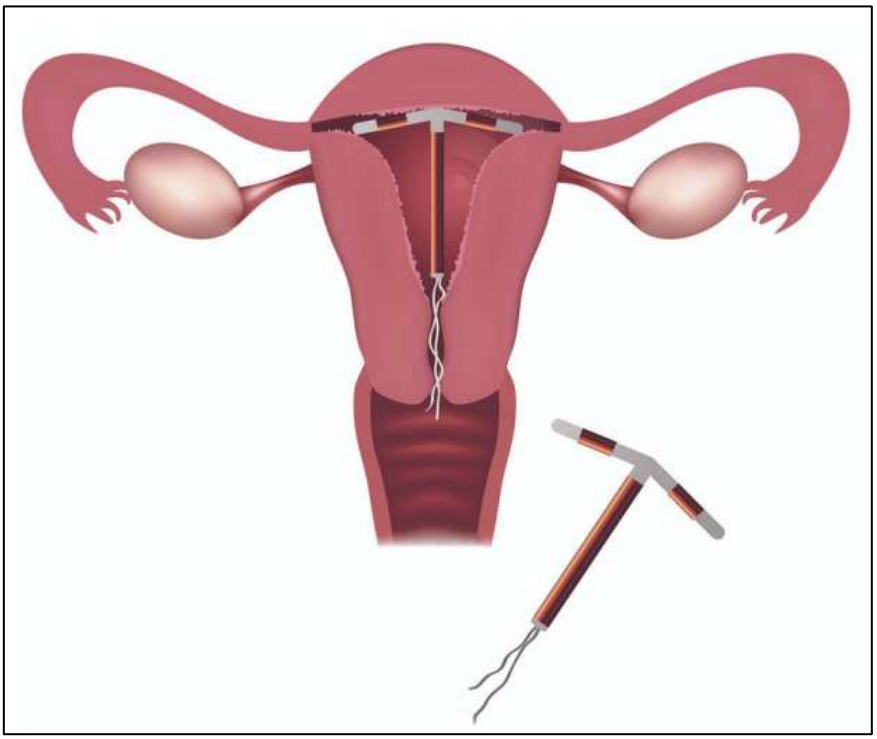


(1.1) What is the phase of the ovarian cycle when body temperature is high? (4 marks)

(1.2) Which hormone causes this rise in body temperature? (3 marks)

(1.3) Which structure in the ovary produces this hormone? (3 marks)

(2) A contraceptive device

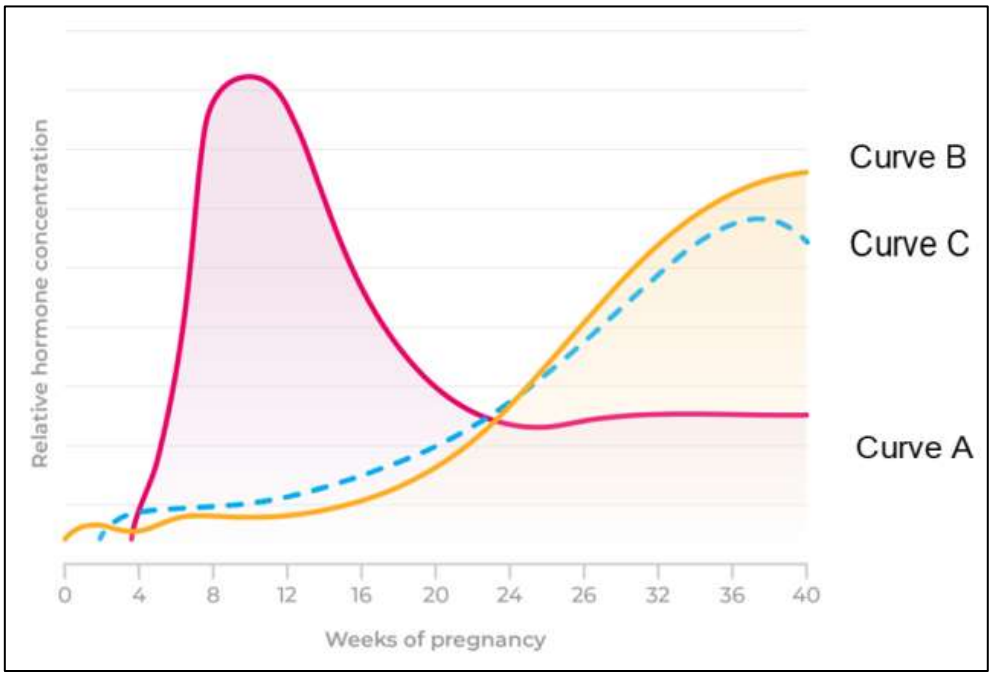


(2.1) Identify the contraceptive device shown above. (3 marks)

(2.2) State the primary mechanism by which this device prevents pregnancy.

(2.3) Mention one (01) common side effects a patient might experience in the first few months after insertion. (3 marks)

(3) Hormonal changes during pregnancy



A graph shows the relative concentrations of three hormones across weeks of pregnancy.

(3.1) Identify the hormones represented by curves A, B, and C. (3 marks)

(3.2) State two (02) physiological roles of the hormone represented by curve A. (4 marks)

(3.3) Mention two (02) effects of high levels of the hormone represented by curve B towards the 40 weeks. (3 marks)

(4) Semen analysis report

Parameter	Result	Unit	Normal Values
Sperm Count	2.2	million/ml	≥ 20
Slow Motility	20%	%	10-20
Non-Motile	80%	%	<60
Morphology (Normal)	50%	%	≥ 60

(4.1) State two (02) advises you would give the patient to follow after collecting the seminal fluid sample. (4 marks)

(4.2) Identify two (02) abnormal findings in this report. (4 marks)

(4.3) Name two (02) possible causes for the abnormalities mentioned. (2 marks)

(5) Renal Functions Tests

A



B



C



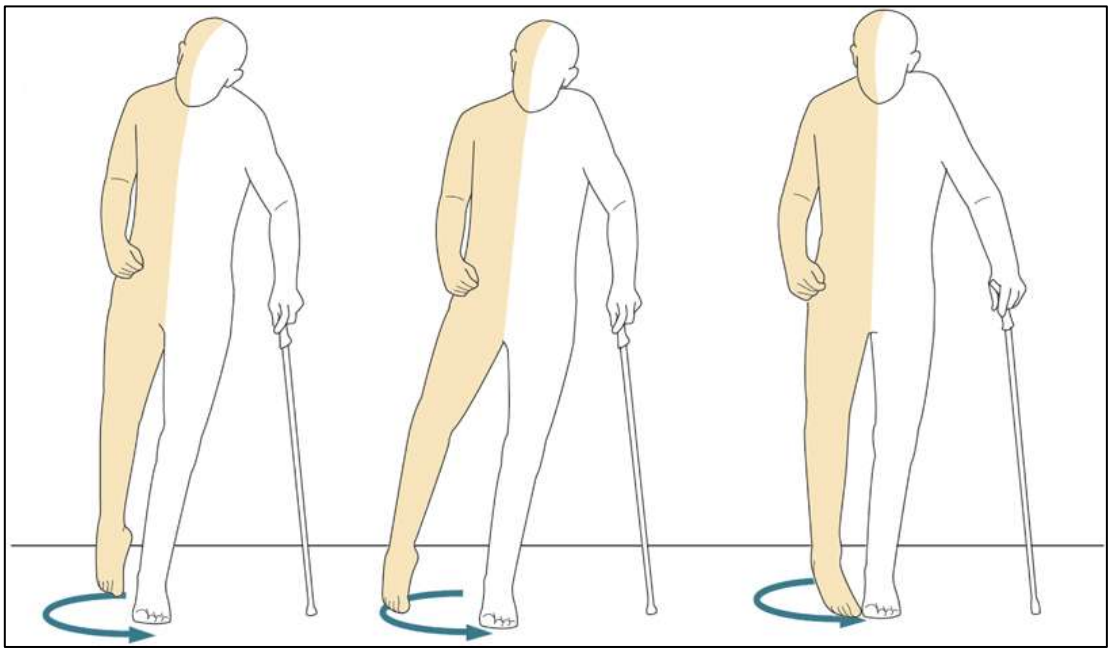
D



Match each test with the most appropriate clinical indication from the list given. (10 marks)

Indications	Test
(5.1) Accurate measurement of glomerular filtration rate	.....
(5.2) Estimation of glomerular filtration rate in clinical practice	.....
(5.3) Detects microalbuminuria in early diabetic nephropathy	.....
(5.4) Screening for proteinuria and glycosuria	.....

(6) A patient with difficulty in walking,

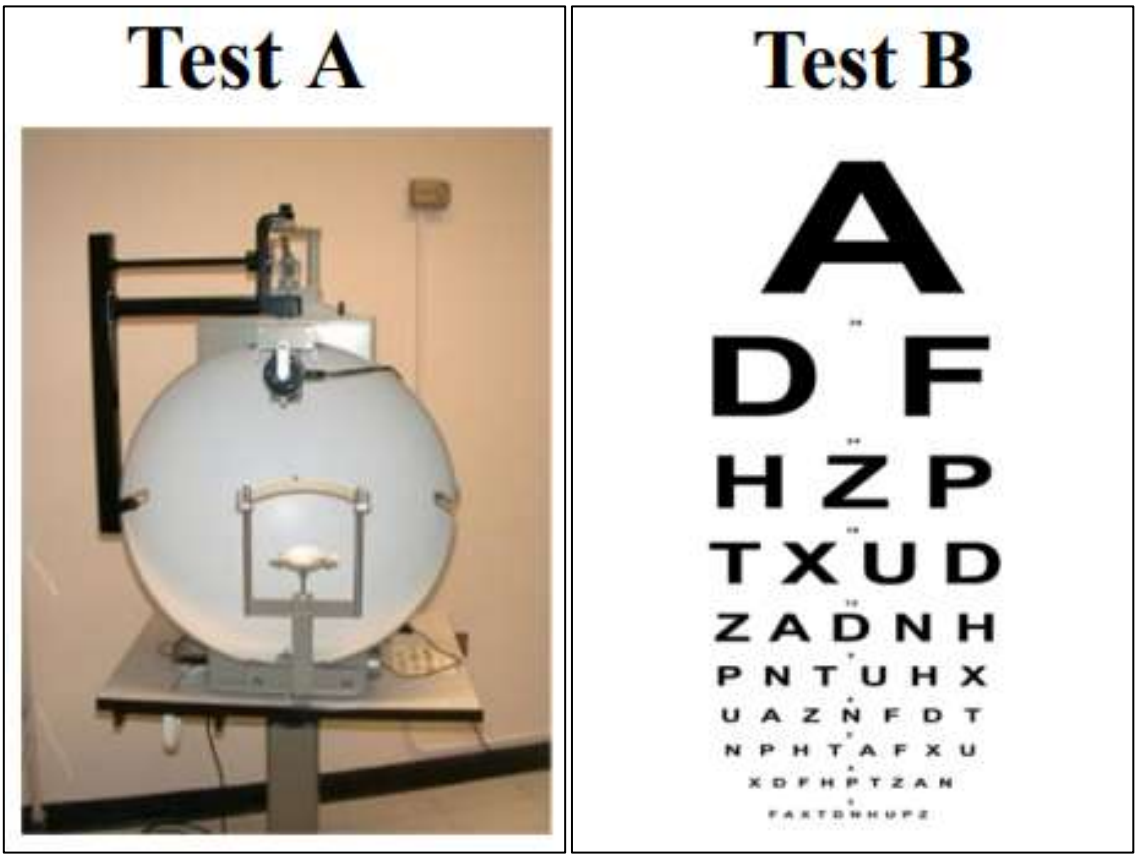


(6.1) What is the abnormality in his gait? (5 marks)

(6.2) What is the most likely cause for it? (3 marks)

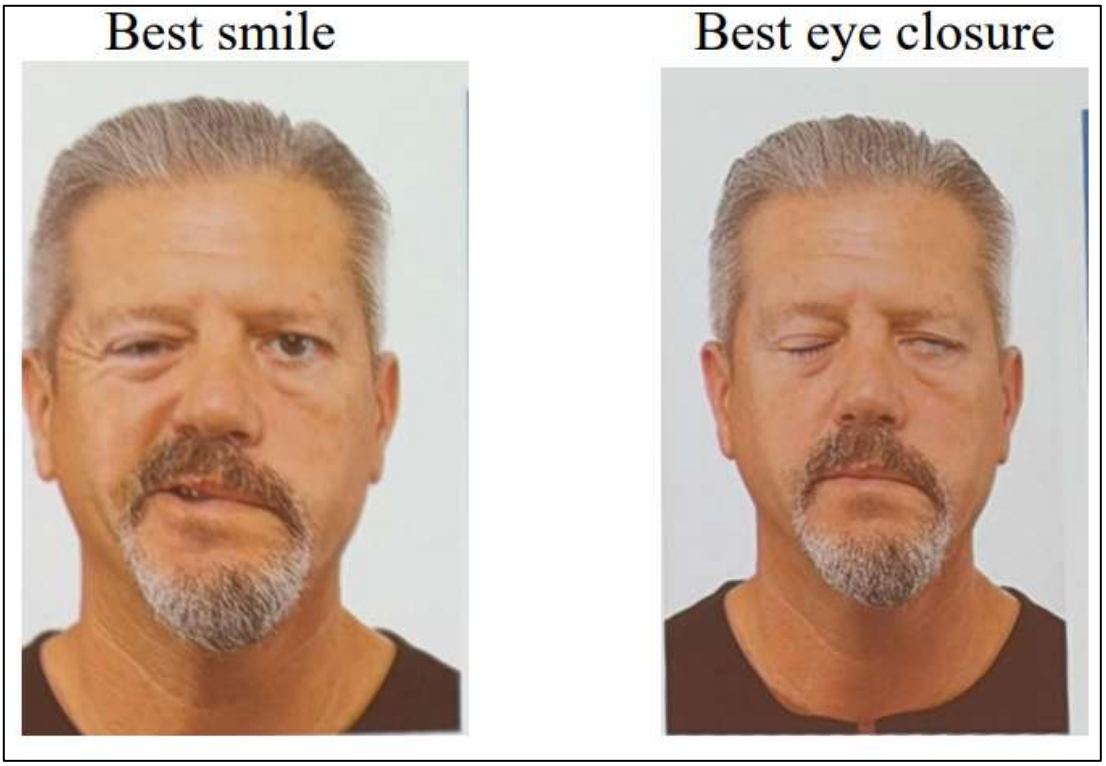
(6.3) Name one (01) radiological investigation to confirm the underlying cause. (2 marks)

(7) Visual tests



(7.1) Name the instrument shown in test A (2 marks)
(7.2) State the visual function tested using this instrument (3 marks)
(7.3) Identify the chart shown in test B. (2 marks)
(7.4) What is the distance from which this chart (test B) should be read? (3 mark)

(8) A patient with a physical sign



(8.1) List two (02) abnormalities you observed (4 marks)
(8.2) What is the complete neurological diagnosis? (3 marks)
(8.3) Name two (02) possible causes for this condition (3 marks)

(9) Nerve conduction study

Nerve	Left Foot	Right Foot	Normal Range
Sural sensory response	Absent	Absent	Present
Common peroneal motor study			
Distal latency	8.5 ms	8.7 ms	3.5 – 5.5 ms
Conduction velocity	27 m/s	28 m/s	40 – 45 m/s
Amplitude	2.7 mV	2.7 mV	2.5 – 3.5 mV

A 50-year-old non-diabetic male presents with bilateral foot numbness for one year. Nerve conduction studies are performed, and the results are shown above

(9.1) Identify two (02) abnormal findings in this report. (4 marks)
(9.2) What is the most likely nerve pathology? (4 marks)
(9.3) Name one (01) clinical condition that causes this type of nerve conduction abnormality. (2 marks)

(10) Cranial nerve examination



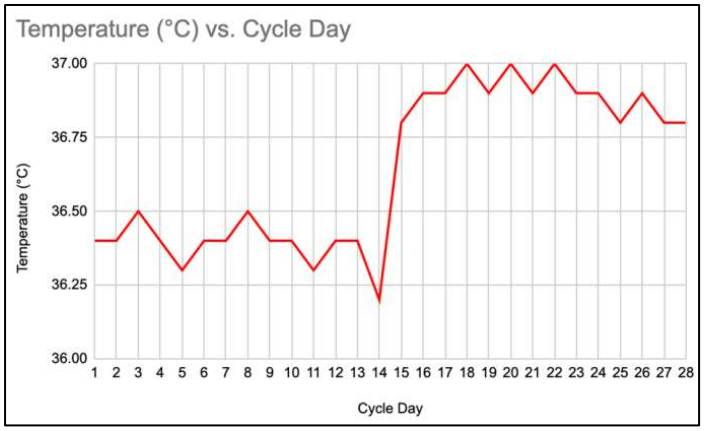
The above examination techniques were performed during a cranial nerve examination

(10.1) Identify test A and test B (6 marks)

(10.2) What cranial nerve is being tested? (04 marks)

CAT-3 (BATCH 2) OSPE ANSWERS

(1)

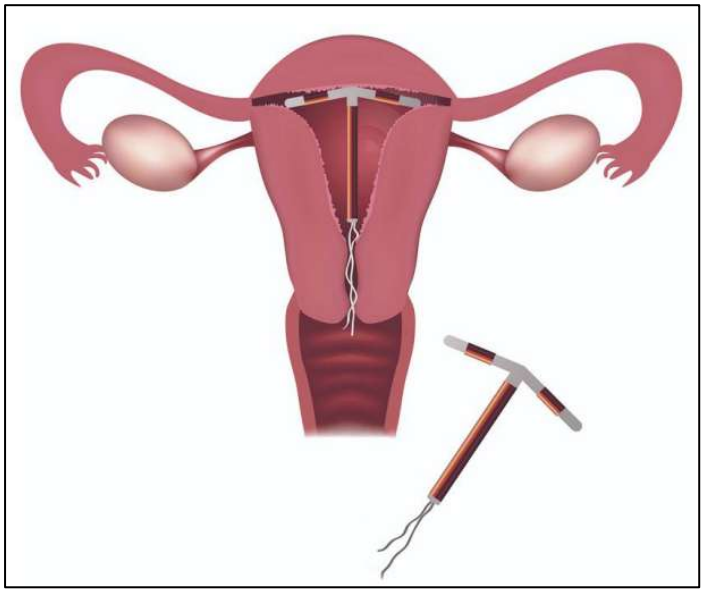


(1.1) Luteal phase (post-ovulatory phase).

(1.2) Progesterone

(1.3) Corpus luteum

(2)



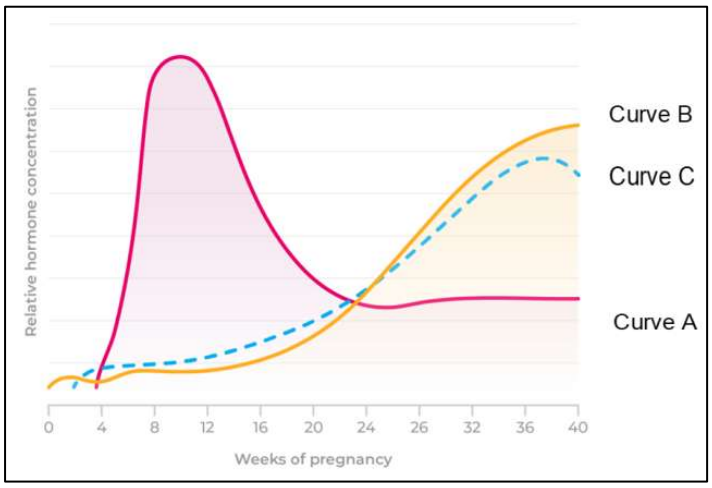
(2.1) Copper-T intrauterine contraceptive device (IUCD)

(2.2) Copper ions released from the IUCD produce a local inflammatory reaction within the uterus.
This impairs sperm motility and viability, thereby preventing fertilization.

(2.3) Any one:

- Increased menstrual bleeding
- Dysmenorrhoea
- Irregular spotting
- Lower abdominal discomfort

(3)



(3.1) A – Human chorionic gonadotropin (hCG)
B – Progesterone
C – Oestrogen

(3.2) Maintains the corpus luteum during early pregnancy.
Stimulates progesterone secretion by the corpus luteum.

(3.3) Maintains uterine quiescence by reducing uterine contractions.
Promotes development of mammary glands.

(4)

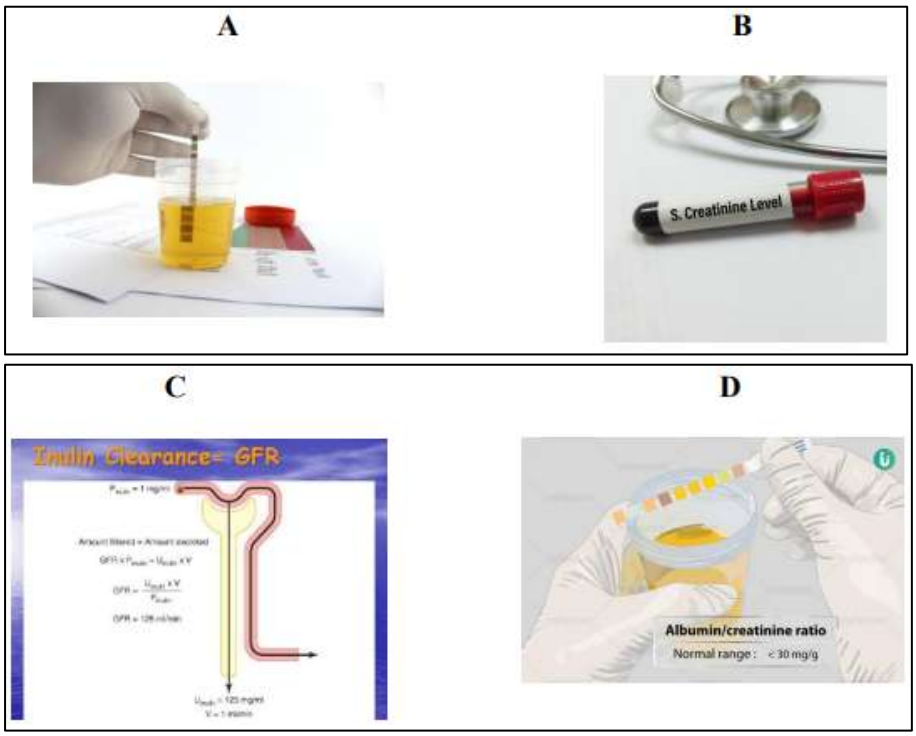
Parameter	Result	Unit	Normal Values
Sperm Count	2.2	million/ml	≥ 20
Slow Motility	20%	%	10-20
Non-Motile	80%	%	<60
Morphology (Normal)	50%	%	≥ 60

(4.1) Deliver the sample to the laboratory within one hour.
Keep the sample close to body temperature during transport.

(4.2) Low sperm count (2.2 million/ml) – Oligozoospermia.
High percentage of non-motile sperm (80%) – Reduced motility.
(Also acceptable: abnormal morphology.)

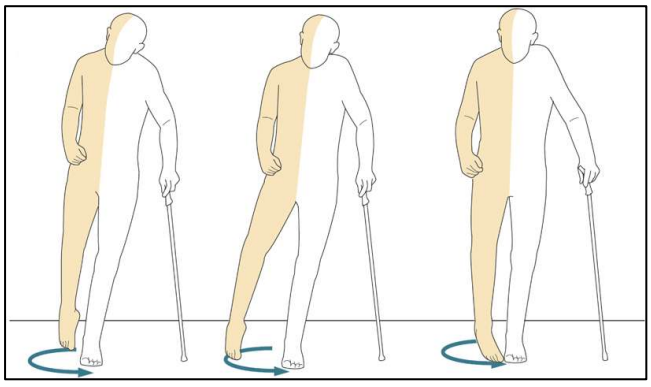
(4.3) Any two:
Varicocele
Testicular failure
Mumps orchitis
Hormonal deficiency
Undescended testes

(5)



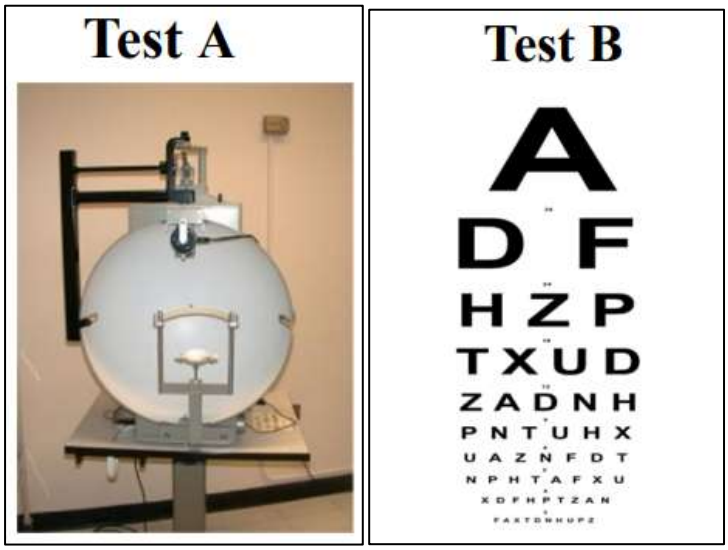
(5.1) C – Inulin clearance
(5.2) B – Serum creatinine
(5.3) D – Urine albumin/creatinine ratio
(5.4) A – Urine dipstick test

(6)



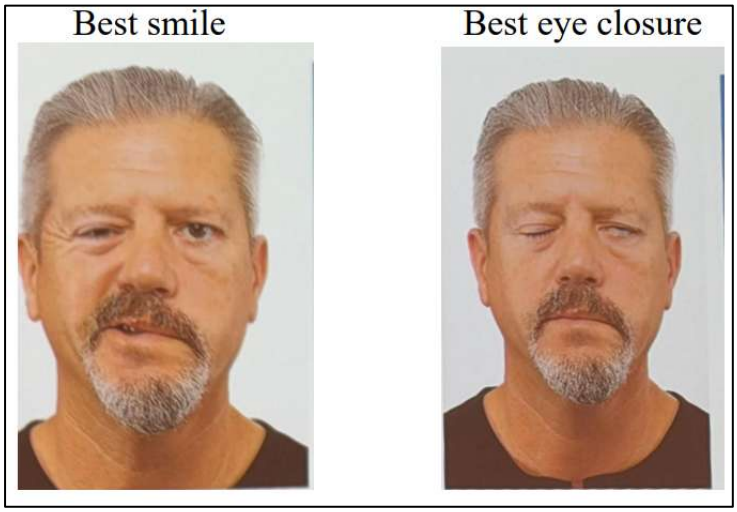
(6.1) Circumduction Gait
(6.2) Stroke/Tumor/Traumatic Brain Injury
(6.3) MRI brain/CT Brain

(7)



(7.1) Perimeter
(7.2) Visual fields
(7.3) Snellen chart
(7.4) 6 metres (20 feet)

(8)



(8.1) Deviation of angle of mouth to one side.
Inability to completely close one eye.
(8.2) Lower motor neuron facial nerve palsy (Bell's palsy)
(8.3) Bell's palsy (idiopathic facial nerve palsy)
Facial nerve compression/infection
Other acceptable answers:

- Herpes simplex infection
- Parotid tumour
- Temporal bone injury

(9)

Nerve	Left Foot	Right Foot	Normal Range
Sural sensory response	Absent	Absent	Present
Common peroneal motor study			
Distal latency	8.5 ms	8.7 ms	3.5 – 5.5 ms
Conduction velocity	27 m/s	28 m/s	40 – 45 m/s
Amplitude	2.7 mV	2.7 mV	2.5 – 3.5 mV

(9.1) Absent sural sensory responses bilaterally.
Reduced conduction velocity with prolonged distal latency.

(9.2) Demyelinating peripheral neuropathy

(9.3) Any one:

- Chronic inflammatory demyelinating polyneuropathy (CIDP)
- Guillain–Barré syndrome
- Hereditary demyelinating neuropathy

(10)



(10.1) Test A – Shoulder shrug against resistance
Test B – Head turning against resistance

(10.2) Accessory nerve (Cranial Nerve XI)

2nd MBBS PAPERS

2022/2023 (1st Batch)
2nd MBBS
Papers & Answers

2nd MBBS (BATCH 1) MCQ PAPER

Questions numbers 01 to 30 are True or False type questions. Mark your answer for each of the 5 responses (A to E).

(1) True or false regarding positive and negative feedback mechanisms operating in the body?

(A) Gastric acid secretion is regulated by a negative feedback mechanism.
(B) Negative feedback mechanisms disrupt homeostasis.
(C) Positive feedback loops operate during blood clotting.
(D) Positive feedback mechanisms amplify the output signal.
(E) Positive feedback occurs more frequently than negative feedback in the body.

(2) True or false regarding the cell communication and transport?

(A) Gap junctions help to transport molecules between adjacent cells.
(B) Intracellular Ca^{2+} acts as a second messenger.
(C) Lipid-soluble messengers act on plasma membrane receptors.
(D) Molecules move across the cell membrane according to the concentration gradient in facilitated diffusion.
(E) Paracrine communication by chemical messengers affects neighboring cells.

(3) True or false regarding the resting membrane potential of a nerve?

(A) Intracellular proteins contribute to the negativity in the inner side of the membrane.
(B) It is maintained by voltage-gated calcium channels.
(C) K^+ efflux is the main factor contributing to the negativity inside the membrane.
(D) Membrane is more permeable to Na^+ than to K^+ at rest.
(E) Sodium-potassium pump generates more positivity in the inner side of the membrane.

(4) True or False regarding neurotransmitters?

(A) Endocannabinoids are secreted from the postsynaptic membrane.
(B) Glutamate is the most abundant excitatory neurotransmitter in the brain.
(C) Glycine is an excitatory neurotransmitter in the spinal cord.
(D) Increased GABA activity causes sedation.
(E) Nicotinic acetylcholine receptors are present in the parasympathetic effector organs.

(5) Which of the following combinations are correctly matched?

(A) Basophils - release of inflammatory mediators
(B) Dendritic cells - antigen presentation to T cell
(C) Eosinophils - act against parasites
(D) Helper T cells - activate humoral immunity
(E) Neutrophil - conversion to tissue macrophages

(6) Which of the following red cell abnormalities are correctly matched with the given clinical conditions?

(A) Bite cells - G6PD deficiency
(B) RBC agglutination - Cold type auto immune hemolytic anemia
(C) Rouleaux formation - Multiple myeloma
(D) Target cell - Thalassemia
(E) Tear drop cell - Post splenectomy

(7) True or False regarding fluid movement and its clinical relevance?

(A) Decreased capillary oncotic pressure contributes to oedema in chronic liver disease.
(B) Increased capillary hydrostatic pressure at the arterial end is a cause of oedema in nephrotic syndrome.
(C) Increased capillary hydrostatic pressure at the venular end is a cause of oedema in heart failure.
(D) Increased capillary permeability causes leakage of fluid into tissues in acute inflammation.
(E) Increased capillary permeability causes leakage of fluid into tissues in anaphylaxis.

(8) True or false regarding platelets?

(A) Majority of platelets are stored in the liver in healthy individuals.
(B) Platelet aggregation is promoted by von Willebrand factor.
(C) Platelet synthesis is regulated by thrombopoietin.
(D) Platelets are a major source of circulating prostacyclin.
(E) Platelets secrete a growth factor that promotes vascular repair.

(9) True or false regarding the immune system?

(A) Acquired immunity has immune memory.
(B) Activated complements of complement system function as opsonins.
(C) Booster doses of vaccines increase the specific IgG levels.
(D) Cytotoxic T cells destroy virus-infected cells.
(E) IgM mediates type 1 hypersensitivity reactions.

(10) Which of the following are correctly matched?

(A) Activated protein C - inactivation of clotting factor V
(B) Antithrombin III - inactivation of the extrinsic pathway of clotting
(C) Thrombin - activation of protein C
(D) Thromboxane A2 - vasodilation
(E) Tissue plasminogen activator - stabilizes fibrin clot

(11) True or false regarding transfusion of blood components?

(A) Before red cell transfusions, compatibility testing is done using patient's red cells and donor plasma.
(B) Cryoprecipitate is used to treat Factor VIII deficiency in a Hemophilia A patient.
(C) During transfusions of blood components, patients should be monitored for acute transfusion reactions.
(D) Fresh Frozen Plasma (FFP) does not contain clotting factors.
(E) Platelet transfusions are not indicated in patients with massive bleeding.

(12) True or false regarding electrical properties of cardiac muscle?

(A) Final repolarization is due to activation of sodium-potassium pumps.
(B) In hyperkalemia, resting membrane potential becomes less negative.
(C) Initial rapid depolarization and overshoot takes about 2 milliseconds.
(D) Plateau phase is due to closure of Na^+ channels.
(E) The resting membrane potential is about -70 mV.

(13) True or false regarding the cardiac cycle?

(A) In the jugular venous pulse (JVP), the c wave corresponds to right ventricular contraction.
(B) The first heart sound (S1) is due to closure of the mitral and tricuspid valves.
(C) The fourth heart sound (S4) is an early diastolic sound.
(D) The second heart sound (S2) is due to closure of the aortic and pulmonary valves.
(E) The third heart sound (S3) is due to rapid ventricular filling.

(14) Which of the following occur when a person stands up from lying down position?

(A) Increased baroreceptor discharge.
(B) Increased sympathetic discharge to heart.
(C) Reduction in stroke volume.
(D) Reduction of baroreceptor stretching.
(E) Reduction of venous return.

(15) True or false regarding the normal ECG wave pattern?

(A) P wave reflects atrial repolarization.
(B) PR interval reflects conduction through the AV node.
(C) ST segment can get abnormal in myocardial infarction.
(D) The J point is the junction between the termination of the QRS complex and the beginning of the ST segment.
(E) The T wave represents ventricular repolarization.

(16) True or false regarding cardiac function and heart failure?

(A) According to Frank-Starling law of the heart, higher the end-diastolic volume, lower the force of contraction.
(B) Afterload refers to the amount of resistance against which the heart muscle pumps when ejecting blood.
(C) Heart rate is not a determinant of cardiac output.
(D) In heart failure, the ejection fraction is always less than 50%.
(E) Pulmonary oedema is a cardinal feature of right heart failure.

(17) True or false regarding fetal circulation?

(A) Blood in the pulmonary artery is diverted to aorta through ductus venosus.
(B) Most of the blood entering the right atrium through inferior vena cava is diverted to left atrium via foramen ovale.
(C) Most of the blood entering the right atrium through superior vena cava enters right ventricle.
(D) Pulmonary arterial pressure is higher than aortic pressure.
(E) Umbilical venous blood is 100% saturated with oxygen.

(18) True or false regarding changes that occur in voluntary hyperventilation?

(A) Arterial $HCO3^-$ concentration becomes high.
(B) Arterial pH becomes low.
(C) $PaCO2$ becomes low.
(D) $PaO2$ becomes high.
(E) Renal H^+ secretion becomes high.

(19) Which of the following lung volumes/capacities can be measured with a spirometer?

(A) Functional Residual Capacity (FRC).
(B) Inspiratory Reserve Volume (IRV).
(C) Residual Volume (RV).
(D) Total Lung Capacity (TLC).
(E) Vital Capacity (VC).

(20) True or false regarding swallowing?

(A) Contraction of the posterior cricoarytenoid muscles decreases chances of food entering the lower respiratory tract.
(B) Destruction of the neurons in the myenteric plexus at lower end of the oesophagus results in achalasia.
(C) It is initiated by the voluntary movement of the food bolus to the back of the oral cavity.
(D) Paralysis of the soft palate results in difficulty in swallowing.
(E) Primary peristalsis of oesophagus is initiated by contraction of the cricopharyngeus muscle.

(21) Which of the following structures and their functions are correctly paired?

(A) Duodenum - absorption of vitamin B12
(B) Jejunum - absorption of glucose
(C) Rectum - storage of feces
(D) Sigmoid colon - absorption of water
(E) Terminal ileum - reabsorption of bile salts

(22) True or false regarding physiology of the colon?

(A) Mass action contractions are small localized contractions of the colon.
(B) Movements of the colon are independent of the basal electrical rhythm (BER).
(C) Segmentation contractions of the colon mixes the contents without net propulsion.
(D) The gastroileal reflex decreases passage of chyme through the ileocecal valve.
(E) The ileocecal valve prevents reflux of colonic contents into the ileum.

(23) Which of the following are functions of the kidney?

(A) Conversion of angiotensin I to angiotensin II.
(B) Conversion of cholecalciferol to 25 hydroxy cholecalciferol.
(C) H^+ excretion.
(D) Long term regulation of blood pressure.
(E) Water conservation.

(24) Which of following components of urinalysis are correctly matched with its clinical significance?

(A) Glucose - Suggests tubular dysfunction or hyperglycemia
(B) Ketone bodies - Prolonged starvation
(C) Protein - Indicates glomerular leakage
(D) Red cell casts - Indicate tubular pathology
(E) Specific Gravity - Measures concentrating ability of the kidneys

(25) True or false regarding the physiology of vision?

(A) Accommodation convergence reflex involves relaxation of ciliary muscles.
(B) Astigmatism is corrected by using biconvex lenses.
(C) Initial quick phase in dark adaptation is due to adaptation of cones.
(D) Origin of the optic nerve corresponds to the site of the macula.
(E) Phototransduction is due to photo receptor membrane hyperpolarization.

(26) True or false regarding sleep and EEG?

(A) Beta waves are seen during stage 2 slow wave sleep.
(B) Body movements are decreased during slow wave sleep.
(C) Dreams are generally seen during REM sleep.
(D) Exposure to bright light inhibits melatonin production.
(E) Sleep spindles are seen in stage 2 REM sleep.

(27) True or false regarding blood brain barrier and CSF?

(A) Area postrema is located outside the blood brain barrier.
(B) Blood-brain barrier is formed by tight junctions between endothelial cells of the cerebral capillaries.
(C) CSF glucose is equal to blood glucose levels.
(D) CSF has significantly lower protein content than that of plasma.
(E) Highly lipid-soluble drugs cross blood brain barrier relatively easily.

(28) True or false regarding erection and ejaculation?

(A) Efferent pathway for erection is the hypogastric nerve.
(B) Ejaculation is mediated by the lumbar segments of the spinal cord.
(C) Erection is initiated by the dilatation of the arterioles of the penis.
(D) Erection is mediated predominantly by the sympathetic nervous system.
(E) The main neurotransmitter in ejaculation is Nitric oxide (NO).

(29) True or false regarding hypothalamic regulation of the pituitary gland?

(A) Dopamine acts as a stimulatory factor for prolactin secretion.
(B) Growth hormone–releasing hormone (GHRH) is released in a pulsatile manner.
(C) Hypothalamic releasing hormones reach the anterior pituitary through the hypothalamo-hypophyseal portal circulation.
(D) Pituitary stalk damage results in inhibition of secretion of all the anterior pituitary hormones.
(E) Somatostatin inhibits secretion of both growth hormone and TSH.

(30) True or false regarding metabolism of thyroid hormones?

(A) Deiodinase enzymes convert T4 to T3 in peripheral tissues.
(B) Free T4 has a shorter half-life than free T3.
(C) More than 99% of circulating thyroid hormone is protein-bound.
(D) Reverse T3 (rT3) is metabolically active.
(E) Thyroxine-binding globulin (TBG) has a higher affinity for T4 than T3.

Questions numbers 31 to 60 are Single Best Response (SBR) type. Select the best response to each question.

(31) A 16-year-old boy was admitted following a collapse after a marathon run. He has been drinking a lot of plain water throughout the run to avoid getting dehydrated. On examination, he is drowsy, BP 88/60 mmHg, pulse 110/min with dry mucous membranes.
Laboratory results show:

- **Serum Na^+ : 120 mmol/L**
- **Plasma osmolality : 265 mOsm/kg (275 – 295 mOsm/kg)**
- **Urine osmolality : 600 mOsm/kg (50 – 1200 mOsm/kg)**

Which of the following best describes his condition?

(A) Hypertonic dehydration due to predominant water loss
(B) Hypotonic dehydration due to predominant sodium loss
(C) Isotonic dehydration due to equal loss of water and sodium
(D) Nephrogenic diabetes insipidus
(E) SIADH due to inappropriate ADH secretion

(32) A 28-year-old female presents with severe diarrhoea and vomiting for three days. She complains of muscle weakness and cramps. Her laboratory results show a serum potassium concentration of 2.5 mEq/L.

Which of the following best explains the effect of this electrolyte abnormality on her nerve and muscle function?

(A) The membrane potential becomes less negative, leading to an increased number of open voltage-gated sodium channels.
(B) The membrane potential becomes less negative, which causes a sustained contraction of muscle cells.
(C) The membrane potential becomes more negative, moving it further away from the threshold.
(D) The membrane potential remains unchanged, but the potassium channels become less efficient, impairing repolarization.
(E) The sodium-potassium pump is inhibited, leading to a net gain of positive ions inside the cell.

(33) A patient with chest pain is treated with low-dose aspirin to reduce the risk of ischemic heart disease.

Which action of aspirin is most beneficial in this patient?

(A) Elevation of gastric acid secretion
(B) Lowering temperature set point
(C) Reduction of inflammatory response
(D) Reduction of synthesis of prostacyclin
(E) Reduction of synthesis of thromboxane A2

(34) The following investigation results are from an adult male with a bleeding tendency.

- **Haemoglobin concentration : 11.8 g/dL (13.5-16 g/dL)**
- **Bone marrow examination : Normal**
- **Platelet count : 300,000/µL (150000-450000/µL)**
- **Prothrombin time/INR : 1.0 (0.8-1.2)**
- **Activated partial thromboplastin time : Prolonged**

Which of the following is the most likely cause for this?

(A) Chronic liver failure
(B) Haemophilia A
(C) Resection of the terminal ileum
(D) Scurvy
(E) von Willebrand disease

(35) After a baseline investigation of the clotting profile, heparin was administered to a patient to minimize the risk of thrombosis.

Which of the following investigations is not likely to be prolonged after heparin therapy?

(A) Activated partial thromboplastin time
(B) Bleeding time
(C) Prothrombin time/INR
(D) Thrombin time
(E) Whole blood clotting time

(36) Bradycardia occurs towards the end of Valsalva manoeuvre (after stopping the straining). What is the best physiological explanation for it?

(A) Baroreceptor resetting
(B) Dysfunction of the SA node
(C) Poor autonomic function
(D) Poor venous return due to high intrathoracic pressure
(E) Reflex bradycardia due to baroreceptor stimulation

(37) Heart rate increases due to alteration of activity of SA node in sympathetic stimulation. Which of the following is the most possible mechanism operating in the SA node?

(A) Closure of K^+ channels.
(B) Elevation of resting membrane potential.
(C) Increased steepness of prepotential.
(D) Lowering of the threshold.
(E) Making membrane of SA node more excitable.

(38) Perfusion to the subendocardial region of the left ventricle is lower during systole compared to diastole. What is the best explanation for this?

(A) Compression of blood vessels supplying this region during systole.
(B) Obstruction of the opening of the coronary arteries due to opening of the aortic valve.
(C) Poor venous drainage from the heart during systole.
(D) Rise in intrapericardial pressure during systole.
(E) Vasoconstriction due to sympathetic activity.

(39) Phosphate is considered a significant buffer in the distal tubule but not in the proximal tubule of the nephron.

What is the reason for it to be a significant buffer in the distal tubule?

(A) It is found in higher concentration at distal tubule.
(B) Optimum pH for phosphate buffer is found at distal tubule.
(C) Other buffers are saturated in the distal tubule.
(D) There are inhibitors to phosphate buffer in the proximal tubule
(E) There are no other buffers in the distal tubule.

(40) A 40-year-old woman presents with episodic headache, sweating, and palpitations. From time to time, her blood pressure readings were high, reaching up to 180/110 mmHg, while sometimes readings were normal.

Which of the following best explains her paroxysmal hypertension?

(A) Continuous high renin secretion from a renal tumour.
(B) Excess aldosterone secretion from an adrenal tumour.
(C) High deoxycortisol secretion from an adrenal cortical tumour.
(D) Increased cortisol release from an adrenal cortical tumour.
(E) Intermittent release of catecholamines from an adrenal medullary tumour.

(41) A 35-year-old male presents with progressive weakness, starting in his eyes, causing ptosis (drooping of eyelids) and double vision. The weakness is worse at the end of the day and after exercise. He has difficulty in chewing and swallowing. A diagnosis of myasthenia gravis is suspected.

What is the most likely mechanism responsible for the development of this condition?

(A) Abnormality in the presynaptic acetylcholine synthesis.
(B) Antibodies forming against postsynaptic acetylcholine receptors.
(C) Antibody-mediated demyelination of motor nerve axons.
(D) Damage of motor neurons in the spinal cord.
(E) Disruption of calcium channels, impairing acetylcholine release.

(42) A 45-year-old female presents to a neurology clinic. She frequently burns her fingers while cooking but does not feel the heat, and she has several old, painless cuts on her arms. Physical examination reveals a loss of pain and temperature sensation over the shoulders and upper arms, but her sensation to vibration and proprioception remain intact.

Which of the following is the most likely pathological process causing this patient's sensory deficit?

(A) Brainstem lesion.
(B) Compression of the crossing fibers of the lateral spinothalamic tract.
(C) Damage to the dorsal columns.
(D) Destruction of the nerve roots as they exit the spinal cord.
(E) Lesion in the thalamus.

(43) A 65-year-old patient presented with visual impairment. On examination, he has right homonymous hemianopia.

What is the most likely site of visual defect?

(A) Left optic nerve
(B) Left optic tract
(C) Optic chiasm
(D) Right occipital lobe
(E) Right optic radiation

(44) A 22-year-old male presents with features suggestive of narcolepsy. The pathophysiology of this condition is closely linked to a deficiency of a neurotransmitter.

What is the most likely neurotransmitter responsible for this condition?

(A) Acetylcholine
(B) Dopamine
(C) GABA
(D) Orexin
(E) Serotonin

(45) A 50-year-old patient develops significant cerebral oedema following a large ischemic stroke.

According to the Monro-Kellie doctrine, what compensatory mechanism is initially activated to maintain a stable intracranial pressure (ICP)?

(A) Displacement of CSF from the cranial cavity into the spinal canal.
(B) Increased production of cerebrospinal fluid (CSF).
(C) Reduced cerebral blood flow.
(D) Tight junctions become leaky.
(E) Vasodilation of cerebral blood vessels.

(46) A 28-year-old man is brought to the emergency department following a stab injury to the chest. His clinical features are consistent with obstructive shock due to tension pneumothorax.

Which of the following best describes the main physiological change that leads to the development of shock in this patient?

(A) Decreased left ventricular filling due to increased tension in the pericardial sac.
(B) Decreased myocardial contractility due to direct cardiac compression.
(C) Increased preload leading to reduced cardiac output.
(D) Increased systemic vascular resistance due to sympathetic activation.
(E) Reduced venous return to the right atrium due to kinking of great veins.

(47) A 45-year-old man suffers a spinal cord injury at the level of T12. Several weeks later, he develops urinary incontinence. Examination shows that the bladder empties automatically when filled to a certain volume, without voluntary control.

Which of the following best explains the physiological basis of this condition?

(A) Damage to the parasympathetic efferents.
(B) Increased sensitivity of the pontine micturition center.
(C) Loss of cerebral cortical inhibition leading to automatic micturition reflex.
(D) Loss of sympathetic supply to the bladder.
(E) Overactivity of the pudendal nerve.

(48) Using different substances GFR, renal blood flow, renal plasma flow etc can be measured. Which of the following substance, can be used to measure the GFR most accurately?

(A) Creatinine
(B) Inulin
(C) Para-aminohippurate (PAH)
(D) Sodium
(E) Urea

(49) A 35-year-old man undergoes surgery for a pituitary adenoma. Postoperatively, he passes about 8 L of dilute urine per day and subsequently develops hypernatremia with a serum Sodium of 156 mmol/L.

What is the most likely explanation for the given clinical scenario?

(A) Development of resistance of the nephron to action of ADH.
(B) Excessive release of pre-formed ADH following the surgery.
(C) Increased ANP secretion due to stress response.
(D) Loss of ADH secretion due to posterior pituitary damage.
(E) Osmotic diuresis due to hyperglycemia.

(50) A 40-year-old male presents with polyuria and polydipsia for 1 month. He is obese and has acanthosis nigricans. His fasting blood glucose is markedly elevated.

Which of the following best explains the primary hormonal abnormality?

(A) Absolute deficiency of glucagon
(B) Absolute deficiency of insulin
(C) Excessive secretion of somatostatin
(D) Resistance to glucagon action
(E) Resistance to insulin action

(51) A 40-year-old smoker with family history of asthma presents with shortness of breath. On examination widespread wheezing is identified. His vital parameters are stable. He is started on inhalers.

Which of the following test would be helpful to diagnose whether his symptoms and signs are due to asthma or COPD?

(A) Arterial blood gas.
(B) Daily saturation monitoring with pulse oximeter.
(C) Spirometry with bronchodilator reversibility test.
(D) Spirometry with DLCO test.
(E) Three readings of peak expiratory flow rate.

(52) A 65-year-old man presents with tremor in his right hand, stiffness in his limbs, and difficulty initiating walking. On examination, he has a resting tremor, cogwheel rigidity, and bradykinesia.

Which of the following is the most likely underlying neurochemical abnormality in this condition?

(A) Decreased dopamine in the substantia nigra.
(B) Decreased serotonin in the basal ganglia.
(C) Increased acetylcholine in the cerebral cortex.
(D) Increased GABA in the striatum.
(E) Increased noradrenaline in the hypothalamus.

(53) A 48-year-old man presents with weakness of his right arm and leg following a stroke. One month later on his clinic visit the following clinical findings were identified: increased tone in the affected limbs, exaggerated deep tendon reflexes, and an extensor plantar response. Fasciculations are absent.

Which of the following is the most likely diagnosis?

(A) Lower motor neuron lesion
(B) Myopathy
(C) Neuromuscular junction disorder
(D) Peripheral neuropathy
(E) Upper motor neuron lesion

(54) Pain in some areas of the body can be partially relieved by gently rubbing the skin over the affected area.

Which of the following best explains this phenomenon?

(A) All-or-none phenomenon
(B) Convergence-projection theory
(C) Dermatomal rule
(D) Gate control theory
(E) Slowly adapting receptors

(55) A 9-year-old girl is brought to the clinic by her mother who is concerned that her daughter is going to attain puberty.

Which of the following represents the earliest sign of puberty in this girl?

(A) Axillary hair development
(B) Breast budding (thelarche)
(C) Growth spurt
(D) Menarche
(E) Pubic hair development

(56) 56. A newborn male infant is noted to have ambiguous genitalia. Genetic testing reveals a 46, XY karyotype, and further evaluation shows absence of Müllerian structures.

Which of the following factors is primarily responsible for the regression of Müllerian ducts during sexual differentiation?

(A) Anti-Müllerian hormone (AMH)
(B) Dihydrotestosterone (DHT)
(C) Oestrogen
(D) Progesterone
(E) Testosterone

(57) A 30-year-old man undergoes surgical resection of the terminal ileum due to Crohn's disease.

Which of the following processes would be most impaired as a result of this surgery?

(A) Bile salt reabsorption
(B) Calcium absorption
(C) Glucose absorption
(D) Protein digestion
(E) Water absorption

(58) A 55-year-old man presents with difficulty in walking. On examination, he has a broad-based gait, positive Romberg test, and impaired vibration sensation in both lower limbs.

Which of the following is the most likely type of gait abnormality in this patient?

(A) Cerebellar ataxic gait
(B) Hemiplegic gait
(C) Parkinsonian gait
(D) Sensory ataxic gait
(E) Spastic paraplegic gait (scissoring gait)

(59) A premature infant develops severe respiratory distress shortly after birth. Chest X-ray shows ground-glass appearance, and the condition is attributed to deficiency of pulmonary surfactant.

Which of the following best describes the physiological role of surfactant in the alveoli?

(A) It decreases alveolar compliance by increasing surface tension.
(B) It enhances diffusion capacity of oxygen across alveolar membrane.
(C) It increases airway resistance by narrowing bronchioles.
(D) It Increases lung compliance by reducing alveolar surface tension.
(E) It promotes alveolar collapse during expiration.

(60) A 26-year-old woman at 39 weeks of gestation presents in active labour. Uterine contractions are strong and regular.

Which of the following hormones plays the most important role in stimulating uterine contractions during parturition?

(A) Human chorionic gonadotropin (hCG)
(B) Oestrogen
(C) Oxytocin
(D) Progesterone
(E) Prolactin

2nd MBBS (BATCH 1) MCQ PAPER ANSWERS

(1)	TFTTF	(31)	B
(1)	TTFTT	(32)	C
(2)	TFTFF	(33)	E
(3)	TTFTF	(34)	B
(4)	TTTTF	(35)	C
(5)	TTTTF	(36)	E
(6)	TFTTT	(37)	C
(7)	FTTFT	(38)	A
(8)	TTTTF	(39)	A
(9)	TFTFF	(40)	E
(10)	FTTFF	(41)	B
(11)	FTTFF	(42)	B
(12)	TTFTT	(43)	A
(13)	FTTTT	(44)	D
(14)	FTTTT	(45)	A
(15)	FTFFF	(46)	E
(16)	FTTTF	(47)	C
(17)	FFTTF	(48)	B
(18)	FTFFT	(49)	D
(19)	FTTTF	(50)	E
(20)	FTTTT	(51)	C
(21)	FFTFT	(52)	A
(22)	FFTTT	(53)	E
(23)	TTTFT	(54)	D
(24)	FFTFT	(55)	B
(25)	FTTTT	(56)	A
(26)	TTFTT	(57)	A
(27)	FTTFF	(58)	D
(28)	FTTFT	(59)	D
(29)	TFTFT	(60)	C

2nd MBBS (BATCH 1) STRUCTURED ESSAY (SEQ) PAPER

(1) Baroreceptors are specialized stretch- sensitive mechanoreceptors that play a crucial role in the regulation of the cardiovascular system.

(1.1) Name the location of two (02) baroreceptors which monitor arterial blood pressure. (10 marks)

(1.2) State the nerve supply to these two (02) baroreceptors. (10 marks)

(1.3) Explain how the baroreceptor reflex helps to regulate blood pressure during a sudden elevation of blood pressure. (40 marks)

(1.4) Briefly explain what happens to the baroreceptor reflex in the following situations:

(1.4.1) Hypovolaemic shock (10 marks)

(1.4.2) Carotid sinus massage (10 marks)

(1.4.3) Autonomic insufficiency (10 marks)

(1.4.4) Chronic hypertension (10 marks)

(2) A 52-year-old heavy alcohol user presented with jaundice and confusion. He had gross ascites, ankle oedema, and an enlarged spleen. He developed haematemesis (vomiting of blood) after admission to the ward.

His investigation results are given below.

Test	Test result	Reference range
Platelet count (per μL)	98,000	150,000 - 400,000
Total protein (g/dL)	5.5	6.3 - 7.9
Albumin (g/dL)	2.5	3.5 - 5.0
Serum bilirubin (mg/dL)	3.8	0.1 - 1.2
Direct bilirubin (mg/dL)	2.4	0.0 - 0.3
Prothrombin time (INR)	2.2	0.8 - 1.2
Aspartate aminotransferase (AST) (IU/L)	75	7 - 40
Alanine aminotransferase (ALT) (IU/L)	50	8 - 48
Gamma-glutamyl transferase (GGT) (IU/L)	100	5 - 40
Alkaline phosphatase (ALP) (IU/L)	140	40 - 129

(2.1) Outline the functions of platelets in haemostasis. (30 marks)

(2.2) Comment and give two reasons for his platelet count. (10 marks)

(2.3) Outline the clotting pathway with a labelled diagram in a healthy adult. (30 marks)

(2.4) Explain the reason for the prothrombin time INR observed in this patient. (30 marks)

(3) A 25-year-old mountaineer develops symptoms of shortness of breath, dizziness, and fatigue while climbing to 4,000 meters. During evaluation, different types of hypoxias are discussed.
  (3.1) Define hypoxia. (10 marks)
  (3.2) Name four (04) causes and three (03) respiratory compensatory changes of hypoxic hypoxia. (25 marks)
  (3.3) Explain the features and compensatory mechanisms of anaemic hypoxia. (20 marks)
  (3.4) Describe the pathophysiology and characteristic features of stagnant hypoxia. (20 marks)
  (3.5) Outline the mechanism and distinguishing features of histotoxic hypoxia. (25 marks)

(4) A 30-year-old woman presents with weight loss, palpitations, and protruding eyes for 3months. Examination reveals bilateral exophthalmos (protruding eyeballs) and diffuse thyroid enlargement. A clinical diagnosis of Graves' disease is made.
  (4.1) List three (03) other clinical features of this disease. (15 marks)
  (4.2) Describe the pathophysiological mechanism responsible for development of excess thyroid functions in this patient. (15 marks)
  (4.3) Comment on the TSH levels in this patient, giving reasons (15 marks)
  (4.4) Explain the systemic physiological effects of excess thyroid hormones on:
    (4.4.1) Metabolism (15 marks)
    (4.4.2) Cardiovascular system (15 marks)
    (4.4.3) Nervous system (15 marks)
  (4.5) State two (02) ECG changes expected in this patient. (10 marks)

(5) Explain the physiological basis for the following observations:
  (5.1) Calcium channels are essential for transmission of a nerve impulse through the neuromuscular junction. (30 marks)
  (5.2) Anticholinesterases reverse the action of competitive neuromuscular junction blockers. (40 marks)
  (5.3) Botulinum toxin causes a neuromuscular junction block. (30 marks)

(6) Explain the physiological basis for the following observations using a diagram when appropriate.
  (6.1) Biconvex lenses are used in the correction of hypermetropia. (25 marks)
  (6.2) Disturbance of vision may occur in a patient with a pituitary tumour. (25 marks)
  (6.3) Vitamin A deficiency may cause night blindness. (25 marks)
  (6.4) During Weber's test a patient with conduction deafness hears better from the affected ear. (25marks)

2nd MBBS (BATCH 1) SEQ PAPER ANSWERS

(1) Baroreceptors are specialized stretch- sensitive mechanoreceptors that play a crucial role in the regulation of the cardiovascular system.

(1.1) Name the location of two (02) baroreceptors which monitor arterial blood pressure. (10 marks)

Answer	Marks
Carotid sinus (at bifurcation of common carotid artery)	5
Aortic arch	5

(1.2) State the nerve supply to these two (02) baroreceptors. (10 marks)

Answer	Marks
Carotid sinus → Glossopharyngeal nerve (CN IX, Hering's nerve)	5
Aortic arch → Vagus nerve (CN X)	5

(1.3) Explain how the baroreceptor reflex helps to regulate blood pressure during a sudden elevation of blood pressure. (40 marks)

Point	Marks
Increase in arterial pressure	5
Stretch of carotid sinus and aortic arch	5
Increased baroreceptor firing	5
Impulses carried via CN IX and CN X to NTS (medulla)	5
Activation of cardioinhibitory centre	5
Inhibition of vasomotor centre / sympathetic outflow	5
Bradycardia and reduced contractility → ↓ CO	5
Vasodilatation → ↓ TPR → BP returns toward normal	5

(1.4) Briefly explain what happens to the baroreceptor reflex in the following situations:

(1.4.1) Hypovolaemic shock (10 marks)

Point	Marks
Decreased arterial pressure/stretch	2
Reduced baroreceptor firing	2
Reduced NTS stimulation	2
Increased sympathetic activity	2
Tachycardia, vasoconstriction, increased CO/TPR	2

(1.4.2) Carotid sinus massage (10 marks)

Point	Marks
External pressure stretches carotid sinus	2
Increased baroreceptor discharge	2
Increased vagal activity	2
Decreased sympathetic activity	2
Bradycardia and fall in BP	2

(1.4.3) Autonomic insufficiency (10 marks)

Point	Marks
Impaired autonomic pathways	3
Defective baroreceptor reflex	3
Inability to compensate for BP changes	2
Orthostatic hypotension	2

(1.4.4) Chronic hypertension (10 marks)

Point	Marks
Sustained elevation of BP	2
Baroreceptor resetting/adaptation	4
Reduced sensitivity	2
Less effective BP buffering	2

(2) A 52-year-old heavy alcohol user presented with jaundice and confusion. He had gross ascites, ankle oedema, and an enlarged spleen. He developed haematemesis (vomiting of blood) after admission to the ward.

His investigation results are given below.

Test	Test result	Reference range
Platelet count (per µL)	**98,000**	**150,000 - 400,000**
Total protein (g/dL)	**5.5**	**6.3 - 7.9**
Albumin (g/dL)	**2.5**	**3.5 - 5.0**
Serum bilirubin (mg/dL)	**3.8**	**0.1 - 1.2**
Direct bilirubin (mg/dL)	**2.4**	**0.0 - 0.3**
Prothrombin time (INR)	**2.2**	**0.8 - 1.2**
Aspartate aminotransferase (AST) (IU/L)	**75**	**7 - 40**
Alanine aminotransferase (ALT) (IU/L)	**50**	**8 - 48**
Gamma-glutamyl transferase (GGT) (IU/L)	**100**	**5 - 40**
Alkaline phosphatase (ALP) (IU/L)	**140**	**40 - 129**

(2.1) Outline the functions of platelets in haemostasis. (30 marks)

Primary haemostasis

Function	**Marks**
Platelet adhesion	5
Platelet activation	5
Platelet aggregation	5

Mediators

Function	**Marks**
Release of ADP	3
Release of thromboxane A_2	3
Release of serotonin/vasoconstrictors	2

Secondary haemostasis support

Function	**Marks**
Provide phospholipid surface	4
Clot retraction	3

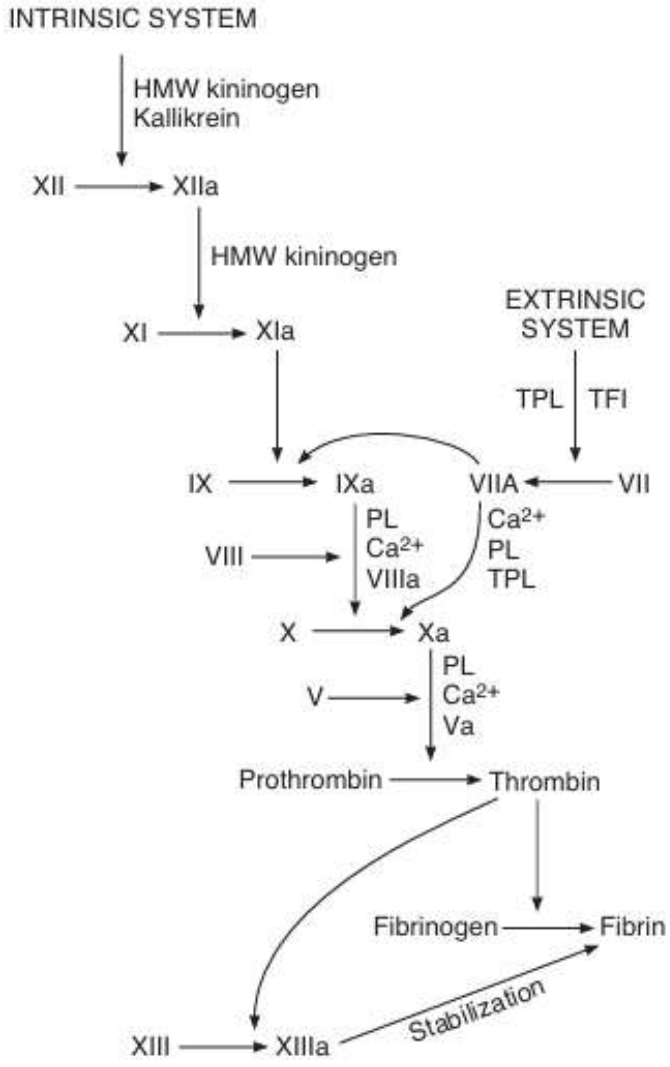
(2.2) Comment and give two reasons for his platelet count. (10 marks)

Thrombocytopenia (2 marks)

Reasons

Reason	Marks
Splenic sequestration due to splenomegaly/portal hypertension	4
Reduced thrombopoietin production due to liver disease	4

(2.3) Outline the clotting pathway with a labelled diagram in a healthy adult. (30 marks)



Intrinsic pathway (10)

- XII → XIIa
- XI → XIa
- IX → IXa
- VIIIa
- Activation of X

Extrinsic pathway (10)
- Tissue factor (III)
- VII → VIIa
- Activation of X

Common pathway (10)
- Xa + Va
- Prothrombin → Thrombin
- Fibrinogen → Fibrin
- XIII → XIIIa (cross-linking)

(2.4) Explain the reason for the prothrombin time INR observed in this patient. (30 marks)

Point	Marks
Impaired hepatic synthesis of clotting factors	10
Reduced vitamin K–dependent factors (II, VII, IX, X)	10
Cholestasis → reduced vitamin K absorption	5
Prolonged PT reflected as increased INR	5

(3) A 25-year-old mountaineer develops symptoms of shortness of breath, dizziness, and fatigue while climbing to 4,000 meters. During evaluation, different types of hypoxias are discussed.

(3.1) Define hypoxia. (10 marks)

Reduced oxygen availability at tissue level (10)

(3.2) Name four (04) causes and three (03) respiratory compensatory changes of hypoxic hypoxia. (25 marks)

Causes (4 × 5 marks)

Any four:

- High altitude
- Hypoventilation
- Diffusion defect
- V/Q mismatch
- Pulmonary disease
- Right-to-left shunt

= 20 marks

Compensatory changes (2.5 marks each)

- Hyperventilation
- Increased pulmonary diffusion
- Increased erythropoietin

= 5 marks

(3.3) Explain the features and compensatory mechanisms of anaemic hypoxia. (20 marks)

Features (10)

- Reduced Hb
- Reduced O_2 content
- Normal PaO_2
- Normal SaO_2
- Increased extraction

Compensation (10)

- Increased cardiac output
- Increased 2,3-BPG
- Increased tissue extraction
- Increased erythropoiesis

(3.4) Describe the pathophysiology and characteristic features of stagnant hypoxia. (20 marks)

Mechanism (10)

Reduced blood flow despite normal oxygenation.

Examples:

- Heart failure
- Shock

Features (10)

- Increased AV O_2 difference
- Low venous PO_2
- Tissue hypoxia
- Cyanosis

(3.5) Outline the mechanism and distinguishing features of histotoxic hypoxia. (25 marks)

Mechanisms (15)

Point	Marks
Tissue unable to utilize oxygen	5
Cellular oxidative phosphorylation impaired	5
Cyanide poisoning example	5

Features (10)

Feature	Marks
Normal PaO_2	2.5
Normal O_2 content	2.5
Reduced A-V difference	2.5
High venous PO_2	2.5

(4) A 30-year-old woman presents with weight loss, palpitations, and protruding eyes for 3months. Examination reveals bilateral exophthalmos (protruding eyeballs) and diffuse thyroid enlargement. A clinical diagnosis of Graves' disease is made.

(4.1) List three (03) other clinical features of this disease. (15 marks)

Any five:

- Weight loss
- Heat intolerance
- Palpitations
- Tremor
- Anxiety
- Hyperactivity
- Diffuse goitre
- Exophthalmos

(3 marks each)

(4.2) Describe the pathophysiological mechanism responsible for development of excess thyroid functions in this patient. (15 marks)

Point	**Marks**
Autoimmune disease	3
TSH receptor antibodies	4
Continuous receptor stimulation	4
Increased T3/T4 secretion	4

(4.3) Comment on the TSH levels in this patient, giving reasons (15 marks)

Point	**Marks**
TSH very low/suppressed	5
High T3/T4 inhibit pituitary	5
Negative feedback mechanism	5

(4.4) Explain the systemic physiological effects of excess thyroid hormones on:

(4.4.1) Metabolism (15 marks)

- Increased BMR
- Increased O_2 consumption
- Increased glucose utilization
- Increased lipolysis
- Weight loss

(3 marks each)

(4.4.2) Cardiovascular system (15 marks)

- Tachycardia
- Increased contractility
- Increased cardiac output
- Increased pulse pressure
- High-output cardiac failure

(3 marks each)

(4.4.3) Nervous system (15 marks)

- Anxiety
- Irritability
- Tremor
- Hyperreflexia
- Emotional lability

(3 marks each)

(4.5) State two (02) ECG changes expected in this patient. (10 marks)

Any two:

- Sinus tachycardia
- Atrial fibrillation
- Increased QRS voltage
- Shortened PR interval

(5 marks each)

(5) Explain the physiological basis for the following observations:

(5.1) Calcium channels are essential for transmission of a nerve impulse through the neuromuscular junction. (30 marks)

Point	Marks
AP reaches presynaptic terminal	5
Voltage-gated Ca^{2+} channels open	5
Ca^{2+} influx occurs	5
Vesicle fusion with membrane	5
Acetylcholine released	5
End plate potential generated	5

(5.2) Anticholinesterases reverse the action of competitive neuromuscular junction blockers. (40 marks)

Point	Marks
Competitive blockers occupy nicotinic receptors	8
Anticholinesterases inhibit ACh breakdown	8
Increased ACh concentration	8
ACh competes with blocker	8
Neuromuscular transmission restored	8

(5.3) Botulinum toxin causes a neuromuscular junction block. (30 marks)

Point	Marks
Toxin enters presynaptic terminal	6
Cleaves SNARE proteins	6
Prevents vesicle docking	6
Prevents ACh release	6
Flaccid paralysis results	6

(6) Explain the physiological basis for the following observations using a diagram when appropriate.

(6.1) Biconvex lenses are used in the correction of hypermetropia. (25 marks)

Point	Marks
Image forms behind retina	5
Eye too short / insufficient refractive power	5
Convex lens used	5
Converges light rays	5
Image focused on retina	5

(6.2) Disturbance of vision may occur in a patient with a pituitary tumour. (25 marks)

Point	Marks
Pituitary below optic chiasma	5
Upward expansion compresses chiasma	5
Nasal retinal fibres affected	5
Temporal visual fields lost	5
Bitemporal hemianopia	5

(6.3) Vitamin A deficiency may cause night blindness. (25 marks)

Point	Marks
Rods responsible for dim-light vision	5
Rhodopsin required for rod function	5
Retinal derived from vitamin A	5
Rhodopsin regeneration impaired	5
Night blindness develops	5

(6.4) During Weber's test a patient with conduction deafness hears better from the affected ear. (25 marks)

Point	Marks
Weber's test is performed by placing a vibrating tuning fork on the midline of the skull/forehead	3
Sound is transmitted to both cochleae through bone conduction	3
In conductive deafness, external or middle ear transmission is impaired	4
Environmental/background sounds reaching the affected ear are reduced (masking effect diminished)	5
Bone-conducted sound is therefore perceived as relatively louder in the affected ear	5
Sound lateralizes to the ear with conductive deafness in Weber's test	5

2nd MBBS (BATCH 1) OSPE QUESTIONS

(1) An instrument



(1.1) Identify the instrument. (02 Marks)

(1.2) What parameter is measured using this? (04 Marks)

(1.3) Name one condition in which the above measurement is

(1.3.1) higher than normal

(1.3.2) lower than normal (04 Marks)

(2) Clinical sign

A 32-year-old woman presents with intermittent abdominal pain, perioral numbness, muscle cramps and tingling of hands and feet for few hours.



(2.1) Name the clinical sign. (04 Marks)

(2.2) What instrument is used to elicit this sign? (03 Marks)

(2.3) Name the deficiency which leads to this condition. (03 Marks)

(3) Neurological sign

The photograph shows a neurological sign elicited when the sole of the foot of an adult is stroked with a blunt instrument.



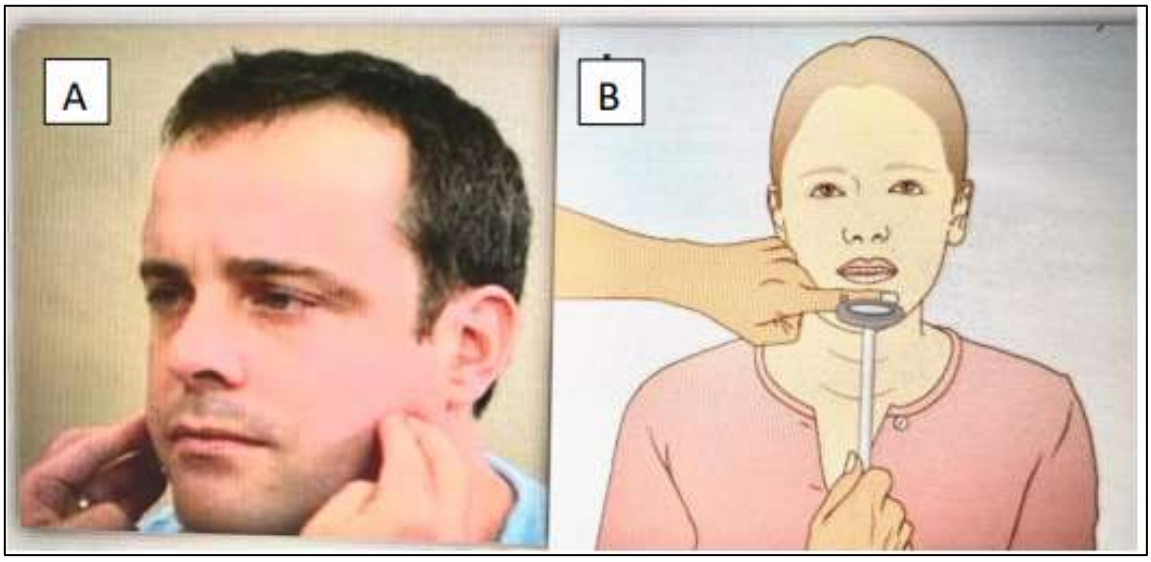
(3.1) Name the test. (03 Marks)

(3.2) State the sign observed in this patient. (04 Marks)

(3.3) Name one condition in which this physical sign is observed. (03 Marks)

(4) Cranial nerve examination

The following examination techniques were performed during a cranial nerve examination

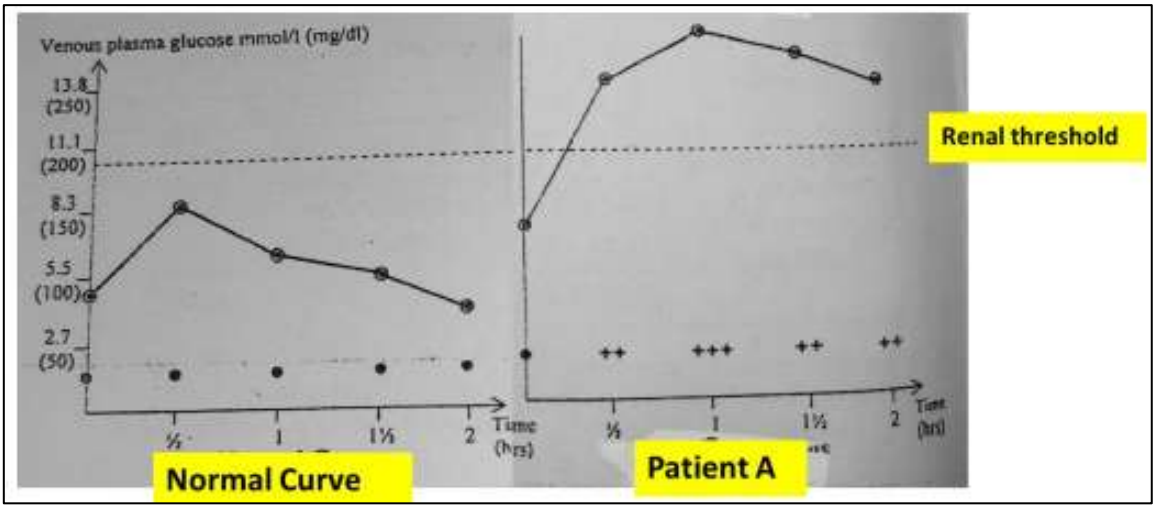


(4.1) Identify test A and test B (06 Marks)

(4.2) What cranial nerve is being tested? (04 Marks)

(5) Oral Glucose Tolerance Test (OGTT)

This test was performed on Patient A



(5.1) Identify two abnormalities in OGTT of patient A (04 Marks)

(5.2) What is the diagnosis of patient A (02 Marks)

(5.3) State two other situations in which this test is performed? (04 Marks)

(6) Haemostatic abnormality

Photograph shows the lower limbs of a patient.



(6.1) Name the clinical feature shown in the photograph. (03 Marks)

(6.2) List two possible causes for the above clinical feature. (03 Marks)

(6.3) Name two investigations that would be helpful in confirming the haematological condition. (04 Marks)

(7) Lung function test

Lung function test findings of a patient is given below

Lung function	Best reading	Expected range
FEV1	1.5 L	2.3 L - 4.2 L
FVC	2 L	3L -5 L
FEV1/FVC	75%	
PEFR	420 L/ min	400 L/min -550 L/min

(7.1) Which lung function test has been performed? (04 Marks)

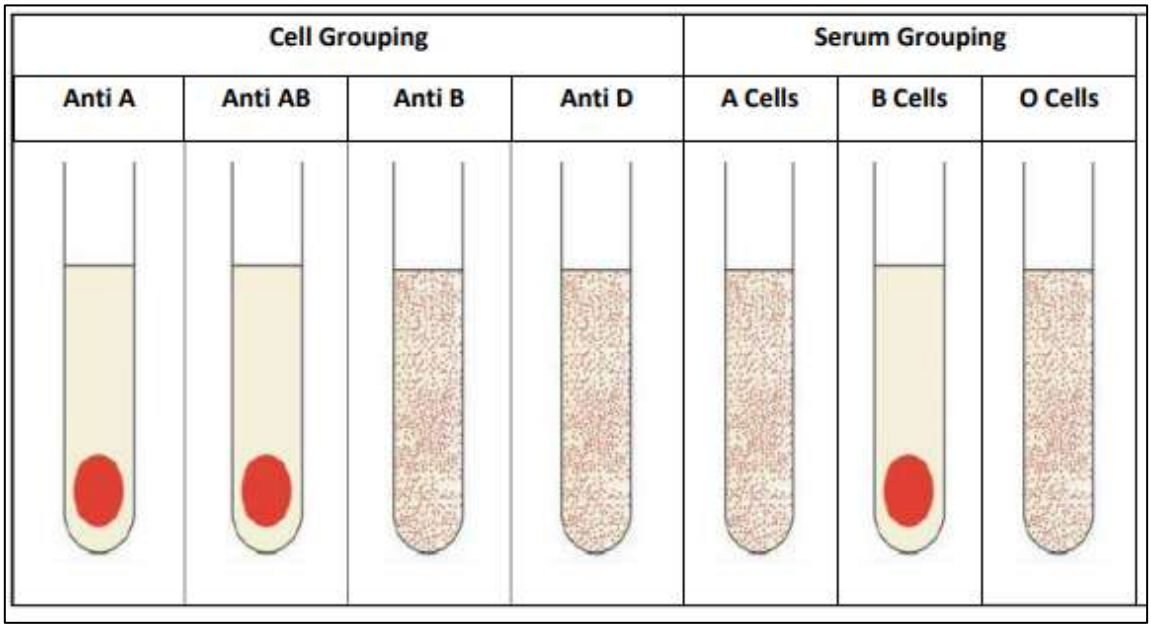
(7.2) What is the lung function test diagnosis? (04 Marks)

(7.3) State one condition that could give rise to the above diagnosis. (02 Marks)

(8) Blood grouping

The blood bank received a blood sample from a pregnant mother awaiting delivery for blood grouping and crossmatching.

The results of blood grouping [cell and serum] are shown below.



(8.1) State the mother's blood group. (04 Marks)

(8.2) If her blood group is not available which ABO group red cells can be transfused? (03 Marks)

(8.3) She later delivers Group A, Rh D positive baby who was jaundiced at birth and had a low haemoglobin. What is the most likely diagnosis? (03 Marks)

(9) Photograph of lower limbs



(9.1) Identify the physical sign shown in the picture. (04 marks)

(9.2) Name two possible causes. (04 marks)

(9.3) Name one biochemical test you would perform on this patient. (02 marks)

(10) Neurological sign

The following photograph shows a patient with an ocular abnormality



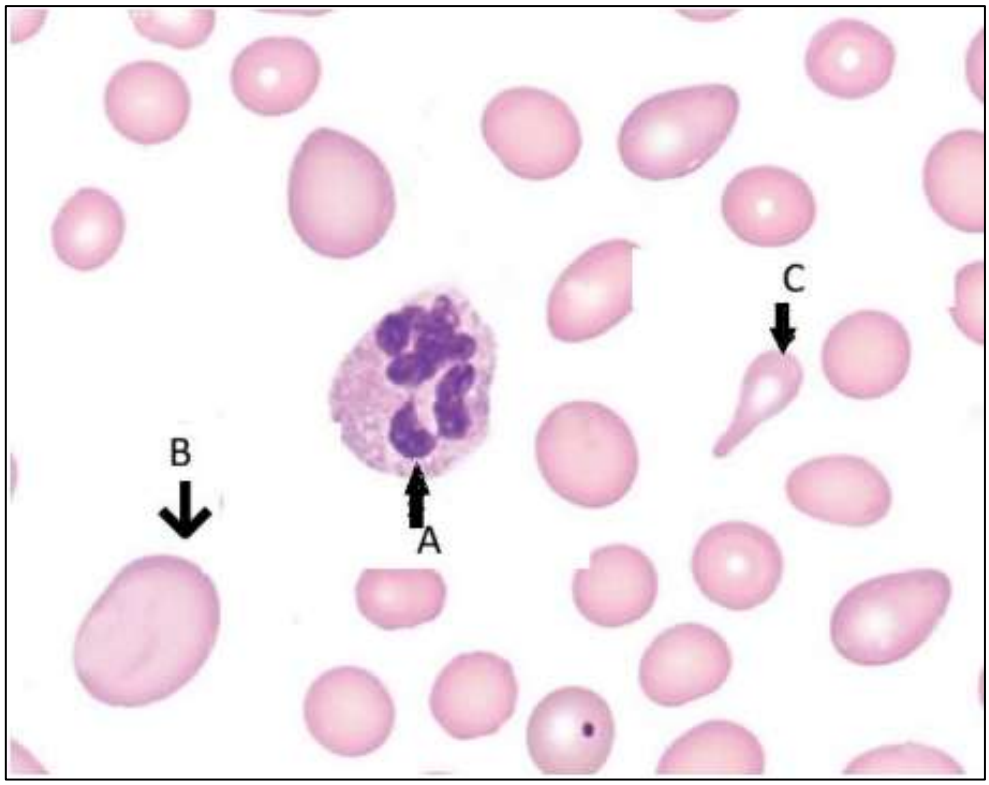
(10.1) Name the ocular abnormality seen in this patient. (02 Marks)

(10.2) Mention two possible causes for this clinical finding. (04 Marks)

(10.3) What additional two clinical features would you look for to differentiate between the causes you mentioned? (04 Marks)

(11) Blood picture

A 50-year-old female presents with a history of fatigue lasting for 2 months. This photograph shows her blood picture.



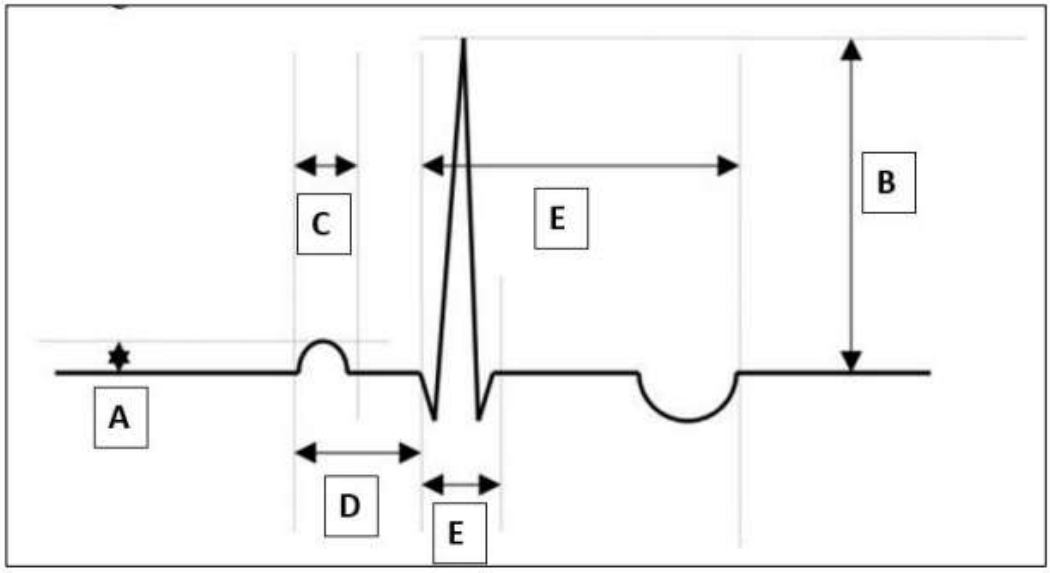
(11.1) Identify A, B, and C (0 3 Marks)

(11.2) What is the hematological diagnosis? (03 Marks)

(11.3) Name two causes for her condition. (04 Marks)

(12) ECG

A diagram of a normal ECG is shown below

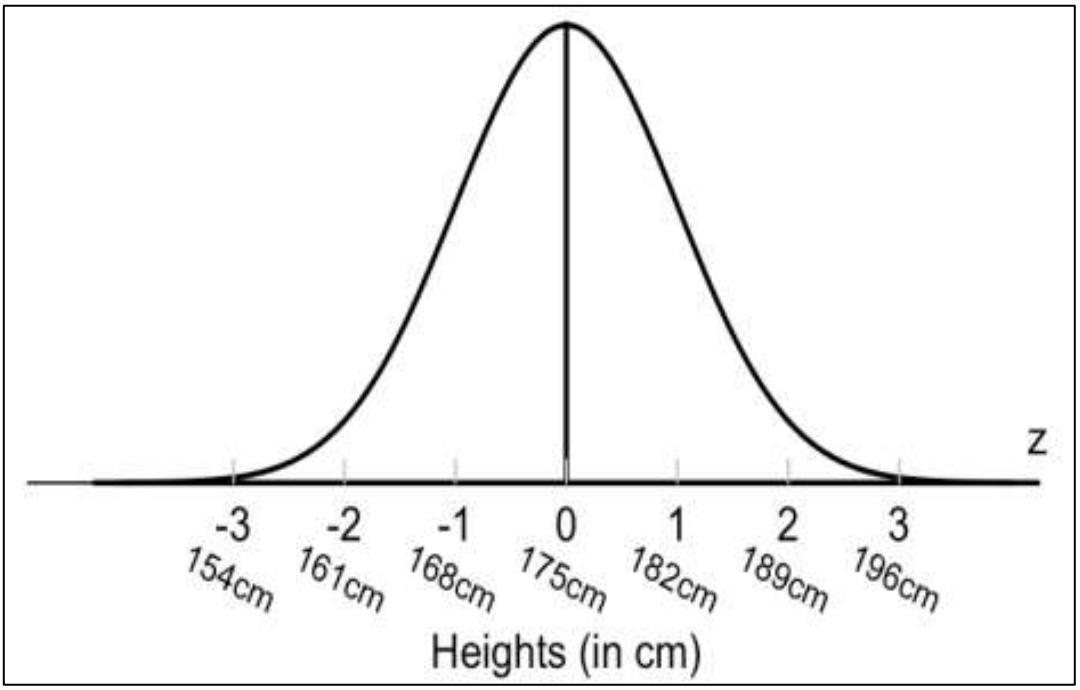


(12.1) Identify C, D, E and F. (04 Marks)

(12.2) Mention one condition in which the duration of following is increased. (06 Marks)

(13) Histogram

A histogram of heights (cm) of 100 medical students is shown below.



(13.1) Name the type of distribution shown in the graph. (02 Marks)

(13.2) What is the mean and the standard deviation (SD) of the heights of the students? (04 Marks)

(13.3) Calculate the range of heights within which 95% of students fall. (04 Marks)

(14) An Instrument



(14.1) What parameter in urine is measured by this instrument? (02 Marks)

(14.2) How does this parameter change in the following situations? (06 Marks)

(14.2.1) Dehydration

(14.2.2) After drinking 1 L of water

(14.2.3) After drinking 1 L of ORS

(14.3) Mention one clinical condition in which this instrument is used. (02 Marks)

(15) Collapsed patient

You find a man lying on the road who is unresponsive. On quick assessment, he has no spontaneous breathing and no palpable major pulses.



(15.1) List three (3) initial steps you would take immediately. (03 Marks)

(15.2) State two steps that you would follow when giving chest compressions according to Basic Life Support (BLS) guidelines. (04 Marks)

(15.3) State the compression-to-ventilation ratio for single rescuer Cardio Pulmonary Resuscitation (CPR) in this person. (03 Marks)

(16) The motor system examination

During motor system examination following techniques were performed

A



B



(16.1) Name tests A and B. (04 Marks)

(16.2) Name the system being examined. (03 Marks)

(16.3) State one condition where both A and B are abnormal. (03 Marks)

(17) Radiological contrast study



(17.1) Name the investigation. (05 Marks)

(17.2) Name two clinical conditions that can be diagnosed using this investigation. (05 Marks)

(18) Physical sign

This patient complains of headache and excessive sweating along with progressive changes in body appearance.



(18.1) State two abnormalities seen in this patient. (04 Marks)

(18.2) What is the name given for this condition? (02 Marks)

(18.3) What is the hormone responsible for this condition? (04 Marks)

(19) Fluids and blood products for rehydration and resuscitation.



(19.1) Name A, B, C, and D. (04 Marks)

(19.2) State one clinical use of each. (04 Marks)

(19.3) What is the main physiological difference between A and B in correcting dehydration? (02 Marks)

(20)

(20.1) Test the visual field of this patient using confrontation method. (08 Marks)

(20.2) Write the findings. (02 Marks)

2nd MBBS (BATCH 1) OSPE ANSWERS

(1)



(1.1) Peak flow meter – 2

(1.2) Peak Expiratory Flow Rate (PEFR) – 4

(1.3) Higher than normal (2)

Any one:

- Athlete
- After bronchodilator in asthmatic
- Large healthy adult male

Lower than normal (2)

Any one:

- Bronchial asthma
- COPD
- Airway obstruction

(2)



(2.1) Trousseau's sign / Carpopedal spasm – 4

(2.2) Sphygmomanometer – 3

(2.3) Calcium deficiency / Hypocalcaemia – 3

(3)



(3.1) Plantar reflex test – 3

(3.2) Sign observed (4)

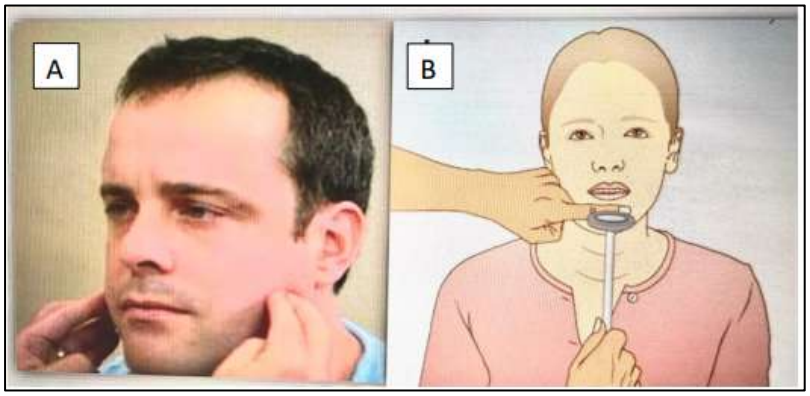
- Positive Babinski sign
- Dorsiflexion of great toe
- Fanning of other toes

(3.3) One condition (3)

Any one:

- UMN lesion
- Stroke
- Multiple sclerosis
- Spinal cord lesion

(4)



(4.1) A = Taste sensation test (3)

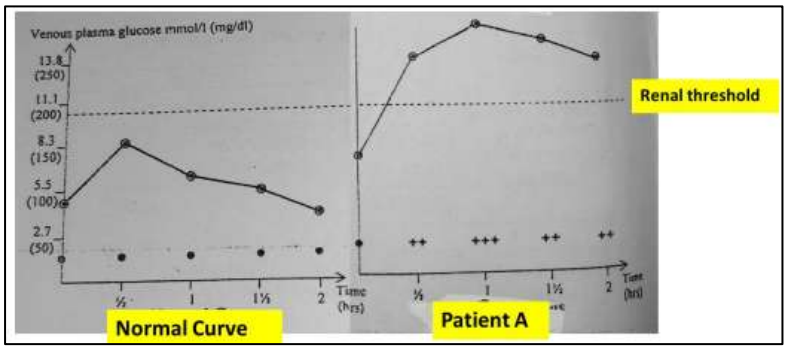
B = Taste examination using solutions (3)

(4.2) Cranial nerve tested (4)

Facial nerve (CN VII)

Chorda tympani

(5)



(5.1) Two abnormalities (4)

Any two:

- Elevated fasting blood glucose
- Peak glucose above normal
- Delayed return to baseline
- Glycosuria present

(2 marks each)

(5.2) Diabetes mellitus – 2

(5.3) Any two:

- Gestational diabetes
- Impaired glucose tolerance
- Borderline diabetes screening
- Investigation of unexplained glycosuria

(2 marks each)

(6)



(6.1) Petechiae / Purpura – 3

(6.2) Any two:

- Thrombocytopenia
- Dengue fever
- ITP
- Leukaemia
- Platelet dysfunction

(1.5 marks each)

(6.3) Any two:

- Platelet count
- Peripheral blood film
- Bleeding time
- Bone marrow examination
- Coagulation profile

(2 marks each)

(7)

Lung function	Best reading	Expected range
FEV1	1.5 L	2.3 L - 4.2 L
FVC	2 L	3L -5 L
FEV1/FVC	75%	
PEFR	420 L/ min	400 L/min -550 L/min

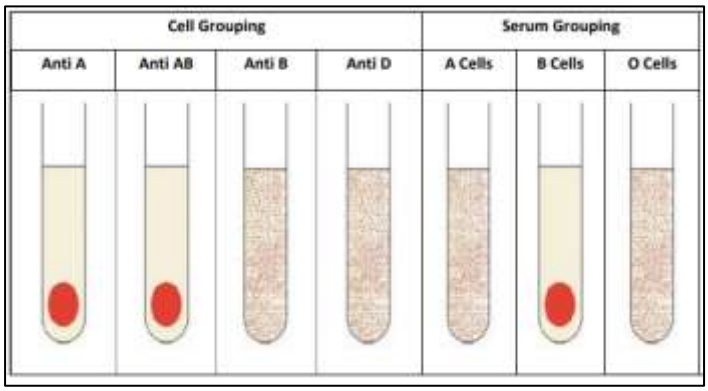
(7.1) Spirometry – 4

(7.2) Restrictive lung disease – 4

(7.3) Any one (2):

- Pulmonary fibrosis
- Kyphoscoliosis
- Obesity
- Interstitial lung disease

(8)



(8.1) Mother's blood group (4)

Likely:

O Rh negative

(8.2) O negative red cells – 3

(8.3) Diagnosis of jaundiced Rh-positive baby (3)

Haemolytic disease of the newborn (HDN)

Rh incompatibility

(9)



(9.1) Bilateral pitting oedema – 4

(9.2) Two causes (4)

Any two:

- Congestive cardiac failure
- Nephrotic syndrome
- Liver failure
- Protein malnutrition

(2 marks each)

(9.3) Biochemical test (2)

Any one:

- Serum albumin
- Renal function tests
- Liver function tests

(10)



(10.1) Ptosis – 2

(10.2) Two causes (4)

Any two:

- Oculomotor nerve palsy
- Myasthenia gravis
- Horner syndrome

(2 marks each)

(10.3) For CN III palsy:

- Dilated pupil
- Eye down and out

For Horner syndrome:

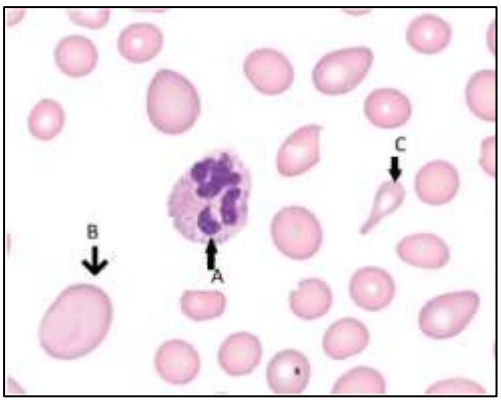
- Miosis
- Anhidrosis

For Myasthenia:

- Fatigability
- Diplopia

(2 marks each)

(11)



(11.1) A = Hypersegmented neutrophil

B = Macro-ovalocyte

C = Tear-drop cell

(1 mark each)

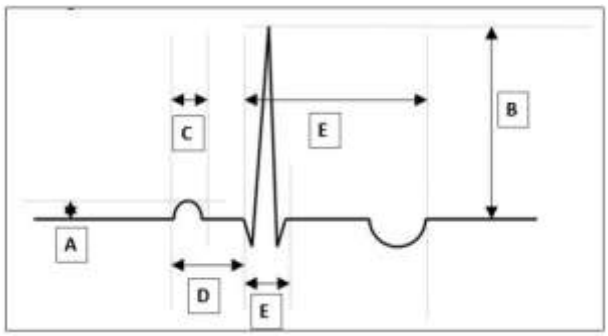
(11.2) Megaloblastic anaemia – 3

(11.3) Vitamin B12 deficiency

Folate deficiency

(2 marks each)

(12)



(12.1) C = PR interval

D = QRS duration

E = QT interval

F = ST segment

(1 mark each)

(12.2) PR interval:

- First degree heart block

QRS:

- Bundle branch block

QT:

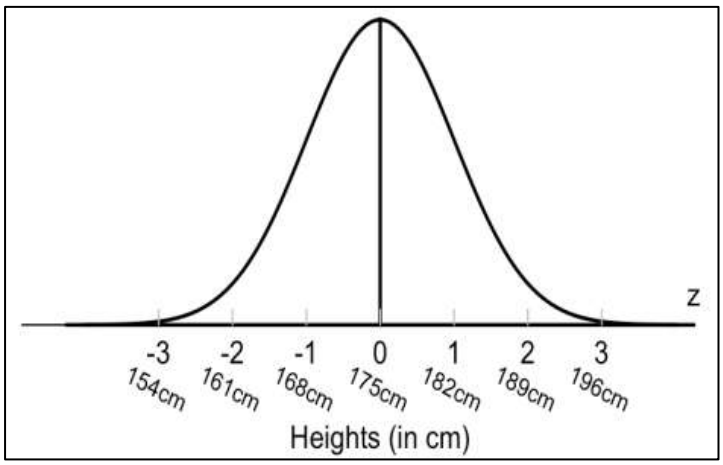
- Hypocalcaemia
- Long QT syndrome

ST segment:

- Myocardial ischaemia/injury

(1.5 marks each)

(13)



(13.1) Normal distribution – 2

(13.2) Mean = 175 cm (2)
SD = 7 cm (2)

(13.3) 95% = Mean ± 2SD
= 175 ± 14
= 161 cm – 189 cm
Calculation = 2 marks
Answer = 2 marks

(14)



(14.1) Urine specific gravity – 2

(14.2) Dehydration

- Increase (2)

After 1 L water

- Decrease (2)

After 1 L ORS

- Minimal change/slight increase (2)

(14.3) Any one:

- Diabetes insipidus
- Renal disease
- Hydration assessment

(15)

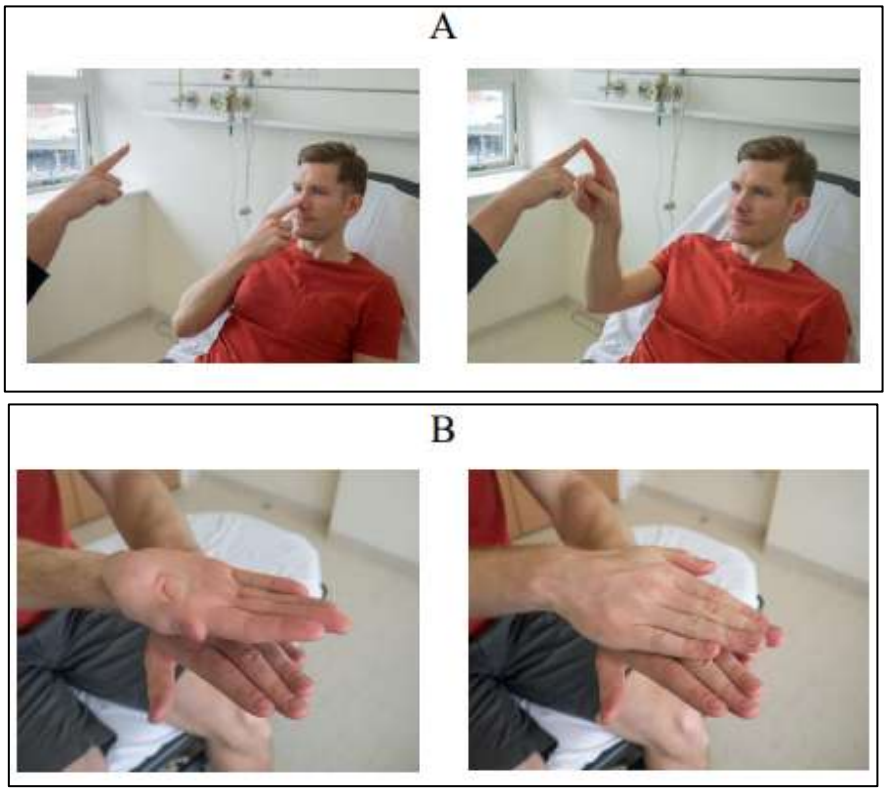


(15.1) Ensure safety
Check responsiveness
Call for help / activate emergency response
(1 mark each)

(15.2) Any two:
Lower half of sternum
Depth 5–6 cm
Rate 100–120/min
Allow full recoil
(2 marks each)

(15.3) 30 : 2 – 3 marks

(16)



(16.1) A = Finger–nose test
B = Rapid alternating movements (Dysdiadochokinesia test)
(2 marks each)

(16.2) Cerebellar system / Coordination – 3

(16.3) One condition (3)
Any one:
Cerebellar lesion
Cerebellar stroke
Cerebellar degeneration

(17)



(17.1) Barium swallow – 5

(17.2) Any two:

Achalasia cardia
Oesophageal stricture
Oesophageal carcinoma
Hiatus hernia
GERD
(2.5 marks each)

(18)



(18.1) Any two:

Enlarged hands
Coarse facial features
Frontal bossing
Prognathism
Enlarged nose
(2 marks each)

(18.2) Acromegaly – 2

(18.3) Growth hormone (GH) excess – 4

(19)



(19.1) A = Normal saline (0.9% NaCl)
B = Oral rehydration solution (ORS)
C = Fresh frozen plasma (FFP)
D = Packed red cells (PRC)
(1 mark each)

(19.2) A – IV dehydration/shock
B – Oral dehydration
C – Coagulation factor replacement
D – Severe anaemia/haemorrhage
(1 mark each)

(19.3) Physiological difference between A and B (2)

- ORS promotes intestinal sodium-glucose co-transport and water absorption.
- Normal saline replaces extracellular fluid intravenously.

(1 mark each)

(20) Live Station

2022/2023 (1st Batch)
2nd MBBS
Repeat Exam
Papers & Answers

2nd MBBS Repeat Exam (BATCH 1) MCQ PAPER

Questions numbers 01 to 30 are True or False type questions. Mark your answer for each of the 5 responses (A to E).

(1) Which of the following cellular structures are correctly matched with its function?

(A) Golgi apparatus - Intracellular digestion of waste and foreign material
(B) Lysosomes - Packaging and modifying proteins for secretion
(C) Mitochondria - Oxidative phosphorylation
(D) Ribosomes - Protein synthesis
(E) Smooth endoplasmic reticulum- Lipid synthesis

(2) True or false regarding the interstitial fluid in a healthy adult?

(A) It constitutes approximately 15% of total body water.
(B) It contains larger quantities of proteins than plasma.
(C) It is an ultrafiltrate of plasma.
(D) It is contained within a gel-like extracellular matrix.
(E) It surrounds all cells except blood cells.

(3) True or false regarding formation of the tissue fluid?

(A) About 15% of tissue fluid drains via lymphatics.
(B) Colloid osmotic pressure draws fluid back into the venous end of capillaries.
(C) Hydrostatic pressure forces fluid out at the arterial end of capillaries.
(D) Significant amount is formed by capillaries in the pulmonary circulation.
(E) Tissue fluid formation is high in metabolically active tissues.

(4) Which of the following receptors are correctly matched with their physiological functions?

(A) Muscarinic M_2 receptor - increases cardiac muscle contractility
(B) Muscarinic M_3 receptor - contracts smooth muscles around glandular tissues.
(C) α_1 adrenergic receptor - produces vasoconstriction.
(D) β_1 adrenergic receptor - decreases heart rate by inhibiting SA node
(E) β_2 adrenergic receptor - causes bronchodilation

(5) True or false regarding packed red cell transfusion to a patient?

(A) Compatibility testing should always be performed using patient's serum and donor red cells before a red cell transfusion.
(B) Hb level of 10g/dl is always an indication for a red cell transfusion to an anaemic patient.
(C) If the patient develops a temperature rise of >1.5°C, the transfusion can be continued after treating with paracetamol.
(D) It should be completed within 4 hours.
(E) It should be done only with the patient's group specific red cells.

(6) Which of the following substances stimulate pain receptors?

(A) Bradykinin
(B) Histamine
(C) Morphine
(D) NSAID
(E) Substance P

(7) True or false regarding blood groups?

(A) Blood group AB is called the universal donor group.
(B) Blood group antigens are present only on RBCs.
(C) Bombay O blood group lacks the H antigen on their red cell surface.
(D) Rh Blood group system consists of more than 40 antigens.
(E) The ABO blood group system is the first blood group system discovered by Carl Landsteiner.

(8) True or false regarding electrical activity of the cardiac ventricular muscles?

(A) Duration of action potential is about 200 ms.
(B) Efflux of Ca^{2+} causes repolarization.
(C) Influx of Na^{+} causes rapid depolarization.
(D) Membrane permeability to K^{+} is more important than that of Na^{+} in determining the resting membrane potential.
(E) Resting membrane potential is about -70 mV.

(9) True or false regarding pathophysiology of heart failure?

(A) Increased aldosterone levels contribute to fluid retention.
(B) Increased left atrial pressure contributes to the pulmonary venous congestion.
(C) Natriuretic peptides contribute to increased blood volume.
(D) Reduced cardiac output in heart failure activates the renin–angiotensin–aldosterone system (RAAS).
(E) Ventricular hypertrophy is a long-term compensatory mechanism to increased wall stress.

(10) True or false regarding the features of ECG in clinical practice?

(A) Atrial and ventricular rates may be different if the patient is in complete heart block.
(B) In an ECG, the lead V1 is placed in the 4th intercostal space at the right margin of the sternum.
(C) ST segment elevation represents myocardial infarction.
(D) The normal PR interval is between 120 – 200 ms in duration.
(E) The QT interval is not affected by heart rate.

(11) Which of the following statements correctly differentiate the first heart sound (S_1) from the second heart sound (S_2)?

(A) S_1 coincides with the onset of ventricular systole.
(B) S_1 is best heard in the mitral and tricuspid areas.
(C) S_1 is higher-pitched than S_2.
(D) S_2 is longer than S_1.
(E) S_2 is produced by closure of the mitral and tricuspid valves.

(12) True or false regarding regulation of respiration?

(A) Central chemoreceptors are sensitive to H^+.
(B) Pulmonary stretch receptors are activated during exercise.
(C) Severe hypercapnoea depresses the respiratory centre.
(D) The brainstem acts as the coordinating centre.
(E) The effectors are the diaphragm and the external intercostal muscles

(13) Which of the following correctly differentiates the jugular venous pulse (JVP) from the carotid arterial pulse?

(A) Carotid pulse decreases with abdominal pressure, while JVP remains unchanged.
(B) Carotid pulse has a single outward pulsation, while the JVP has multiple waves.
(C) Carotid pulse is non-palpable, whereas JVP is easily palpable in the neck.
(D) JVP appears during ventricular systole, while carotid pulse appears during diastole.
(E) JVP varies with respiration, while the carotid pulse does not.

(14) True or false regarding gas exchange and transport in a healthy adult?

(A) About 70% of carbon dioxide in blood is transported as bicarbonate ions in plasma.
(B) Carbon dioxide diffuses more rapidly than oxygen across the respiratory membrane.
(C) Most of the oxygen in blood is transported bound to haemoglobin.
(D) Oxygen diffusion depends on the alveolar capillary partial pressure gradient.
(E) The oxygen haemoglobin dissociation curve shifts to the left when 2,3-DPG levels increase.

(15) True or false regarding Ventilation/Perfusion (V/Q) ratio?

(A) In a healthy adult, the overall V/Q ratio for the entire lung is 1.0.
(B) It depends on pulmonary blood flow per minute.
(C) It is higher at the base of the lung compared to the apex.
(D) It is zero in a lung area with total alveolar collapse.
(E) V/Q mismatch is a cause of hypoxemia.

(16) Which of the following changes occur during moderate dynamic exercise in a healthy adult?

(A) Arterial PO_2 rises significantly above normal.
(B) Blood flow to the contracting muscle increases during strong isometric contraction.
(C) Increase in cardiac output due to increased stroke volume.
(D) There is an increasing tidal volume and respiratory rate.
(E) Total peripheral resistance increases markedly during isotonic exercise.

(17) True or false regarding the gastrointestinal tract?

(A) A defective Miessner's plexus reduces gastrointestinal secretions.
(B) Absorption of the nutrients is a major function of the mucosa.
(C) Peristalsis is important for the propulsion of the food bolus.
(D) Sympathetic stimulation promotes digestion and absorption.
(E) Vagotomy reduces gastrointestinal slow waves.

(18) True or false regarding the small intestine?

(A) Amino acids are absorbed with secondary active transport with Na^+.
(B) Bile acids are reabsorbed.
(C) Fructose is absorbed independently of Na^+.
(D) Motilin secretion is stimulated in well-fed state.
(E) The entero-gastric reflex inhibits the gastric emptying.

(19) True or false regarding the structure and functions of the lower oesophageal sphincter?

(A) It prevents the passage of food back into the oesophagus.
(B) Sling fibres of the stomach form part of the lower oesophageal sphincter mechanisms.
(C) The diaphragmatic crus is made of skeletal muscle.
(D) The intrinsic sphincter consists of oesophageal smooth muscle.
(E) The lower oesophageal sphincter is maintained in a relaxed state at rest.

(20) True or false regarding the synthetic functions of the liver?

(A) Glycogenesis and gluconeogenesis occur in the liver.
(B) Prothrombin time (PT) and PT-INR are indirect measurements of the synthetic function of the liver.
(C) The liver produces all plasma proteins except gamma globulin.
(D) The liver produces protein C and protein S.
(E) The sole reason for low serum albumin level is poor synthetic functions of the liver.

(21) True or false regarding hormones of the adrenal cortex?

(A) Aldosterone acts mainly on the distal nephron to increase sodium reabsorption and potassium secretion.
(B) Aldosterone secretion is primarily regulated by the renin–angiotensin–aldosterone system (RAAS).
(C) Androgens produced by the adrenal cortex are the main source of testosterone in adult males.
(D) Cortisol increases gluconeogenesis.
(E) Cortisol secretion decreases markedly during chronic stress.

(22) True or false regarding insulin synthesis and action?

(A) C-peptide is released in equimolar amounts with insulin.
(B) Insulin increases hepatic glycogenolysis.
(C) Insulin inhibits protein catabolism in muscles.
(D) Insulin is synthesized as preproinsulin in the β-cells of the pancreas.
(E) Insulin promotes glucose uptake in skeletal muscle via GLUT-4 transporters.

(23) Which of the following features of inulin make it a suitable substance to measure GFR?

(A) Free filterability at the glomerulus.
(B) It does not alter renal functions.
(C) It is completely reabsorbed at the renal tubule.
(D) It is concentrated at the deeper parts of the renal medulla.
(E) It is not secreted by the renal tubule.

(24) True or false regarding handling of H^+ by the kidney?

(A) H^+ secreted in the distal tubule are buffered by ammonia.
(B) H^+ secretion at the proximal tubule is increased by aldosterone.
(C) Largest amount of H^+ secretion take place at the proximal tubule.
(D) Largest pH change of tubular fluid takes place at the proximal tubule.
(E) Mechanism of H^+ secretion is identical at the proximal and distal tubules.

(25) Match the phases of the menstrual cycle with the dominant hormone or hormonal event.

(A) Early follicular phase - FSH rise
(B) Early luteal phase - Declining progesterone
(C) Late follicular phase - High oestrogen
(D) Late luteal phase - Progesterone dominance
(E) Ovulation - LH surge

(26) True or false regarding the biological effects of oestrogen?

(A) It increases the sensitivity of the uterus to oxytocin.
(B) It promotes growth and development of the female reproductive tract during puberty.
(C) It promotes proliferation of the endometrium during the follicular phase.
(D) It reduces HDL cholesterol and increases LDL cholesterol.
(E) It stimulates closure of epiphyseal growth plates in long bones.

(27) The location and the neurotransmitter are correctly paired

(A) Parasympathetic ganglia - acetylcholine
(B) Postganglionic parasympathetic ending - acetylcholine
(C) Postganglionic sympathetic nerve ending - norepinephrine
(D) Preganglionic nerve ending at adrenal gland - acetylcholine
(E) Sympathetic ganglia - norepinephrine

(28) True or false regarding cutaneous mechanoreceptors?

(A) Meissner corpuscles are more superficially located than Pacinian corpuscles.
(B) Meissner corpuscles have a wider receptive field than Ruffini endings.
(C) Meissner corpuscles respond to slow vibration.
(D) Merkel cells are slowly adapting receptors.
(E) Pacinian corpuscles are the largest type.

(29) True or false regarding conversion of a receptor stimulus into a recognizable sensation?

(a) Adequate stimulus' has the lowest threshold.
(b) As the intensity of the stimulus increases, a smaller number of nerve terminals are stimulated.
(c) As the intensity of the stimulus increases, the frequency of action potentials increases.
(d) Lateral inhibition helps in localization of the stimulus.
(e) This is called sensory coding.

(30) Which of the following statements correctly differentiate conductive deafness from sensorineural deafness?

(A) Air conduction is greater than bone conduction in conductive deafness.
(B) Conductive deafness results from otitis media and wax impaction.
(C) In sensorineural deafness, bone conduction is better than air conduction on Rinne's test.
(D) In sensorineural deafness, Weber's test lateralizes to the normal ear.
(E) Sensorineural deafness improves markedly with external sound amplification.

Questions numbers 31 to 60 are Single Best Response (SBR) type. Select the best response to each question.

(31) There are different types of dehydration, namely, hypotonic, hypertonic and isotonic dehydration.

Which of the following statement best describes the physiological changes that occur in isotonic dehydration?

(A) Loss of equal proportion of water and sodium, without major change in plasma osmolality.
(B) Loss of sodium counter-balanced by retention of potassium.
(C) Loss of sodium only, causing decreased plasma osmolality.
(D) Loss of water exceeding sodium loss, leading to increased plasma osmolality.
(E) Loss of water only, leading to increased plasma osmolality.

(32) Vitamin B12 deficiency affects red cell formation in the bone marrow.

Which of the following best describes the underlying physiological defect in megaloblastic anaemia?

(A) Defective DNA synthesis causing delayed maturation of the nucleus relative to the cytoplasm.
(B) Defective synthesis of RNA leading to abnormally large erythrocytes.
(C) Impaired synthesis of globin chain.
(D) Increased destruction of red cells due to membrane defects.
(E) Reduced erythropoietin production causing megaloblasts.

(33) Red cell formation in the bone marrow is controlled by different mechanisms.

Which of the following factor plays the most important physiological role in stimulating erythropoiesis?

(A) Increased blood thyroid hormones concentration.
(B) Increased methemoglobin level in blood.
(C) Increased plasma androgen concentration.
(D) Reduced RBC count.
(E) Reduced renal oxygen delivery.

(34) Primary haemostasis is marked by platelet plug formation.

What is the most important factor required for platelet adhesion to the damaged vascular endothelium?

(A) Fibrinogen
(B) Prostacyclin
(C) Serotonin
(D) Thromboxane A_2
(E) von Willebrand factor

(35) Different compensatory mechanisms take place in patients with hypovolaemia.

Which of the following physiological mechanism is most responsible for maintaining blood pressure initially in a patient with hypovolaemic shock?

(A) Baroreceptor-mediated increase in sympathetic activity.
(B) Decreased parasympathetic tone to the heart.
(C) Increased secretion of aldosterone.
(D) Increased secretion of vasopressin (ADH).
(E) Release of rennin from the Juxta glomerular apparatus.

(36) At the end of the repolarization phase of cardiac pacemaker cells, membrane begins to depolarize automatically.

What is the channel responsible for the initial part of this depolarization?

(A) Funny channels
(B) K^+ channels
(C) Ligand-gated Na^+ channels
(D) Long-lasting Ca^{2+} channels
(E) Transient Ca^{2+} channels

(37) Given below is blood gas analysis findings of a 28-year-old male in coma who is hyperventilating.
pH - 7.2
PCO2 - 38 mmHg
HCO3- - 15 mmol/L

What is the acid-base status of this patient?

(A) Metabolic acidosis
(B) Metabolic alkalosis
(C) Normal acid-base balance
(D) Respiratory acidosis
(E) Respiratory alkalosis

(38) Fetal brain receives oxygen rich blood.

What arrangement of fetal circulation assures that the fetal brain receives oxygen rich blood?

(A) Communication between pulmonary artery and aorta via patent ductus arteriosus.
(B) Passing of blood from inferior vena cava to left atrium via foramen ovale.
(C) Presence of fetal haemoglobin (HbF).
(D) Presence of two umbilical veins and one umbilical artery.
(E) Superior vena caval blood draining into right ventricle via right atrium.

(39) Infant is born with insufficient production of pulmonary surfactant.

According to the Law of Laplace, which of the following is the most direct consequence of this deficiency in the infant's lungs?

(A) A decrease in the elastic properties of the lung parenchyma.
(B) A reduction in the overall work of breathing.
(C) An increase in lung and chest wall compliance.
(D) Collapse of smaller alveoli.
(E) Prevention of pulmonary oedema by increased surface tension.

(40) A 40-year-old woman has persistently elevated blood pressure for several months. Her blood tests show increased sodium retention and expanded extracellular fluid volume.

Which of the following mechanism best explains the long-term elevation of her blood pressure?

(A) Altered renal regulation of body fluids.
(B) Excess secretion of atrial natriuretic peptide.
(C) Failure of baroreceptor sensitivity.
(D) Increase in sympathetic discharge.
(E) Increased peripheral chemoreceptor activity.

(41) A 60-year-old patient with exertional shortness of breath is found to have normal FEV1/FVC but significantly low FVC and a small sized but normal shaped flow-volume curve.

Which one of the following investigations would be helpful to further assess this assessment by a Peak flow meter?

(A) Carbon monoxide diffusion capacity
(B) Electrocardiogram
(C) Maximal voluntary ventilation
(D) Patient's underlying lung disease
(E) Respiratory minute volume

(42) A 62-year-old man with long-standing COPD is treated with Oxygen. During oxygen therapy, he becomes drowsy with decreased respiratory rate.

Which of the following mechanism best explains this?

(A) Activation of the J-receptors in the alveolar interstitium.
(B) Inhibition of the apneustic center in the pons.
(C) Removal of stimulation for peripheral chemoreceptors.
(D) Stimulation of pulmonary stretch receptors.
(E) Suppression of the central chemoreceptors.

(43) Inadequate oxygen supply to the peripheral tissues is known as hypoxia.

Which of the following best describes the primary physiological feature of anaemic hypoxia?

(A) Decreased tissue blood flow leading to inadequate oxygen delivery.
(B) Inhibition of cellular oxidative enzymes preventing oxygen utilization.
(C) Reduced arterial PO_2 due to inadequate oxygenation of blood in the lungs.
(D) Reduced oxygen-carrying capacity of blood despite normal arterial PO_2.
(E) Reduced venous return resulting in lower cardiac output.

(44) Gastric environment is maintained acidic by secretion of HCL from the parietal cells.

Which of the following best describes the primary mechanism by which parietal cells secrete hydrochloric acid (HCl) into the gastric lumen?

(A) Active transport of hydrogen ions via the H^+/K^+ ATPase pump.
(B) Exchange of chloride ions for bicarbonate across the apical membrane.
(C) Increased gastrin release stimulating chief cells to produce acid.
(D) Passive diffusion of hydrogen ions through apical membrane channels.
(E) Secretion of pepsinogen that converts to pepsin in acidic PH.

(45) Chronic pancreatitis leads to pancreatic insufficiency.

Which of the following best describes the major pathophysiological consequence of chronic pancreatic insufficiency?

(A) Endocrine failure comes earlier than exocrine failure.
(B) Fat malabsorption is the most prominent effect.
(C) Less responsiveness of the exocrine pancreas to secretin.
(D) Reduced amylase secretion is overcome by brush -boarder enzymes.
(E) Weight loss and malnutrition appear early part of the disease.

(46) Parathyroid hormone (PTH) acts at many sites in regulating calcium metabolism.

Which of the following best describes the primary physiological action of PTH in maintaining serum calcium concentration?

(A) It increases formation of 1,24 DHCC.
(B) It increases osteoblastic activity.
(C) It increases osteoclastic activity.
(D) It increases reabsorption of calcium in the Proximal convoluted tubule (PCT).
(E) It increases renal phosphate excretion.

(47) A 46-year-old man presents with increasing shoe size, coarse facial features, excessive sweating, and new-onset diabetes. His serum insulin-like growth factor 1 (IGF-1) levels is markedly elevated. During an oral glucose tolerance test (OGTT), his serum growth hormone levels (GH levels) fail to suppress. Brain imaging shows a 1.2 cm pituitary mass.

Which physiological mechanism best explains his elevated IGF-1 levels?

(A) Conversion of insulin to IGF-1.
(B) Increased hepatic sensitivity to GH.
(C) Increased secretion of GHRH.
(D) Increased serum GH levels acting on liver.
(E) Increased somatostatin release from the hypothalamus.

(48) A 32-year-old woman presents with palpitations, heat intolerance and weight loss despite increased appetite. On examination, she has a fine tremor and a diffusely enlarged, non-tender thyroid gland. She has exophthalmos.

Her laboratory results are as follows:

i) **TSH is <0.01 mIU/L (low)**
ii) **Free T4 is elevated**
iii) **T3 is elevated**

Which of the following is the most likely underlying mechanism causing her condition?

(A) Autoantibody-mediated stimulation of the TSH receptor.
(B) Excessive iodine intake leading to hormone overproduction.
(C) Release of preformed thyroid hormone from damaged follicles.
(D) TSH-secreting pituitary adenoma.
(E) Uncontrolled hormone secretion from a single toxic nodule.

(49) A 60-year-old man with long-standing type 2 diabetes on insulin therapy presents with sweating, tremors, and confusion. His capillary blood glucose is 42 mg/dL.

Which of the following hormone is most important for the immediate counter-regulatory response to restore blood glucose levels?

(A) Cortisol
(B) Epinephrine
(C) Glucagon
(D) Growth hormone
(E) Somatostatin

(50) Hypotension is a clinical feature of Addison disease. One of the reasons for this hypotension is lack of permissive action of cortisol.

Which of the following best explains the other reason for hypotension?

(A) Disturbance of baroreceptor functions.
(B) Hyperkalemia.
(C) Lack of mineralocorticoid activity.
(D) Low ADH concentration.
(E) Reduction of catecholamine levels.

(51) Fertilization is the process by which a haploid sperm fuses with a haploid ovum to form a diploid zygote. There are mechanisms that operate to prevent entry of multiple sperms into a single ovum (polyspermy).

What is the initial change that occur in the ovum which prevents polyspermy?

(A) Acrosomal reaction.
(B) Alteration of the chromosomal arrangements.
(C) Change in the membrane potential.
(D) Hardening of the nuclear membrane.
(E) Hardening of the zona pellucida by cortical reaction.

(52) The reproductive axis remains largely quiescent during childhood. The onset of true puberty, characterized by rising gonadal steroid production, is driven by maturation of the hypothalamic–pituitary–gonadal axis.

Which of the following hormone is most strongly implicated in signalling adequate nutritional status and a critical body-weight threshold to the hypothalamus, thereby triggering the initiation of puberty?

(A) Growth Hormone (GH)
(B) Leptin
(C) Melatonin
(D) Prolactin
(E) Thyroid Hormone

(53) A 22-year-old university student seeks contraception. She has regular menstrual cycles, no medical illnesses, and prefers a contraceptive that will also help with dysmenorrhea (painful menstruation) and acne.

Which of the following contraceptive method best meets her needs?

(A) Combined oral contraceptive pill.
(B) Copper intrauterine device.
(C) Depot medroxyprogesterone acetate injection.
(D) Levonorgestrel intrauterine system.
(E) Progestin-only implant.

(54) A 55-year-old patient with poorly controlled diabetes mellitus has a plasma venous glucose concentration of 400 mg/dL and is found to have glucose in his urine.

What is the best description of physiological basis for the appearance of glucose in urine?

(A) Active secretion of glucose into tubular fluid.
(B) Increased amount of filtration of glucose at the glomerulus.
(C) Lack of action of insulin on renal tubular cells.
(D) Osmotic diuresis.
(E) Tubular transport maximum for glucose reabsorption is exceeded.

(55) A 50-year-old man with long-standing diabetes complains of unstable walking, especially in the dark.
On examination:

i) **Gait is stamping**
ii) **Romberg test is positive (falls with eyes closed)**
iii) **Joint position sensation is reduced in both feet**
iv) **Muscle power of lower limbs is normal**

What is the most likely physiological explanation for this gait abnormality?

(A) Abnormal inputs from the vestibular apparatus.
(B) Damage to cerebellar vermis.
(C) Damage to the common peroneal nerve.
(D) Hyperexcitable stretch reflexes.
(E) Impaired proprioceptive input.

(56) Upper motor neurone lesions cause characteristic changes in muscle tone, reflex activity, and voluntary movements.

Which of the following mechanism best explains the increased muscle tone seen in upper motor neurone lesions?

(A) Denervation hypersensitivity.
(B) Increased activity of antagonistic muscles.
(C) Increased activity of primary motor cortex.
(D) Increased activity of spinocerebellar pathway.
(E) Loss of descending inhibitory input.

(57) Myopia is a refractive error resulting in blurred distant vision. Which of the following best explains the physiological basis of myopia?

(A) An elongated eyeball causing parallel light rays to focus in front of the retina.
(B) Excessive convergence of parallel light rays causing them to focus infront of the retina during accommodation.
(C) Failure of the ciliary muscle to maintain the lens in a fully relaxed, flattened state.
(D) Increased refractive power of the lens only during close-up vision causing blurred distant vision
(E) Spherical aberration of the lens.

(58) When CSF is obtained by lumbar puncture, a venous blood sample is also obtained to measure its glucose concentration.

What is the best explanation for simultaneous assessment of blood glucose?

(A) Cells in the CSF utilize glucose until CSF is being assessed in the laboratory
(B) Glucose is actively secreted from blood into CSF during formation of CSF.
(C) High blood glucose has an osmotic effect on cells in the CSF.
(D) Interpretation of CSF glucose report requires blood glucose concentration.
(E) Lumbar puncture is contraindicated if the patient is hypoglycaemic.

(59) A 35-year-old woman presents with difficulty in walking for 2 weeks. On examination:

i) Left-sided limb ataxia
ii) Past-pointing on finger–nose test (left side)
iii) Intention tremor on the left
iv) Nystagmus on lateral gaze
v) Dysdiadochokinesia
vi) Normal muscle strength and normal sensation

Which of the following physiological function of the cerebellum is most likely impaired in this patient?

(A) Control of emotional motor expression.
(B) Coordination of voluntary movements.
(C) Initiation of voluntary movements.
(D) Modulation of muscle tone.
(E) Regulation of posture and balance by the flocculonodular lobe.

(60) Electroencephalography (EEG) is a non-invasive technique that records the brain's electrical activity through scalp electrodes to assess cortical function and diagnose neurological disorders.

Which of the following best describes the EEG pattern characteristic of deep (slow-wave) sleep?

(A) High-amplitude delta waves with low frequency.
(B) Low-voltage, fast beta waves.
(C) Mixed-frequency theta and beta activity with muscle atonia.
(D) Saw-tooth waves.
(E) Sleep spindles.

2nd MBBS Repeat Exam (BATCH 1) MCQ PAPER ANSWERS

(1) FFTTT
(2) FFTTT
(3) TTTFT
(4) FTTFT
(5) TFFTF
(6) TTFFT
(7) FFTTT
(8) TFTTF
(9) TTFTT
(10) TTTTF
(11) TTFTF
(12) TTTTT
(13) FTFFT
(14) TTTTF
(15) FTFTT
(16) FFTTF
(17) TTTFF
(18) TTTFT
(19) TTTTF
(20) TTTTF
(21) TTFTF
(22) TFTTT
(23) TTFFT
(24) TTTFF
(25) TFTFT
(26) TTTFF
(27) TTTTF
(28) TFTTT
(29) TFTTT
(30) FTFTF
(31) A
(32) A
(33) E
(34) E
(35) A
(36) A
(37) A
(38) B
(39) D
(40) A
(41) A
(42) C
(43) D
(44) A
(45) B
(46) C
(47) D
(48) A
(49) C
(50) C
(51) C
(52) B
(53) A
(54) E
(55) E
(56) E
(57) A
(58) D
(59) B
(60) A

2nd MBBS Repeat Exam (BATCH 1) STRUCTURED ESSAY (SEQ) PAPER

(1) A 22-year-old male presents with progressive swelling of the face and legs and frothy urine (urine that appears bubbly or foamy) for 3 weeks. On examination, he has periorbital puffiness and pitting oedema of both legs. Clinical diagnosis of nephrotic syndrome is made.

His investigation results are as follows;

- Serum albumin: 1.8 g/dL (Normal: 3.5–5.0 g/dL)
- Urine protein (dipstick): ++++
- Serum creatinine: 0.8mg/dL (0.7-1.3mg/dL)

(1.1) Define the term oedema. (10 Marks)

(1.2) Briefly explain the reasons for his serum albumin level. (15 Marks)

(1.3) Describe the pathophysiological basis of generalized oedema in this patient. (45 Marks)

(1.4) List two abnormalities you expect to see in the serum protein electrophoresis of this patient. (20 Marks)

(1.5) Name one biochemical test that can quantify the amount of protein in the urine of this patient. (10 Marks)

(2) Certain changes take place in the cardiovascular system when a healthy person stands up from lying down position.

(2.1) Briefly explain what happens to the following when a person stands up from lying down position:

(2.1.1) Venous return (10 Marks)

(2.1.2) Cardiac output (10 Marks)

(2.1.3) Blood pressure (10 Marks)

(2.2) Explain the mechanism by which the baroreceptors help to maintain blood pressure when a person stands up from lying down position. (30 Marks)

(2.3) What is postural hypotension? (10 Marks)

(2.4) Explain why postural hypotension occurs in the following conditions:

(2.4.1) Patients with longstanding diabetes mellitus (15 Marks)

(2.4.2) Patients with hypovolaemia (15 Marks)

(3) A 22-year-old male presents with reduced facial hair growth, decreased libido, and poor muscle development. His voice has remained relatively high-pitched since adolescence. On examination, he has sparse axillary and pubic hair, small testicular volume, and reduced muscle mass. clinical diagnosis of primary hypogonadism is made.
His investigations are as follows

Test	Result	Normal Range
Serum Testosterone	6 nmol/L	(10–35 nmol/L)
Serum LH	22 IU/L	(1.8–8.6 IU/L)
Serum FSH	28 IU/L	(1.5–12.4 IU/L)
Serum Prolactin	10 ng/mL (4–15 ng/mL)	(4–15 ng/mL)

(3.1) Define the term secondary sexual characteristics. (10 Marks)
(3.2) Name one male secondary sexual characteristic that occurs in each of the following body parts. (15 Marks)
(3.2.1) The penis
(3.2.2) The skin
(3.2.3) The vocal cords
(3.3) List three (03) metabolic effects of testosterone (15 Marks)
(3.4) With the help of an illustrated diagram, explain the regulation of testosterone synthesis in a healthy adult. (40 Marks)
(3.5) Comment on the FSH and LH levels in this patient, giving reasons. (20 Marks)

(4) Explain the physiological basis of following:
(4.1) Elevated serum bilirubin levels in patients with sickle cell anaemia. (25 Marks)
(4.2) Peak expiratory flow rate (PEFR) measurements are useful for assessing the treatment response during an acute attack of asthma. (25 Marks)
(4.3) Steatorrhea occurring in pancreatic insufficiency. (25 Marks)
(4.4) Anaemia in chronic kidney disease (CKD) (25 marks)

(5) Pain is not merely a sensation but a complex, modulated physiological response essential for protection, survival and behavioural adaptation.
(5.1) State the definition of pain (10 Marks)
(5.2) State the differences between superficial pain and visceral pain. (30 Marks)
(5.3) Explain the term referred pain. (10 Marks)
(5.4) Explain the convergence-projection theory of referred pain. (30 Marks)
(5.5) Give four examples of referred pain (20 Marks)

(6) Explain the physiological basis of following observations:

(6.1) Competitive neuromuscular junction blockers have a non-depolarising type of action. (25 Marks)

(6.2) Numbness of the lateral three fingers of the hand is observed in nerve compression at the wrist. (25 Marks)

(6.3) A thoracic spinal cord lesion produces a sensory level at T10 dermatome. (25 Marks)

(6.4) The pupil changes its size reflexively in response to changes in illumination. (25 Marks)

2nd MBBS Repeat Exam (BATCH 1) SEQ PAPER ANSWERS

(1) A 22-year-old male presents with progressive swelling of the face and legs and frothy urine (urine that appears bubbly or foamy) for 3 weeks. On examination, he has periorbital puffiness and pitting oedema of both legs. Clinical diagnosis of nephrotic syndrome is made.

His investigation results are as follows;

- **Serum albumin: 1.8 g/dL (Normal: 3.5–5.0 g/dL)**
- **Urine protein (dipstick): ++++**
- **Serum creatinine: 0.8mg/dL (0.7-1.3mg/dL)**

(1.1) Define the term oedema. (10 Marks)

Point	Marks
Abnormal accumulation of fluid	4
In interstitial/tissue spaces	3
Producing clinically detectable swelling	3

(1.2) Briefly explain the reasons for his serum albumin level. (15 Marks)

Point	Marks
Glomerular filtration barrier damage	3
Increased permeability to plasma proteins	3
Massive proteinuria/albuminuria	3
Urinary protein loss exceeds hepatic synthesis	3
Resulting hypoalbuminaemia	3

(1.3) Describe the pathophysiological basis of generalized oedema in this patient. (45 Marks)

Point	Marks
Heavy protein loss in urine	5
Hypoalbuminaemia develops	5
Reduced plasma colloid osmotic pressure	5
Reduced fluid reabsorption into capillaries	5
Fluid shifts into interstitial space	5
Oedema develops	5
Reduced effective circulating volume	5
Activation of RAAS/ADH/SNS	5
Sodium and water retention worsening oedema	5

(1.4) List two abnormalities you expect to see in the serum protein electrophoresis of this patient. (20 Marks)

a) Reduced albumin fraction

- Identification – 5
- Explanation – 5

b) Increased α2-globulin fraction

- Identification – 5
- Explanation – 5

(1.5) Name one biochemical test that can quantify the amount of protein in the urine of this patient. (10 Marks)

Urinary protein quantification (10 Marks)

Any one:

- 24-hour urinary protein estimation
- Urine protein-creatinine ratio

(2) Certain changes take place in the cardiovascular system when a healthy person stands up from lying down position.

(2.1) Briefly explain what happens to the following when a person stands up from lying down position:

(2.1.1) Venous return (10 Marks)

Point	Marks
Gravity causes pooling of blood in legs	4
Reduced venous return to heart	6

(2.1.2) Cardiac output (10 Marks)

Point	Marks
Reduced venous return	3
Reduced ventricular filling/preload	3
Reduced stroke volume	2
Reduced cardiac output	2

(2.1.3) Blood pressure (10 Marks)

Point	Marks
Reduced cardiac output	4
Transient fall in arterial BP	6

(2.2) Explain the mechanism by which the baroreceptors help to maintain blood pressure when a person stands up from lying down position. (30 Marks)

Point	Marks
Reduced stretch of carotid sinus/aortic arch	3
Reduced baroreceptor firing	3
Reduced impulses via CN IX & X	3
Reduced NTS stimulation	3
Increased sympathetic activity	4
Reduced parasympathetic activity	3
Increased heart rate	3
Increased contractility	3
Vasoconstriction	3
BP restored toward normal	2

(2.3) What is postural hypotension? (10 Marks)

Point	Marks
Definition of orthostatic hypotension	5
≥20 mmHg systolic or ≥10 mmHg diastolic fall on standing	5

(2.4) Explain why postural hypotension occurs in the following conditions:

(2.4.1) Patients with longstanding diabetes mellitus (15 Marks)

Point	Marks
Diabetic autonomic neuropathy	5
Impaired baroreceptor reflex	5
Inadequate sympathetic compensation → BP fall	5

(2.4.2) Patients with hypovolaemia (15 Marks)

Point	Marks
Reduced circulating blood volume	5
Reduced venous return and CO	5
Standing worsens BP fall causing postural hypotension	5

(3) A 22-year-old male presents with reduced facial hair growth, decreased libido, and poor muscle development. His voice has remained relatively high-pitched since adolescence. On examination, he has sparse axillary and pubic hair, small testicular volume, and reduced muscle mass. clinical diagnosis of primary hypogonadism is made.

His investigations are as follows

Test	Result	Normal Range
Serum Testosterone	**6 nmol/L**	**(10–35 nmol/L)**
Serum LH	**22 IU/L**	**(1.8–8.6 IU/L)**
Serum FSH	**28 IU/L**	**(1.5–12.4 IU/L)**
Serum Prolactin	**10 ng/mL (4–15 ng/mL)**	**(4–15 ng/mL)**

(3.1) Define the term secondary sexual characteristics. (10 Marks)

Point	Marks
Physical characteristics developing at puberty	4
Due to sex hormones	3
Not directly involved in reproduction	3

(3.2) Name one male secondary sexual characteristic that occurs in each of the following body parts. (15 Marks)

(3.2.1) The penis

Increase in penile size – 5

(3.2.2) The skin

Growth of facial/body hair – 5

(3.2.3) The vocal cords

Deepening of voice – 5

(3.3) List three (03) metabolic effects of testosterone (15 Marks)

Any three:

- Increased protein synthesis
- Increased muscle mass
- Increased bone growth
- Increased erythropoiesis
- Increased basal metabolic activity

5 marks each × 3 = 15

(3.4) With the help of an illustrated diagram, explain the regulation of testosterone synthesis in a healthy adult. (40 Marks)

Point	Marks
Hypothalamus secretes GnRH	5
GnRH stimulates anterior pituitary	5
LH secretion	5
LH stimulates Leydig cells	5
Testosterone production	5
Negative feedback on hypothalamus	5
Negative feedback on pituitary	5
Inhibin suppresses FSH	5

(3.5) Comment on the FSH and LH levels in this patient, giving reasons. (20 Marks)

Point	Marks
Both elevated	5
Primary testicular failure	5
Reduced testosterone	5
Loss of negative feedback → ↑ LH & FSH	5

(4) Explain the physiological basis of following:

(4.1) Elevated serum bilirubin levels in patients with sickle cell anaemia. (25 Marks)

Point	Marks
Sickle cell disease causes chronic haemolysis	5
Increased destruction of RBCs	5
Increased haemoglobin breakdown	5
Increased bilirubin production (mainly unconjugated bilirubin)	5
Production exceeds hepatic conjugating capacity → hyperbilirubinaemia	5

(4.2) Peak expiratory flow rate (PEFR) measurements are useful for assessing the treatment response during an acute attack of asthma. (25 Marks)

Point	Marks
PEFR reflects degree of airway obstruction	5
Asthma causes bronchoconstriction and increased airway resistance	5
PEFR decreases during acute attack	5
Treatment reduces airway obstruction	5
Improvement in PEFR indicates response to treatment	5

(4.3) Steatorrhea occurring in pancreatic insufficiency. (25 Marks)

Point	Marks
Pancreatic insufficiency reduces pancreatic enzyme secretion	5
Lipase deficiency develops	5
Impaired digestion of dietary fat	5
Reduced fat absorption from intestine	5
Excess fat excreted in stool → steatorrhoea	5

(4.4) Anaemia in chronic kidney disease (CKD) (25 marks)

Point	Marks
Kidneys normally produce erythropoietin (EPO)	5
CKD damages renal tissue	5
Reduced EPO production	5
Reduced erythropoiesis in bone marrow	5
Anaemia develops (may be worsened by uraemic toxins)	5

(5) Pain is not merely a sensation but a complex, modulated physiological response essential for protection, survival and behavioural adaptation.

(5.1) State the definition of pain (10 Marks)

Point	Marks
Unpleasant sensory experience	4
Associated with actual or potential tissue damage	4
Includes emotional component	2

(5.2) State the differences between superficial pain and visceral pain. (30 Marks)

Superficial Pain	Visceral Pain
Well localized	Poorly localized
Sharp/pricking	Dull, aching/cramping
Arises from skin	Arises from viscera
Mainly Aδ fibres	Mainly C fibres
Less commonly referred	Frequently referred
Easier to identify source	Difficult to identify source

(5.3) Explain the term referred pain. (10 Marks)

Point	Marks
Pain perceived at site distant from source	5
Due to shared neural pathways/segmental innervation	5

(5.4) Explain the convergence-projection theory of referred pain. (30 Marks)

Point	Marks
Visceral afferents enter spinal cord	5
Somatic afferents enter same spinal segment	5
Both converge on common second-order neuron	5
Brain is more accustomed to somatic pain signals	5
Visceral pain impulses interpreted as somatic origin	5
Pain perceived in corresponding dermatome	5

(5.5) Give four examples of referred pain (20 Marks)

Example	Marks
Myocardial infarction → left arm/shoulder	5
Gallbladder disease → right shoulder	5
Diaphragmatic irritation → shoulder tip	5
Ureteric colic → groin	5
Appendicitis → umbilical region	5
Pancreatitis → back	5

(6) Explain the physiological basis of following observations:

(6.1) Competitive neuromuscular junction blockers have a non-depolarising type of action. (25 Marks)

Point	Marks
Drug binds nicotinic ACh receptors	5
Competitive antagonism with acetylcholine	5
Prevents receptor activation	5
End-plate depolarisation does not occur	5
Muscle action potential and contraction prevented	5

(6.2) Numbness of the lateral three fingers of the hand is observed in nerve compression at the wrist. (25 Marks)

Point	Marks
Median nerve passes through carpal tunnel	5
Compression causes carpal tunnel syndrome	5
Median nerve supplies sensation to thumb, index and middle fingers	5
Sensory impulse transmission impaired	5
Numbness/paresthesia develops in lateral three fingers	5

(6.3) A thoracic spinal cord lesion produces a sensory level at T10 dermatome. (25 Marks)

Point	Marks
Each spinal segment supplies a dermatome	5
T10 dermatome corresponds to umbilical region	5
Thoracic spinal lesion interrupts ascending sensory pathways	5
Sensory information from below lesion cannot ascend normally	5
Sensory loss begins below T10 producing sensory level	5

(6.4) The pupil changes its size reflexively in response to changes in illumination. (25 Marks)

Point	Marks
Light stimulates retinal photoreceptors	5
Impulses travel via optic nerve (CN II)	5
Signals reach pretectal and Edinger–Westphal nuclei	5
Parasympathetic fibres travel in oculomotor nerve (CN III) to sphincter pupillae	5
Pupil constricts in bright light (miosis); dilates in dim light (mydriasis)	5

2nd MBBS Repeat Exam (BATCH 1) OSPE QUESTIONS

(1) Descriptive statistics

A study measured resting heart rates (beats per minute) in 8 medical students:
68, 72, 70, 72, 76, 72, 68, 80

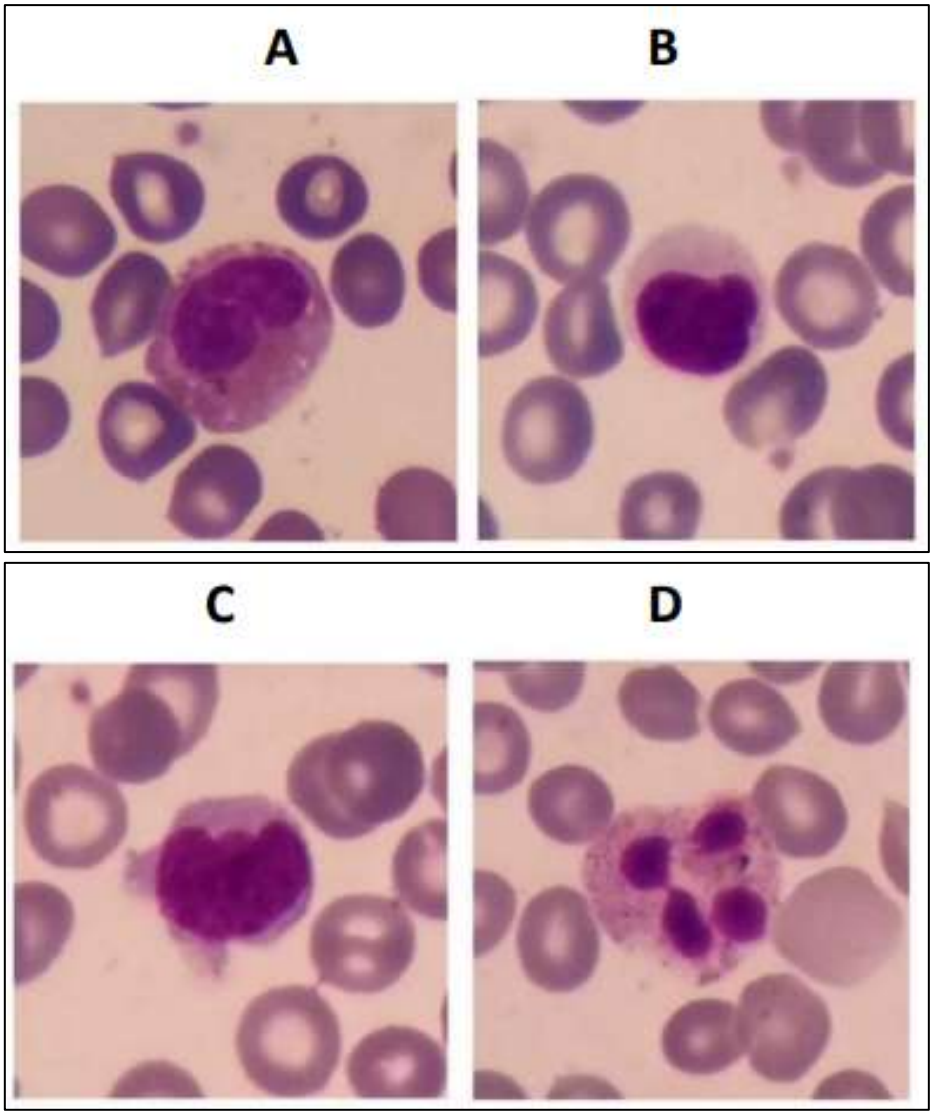
Answer the following questions:

(1.1) What is the mode of the dataset? (3 marks)

(1.2) What is the range of the heart rates? (4 marks)

(1.3) State one reason why standard deviation is preferred over range as a measure of dispersion. (3 marks)

(2) Blood cells

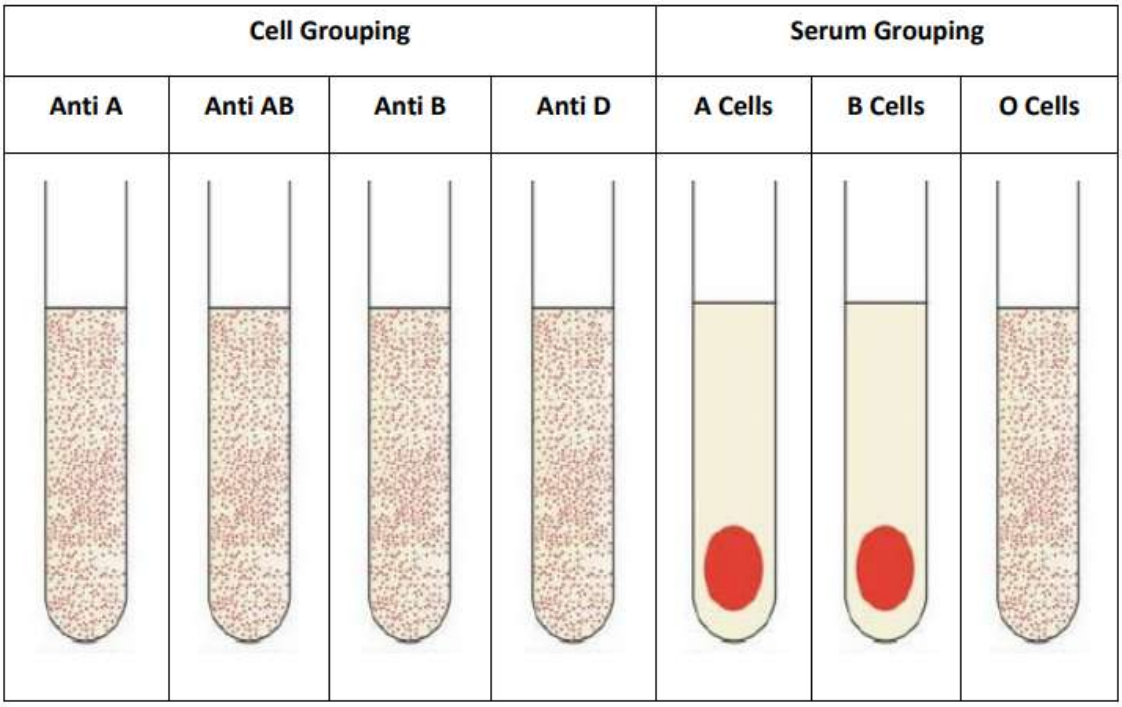


(2.1) Identify the blood cells labelled A, B, C and D (6 marks)

(2.2) Name one condition in which each of these cells A, B, C and D are elevated (4marks)

(3) Blood Grouping

Blood grouping results [cell and serum] of a 25year old female blood donor are shown below

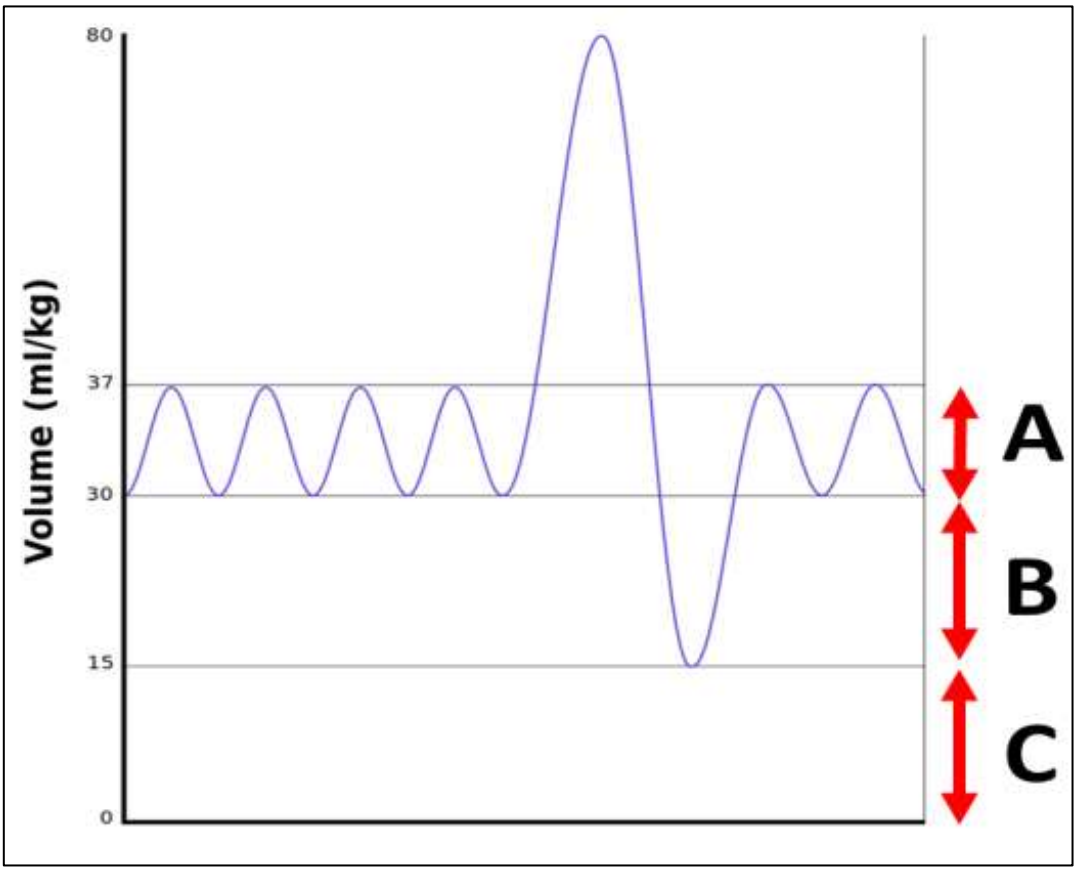


(3.1) Identify the blood group of the donor. (4 marks)

(3.2) If this blood donor marries a Group O, Rh D positive man who is heterozygous for the D antigen [Dd], what is the percentage chance that their child becoming Rh D positive (3marks)

(3.3) If the mother, in her second pregnancy, delivers a Group O, Rh D positive baby who is jaundiced at birth and has a low Hb level, what is the most likely diagnosis in the baby? (3 marks)

(4) Lung volumes and capacities

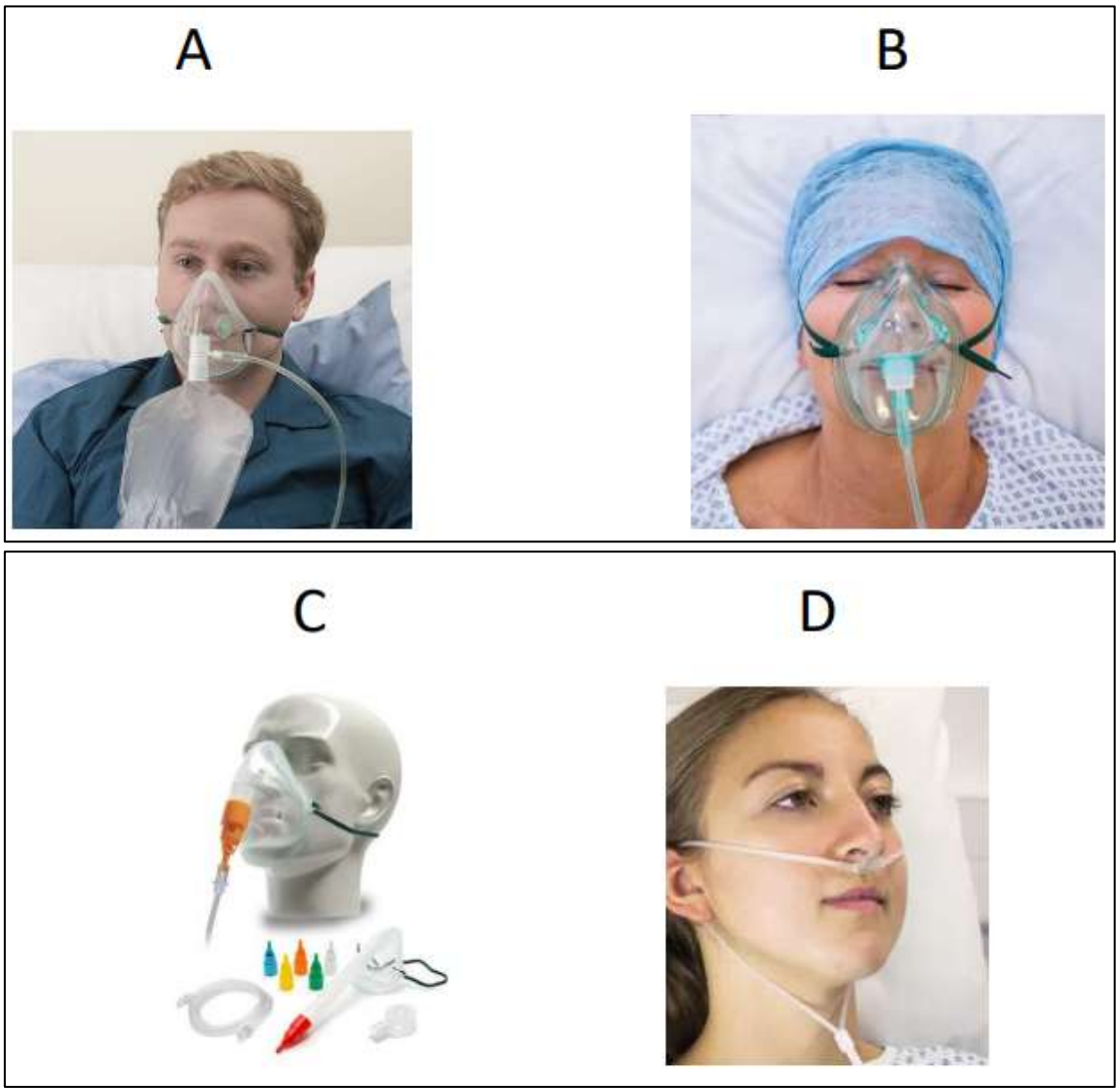


(4.1) Identify A.B, and C. (6 marks)

(4.2) What is the term used to describe the sum of B and C? (2 marks)

(4.3) State one clinical condition in which C is increased. (2 marks)

(5) Oxygen Delivery Devices



(5.1) Identify A, B, C and D (4 marks)

(5.2) State which device out of A, B, C and D would be the best device to use in each of the following clinical conditions/situations. (6 marks)

(5.2.1) Low flow oxygen delivery for stable patients

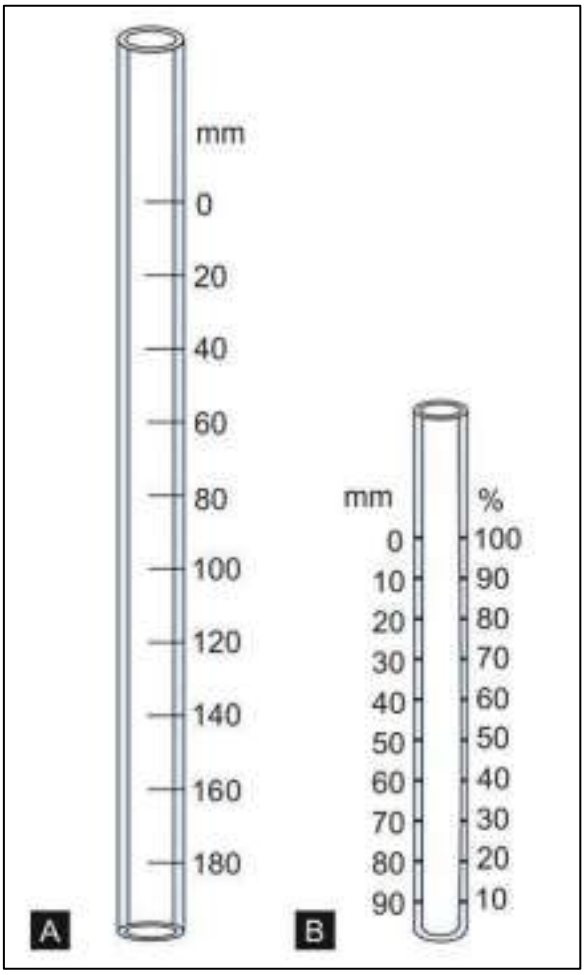
(5.2.2) Moderate hypoxemia

(5.2.3) COPD

(5.2.4) Severe hypoxemia

(6) Two instruments

The two instruments shown below are used to perform a specific blood test



(6.1) Identify the instruments labelled A and B (4 marks)

(6.2) Name the blood test carried out using

(6.2.1) instrument A

(6.2.2) instrument B (4 marks)

(6.3) State two disease conditions in which the instrument A would give very high readings. (2 marks)

(7) Palpation of arterial pulse



Identify palpation of arterial pulse labelled D E, F, G and H. (10 marks)

(8) Collapsed patient

The pictures shown below are the steps in cardiopulmonary resuscitation (CPR)

A



B



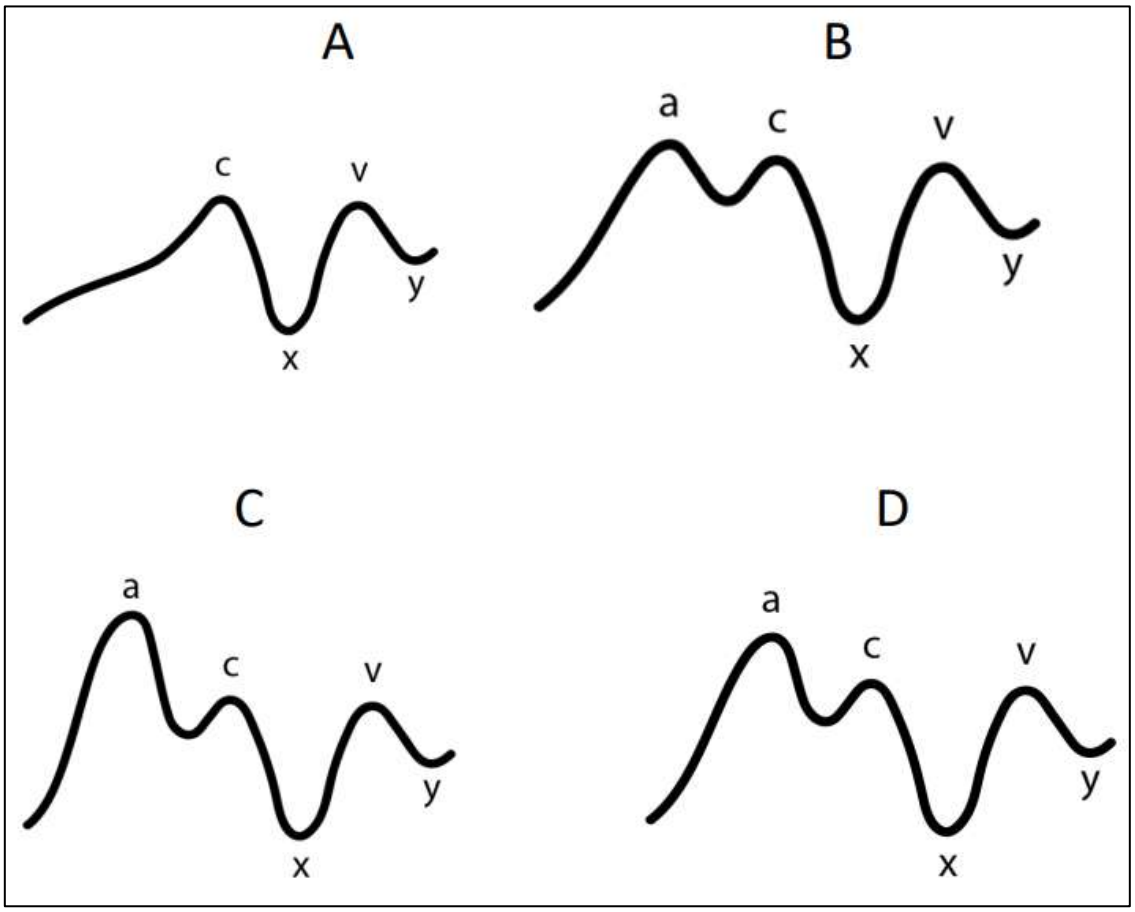
C



(8.1) Identify the steps A, B, and C (6 marks)

(8.2) State two steps that you would follow when giving chest compressions according to Basic Life Support (BLS) guidelines (4 marks)

(9) Jugular venous pulse (JVP) waves



Different patterns of JVP waves are shown above.

Match them with A, B, C and D.

(9.1) Canon wave

(9.2) Normal wave

(9.3) Large a wave

(9.4) Absent a wave.

(10) An ECG

Please calculate the following in this standard ECG



(10.1) PR interval in milliseconds (4 marks)

(10.2) Heart rate (3 marks)

(10.3) Height of the R wave in millivolts (3 marks)

(11) Live station

Demonstrate how to correctly measure Peak Expiratory Flow Rate (PEFR) using this device. (Peak flow meter is provided (10 marks)

(12) Neurological examination of the lower limb



(12.1) What is being tested in this examination? (2marks)

(12.2) What is the normal response? (4 marks)

(12.3) State one clinical condition in which this response is

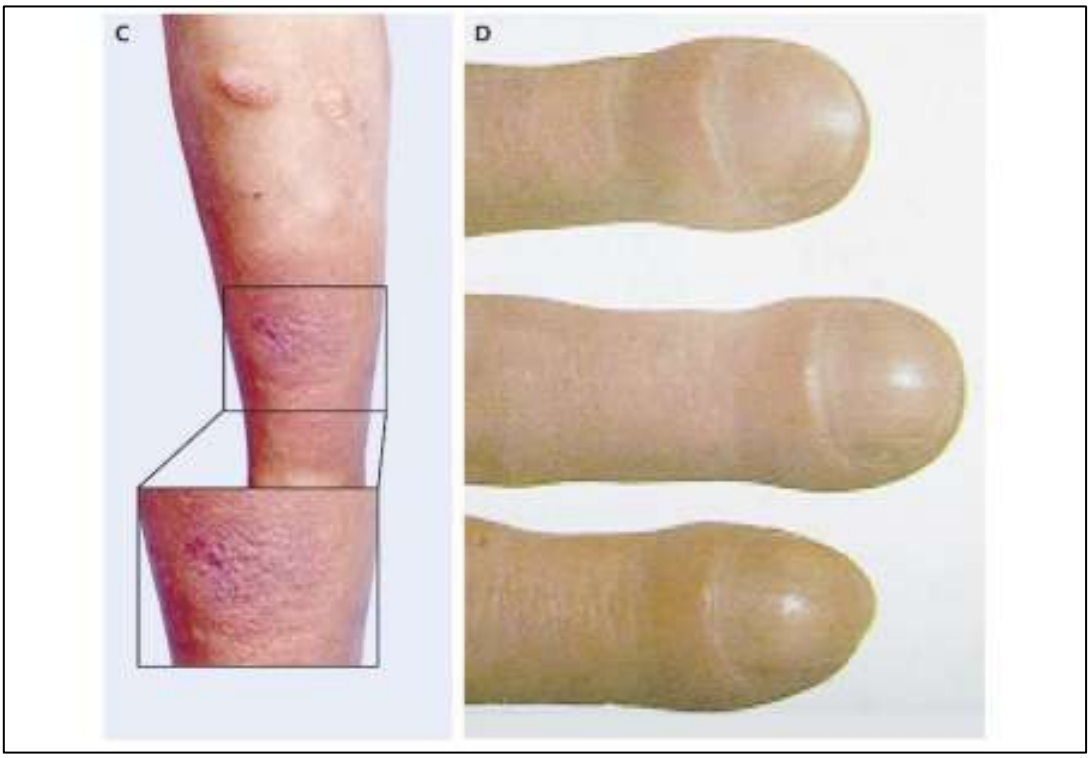
(12.3.1) Absent

(12.3.2) Exaggerated (4 marks)

(13) Physical sign

This patient presents with weight loss, palpitation and heat intolerance.





(13.1) State two abnormalities seen in this patient (4 marks)

(13.2) What is the name given for this condition (3marks)

(13.3) What is the hormone responsible for this condition? (3 marks)

(14) The Respiratory system examination

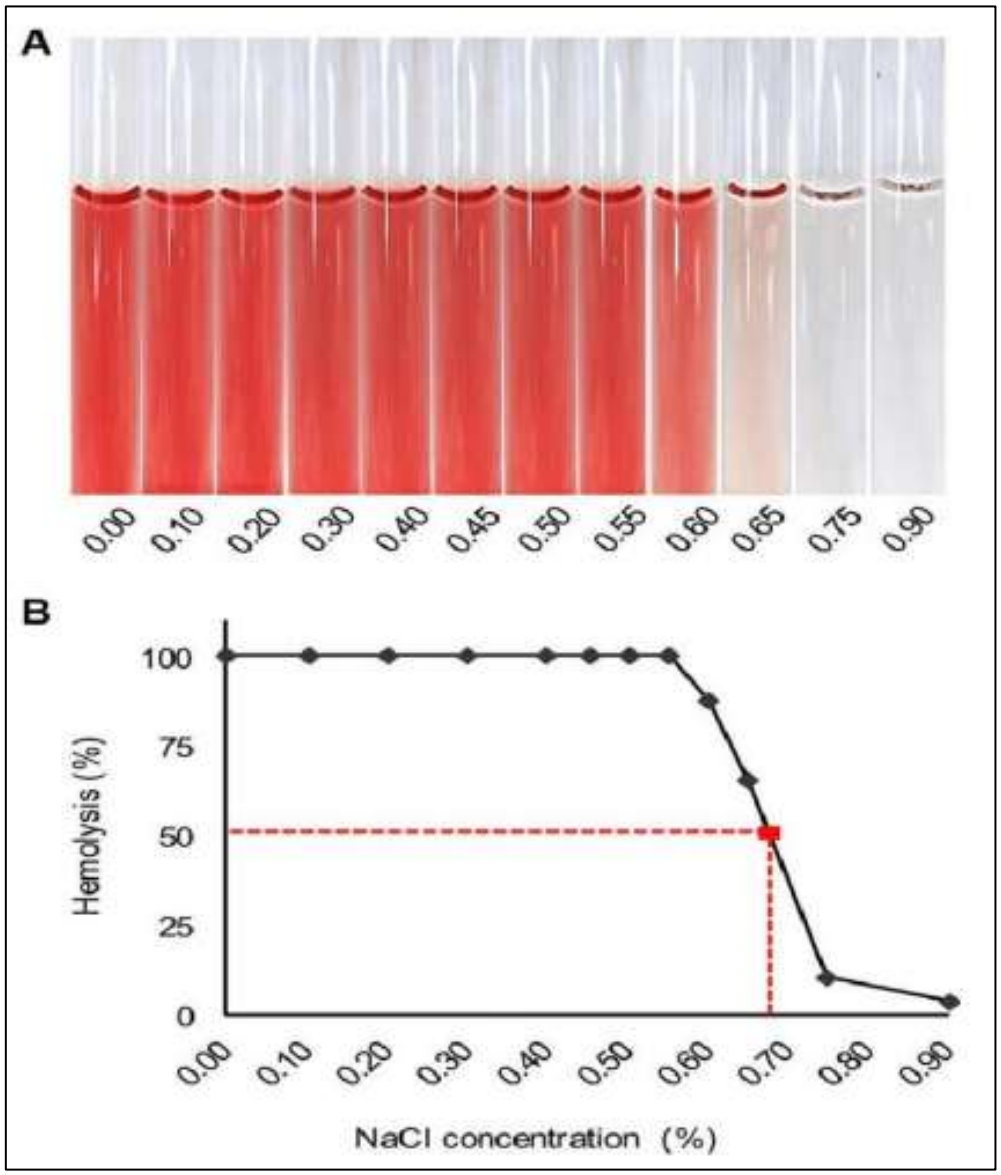


(14.1) What is the examination step being performed? (3 marks)

(14.2) State two important techniques when performing this step (4 marks)

(14.3) What is the finding in a healthy adult during this examination? (3 marks)

(15) A hematological test



(15.1) what is the name of this test (3marks)

(15.2) Identify A and B (3 marks)

(15.3) Name two conditions that can show abnormal results in this test (4 marks)

(16) Semen analysis report

Macroscopic Parameter	Result	Normal values
Appearance	normal	Normal
Liquefaction	normal	Within 60 min
Viscosity	normal	Normal
Volume	2	1.5 – 5.5cc
pH	7	7.0 - 8.0
WBC	1-2	None - Occasional

SQA-V Automated Parameter	Result	Unit	Normal Values
Sperm Count	2.2	million/ml	≥20
• Slow Motility	20%		
• Non-Motile	80%		
Morphology (% Normal Forms)	50	%	≥60

(16.1) State two advises you give to the patient to follow before the test. (4 marks)

(16.2) Identify two abnormal findings in this report (4 marks)

(16.3) Name two possible causes for the abnormalities mentioned. (2 marks)

(17) Cranial nerve examination

The following examination techniques were performed during a cranial nerve examination

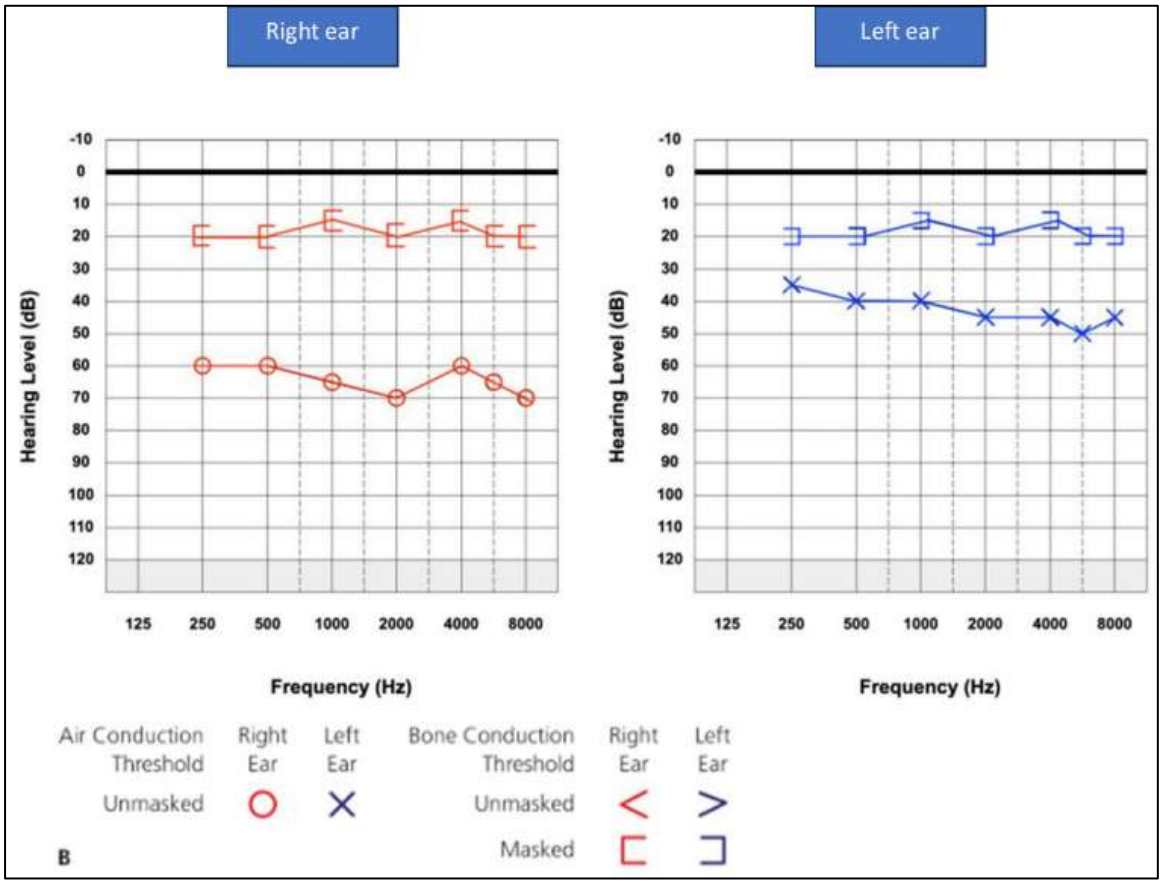


(17.1) Identify test A and test B (6 marks)

(17.2) What cranial nerve is being tested? (4 marks)

(18) Hearing test

A 50-year-old male presents with reduced hearing, Audiometry was performed

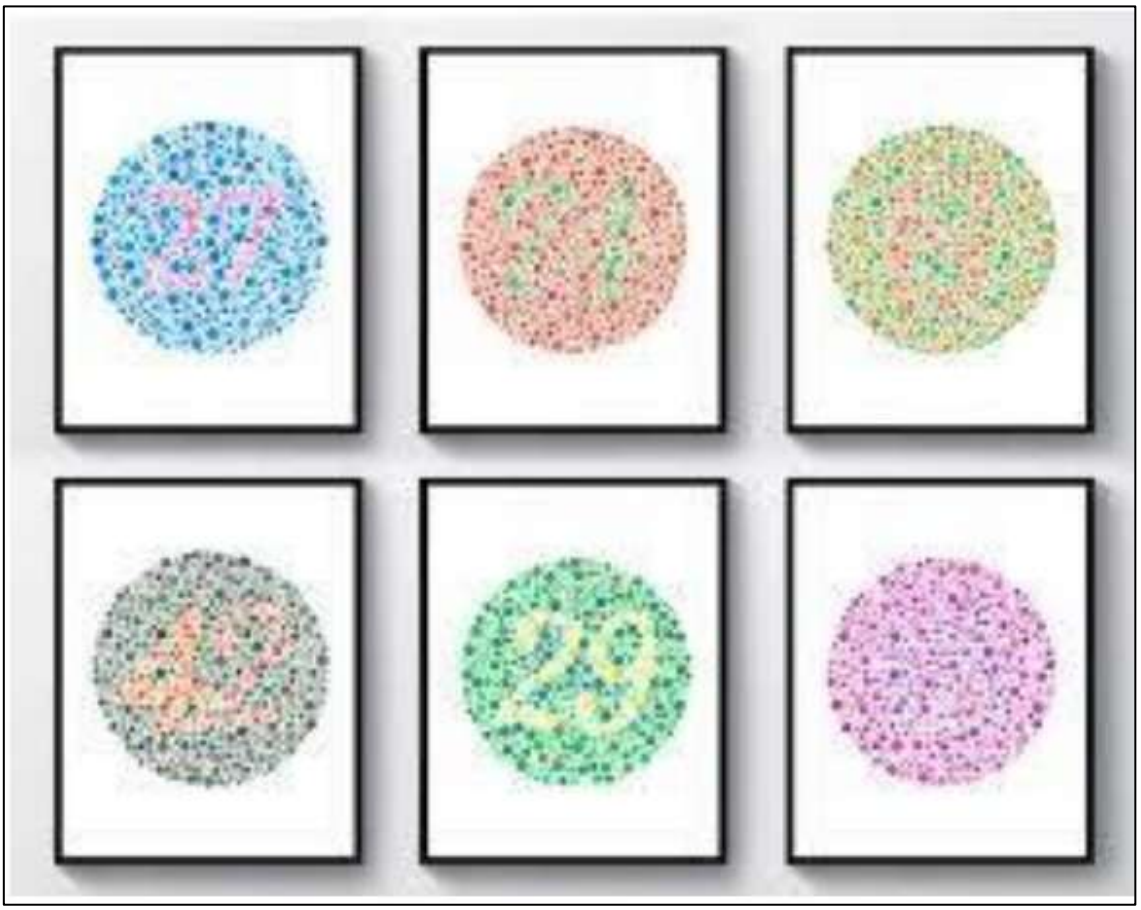


(18.1) Identify the type of hearing loss shown in the audiogram (4 marks)

(18.2) Provide reasons for your answer in 18.1 (4 marks)

(18.3) What are the hearing loss thresholds in the left and right ears (2 marks)

(19) A visual test



(19.1) what is the name of this chart? (4 marks)

(19.2) What is the use of it? (4 marks)

(19.3) Name one condition that gives abnormal results with this chart? (2 marks)

(20) Live station

(20.1) Please measure the systolic and diastolic blood pressure of this patient

(20.2) Record your finding (10 marks)

2nd MBBS Repeat Exam (BATCH 1) OSPE ANSWERS

(1) A study measured resting heart rates (beats per minute) in 8 medical students:
68, 72, 70, 72, 76, 72, 68, 80

(1.1) mode = 72 (03 marks)

(1.2) Range 80-68=12bpm (04 marks) highest value=80 lowest value 68

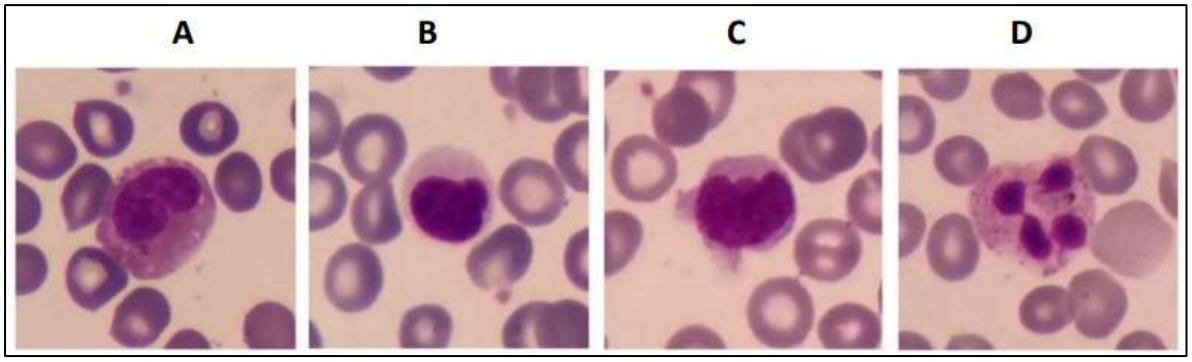
(1.3) Reason SD is preferred:

It uses all data points, not just the highest and lowest.

Less affected by outliers.

Gives a more accurate measure of variability.

(2)



(2.1) A Eosinophil B. Lymphocyte C Monocyte D Neutrophil (1.5*4 = 06 marks)

(2.2) A Allergic Asthma, parasitic infection

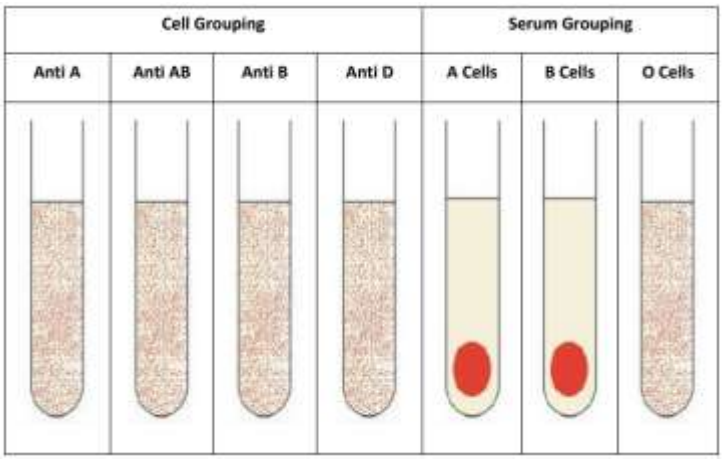
B. Viral infection

C. Chronic infection eg TB

D acute bacterial infection

(1*4 = 04 marks)

(3)

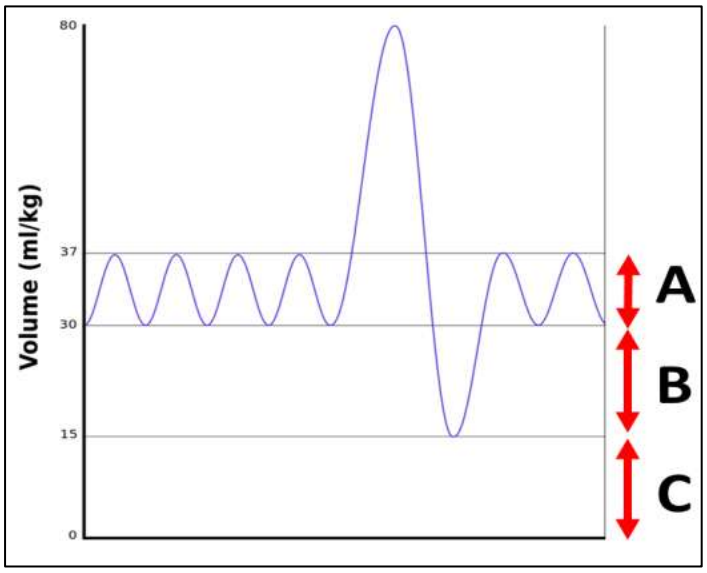


(3.1) Group O Rh D Negative (04 marks)

(3.2) 50% (03 marks)

(3.3) Hemolytic Disease of the Newborn [HDN] or Hemolytic Disease of Fetus and Newborn [HDFN] Both answers are correct (03 marks)

(4)

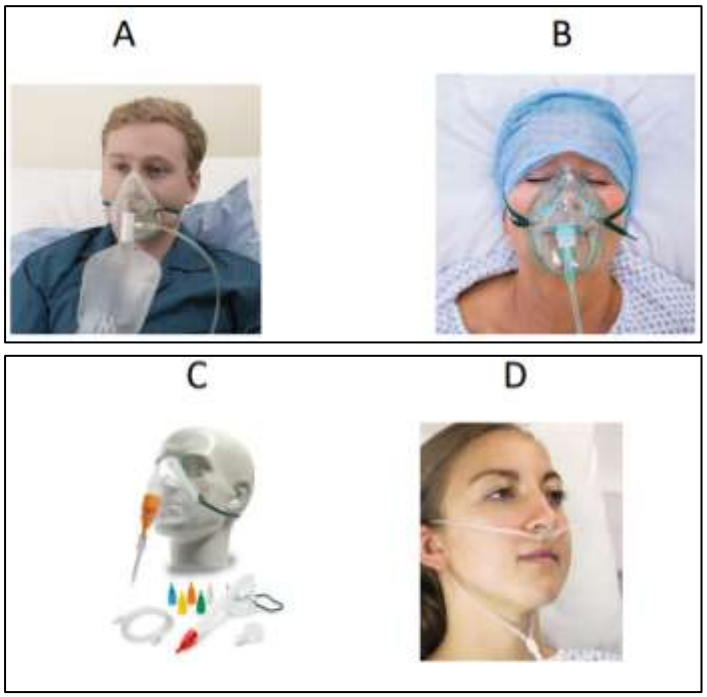


(4.1) A Tidal volume (TV) B Expiratory reserve volume (ERV) C Residual volume (RV) (2*3 = 06 marks)

(4.2) Functional residual capacity (FRC) (02 marks)

(4.3) Obstructive lung disease (Asthma, COPD, chronic bronchitis, emphysema) (02 marks)

(5)



(5.1) A – non-rebreather mask (reservoir mask), B – simple face mask, C – venturi mask, D – nasal cannula (nasal prongs) (1*4 = 04 marks)

(5.2)

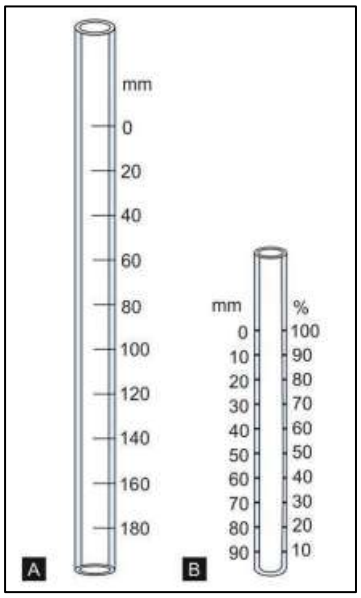
(5.2.1) nasal cannula (D),

(5.2.2) simple face mask (B),

(5.2.3) venturi mask (C),

(5.2.4) non-rebreather mask (A) (1.5*4 = 6 marks)

(6)



(6.1) A = Westergren tube, B = Wintrobe tube (2*2 = 02 marks)

(6.2) A – erythrocyte sedimentation rate (ESR), B – PCV (2*2 = 02 marks)

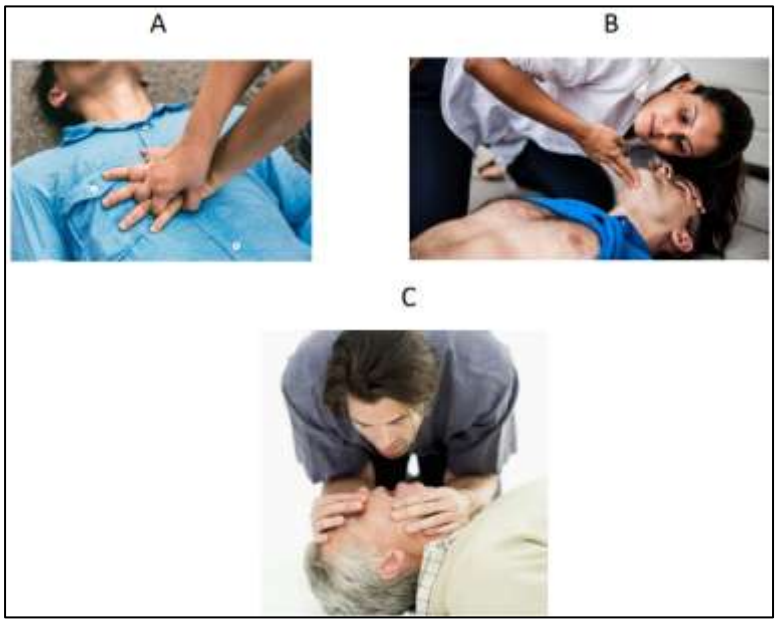
(6.3) TB, MM, RA, Malignancy (1*2 = 02 marks)

(7)



D – ulnar pulse, E – femoral pulse, F – popliteal pulse, G – dorsalis pedis pulse, H – posterior tibial pulse (2*5 = 10 marks)

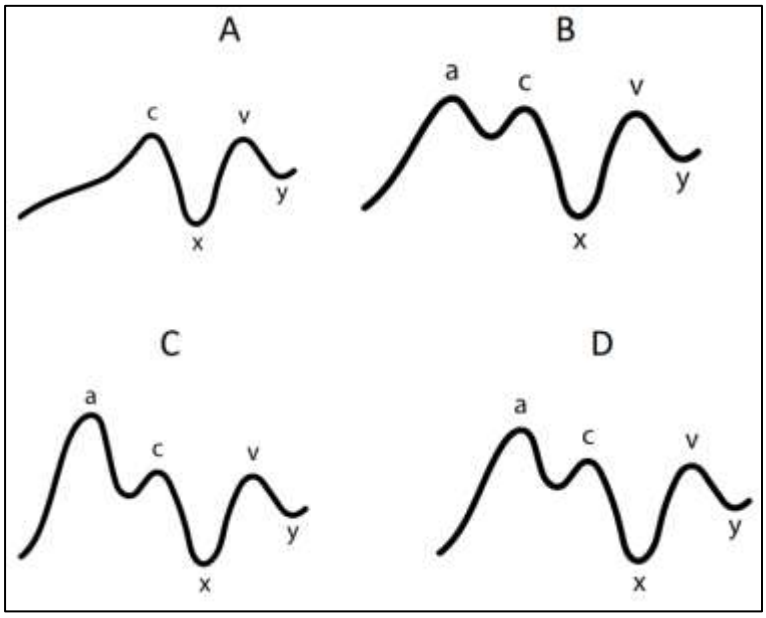
(8)



(8.1) A – compressions/push hard and fast on the center of the victim's chest
B – airway/tilt the victim's head back and lift the chin to open the airway
C – breathing/give mouth-to-mouth rescue breaths (2*3 = 06 marks)

(8.2) Hand position: heel of one hand on center of chest (lower half of the sternum), other hand on top. Depth: at least 5 cm (2 inches), Rate: 100-120 compressions per minute. Allow chest to recoil after each compression. (2*2 = 04 marks)

(9)



(9.1) C
(9.2) B
(9.3) D
(9.4) A (2.5*4 = 10 marks)

(10)



(10.1) Calculations (04 marks)
1 small square = 0.04 s = 40 ms
PR interval = 4*40 ms = 160 ms

(10.2) Calculations (03 marks)
1 large square = 0.2 s
R-R interval = 4*0.2 = 0.8 s
Heart rate = 60/0.8 = 75 bpm (alternatively: 300/4 large squares = 75 bpm)

(10.3) Calculations (03 marks) Height of R wave = 10 mm (from isoelectric line to peak) 10 mm = 1 mV R wave amplitude = 1 mV

(11) Live station: Peak Expiratory Flow Meter (10 marks)

(12)



(12.1) Patellar (knee jerk) reflex (02 marks)

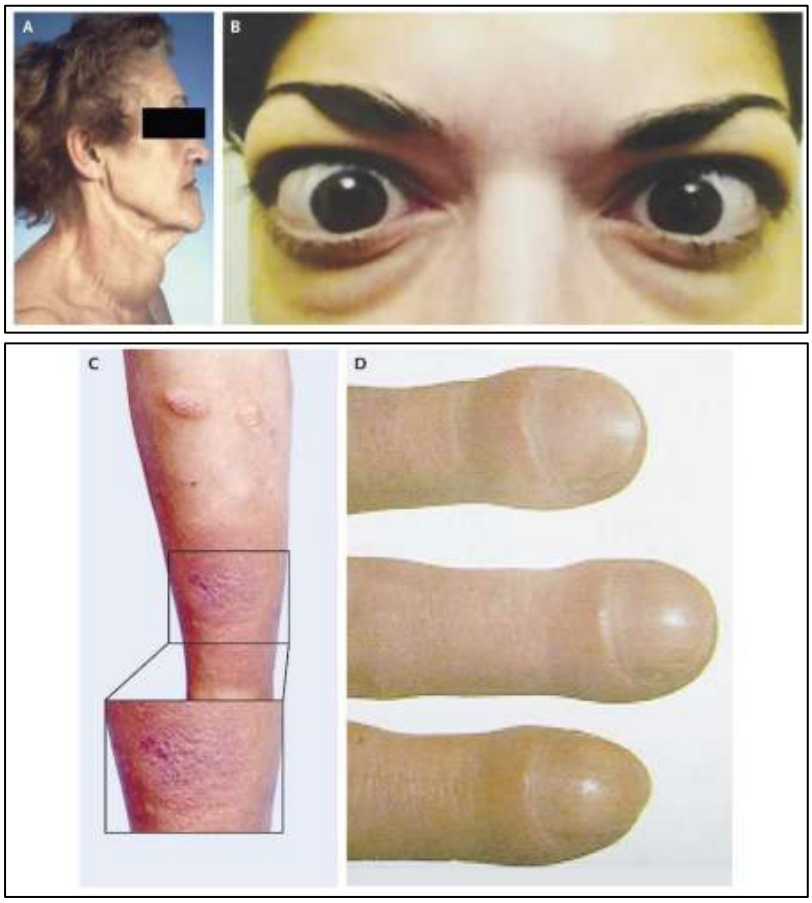
(12.2) Sudden contraction of the quadriceps femoris muscle (02 marks), Extension of the knee joint (02 marks)

(12.3)

(12.3.1) Absent (02 marks) lower motor neuron lesion at L3-L4 example: femoral neuropathy/lumbar disc prolapse (L4 root lesion)

(12.3.2) exaggerated (02 marks) Upper motor neuron lesion above L3-L4 example: stroke/spinal cord lesion above L3

(13)



(13.1) Any two of the following earn full marks: diffuse goitre (neck swelling) exophthalmos/Graves' ophthalmopathy (proptosis with lid retraction) pretibial myxoedema (localized dermopathy over the shins) thyroid acropachy (clubbing and soft-tissue swelling of fingers) (02 marks per correctly identified abnormality)

(13.2) Graves' disease (Autoimmune hyperthyroidism) (03 marks)

(13.3) Thyroid hormones – thyroxine (T4) and Tri-iodothyronine (T3) (03 marks)

(14)

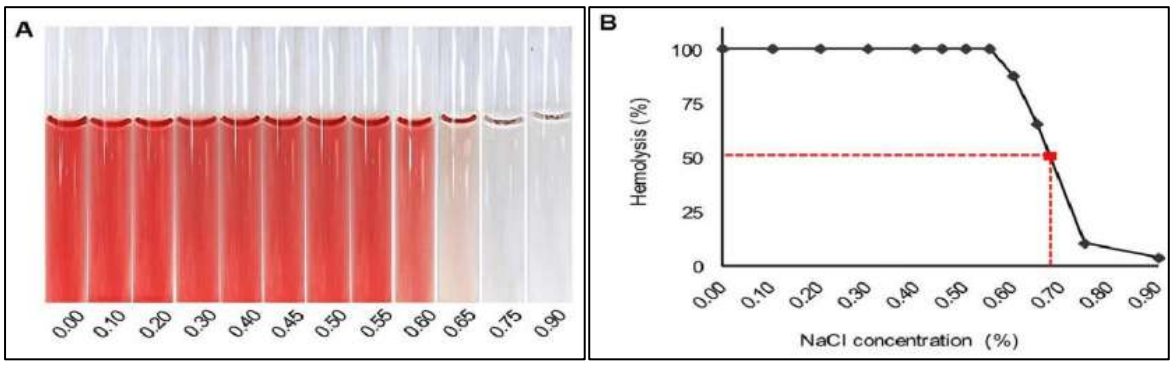


(14.1) Percussion of the chest/chest (03 marks)

(14.2) Any two of the following (02 marks each) use the middle finger of the non-percussing hand firmly placed on the intercostal space parallel to the ribs strike the distal interphalangeal joint of the pleximeter finger sharply with the tip of the middle finger of the other hand percuss symmetrically, comparing side to side at the same level percuss over intercostal spaces, not directly over bone or scapula

(14.3) Resonant percussion note heard over the lung fields (03 marks)

(15)



(15.1) Osmotic fragility test (03 marks)

(15.2) A – osmotic fragility tubes

Series of test tubes containing decreasing concentrations of NaCl

Progressive haemolysis of RBCs is seen as NaCl concentration falls

B – osmotic fragility curve Graph showing percentage hemolysis plotted against NaCl concentration (%) The point at which 50% hemolysis occurs indicates RBC fragility (1.5*2 = 03 marks)

(16)

Macroscopic Parameter	Result	Normal values
Appearance	normal	Normal
Liquefaction	normal	Within 60 min
Viscosity	normal	Normal
Volume	2	1.5 – 5.5cc
pH	7	7.0 - 8.0
WBC	1-2	None - Occasional

SQA-V Automated Parameter	Result	Unit	Normal Values
Sperm Count	2.2	million/ml	≥20
• Slow Motility	20%		
• Non-Motile	80%		
Morphology (% Normal Forms)	50	%	≥60

(16.1) Any two of the following

a) Maintain sexual abstinence for 2-7 days before providing semen sample

b) Avoid fever, acute illness, alcohol, and smoking for several days prior to the test

c) Sample should be collected by masturbation into a clean, dry, sterile container

d) Entire ejaculate should be collected and delivered to the laboratory within 1 hour, kept close to body temperature. (2*2 = 04 marks)

(16.2) Low sperm count (oligozoospermia)

reduced sperm motility (asthenozoospermia)

(morphology is also borderline low at 50%, normal ≥60%, but two abnormalities are sufficient) (2*2 = 04 marks)

(16.3) Any two of the following

Varicocele

Hormonal abnormalities (↓ testosterone, FSH/LH imbalance)

Testicular damage (infection, trauma, mumps orchitis)

Chronic alcohol use, smoking, or heat exposure

Genetic causes (e.g., Y-chromosome microdeletions) (1*2 = 02 marks)

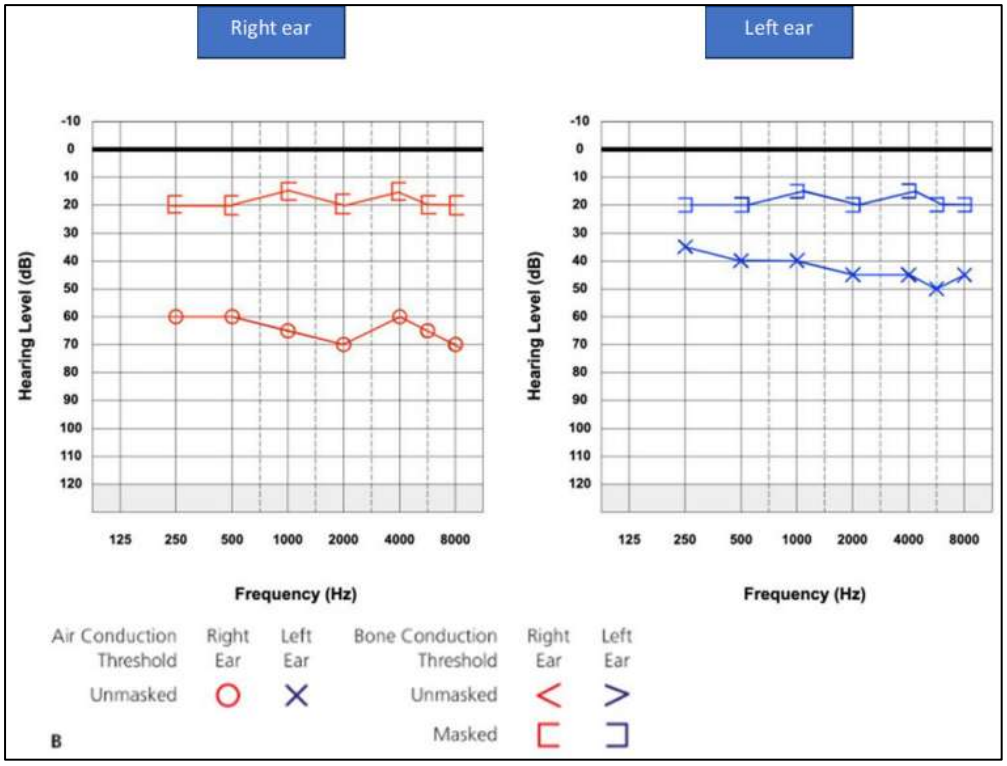
(17)



(17.1) Test A: Shoulder shrug against resistance Used to assess the trapezius muscle Test B: Head rotation against resistance Used to assess the sternocleidomastoid muscle (3*2 = 06 marks)

(17.2) Accessory nerve (Cranial nerve XI) (04 marks)

(18)

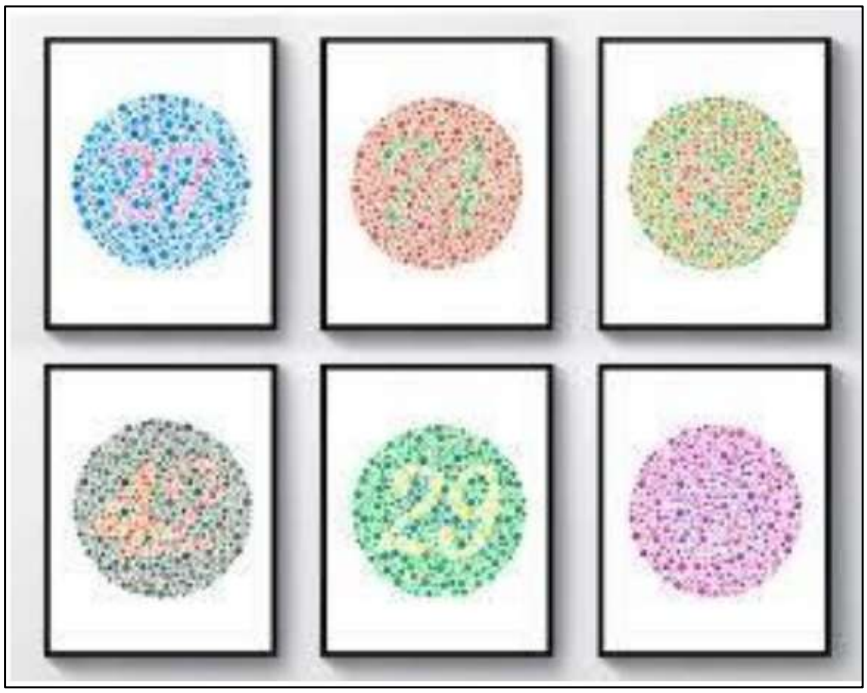


(18.1) Conductive deafness in both left and right ears/bilateral conductive hearing loss (04 marks)

(18.2) Bone conduction is normal and air conduction is reduced in both ears (increased air bone gap on the audiogram) (04 marks)

(18.3) Right ear – 20-70 dB average 40 dB left ear – 20-50 dB average 20 dB (02 marks)

(19)



(19.1) Ishihara color vision chart (Ishihara plates) (04 marks)

(19.2) To screen for color vision defects, especially red, green color blindness (04 marks)

(19.3) Anyone of the following red, green color blindness Congenital color vision defect (02 marks)

(20) Live station: BP Measurement



MESSAGE OF THE DEAN

As the Dean of the Uva Wellassa Medical Faculty, I am delighted to present "Mastering Physiology – Part III: A Comprehensive Guide to MCQs, Essays, and OSPEs." This publication represents a significant achievement in our ongoing commitment to enhancing the quality of medical education and supporting student learning.

In the ever-evolving discipline of medicine, a thorough knowledge of Physiology continues to be a cornerstone of academic and professional success. This guide has been thoughtfully designed to serve as a comprehensive learning resource, covering a wide range of assessment formats, including MCQs, essays, and OSPEs, while providing detailed explanations and model answers to reinforce understanding.

The primary aim of this book is to equip students with the knowledge and skills necessary to excel in examinations and deepen their comprehension of physiological principles. We believe that this guide will become a trusted companion throughout your academic journey, helping to build confidence, improve clarity, and establish a strong foundation for learning.

I extend my heartfelt gratitude to the faculty members and contributors whose dedication, expertise, and hard work made this publication possible. It is our sincere hope that you will find this guide both informative and inspiring as you advance through your medical studies.

I wish you every success in your academic endeavors and in your future career as a medical professional.

Sincerely,
Senior Professor Muditha Vidanapathirana,
MBBS (Col), DLM, MD, MA (SJP), FFFLM (UK)
Dean,
Faculty of Medicine,
Uva Wellassa University of Sri Lanka

Rs. 1500/-

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