INI CET Physiology

Sample Paper – 2

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. The sodium-potassium ATPase (Na^+/K^+ pump) of the plasma membrane, per molecule of ATP hydrolysed, transports:

(A) 2 Na^+ out of the cell and 3 K^+ into the cell

(B) 3 Na^+ out of the cell and 2 K^+ into the cell

(C) 3 Na^+ into the cell and 2 K^+ out of the cell

(D) Equal numbers of Na^+ and K^+ in opposite directions (electroneutral)

Q2. During the **absolute** refractory period of a nerve fibre:

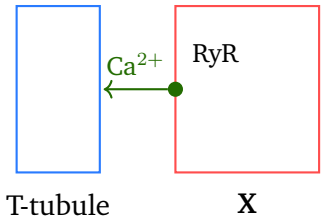
(A) No stimulus, however strong, can evoke a second action potential

(B) A stronger-than-normal stimulus can evoke a second action potential

(C) The membrane is more excitable than at rest

(D) Voltage-gated potassium channels are all closed

Q3. In the schematic of skeletal muscle excitation-contraction coupling below, the calcium ion (Ca^{2+}) that triggers contraction is released mainly from the store marked **X**. This store is the:



(A) Sarcoplasmic reticulum, through ryanodine receptors

(B) Extracellular fluid, entering across the T-tubule membrane

(C) Mitochondrial calcium stores

(D) Golgi apparatus

Blood and Body Fluids

Q4. Which set of clotting factors requires vitamin K for its synthesis in the liver?

(A) Factors I, V, VIII and XIII

(B) Factors II, VII, IX and X

(C) Factors V, VIII, XI and XII

(D) Factors I, V, XI and XIII

Q5. Erythropoietin, the principal hormone stimulating red blood cell production, is secreted chiefly by the:

(A) Liver

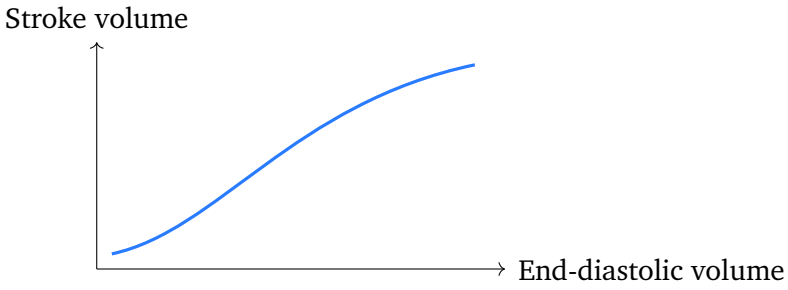
(B) Kidney

(C) Red bone marrow

(D) Spleen

Cardiovascular System

Q6. The curve below plots ventricular end-diastolic volume against stroke volume. It illustrates the Frank-Starling law, namely that within physiological limits an increase in end-diastolic volume (preload):



(A) Decreases stroke volume

(B) Has no effect on stroke volume

(C) Increases stroke volume

(D) Increases heart rate only, not stroke volume

Q7. Baroreceptors in the carotid sinus that buffer sudden changes in blood pressure send their afferent impulses to the medulla through which cranial nerve?

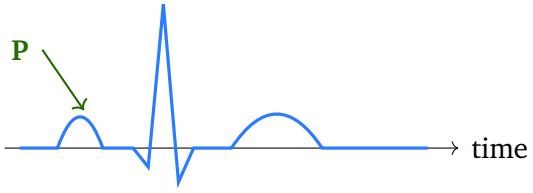
(A) Vagus nerve (CN X)

(B) Facial nerve (CN VII)

(C) Trigeminal nerve (CN V)

(D) Glossopharyngeal nerve (CN IX)

Q8. In the electrocardiogram (ECG) tracing shown, the deflection marked **P** corresponds to:



(A) Ventricular depolarisation

(B) Ventricular repolarisation

(C) Atrial depolarisation

(D) Atrial repolarisation

Respiratory System

Q9. Pulmonary surfactant secreted by type II alveolar cells keeps small alveoli from collapsing. In terms of the Laplace relationship, it does this by:

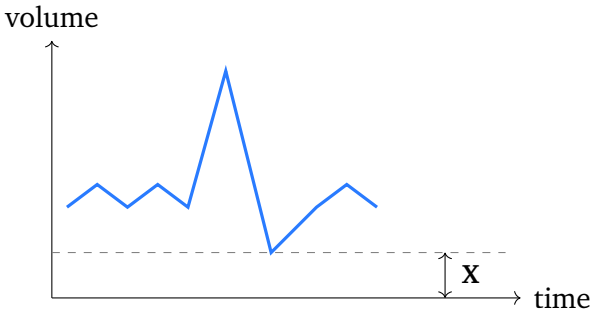
(A) Lowering the surface tension of the fluid lining the alveoli

(B) Raising the surface tension of the fluid lining the alveoli

(C) Thickening the respiratory (alveolar-capillary) membrane

(D) Increasing the resistance of the conducting airways

Q10. The spirogram below shows changes in lung volume during quiet breathing followed by a maximal inspiration and expiration. Which volume, marked **X**, cannot be measured directly by simple spirometry?



(A) Tidal volume

(B) Inspiratory reserve volume

(C) Expiratory reserve volume

(D) Residual volume

Renal System

Q11. The clearance of para-aminohippuric acid (PAH), which is both filtered and almost completely secreted so that it is nearly cleared in a single pass, is used to estimate:

(A) Glomerular filtration rate

(B) Filtration fraction

(C) Urine-concentrating ability

(D) Renal plasma flow

Q12. Aldosterone acts on the principal cells of the collecting duct to:

(A) Increase sodium reabsorption and potassium secretion

(B) Increase potassium reabsorption and sodium secretion

(C) Increase water reabsorption by inserting aquaporin-2 channels

(D) Decrease sodium reabsorption and promote sodium loss

Gastrointestinal, Endocrine and Neurophysiology

Q13. Gastrin, the hormone that stimulates gastric acid secretion, is secreted by which cells?

(A) Parietal cells of the gastric fundus

(B) Chief cells of the gastric body

(C) G cells of the gastric antrum

(D) Acinar cells of the pancreas

Q14. Insulin lowers blood glucose largely by promoting glucose uptake into skeletal muscle and adipose tissue through which membrane transporter?

(A) GLUT1

(B) GLUT2

(C) GLUT4

(D) SGLT1 (sodium-glucose cotransporter 1)

Q15. The knee-jerk (patellar) reflex is a monosynaptic stretch reflex. Its sensory receptor, which detects the stretch of the muscle, is the:

(A) Golgi tendon organ

(B) Muscle spindle

(C) Pacinian corpuscle

(D) Free nerve ending

Detailed Solutions

Q1.

Solution

Concept – the sodium-potassium pump: It is an electrogenic primary active transporter that keeps the ionic gradients.

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

Step 2 – why electrogenic: Because 3 positive charges leave while only 2 enter, each cycle removes one net positive charge, making the pump electrogenic and contributing slightly to the negative resting potential.

Why the other options are wrong:

- A, 2 Na^+ out and 3 K^+ in: reverses the true ratio.
- C, 3 Na^+ in and 2 K^+ out: reverses both directions.
- D, electroneutral exchange: the pump is deliberately electrogenic, not electroneutral.

Final Answer: 3 Na^+ out and 2 K^+ in $\Rightarrow$ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – refractory periods: Excitability changes after an action potential because of the state of the sodium channels.

Step 1 – define the absolute period: During the **absolute** refractory period the voltage-gated Na^+ channels are inactivated, so **no stimulus, however strong, can trigger another action potential**.

Step 2 – contrast the relative period: In the following *relative* refractory period some channels have recovered, so a stronger-than-normal stimulus can fire a spike.

Why the other options are wrong:

- B, stronger stimulus works: that describes the relative, not the absolute, period.
- C, more excitable than rest: false, the fibre is far less excitable.
- D, all K^+ channels closed: incorrect, K^+ channels are actually open during repolarisation.

Final Answer: No stimulus can evoke a second action potential $\Rightarrow$ A

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – excitation-contraction coupling: The store marked **X** sits inside the fibre and releases the calcium that starts contraction.

Step 1 – identify X: It is the **sarcoplasmic reticulum**; the T-tubule depolarisation opens **ryanodine receptors** in its membrane, releasing stored Ca^{2+}.

Step 2 – the effect: The released Ca^{2+} binds troponin C, moving tropomyosin so the myosin heads can bind actin and contract.

Why the other options are wrong:

- B, extracellular Ca^{2+}: only a trigger in cardiac muscle, not the main source in skeletal muscle.
- C, mitochondria: buffer calcium but do not supply the contractile Ca^{2+}.
- D, Golgi apparatus: a protein-processing organelle, not a calcium store for contraction.

Final Answer: Sarcoplasmic reticulum, via ryanodine receptors $\Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – vitamin K and coagulation: Vitamin K is a cofactor for gamma-carboxylation of certain clotting factors.

Step 1 – name the group: The vitamin K-dependent factors are **II, VII, IX and X** (plus proteins C and S).

Step 2 – clinical link: Warfarin blocks vitamin K recycling, so it lowers exactly these four factors and prolongs the prothrombin time.

Why the other options are wrong:

- A, I, V, VIII, XIII: none of these needs vitamin K.
- C, V, VIII, XI, XII: these are vitamin K-independent.
- D, I, V, XI, XIII: fibrinogen and factor V are not vitamin K-dependent.

Final Answer: Factors II, VII, IX and X ⇒ B

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – control of red cell production: Erythropoiesis is driven by a hormone released in response to low oxygen.

Step 1 – name the source: About 90% of erythropoietin comes from the **kidney**, from peritubular fibroblasts in the renal cortex.

Step 2 – the stimulus: Tissue hypoxia stabilises hypoxia-inducible factor, which raises erythropoietin and thus red-cell output.

Why the other options are wrong:

- A, liver: makes only a small amount, mainly in the fetus.
- C, bone marrow: the target that makes red cells, not the source of the hormone.
- D, spleen: destroys old red cells, it does not secrete erythropoietin.

Final Answer: Kidney ⇒ B

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – the Frank-Starling law: The curve rises as end-diastolic volume increases.

Step 1 – read the graph: A larger end-diastolic volume (preload) stretches the ventricle more, and stroke volume **increases** along the ascending curve.

Step 2 – the mechanism: Greater stretch improves the overlap of actin and myosin and raises myofilament calcium sensitivity, so contraction is stronger.

Why the other options are wrong:

- A, decreases stroke volume: contradicts the upward slope.
- B, no effect: the curve clearly rises, so preload does matter.
- D, raises heart rate only: Frank-Starling concerns stroke volume, not rate.

Final Answer: Increases stroke volume ⇒ C

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – the baroreceptor reflex: Stretch receptors in the carotid sinus report arterial pressure to the medulla.

Step 1 – name the nerve: Carotid sinus afferents travel in the **glossopharyngeal nerve (CN IX)** via the nerve of Hering.

Step 2 – complete the arc: The medulla then adjusts sympathetic and vagal outflow to correct the blood pressure. (Aortic arch baroreceptors, by contrast, use the vagus.)

Why the other options are wrong:

- A, vagus (CN X): carries the aortic arch afferents, not the carotid sinus ones.
- B, facial (CN VII): supplies facial muscles and taste, not baroreceptors.
- C, trigeminal (CN V): a sensory nerve of the face, unrelated to this reflex.

Final Answer: Glossopharyngeal nerve (CN IX) $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – reading the ECG: Each ECG deflection maps to one electrical event of the heart.

Step 1 – identify P: The small **P** wave, before the QRS complex, represents **atrial depolarisation**.

Step 2 – the rest: The QRS shows ventricular depolarisation and the T wave shows ventricular repolarisation.

Why the other options are wrong:

- A, ventricular depolarisation: that is the QRS complex.
- B, ventricular repolarisation: that is the T wave.
- D, atrial repolarisation: this is small and buried within the QRS, not the P wave.

Final Answer: Atrial depolarisation $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept – pulmonary surfactant: It is a lipoprotein film that changes the physics of the alveolar lining.

Step 1 – name its action: Surfactant **lowers the surface tension** of the fluid lining the alveoli.

Step 2 – apply Laplace: By Laplace's law, collapsing pressure $= 2T/r$; lowering T most in the smallest alveoli keeps them open and stabilises alveoli of different sizes.

Why the other options are wrong:

- B, raises surface tension: this would promote collapse, the opposite effect.
- C, thickens the membrane: surfactant does not alter membrane thickness.
- D, increases airway resistance: it acts on surface tension, not airway calibre.

Final Answer: Lowers the surface tension of the alveolar lining $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – lung volumes and spirometry: Spirometry measures air that actually moves in and out of the mouth.

Step 1 – identify X: X is the **residual volume**, the air left in the lungs after a maximal expiration; it never leaves the chest, so a spirometer cannot record it.

Step 2 – how it is measured instead: Residual volume needs helium dilution, nitrogen washout or body plethysmography.

Why the other options are wrong:

- A, tidal volume: the air of a normal breath, easily measured.
- B, inspiratory reserve volume: the extra air of a maximal inspiration, measurable.
- C, expiratory reserve volume: the extra air of a maximal expiration, measurable.

Final Answer: Residual volume $\Rightarrow$ D

Answer: (D) Go Back to Q10

Q11.

Solution

Concept – renal clearance markers: The tubular handling of a substance decides what its clearance measures.

Step 1 – reason about PAH: PAH is filtered and then almost completely **secreted**, so nearly all PAH in the plasma entering the kidney is removed in one pass; its clearance therefore estimates **renal plasma flow**.

Step 2 – extend it: Dividing renal plasma flow by (1 minus haematocrit) gives renal blood flow.

Why the other options are wrong:

- A, GFR: measured by inulin, which is filtered but not secreted.
- B, filtration fraction: a calculated ratio (GFR/RPF), not a direct clearance.
- C, concentrating ability: assessed by urine osmolality, not PAH.

Final Answer: Renal plasma flow $\Rightarrow$ D

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – aldosterone in the collecting duct: This mineralocorticoid tunes sodium and potassium balance.

Step 1 – name its actions: On principal cells aldosterone **increases sodium reabsorption and potassium secretion** by raising the number of ENaC channels and Na^+/K^+ pumps.

Step 2 – the consequence: Sodium and water are retained while potassium is lost in the urine, so plasma volume rises.

Why the other options are wrong:

- B, K^+ reabsorption and Na^+ secretion: reverses both real effects.
- C, aquaporin-2 insertion: that is the action of ADH, not aldosterone.
- D, decreases sodium reabsorption: opposite to what aldosterone does.

Final Answer: Increases Na^+ reabsorption and K^+ secretion $\Rightarrow$ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – gastrin secretion: Gastrin is the hormone that drives acid output during a meal.

Step 1 – name the cell: Gastrin comes from **G cells of the gastric antrum** (and duodenum).

Step 2 – its action: Gastrin stimulates parietal cells directly and, more so, indirectly by releasing histamine from ECL cells, raising acid secretion.

Why the other options are wrong:

- A, parietal cells: they secrete acid and intrinsic factor, not gastrin.
- B, chief cells: they secrete pepsinogen.
- D, pancreatic acinar cells: they secrete digestive enzymes, not gastrin.

Final Answer: G cells of the gastric antrum $\Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept – insulin and glucose transporters: Insulin recruits a specific transporter to the cell surface.

Step 1 – name the transporter: Insulin moves **GLUT4** vesicles into the membrane of muscle and fat cells, letting glucose enter.

Step 2 – the result: More GLUT4 at the surface raises glucose uptake, lowering blood glucose.

Why the other options are wrong:

- A, GLUT1: gives basal uptake in many tissues, not insulin-regulated.
- B, GLUT2: a high-capacity, insulin-independent transporter in liver and beta cells.
- D, SGLT1: an intestinal and renal sodium-glucose cotransporter, not insulin-driven.

Final Answer: GLUT4 $\Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept – the stretch reflex: The knee-jerk is the classic monosynaptic reflex.

Step 1 – name the receptor: The sensory receptor is the **muscle spindle**, which detects the stretch produced by tapping the patellar tendon.

Step 2 – the arc: Ia afferents from the spindle synapse directly on alpha motor neurons in the cord, which contract the quadriceps in a single synapse.

Why the other options are wrong:

- A, Golgi tendon organ: senses tension and drives an inhibitory, disynaptic reflex.
- C, Pacinian corpuscle: detects vibration and deep pressure in skin.
- D, free nerve ending: senses pain and temperature, not the stretch reflex.

Final Answer: Muscle spindle $\Rightarrow$ B

Answer: (B) Go Back to Q15

Answer Key

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