INI CET Physiology

Sample Paper – 4

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 Na^+-K^+ pump makes a small direct (electrogenic) contribution to the resting membrane potential because it:

(A) Exchanges ions in a 1:1 electroneutral ratio

(B) Extrudes 3 Na^+ for every 2 K^+ it imports, producing a small net outward positive current

(C) Moves only K^+ into the cell

(D) Is driven by the sodium gradient without using ATP

Q2. At the neuromuscular junction the end-plate potential is normally brought to an end by:

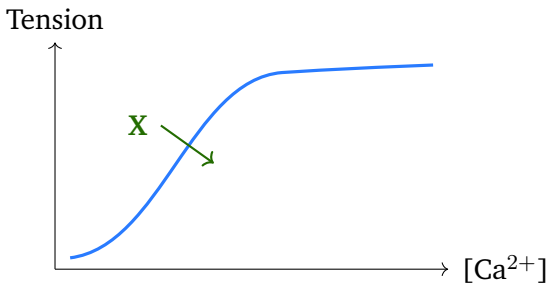
(A) Reuptake of acetylcholine intact into the muscle fibre

(B) Diffusion of acetylcholine into the blood

(C) Hydrolysis of acetylcholine by acetylcholinesterase in the cleft

(D) Closure of voltage-gated calcium channels in the muscle

Q3. In the skeletal-muscle graph below, tension rises steeply as cytosolic calcium increases along region **X**. Cross-bridge cycling is switched on at this point because calcium binds to:



(A) The myosin heads directly

(B) Troponin C, moving tropomyosin off the actin binding sites

(C) Calmodulin on the thick filament

(D) The ryanodine receptor to end contraction

Blood and Body Fluids

Q4. As CO_2 is carried in red cells, HCO_3^- leaves the cell in exchange for Cl^- entering across the membrane. This exchange is called:

(A) The chloride shift (Hamburger phenomenon)

(B) The Bohr effect

(C) The Haldane effect

(D) The Donnan equilibrium

Q5. Haemolytic disease of the newborn due to Rh incompatibility most typically occurs when:

(A) An Rh-positive mother carries an Rh-negative fetus

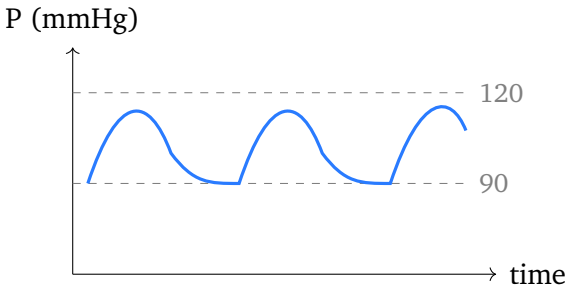
(B) An Rh-negative mother is sensitised to an Rh-positive fetus and her anti-D IgG crosses the placenta

(C) Mother and fetus are both Rh-negative

(D) The fetus lacks the D antigen entirely

Cardiovascular System

Q6. From the arterial pressure trace below (systolic 120 mmHg, diastolic 90 mmHg), the mean arterial pressure is approximately:



(A) 105 mmHg

(B) 110 mmHg

(C) 95 mmHg

(D) 100 mmHg

Q7. During which phase of the cardiac cycle are all four heart valves closed while ventricular pressure rises sharply but ventricular volume stays constant?

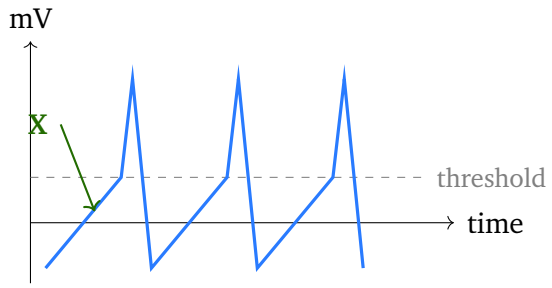
(A) Rapid ejection

(B) Ventricular filling

(C) Isovolumetric relaxation

(D) Isovolumetric contraction

Q8. In the SA node pacemaker recording below, the slow phase 4 depolarisation marked **X**, which drifts the cell up to threshold, is produced chiefly by:



(A) A large potassium efflux

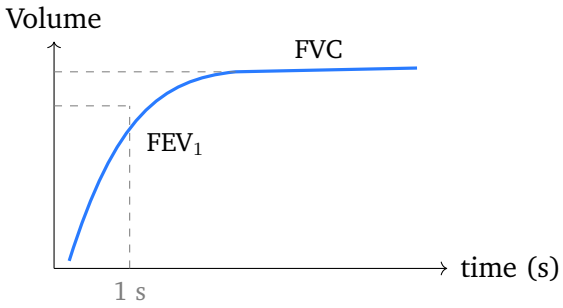
(B) The funny current (If), an inward current through HCN channels

(C) Closure of L-type calcium channels

(D) Chloride influx

Respiratory System

Q9. In the forced-expiration spirogram below, FEV_1 (volume out in the first second) is much smaller than the total FVC, giving a low FEV_1/FVC ratio (well below 0.7). This pattern is the hallmark of:



(A) An obstructive disease such as asthma or COPD

(B) A restrictive disease such as pulmonary fibrosis

(C) A completely normal healthy lung

(D) Pure anaemia with normal lungs

Q10. The finding that deoxygenated haemoglobin carries more CO_2 than oxygenated haemoglobin, which helps CO_2 loading in the tissues, is known as:

(A) The Haldane effect

(B) The Bohr effect

(C) The chloride shift

(D) The Fick principle

Renal System

Q11. In the renin-angiotensin-aldosterone system, renin is released from the juxtaglomerular cells and angiotensin I is then converted to the active angiotensin II by:

(A) Renin itself

(B) Aldosterone

(C) Aldosterone synthase in the adrenal cortex

(D) Angiotensin-converting enzyme (ACE) in the pulmonary vasculature

Q12. If the glomerular filtration rate is 125 mL/min and the renal plasma flow is 625 mL/min, the filtration fraction (GFR ÷ renal plasma flow) is:

(A) 0.05

(B) 0.50

(C) 0.20

(D) 0.80

Gastrointestinal, Endocrine and Neurophysiology

Q13. Which hormone, released from duodenal I cells in response to fat and protein, causes gallbladder contraction and secretion of pancreatic digestive enzymes?

(A) Secretin

(B) Gastrin

(C) Cholecystokinin (CCK)

(D) Somatostatin

Q14. Which hormone raises plasma calcium by acting on bone, on the kidney, and (via activated vitamin D) on the intestine?

(A) Parathyroid hormone

(B) Calcitonin

(C) Insulin

(D) Aldosterone

Q15. During the stretch (myotatic) reflex, the stretched muscle contracts while its antagonist simultaneously relaxes. This relaxation of the antagonist is produced by:

(A) Recurrent inhibition by Renshaw cells

(B) Autogenic inhibition via Golgi tendon organs

(C) Reciprocal inhibition through an inhibitory interneuron acting on the antagonist

(D) Presynaptic facilitation of the antagonist

Detailed Solutions

Q1.

Solution

Concept – the electrogenic Na-K pump: The pump moves unequal charges, so it carries a small net current.

Step 1 – recall the stoichiometry: For each cycle it extrudes **3 Na^+** and imports **2 K^+**.

Step 2 – the electrical effect: That leaves a net loss of one positive charge from the cell each cycle, a small outward current that makes the inside a few millivolts more negative.

Why the other options are wrong:

- A, 1:1 electroneutral: an electroneutral pump would add nothing to the potential.
- C, only K^+ inward: the pump also moves Na^+ outward.
- D, no ATP: it is a primary active pump that hydrolyses ATP.

Final Answer: Extrudes 3 Na^+ for 2 K^+, a net outward current $\Rightarrow$ B

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – terminating the end-plate potential: Transmission stops when the transmitter is cleared from the cleft.

Step 1 – name the enzyme: Acetylcholinesterase in the synaptic cleft hydrolyses acetylcholine into choline and acetate.

Step 2 – the result: With the transmitter destroyed, the end-plate channels close and the end-plate potential decays.

Why the other options are wrong:

- A, intact reuptake: choline is taken back, but the acetylcholine itself is broken down first, not reabsorbed intact.
- B, diffusion into blood: far too slow to end each impulse.
- D, calcium channel closure: governs transmitter release from the nerve, not clearance at the end plate.

Final Answer: Hydrolysis by acetylcholinesterase $\Rightarrow$ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – excitation-contraction coupling: Rising cytosolic calcium is the trigger that unblocks actin.

Step 1 – identify the target: Calcium binds **troponin C** on the thin filament.

Step 2 – what follows: Troponin C shifts the troponin-tropomyosin complex off the actin binding sites, exposing them so myosin heads can form cross-bridges and generate the tension seen along X.

Why the other options are wrong:

- A, myosin heads directly: calcium does not bind myosin to start skeletal contraction.
- C, calmodulin on the thick filament: calmodulin is the switch in smooth muscle, not skeletal cross-bridge gating.
- D, ryanodine receptor to end contraction: the ryanodine receptor releases calcium; it does not terminate contraction.

Final Answer: Troponin C $\Rightarrow$ B

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – CO_2 transport in the red cell: Bicarbonate made inside the cell must be exported.

Step 1 – trace the ions: Carbonic anhydrase makes HCO_3^-; it leaves the cell through band 3, and **Cl^- moves in** to keep charge balance.

Step 2 – name it: This HCO_3^-/Cl^- exchange is the **chloride shift**, or Hamburger phenomenon.

Why the other options are wrong:

- B, Bohr effect: describes how CO_2/H^+ lower haemoglobin's oxygen affinity.
- C, Haldane effect: describes how deoxygenation raises CO_2 carriage.

- D, Donnan equilibrium: the general membrane ion distribution rule, not this specific exchange.

Final Answer: The chloride shift (Hamburger phenomenon) $\Rightarrow$ A

Answer: (A) Go Back to Q4

Q5.

Solution

Concept – Rh haemolytic disease of the newborn: It needs an Rh-negative mother making antibody against Rh-positive fetal cells.

Step 1 – set the scene: An **Rh-negative** mother is sensitised, usually at a previous delivery, to the D antigen of an **Rh-positive** fetus.

Step 2 – the mechanism: Her anti-D is IgG, which crosses the placenta and haemolyses the fetal red cells in a later Rh-positive pregnancy.

Why the other options are wrong:

- A, Rh-positive mother with Rh-negative fetus: the mother is not sensitised to D, so no disease.
- C, both Rh-negative: no D antigen to react against.
- D, fetus lacks D entirely: an Rh-negative fetus cannot trigger anti-D haemolysis.

Final Answer: Rh-negative mother sensitised to an Rh-positive fetus, anti-D IgG crosses $\Rightarrow$ B

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – mean arterial pressure: MAP is nearer diastolic because diastole lasts longer.

Step 1 – write the formula: MAP $=$ diastolic $+ \frac{1}{3}$ (pulse pressure), where pulse pressure $=$ systolic $-$ diastolic.

Step 2 – put in the numbers: Pulse pressure $= 120 - 90 = 30$ mmHg. So MAP $= 90 + \frac{1}{3}(30) = 90 + 10 = 100$ mmHg.

Why the other options are wrong:

- A, 105, and B, 110: too high; they weight systolic too heavily.
- C, 95: uses less than one-third of the pulse pressure.

Final Answer: 100 mmHg $\Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – phases of the cardiac cycle: One early systolic phase changes pressure without ejecting blood.

Step 1 – name it: Isovolumetric contraction: the mitral and aortic valves are both shut, so no blood enters or leaves.

Step 2 – what happens: The ventricle contracts on a fixed volume, so pressure climbs steeply until it exceeds aortic pressure and the aortic valve opens.

Why the other options are wrong:

- A, rapid ejection: the aortic valve is open and volume falls.
- B, ventricular filling: the mitral valve is open and volume rises.
- C, isovolumetric relaxation: volume is also fixed, but pressure is falling, not rising.

Final Answer: Isovolumetric contraction $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – SA node pacemaker potential: Its instability comes from a slow inward current during diastole.

Step 1 – identify X: X is the gradual phase 4 depolarisation, driven mainly by the **funny current (If)**.

Step 2 – the channel: If flows through HCN channels that open on hyperpolarisation and let Na^+ (and some K^+) in, slowly carrying the cell up to threshold.

Why the other options are wrong:

- A, large K^+ efflux: that would hyperpolarise and slow the pacemaker.

- C, closure of L-type Ca channels: L-type opening gives the upstroke, not phase 4.
- D, chloride influx: not the pacemaker mechanism.

Final Answer: The funny current (If) through HCN channels $\Rightarrow$ B

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – FEV_1/FVC ratio: The ratio separates airflow limitation from lung restriction.

Step 1 – read the spirogram: A low **FEV_1/FVC** (below about 0.7) means air leaves slowly relative to the total volume exhaled.

Step 2 – interpret it: That slow airflow points to an **obstructive** disease such as asthma or COPD, where the airways resist emptying.

Why the other options are wrong:

- B, restrictive disease: FVC falls but FEV_1 falls with it, so the ratio is normal or high.
- C, normal lung: the ratio would be roughly 0.7 to 0.8.
- D, anaemia: a blood oxygen-carrying problem, not an airflow one.

Final Answer: An obstructive disease such as asthma or COPD $\Rightarrow$ A

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – CO_2 carriage and oxygenation: Removing oxygen from haemoglobin lets it hold more CO_2.

Step 1 – name the effect: This is the **Haldane effect**.

Step 2 – why it helps: In the tissues, haemoglobin gives up O_2 and so takes up more CO_2 and H^+; in the lungs, oxygenation reverses this and unloads CO_2.

Why the other options are wrong:

- B, Bohr effect: the reciprocal idea, CO_2/H^+ lowering O_2 affinity.
- C, chloride shift: the HCO_3^-/Cl^- membrane exchange, a separate step.

- D, Fick principle: a method for measuring blood flow or uptake, unrelated here.

Final Answer: The Haldane effect $\Rightarrow$ A

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – the renin-angiotensin-aldosterone system: Two enzymatic steps make the active hormone.

Step 1 – first step: Renin from juxtaglomerular cells cleaves angiotensinogen to angiotensin I.

Step 2 – second step: Angiotensin-converting enzyme (ACE), mainly on the pulmonary endothelium, converts angiotensin I to the active angiotensin II.

Why the other options are wrong:

- A, renin itself: renin makes angiotensin I, not II.
- B, aldosterone: aldosterone is released downstream, in response to angiotensin II.
- C, aldosterone synthase: it makes aldosterone in the adrenal, it does not make angiotensin II.

Final Answer: Angiotensin-converting enzyme (ACE) $\Rightarrow$ D

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – filtration fraction: It is the share of plasma flow that gets filtered.

Step 1 – write the formula: Filtration fraction $=$ GFR $\div$ renal plasma flow.

Step 2 – put in the numbers: $= 125 \div 625 = 0.20$, that is about 20%.

Why the other options are wrong:

- A, 0.05: far too low; it would need a GFR near 31 mL/min.
- B, 0.50: would require a much smaller plasma flow.
- D, 0.80: impossibly high; most plasma is not filtered on one pass.

Final Answer: 0.20 ⇒ C

Answer: (C) Go Back to Q12

Q13.

Solution

Concept – duodenal hormone for fat digestion: One hormone links gallbladder and pancreas.

Step 1 – name it: Cholecystokinin (CCK), from duodenal I cells, is released by fat and protein.

Step 2 – its actions: CCK contracts the gallbladder to deliver bile and stimulates pancreatic acinar cells to release digestive enzymes.

Why the other options are wrong:

- A, secretin: drives a watery bicarbonate pancreatic juice, not enzyme release or gallbladder contraction.
- B, gastrin: stimulates gastric acid, mainly from the stomach antrum.
- D, somatostatin: an inhibitory hormone that dampens secretion.

Final Answer: Cholecystokinin (CCK) ⇒ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept – calcium-raising hormone: One hormone acts on three organs to raise plasma calcium.

Step 1 – name it: Parathyroid hormone (PTH).

Step 2 – its three actions: PTH releases calcium from bone, increases renal calcium reabsorption, and activates vitamin D to raise intestinal calcium absorption.

Why the other options are wrong:

- B, calcitonin: lowers plasma calcium, the opposite action.
- C, insulin: regulates glucose, not calcium.
- D, aldosterone: regulates sodium and potassium, not calcium.

Final Answer: Parathyroid hormone ⇒ A

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – reciprocal inhibition in the stretch reflex: Contracting one muscle needs its antagonist to relax.

Step 1 – trace the circuit: The Ia afferent from the stretched muscle excites its own motor neuron and, through an **inhibitory interneuron**, inhibits the motor neuron of the antagonist.

Step 2 – the result: The antagonist relaxes as the agonist contracts, giving smooth reflex movement. This is **reciprocal inhibition**.

Why the other options are wrong:

- A, Renshaw cells: they cause recurrent inhibition of the same motor neuron pool, not antagonist relaxation.
- B, Golgi tendon organ inhibition: that is autogenic inhibition of the same muscle at high tension, a different reflex.
- D, presynaptic facilitation: would increase, not switch off, antagonist activity.

Final Answer: Reciprocal inhibition through an inhibitory interneuron $\Rightarrow$ C

Answer: (C) Go Back to Q15

Answer Key

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