INI CET Physiology

Sample Paper – 7

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. For each molecule of ATP hydrolysed, the Na^+/K^+ ATPase moves ions across the membrane in which ratio, making it electrogenic?

(A) 3 Na^+ out and 2 K^+ in

(B) 2 Na^+ out and 3 K^+ in

(C) 3 Na^+ in and 2 K^+ out

(D) 1 Na^+ out and 1 K^+ in

Q2. According to the size principle of motor-unit recruitment, as the force of a voluntary contraction is graded upward, motor units are normally recruited in which order?

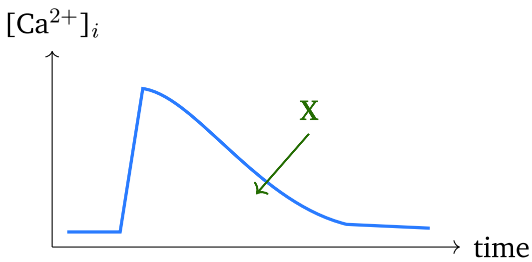
(A) Smallest motor units first, then progressively larger ones

(B) Largest motor units first, then progressively smaller ones

(C) All motor units at once, regardless of size

(D) Randomly, with no relation to motor-unit size

Q3. The trace below shows cytosolic calcium rising and then falling during a single muscle twitch; the label **X** marks the decline that permits relaxation. The pump that returns Ca^{2+} into the sarcoplasmic reticulum to allow relaxation is:



(A) The ryanodine receptor

(B) SERCA (sarcoplasmic reticulum Ca^{2+} ATPase)

(C) The dihydropyridine (voltage-sensor) receptor

(D) The sarcolemmal Na^{+}/Ca^{2+} exchanger

Blood and Body Fluids

Q4. Each gram of fully saturated haemoglobin can carry approximately how much oxygen (its oxygen-carrying capacity)?

(A) 0.003 mL O_2

(B) 0.13 mL O_2

(C) 1.34 mL O_2

(D) 20.1 mL O_2

Q5. The erythrocyte sedimentation rate (ESR) is most directly increased by which of the following changes?

(A) Polycythaemia (a raised red-cell count)

(B) Increased plasma fibrinogen and globulins

(C) Marked sickling of red cells

(D) A fall in total plasma proteins

Cardiovascular System

Q6. Which single change would most directly **increase** venous return to the heart?

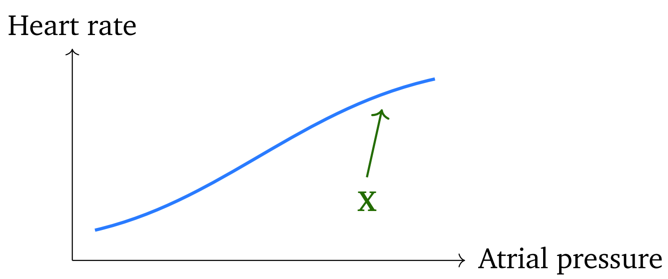
(A) A fall in circulating blood volume

(B) Venodilation of the systemic veins

(C) A large rise in right atrial pressure

(D) Increased mean systemic filling pressure from venoconstriction

Q7. In the plot below, rapid intravenous infusion stretches the right atrium and the heart rate climbs as atrial pressure rises. This response is the:



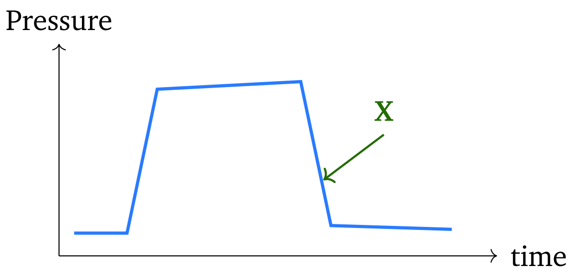
(A) Bezold-Jarisch reflex

(B) Arterial baroreceptor reflex

(C) Cushing reflex

(D) Bainbridge (atrial stretch) reflex

Q8. The ventricular pressure curve below shows a steep fall marked **X**, occurring after ejection with all four valves closed and ventricular volume unchanged, just before the AV valve opens. This phase of the cardiac cycle is:



(A) Isovolumetric relaxation

(B) Isovolumetric contraction

(C) Rapid ventricular ejection

(D) Rapid ventricular filling

Respiratory System

Q9. In a patient with anaemia but entirely normal lungs breathing room air, which statement best describes the arterial oxygen?

(A) Both PO_2 and O_2 content are reduced

(B) PO_2 is normal but O_2 content is reduced

(C) PO_2 is reduced but O_2 content is normal

(D) Both PO_2 and O_2 content are increased

Q10. Excessive inflation of the lungs stimulates slowly adapting pulmonary stretch receptors and inhibits further inspiratory effort. This protective feedback is the:

(A) Hering-Breuer inflation reflex

(B) Cough reflex

(C) J-receptor (pulmonary C-fibre) reflex

(D) Central chemoreceptor response

Renal System

Q11. Potassium secretion into the tubular fluid by the principal cells of the distal tubule and collecting duct is most strongly stimulated by:

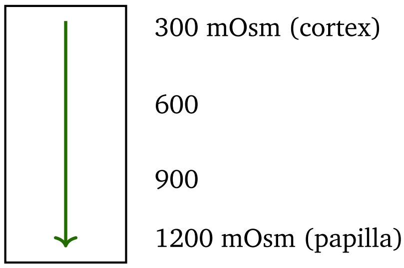
(A) A fall in plasma potassium

(B) A marked reduction in tubular flow

(C) Aldosterone

(D) Atrial natriuretic peptide

Q12. The figure shows interstitial osmolality rising steeply from the cortex toward the renal papilla. This medullary osmotic gradient allows the kidney to:



(A) Dilute the urine below plasma osmolality

(B) Concentrate the urine by drawing water out of the collecting duct

(C) Secrete potassium in the proximal tubule

(D) Reabsorb glucose within the loop of Henle

Gastrointestinal, Endocrine and Neurophysiology

Q13. Between meals, a cyclical wave of strong contractions sweeps undigested residue from the stomach through the small intestine roughly every 90 minutes. This interdigestive "housekeeper" activity is the:

(A) Gastrocolic reflex

(B) Segmentation contractions

(C) Mass movement

(D) Migrating motor complex

Q14. Which pancreatic islet hormone is secreted by the alpha cells and raises blood glucose by stimulating hepatic glycogenolysis and gluconeogenesis?

(A) Insulin

(B) Somatostatin

(C) Glucagon

(D) Pancreatic polypeptide

Q15. Pain and temperature sensation from the body is carried up to the thalamus mainly by which ascending spinal pathway?

(A) Dorsal column-medial lemniscus pathway

(B) Lateral corticospinal tract

(C) Spinothalamic tract

(D) Dorsal spinocerebellar tract

Detailed Solutions

Q1.

Solution

Concept – the electrogenic Na-K pump: The pump moves unequal numbers of the two cations per cycle.

Step 1 – recall the stoichiometry: For every ATP split, it pumps **3 Na^+ out** of the cell and **2 K^+ in**.

Step 2 – why this matters: Because 3 positive charges leave for every 2 that enter, a net positive charge is exported, so the pump is electrogenic and helps set the resting potential.

Why the other options are wrong:

- B, 2 Na^+ out and 3 K^+ in: reverses the true ratio.
- C, 3 Na^+ in and 2 K^+ out: reverses both directions.
- D, 1 Na^+ out and 1 K^+ in: an electroneutral ratio, which the pump is not.

Final Answer: 3 Na^+ out and 2 K^+ in $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – the size principle: A motor unit is one motor neuron plus all the muscle fibres it supplies.

Step 1 – state the rule: Small motor neurons have low thresholds and are recruited first; as more force is needed, **progressively larger** units are added.

Step 2 – the benefit: This orderly recruitment gives smooth, finely graded increases in muscle force.

Why the other options are wrong:

- B, largest first: opposite of the physiological order.
- C, all at once: would prevent fine grading of force.
- D, random: recruitment is orderly, not random.

Final Answer: Smallest motor units first, then larger ones $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – how muscle relaxes: Relaxation needs cytosolic calcium to be cleared quickly.

Step 1 – read the trace: The label **X** sits on the falling limb of the calcium transient, the period when Ca^{2+} is being removed.

Step 2 – name the pump: **SERCA**, the sarcoplasmic reticulum Ca^{2+} ATPase, actively pumps Ca^{2+} back into the SR, lowering cytosolic Ca^{2+} and letting the muscle relax.

Why the other options are wrong:

- A, ryanodine receptor: releases Ca^{2+} from the SR, it does not take it back.
- C, dihydropyridine receptor: the voltage sensor of the T-tubule, not a reuptake pump.
- D, Na^{+}/Ca^{2+} exchanger: extrudes some Ca^{2+} across the sarcolemma but is not the main SR refilling pump.

Final Answer: SERCA $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – oxygen-carrying capacity of haemoglobin: Most blood oxygen is bound to haemoglobin, not dissolved.

Step 1 – recall the constant: Each gram of fully saturated haemoglobin binds about **1.34 mL of oxygen** (Huffner's constant).

Step 2 – apply it: With roughly 15 g/dL of haemoglobin this gives about 20 mL O_2 per 100 mL of blood, the normal bound oxygen content.

Why the other options are wrong:

- A, 0.003 mL: this is the dissolved oxygen coefficient per mmHg, not the Hb capacity.
- B, 0.13 mL: too low by an order of magnitude.
- D, 20.1 mL: this is the content per 100 mL of whole blood, not per gram of Hb.

Final Answer: 1.34 mL O_2 per gram of haemoglobin $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – what drives the ESR: The rate depends chiefly on how readily red cells stack into rouleaux.

Step 1 – name the determinant: Increased plasma fibrinogen and globulins reduce the repulsion between red cells, promoting rouleaux that settle faster, so the ESR rises.

Step 2 – link to disease: This is why the ESR climbs in infection, inflammation, pregnancy and myeloma.

Why the other options are wrong:

- A, polycythaemia: more red cells hinder settling, lowering the ESR.
- C, sickling: abnormally shaped cells form rouleaux poorly, lowering the ESR.
- D, fewer plasma proteins: removes the very factor that speeds sedimentation.

Final Answer: Increased plasma fibrinogen and globulins $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – what governs venous return: Venous return depends on the pressure gradient from the systemic veins back to the right atrium.

Step 1 – identify the driver: Raising the mean systemic filling pressure (for example by venoconstriction or added volume) widens that gradient and increases venous return.

Step 2 – reason it through: More blood pushed from the compliant veins toward the heart means a greater flow back to the right atrium.

Why the other options are wrong:

- A, lower blood volume: lowers filling pressure and reduces venous return.
- B, venodilation: pools blood in the veins, reducing return.
- C, a high right atrial pressure: narrows the gradient and impedes return.

Final Answer: Increased mean systemic filling pressure from venoconstriction $\Rightarrow$ $\boxed{D}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q6

Q7.

Solution

Concept – reflex response to atrial stretch: Stretch of the right atrium signals a rising venous return.

Step 1 – read the graph: As atrial pressure rises the heart rate climbs, the pattern marked **X**.

Step 2 – name the reflex: This is the **Bainbridge reflex**: atrial stretch receptors increase the heart rate, helping the heart pump away the extra returning blood.

Why the other options are wrong:

- A, Bezold-Jarisch: causes bradycardia and hypotension, the opposite response.
- B, baroreceptor reflex: a fall in arterial pressure, not atrial stretch, is its trigger.
- C, Cushing reflex: a response to raised intracranial pressure, giving hypertension and bradycardia.

Final Answer: Bainbridge (atrial stretch) reflex $\Rightarrow$ $\boxed{D}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q7

Q8.

Solution

Concept – phases of the cardiac cycle: Two phases occur with all valves shut and constant ventricular volume.

Step 1 – read the curve: The label **X** marks a steep pressure fall right after ejection, before the AV valve opens.

Step 2 – name the phase: With all valves closed and volume fixed, this falling-pressure phase is **isovolumetric relaxation**, which ends when ventricular pressure drops below atrial pressure and the AV valve opens.

Why the other options are wrong:

- B, isovolumetric contraction: pressure rises, it does not fall.

- C, rapid ejection: the semilunar valve is open and volume is falling.
- D, rapid filling: the AV valve is open and volume is rising.

Final Answer: Isovolumetric relaxation $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – content versus partial pressure of oxygen: Partial pressure reflects dissolved oxygen, while content is the total, mostly Hb-bound, oxygen.

Step 1 – apply it to anaemia: With normal lungs the **PO_2 stays normal**, because gas exchange and dissolved oxygen are unchanged.

Step 2 – explain the content: Because there is less haemoglobin to bind oxygen, the total **oxygen content is reduced**.

Why the other options are wrong:

- A, both reduced: PO_2 is not lowered by anaemia alone.
- C, low PO_2 with normal content: reverses the true picture.
- D, both increased: anaemia reduces, not raises, oxygen content.

Final Answer: PO_2 normal but O_2 content reduced $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept – protective limit on lung inflation: Pulmonary stretch receptors guard against over-expansion.

Step 1 – name the reflex: Large lung inflation stimulates slowly adapting stretch receptors, which through the vagus inhibit further inspiration: the **Hering-Breuer inflation reflex**.

Step 2 – its role: It helps prevent excessive lung stretch, mainly at large tidal volumes such as heavy exercise.

Why the other options are wrong:

- B, cough reflex: a response to airway irritants, not simple stretch.

- C, J-receptor reflex: triggered by pulmonary congestion, causing rapid shallow breathing.
- D, central chemoreceptor response: driven by CSF acidity, not by stretch.

Final Answer: Hering-Breuer inflation reflex $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – distal potassium secretion: Principal cells secrete K^+ under hormonal control.

Step 1 – name the stimulus: Aldosterone increases apical Na^+ and K^+ channels and the basolateral Na-K pump, driving potassium secretion into the tubular fluid.

Step 2 – supporting factors: A high plasma potassium and a high tubular flow also favour secretion, but aldosterone is the key hormonal driver listed here.

Why the other options are wrong:

- A, low plasma potassium: reduces the drive to secrete K^+.
- B, reduced flow: less flow lowers the gradient for secretion.
- D, ANP: promotes sodium and water loss, not principal-cell K^+ secretion.

Final Answer: Aldosterone $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – the medullary osmotic gradient: The interstitium grows saltier from cortex to papilla.

Step 1 – read the figure: Osmolality rises from about 300 mOsm in the cortex to about 1200 mOsm at the papilla.

Step 2 – state its function: This gradient lets the kidney **concentrate the urine** by osmotically drawing water out of the collecting duct (when ADH makes it water-permeable).

Why the other options are wrong:

- A, dilute the urine: dilution occurs where solute is removed without water, not from this gradient.

- C, secrete potassium in the proximal tubule: unrelated to the medullary gradient.
- D, reabsorb glucose in the loop: glucose is reabsorbed in the proximal tubule, not the loop.

Final Answer: Concentrate the urine by drawing water out of the collecting duct $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – interdigestive gut motility: A distinct motor pattern appears in the fasting gut.

Step 1 – name it: The **migrating motor complex** is a cyclical wave, recurring about every 90 minutes, that sweeps residue and bacteria from the stomach down the small intestine.

Step 2 – its nickname: It is called the "housekeeper" of the gut and is linked to the hormone motilin.

Why the other options are wrong:

- A, gastrocolic reflex: increases colonic activity after eating, not a fasting sweep.
- B, segmentation: mixing contractions seen during digestion of a meal.
- C, mass movement: strong propulsive colonic contractions, not the small-bowel housekeeper.

Final Answer: Migrating motor complex $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – the hyperglycaemic islet hormone: Alpha cells oppose insulin.

Step 1 – name it: Glucagon, secreted by the pancreatic alpha cells, raises blood glucose.

Step 2 – its actions: It stimulates hepatic glycogenolysis and gluconeogenesis, releasing glucose into the blood during fasting.

Why the other options are wrong:

- A, insulin: from beta cells, it lowers blood glucose.
- B, somatostatin: from delta cells, it inhibits both insulin and glucagon.
- D, pancreatic polypeptide: modulates gut and pancreatic secretion, not glucose release like this.

Final Answer: Glucagon $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept – ascending sensory pathways: Different modalities travel in different tracts.

Step 1 – name the pathway: Pain and temperature ascend in the **spinothalamic tract**, which crosses within a few segments of entry and projects to the thalamus.

Step 2 – confirm the modality: Its second-order fibres carry the protective sensations of pain and temperature (and crude touch).

Why the other options are wrong:

- A, dorsal column-medial lemniscus: carries fine touch, vibration and proprioception.
- B, corticospinal tract: a descending motor pathway, not sensory.
- D, spinocerebellar tract: carries unconscious proprioception to the cerebellum.

Final Answer: Spinothalamic tract $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q15

Answer Key

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