INI CET Physiology

Sample Paper – 3

Duration: 14 Minutes **Maximum Marks: 15**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Best Response), modelled on the Physiology content of **INI CET** (Institutes of National Importance Combined Entrance Test) conducted by AIIMS New Delhi.
- The **15-question** length matches the number of Physiology items you actually meet in the real 200-question paper.
- Each correct answer carries **+1 mark**. There is **negative marking of one-third (0.33) mark** for every incorrect answer; unattempted questions carry no penalty.
- Every question has **exactly one best answer**. Choose the single most appropriate option.
- Attempt this practice paper in one timed sitting of about **14 minutes**, the pace the real computer-based test demands.

General, Nerve and Muscle Physiology

Q1. Using the Nernst equation, the resting membrane potential of a neuron lies close to the equilibrium potential of one particular ion, because the resting membrane is most permeable to it. That ion is:

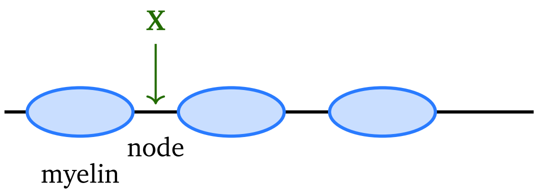
(A) Potassium (K^+)

(B) Sodium (Na^+)

(C) Calcium (Ca^{2+})

(D) Chloride (Cl^-)

Q2. In the myelinated axon below, the impulse jumps from one node of Ranvier (marked **X**) to the next rather than moving continuously. This saltatory conduction mainly produces:



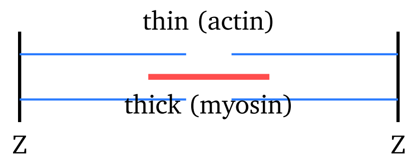
(A) Slower conduction along the axon

(B) A steady loss of action-potential amplitude

(C) Faster conduction velocity along the axon

(D) Continuous depolarisation of the internodal membrane

Q3. In the sarcomere shown, contraction shortens the muscle. According to the sliding filament theory, this happens because:



(A) The thick (myosin) filaments physically shorten

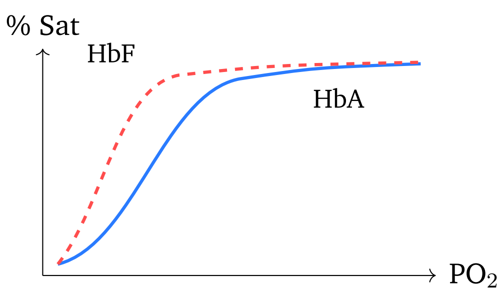
(B) The thin (actin) filaments physically shorten

(C) Both thick and thin filaments shorten together

(D) The thin filaments slide over the thick filaments, so the sarcomere shortens while filament lengths stay the same

Blood and Body Fluids

Q4. The dashed curve shows fetal haemoglobin (HbF) relative to adult haemoglobin (HbA). HbF differs from HbA because it:



(A) Is made of two alpha and two beta chains with the same oxygen affinity as HbA

(B) Is made of two beta and two gamma chains with lower oxygen affinity than HbA

(C) Is made of two alpha and two delta chains with lower oxygen affinity than HbA

(D) Is made of two alpha and two gamma chains ($\alpha_2\gamma_2$) with higher oxygen affinity than HbA

Q5. During primary haemostasis, platelets first adhere to exposed subendothelial collagen at a site of injury. This adhesion is mediated by which plasma protein, which bridges platelet glycoprotein Ib to collagen?

(A) Fibrinogen

(B) Thrombin

(C) von Willebrand factor

(D) Plasminogen

Cardiovascular System

Q6. A resting adult has a heart rate of 72 beats per minute and a stroke volume of 70 mL. Using cardiac output = heart rate $\times$ stroke volume, the cardiac output is closest to:

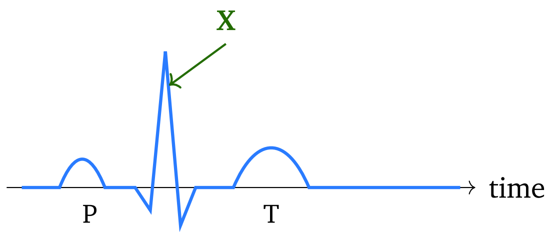
(A) About 5.0 L/min

(B) About 1.0 L/min

(C) About 7.2 L/min

(D) About 3.5 L/min

Q7. In the ECG trace below, the tall deflection marked **X** (the QRS complex) represents:



(A) Depolarisation of the ventricles

(B) Depolarisation of the atria

(C) Repolarisation of the ventricles

(D) Repolarisation of the atria

Q8. Blood flow through the left coronary artery to the left ventricular myocardium is greatest during which part of the cardiac cycle?

(A) Systole

(B) Diastole

(C) Isovolumetric contraction

(D) The rapid ejection phase

Respiratory System

Q9. The term "anatomical dead space" refers to:

(A) Alveoli that are ventilated but not perfused with blood

(B) The tidal volume of about 500 mL that reaches the alveoli

(C) The air remaining in the lungs after a maximal forced expiration

(D) The volume of the conducting airways (about 150 mL) that does not take part in gas exchange

Q10. In a normal upright lung, the ventilation-perfusion (V/Q) ratio is:

(A) Uniform and equal to 1 throughout the lung

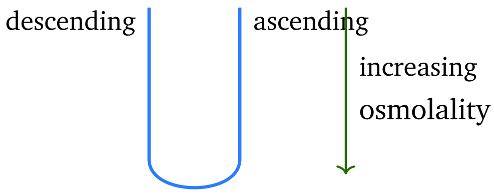
(B) Higher at the apex than at the base

(C) Higher at the base than at the apex

(D) Zero at the apex because it is unventilated

Renal System

Q11. The steep osmotic gradient of the renal medulla, shown by the arrow beside the tubule loop below, is generated mainly by:



loop of Henle

(A) Filtration across the glomerular capillary barrier

(B) The countercurrent multiplier of the loop of Henle

(C) Aldosterone acting on the distal convoluted tubule

(D) Bulk reabsorption in the proximal convoluted tubule

Q12. Glucose starts to appear in the urine once plasma glucose rises above the renal threshold. This "spilling" of glucose occurs because:

(A) The glomerular filtration rate suddenly falls

(B) Glucose begins to be actively secreted into the tubule

(C) The tubular transport maximum (Tm) for glucose is exceeded, so the carriers become saturated

(D) Antidiuretic hormone is released and blocks reabsorption

Gastrointestinal, Endocrine and Neurophysiology

Q13. Secretin, released from duodenal S cells when acidic chyme enters the small intestine, mainly stimulates:

(A) Increased gastric acid secretion by parietal cells

(B) Contraction of the gallbladder to release bile

(C) Secretion of bicarbonate-rich fluid from the pancreatic duct cells

(D) Release of digestive enzymes (zymogens) from pancreatic acini

Q14. In the hypothalamo-pituitary-thyroid axis, a rise in circulating T3 and T4 causes:

(A) Increased release of TSH from the anterior pituitary

(B) Decreased release of TSH from the anterior pituitary by negative feedback

(C) Increased release of TRH from the hypothalamus

(D) No change, because the axis is not feedback controlled

Q15. When muscle tension rises to very high levels, the Golgi tendon organ (via its Ib afferent fibres) triggers a reflex that:

(A) Causes reflex relaxation of the same muscle, protecting it against overload

(B) Causes reflex contraction of the same muscle to add force

(C) Detects the length of the muscle through Ia afferent fibres

(D) Increases gamma motor neuron drive to the muscle spindle

Detailed Solutions

Q1.

Solution

Concept – Nernst equilibrium potential: Each ion has an equilibrium potential set by its concentration gradient.

Step 1 – name the ion: At rest the membrane is most permeable to **potassium (K^+)**, so the potential sits close to the K^+ equilibrium potential (about -90 mV).

Step 2 – why: The resting potential of -70 mV lies near, but slightly positive to, the K^+ equilibrium because of a small Na^+ leak.

Why the other options are wrong:

- B, Na^+: its equilibrium potential is about $+60$ mV, far from rest.
- C, Ca^{2+}: very low resting permeability, does not set the rest.
- D, Cl^-: contributes little in a typical neuron at rest.

Final Answer: Potassium (K^+) $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – saltatory conduction: Myelin insulates the internodes, so current flows only at the nodes of Ranvier.

Step 1 – what happens at X: The impulse regenerates only at each node (**X**) and appears to jump from node to node.

Step 2 – the effect: Skipping the insulated internodes gives **faster conduction velocity** while using less energy.

Why the other options are wrong:

- A, slower conduction: myelination speeds conduction, not slows it.
- B, loss of amplitude: the spike is regenerated fully at every node.
- D, continuous internodal depolarisation: the internode is insulated and is not depolarised.

Final Answer: Faster conduction velocity along the axon $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – sliding filament theory: Muscle shortening comes from filaments sliding, not from filaments shrinking.

Step 1 – the mechanism: Myosin cross-bridges pull the **thin (actin) filaments over the thick (myosin) filaments** toward the centre of the sarcomere.

Step 2 – the result: The Z-lines are drawn closer, so the sarcomere shortens, yet the actin and myosin filaments keep their own lengths.

Why the other options are wrong:

- A, thick filaments shorten: filament length does not change.
- B, thin filaments shorten: they slide, they do not shrink.
- C, both shorten: neither filament changes length.

Final Answer: Thin filaments slide over thick filaments, sarcomere shortens $\Rightarrow$ $\boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q3

Q4.

Solution

Concept – fetal haemoglobin (HbF): HbF is the main haemoglobin before birth and has a different chain make-up.

Step 1 – its structure: HbF is **two alpha and two gamma chains** ($\alpha_2\gamma_2$), unlike adult HbA which is $\alpha_2\beta_2$.

Step 2 – its property: The gamma chains bind 2,3-BPG poorly, so HbF has **higher oxygen affinity**; its curve sits to the *left*, letting the fetus pull oxygen from maternal blood.

Why the other options are wrong:

- A, $\alpha_2\beta_2$: that is adult HbA, not HbF.
- B, $\beta_2\gamma_2$ with lower affinity: wrong chains and wrong affinity.
- C, $\alpha_2\delta_2$: that is HbA2, a minor adult form.

Final Answer: $\alpha_2\gamma_2$ with higher oxygen affinity than HbA $\Rightarrow$ $\boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q4

Q5.

Solution

Concept – platelet adhesion in primary haemostasis: Adhesion needs a molecular bridge to exposed collagen.

Step 1 – name the bridge: von Willebrand factor links platelet glycoprotein Ib to subendothelial collagen.

Step 2 – what follows: This anchors platelets under high shear, letting them activate and aggregate to form the platelet plug.

Why the other options are wrong:

- A, fibrinogen: bridges platelets to each other (aggregation), not to collagen.
- B, thrombin: a coagulation enzyme, not the adhesion bridge.
- D, plasminogen: precursor of plasmin, which dissolves clots.

Final Answer: von Willebrand factor $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – cardiac output: Cardiac output $=$ heart rate $\times$ stroke volume.

Step 1 – put in the numbers: 72 beats/min $\times$ 70 mL $=$ 5040 mL/min.

Step 2 – convert: 5040 mL/min $=$ 5.04 L/min, that is about **5.0 L/min**, the normal resting value.

Why the other options are wrong:

- B, 1.0 L/min: far too low, would not sustain perfusion.
- C, 7.2 L/min: would need a much larger stroke volume or rate.
- D, 3.5 L/min: below the calculated product.

Final Answer: About 5.0 L/min $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – reading the ECG: Each ECG wave maps to an electrical event in the heart.

Step 1 – identify X: The tall spike **X** is the QRS complex, which is **depolarisation of the ventricles**.

Step 2 – confirm the sequence: P is atrial depolarisation, QRS is ventricular depolarisation, and T is ventricular repolarisation.

Why the other options are wrong:

- B, atrial depolarisation: that is the small P wave.
- C, ventricular repolarisation: that is the T wave.
- D, atrial repolarisation: it is small and hidden inside the QRS.

Final Answer: Depolarisation of the ventricles $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept – coronary blood flow timing: Left ventricular wall tension squeezes the coronary vessels.

Step 1 – name the phase: Left coronary flow is greatest during **diastole**, when the ventricle relaxes.

Step 2 – why: During systole the contracting left ventricular muscle compresses its own intramural vessels, throttling flow; relaxation in diastole releases them.

Why the other options are wrong:

- A, systole: compression reduces left coronary flow.
- C, isovolumetric contraction: part of systole, flow is squeezed.
- D, rapid ejection: still systole, high wall tension limits flow.

Final Answer: Diastole $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – anatomical dead space: Some inspired air never reaches the exchange surface.

Step 1 – define it: It is the **volume of the conducting airways, about 150 mL**, from the nose and trachea to the terminal bronchioles.

Step 2 – why it matters: This air has no alveoli around it, so no gas exchange occurs there; only the rest of the tidal volume is useful.

Why the other options are wrong:

- A, ventilated but not perfused alveoli: that is *alveolar* (not anatomical) dead space.
- B, tidal volume reaching alveoli: that is the effective alveolar ventilation, the opposite idea.
- C, air after maximal expiration: that is the residual volume.

Final Answer: Conducting airways (about 150 mL) with no gas exchange $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q9

Q10.

Solution

Concept – regional V/Q in the upright lung: Gravity affects both ventilation and perfusion, but not equally.

Step 1 – state the pattern: The V/Q ratio is **higher at the apex than at the base**.

Step 2 – why: Going down the lung, blood flow (perfusion) rises more steeply than ventilation, so V/Q falls toward the base; at the apex perfusion is relatively low, so V/Q is high.

Why the other options are wrong:

- A, uniform: V/Q varies from apex to base, it is not uniform.
- C, higher at the base: the reverse of the true gradient.
- D, zero at the apex: the apex is still ventilated and perfused, just with a high ratio.

Final Answer: Higher at the apex than at the base $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q10

Q11.

Solution

Concept – the medullary osmotic gradient: Concentrated urine needs a hyper-osmotic medulla.

Step 1 – name the mechanism: The **countercurrent multiplier of the loop of Henle** builds the gradient, driven by active NaCl pumping out of the thick ascending limb.

Step 2 – how it works: The ascending limb pumps out salt but is water-tight, while the descending limb loses water; the hairpin arrangement multiplies a small single-step difference into a large corticomedullary gradient.

Why the other options are wrong:

- A, glomerular filtration: makes filtrate, does not build the medullary gradient.
- C, aldosterone: fine-tunes Na^+ and K^+ distally, it is not the multiplier.
- D, proximal reabsorption: bulk isosmotic reabsorption, not gradient building.

Final Answer: Countercurrent multiplier of the loop of Henle $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – renal threshold and transport maximum: Tubular glucose carriers can be overwhelmed.

Step 1 – name the reason: Glucose spills into urine once the **transport maximum (Tm) for glucose is exceeded** and the SGLT carriers become saturated.

Step 2 – link to threshold: The renal threshold (≈180 mg/dL plasma) is the plasma level at which the first nephrons reach their Tm and glucose starts to appear in urine.

Why the other options are wrong:

- A, GFR falls: glucosuria here is from saturation, not reduced filtration.
- B, glucose is secreted: glucose is reabsorbed, not secreted.
- D, ADH release: ADH controls water, not glucose reabsorption.

Final Answer: The transport maximum (Tm) for glucose is exceeded $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – secretin: It is the "nature's antacid" hormone of the duodenum.

Step 1 – name the action: Secretin stimulates **bicarbonate-rich fluid secretion from the pancreatic duct cells**.

Step 2 – purpose: This alkaline fluid neutralises the acidic chyme entering the duodenum, protecting the mucosa and giving pancreatic enzymes their working pH.

Why the other options are wrong:

- A, more gastric acid: secretin actually reduces gastric acid.
- B, gallbladder contraction: that is cholecystokinin (CCK).
- D, zymogen release: enzyme secretion is driven mainly by CCK.

Final Answer: Bicarbonate-rich fluid from pancreatic duct cells $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept – hypothalamo-pituitary-thyroid feedback: Thyroid hormones regulate their own release.

Step 1 – name the response: A rise in T3 and T4 **suppresses TSH** release from the anterior pituitary (and TRH from the hypothalamus) by negative feedback.

Step 2 – the loop: Lower TSH then reduces further thyroid stimulation, keeping hormone levels stable.

Why the other options are wrong:

- A, increased TSH: that is positive feedback, which does not operate here.
- C, increased TRH: high T3/T4 lowers TRH, it does not raise it.
- D, no change: the axis is clearly feedback controlled.

Final Answer: Decreased TSH from the anterior pituitary by negative feedback $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept – Golgi tendon organ: It is a tension sensor in series with the muscle fibres.

Step 1 – name the reflex: High tension excites the Ib afferents, which reflexly **relax (inhibit) the same muscle**, the inverse stretch (autogenic inhibition) reflex.

Step 2 – purpose: This protects the muscle and tendon from tearing under excessive load.

Why the other options are wrong:

- B, reflex contraction: the tendon organ inhibits, it does not add force.
- C, monitors length via Ia: that is the muscle spindle, not the tendon organ.
- D, increases gamma drive: gamma motor neurons set spindle sensitivity, unrelated to this reflex.

Final Answer: Reflex relaxation of the same muscle, protecting against overload $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q15

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	D	4	D	5	C
6	A	7	A	8	B	9	D	10	B
11	B	12	C	13	C	14	B	15	A