INI CET Physiology

Sample Paper – 9

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. A Gq-coupled receptor activates phospholipase C, which cleaves membrane PIP_2 into two intracellular second messengers. These two messengers are:

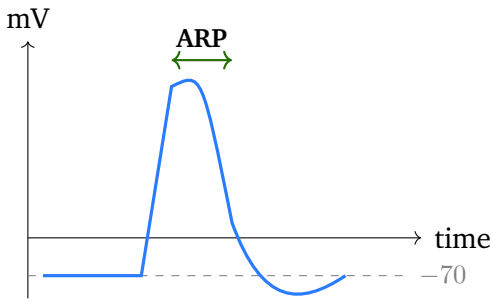
(A) Cyclic AMP and cyclic GMP

(B) Cyclic AMP and calcium

(C) Inositol trisphosphate (IP_3) and diacylglycerol (DAG)

(D) Cyclic GMP and nitric oxide

Q2. The bar marked **ARP** on the action-potential trace below is the absolute refractory period, during which no stimulus, however strong, can trigger a second action potential. This is because:



(A) The potassium channels are all closed

(B) The sodium-potassium pump is switched off

(C) The membrane is hyperpolarised beyond threshold

(D) The voltage-gated sodium channels are in the inactivated state

Q3. In the cross-bridge cycle of skeletal muscle contraction, the myosin head detaches from the actin filament at the moment when:

(A) Calcium binds to troponin C

(B) ADP and inorganic phosphate are released

(C) The power stroke tilts the myosin head

(D) A fresh molecule of ATP binds to the myosin head

Blood and Body Fluids

Q4. Deficiency of vitamin B12 or folate impairs DNA synthesis in developing red-cell precursors in the bone marrow. The resulting anaemia is classically:

(A) Microcytic hypochromic

(B) Megaloblastic (macrocytic)

(C) Aplastic

(D) Haemolytic

Q5. In a resting adult, the single largest fraction of the total blood volume at any moment is held within the:

(A) Systemic arteries

(B) Chambers of the heart

(C) Pulmonary circulation

(D) Systemic veins and venules

Cardiovascular System

Q6. The Fick principle is used to calculate cardiac output. According to it, cardiac output equals:

(A) Oxygen consumption divided by the arteriovenous oxygen difference

(B) Heart rate multiplied by systemic vascular resistance

(C) Mean arterial pressure divided by heart rate

(D) Stroke volume multiplied by blood viscosity

Q7. Afferent impulses from the carotid-sinus and aortic-arch baroreceptors travel to the cardiovascular centres in the medulla through which pair of cranial nerves?

(A) CN V and CN VII

(B) CN VII and CN X

(C) CN IX (glossopharyngeal) and CN X (vagus)

(D) CN X and CN XII

Q8. In the normal heart, which structure is the only electrical connection that allows the impulse to pass from the atria to the ventricles?

(A) The atrioventricular (AV) node

(B) The sinoatrial (SA) node

(C) The foramen ovale

(D) The coronary sinus

Respiratory System

Q9. A large fall in arterial PO_2 (hypoxaemia) increases ventilation. This hypoxic drive is sensed mainly by:

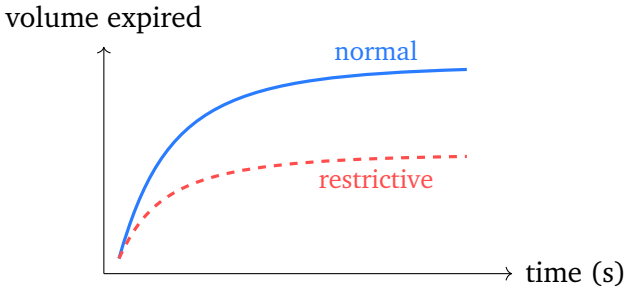
(A) The peripheral chemoreceptors in the carotid and aortic bodies

(B) The central chemoreceptors on the ventral medulla

(C) The pulmonary stretch receptors

(D) The irritant receptors of the large airways

Q10. The spirogram below shows forced expiration for a normal subject (solid) and a patient (dashed). The dashed trace, with a much smaller total volume expired, is the classic pattern of a purely restrictive lung disease, in which:



(A) The FEV_1/FVC ratio is reduced while the FVC stays normal

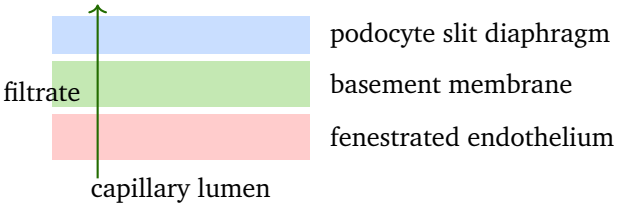
(B) The total lung capacity is increased

(C) The FVC is reduced with a normal or even raised FEV_1/FVC ratio

(D) The FVC is normal but the FEV_1/FVC ratio is reduced

Renal System

Q11. The glomerular filtration barrier, shown in cross-section below, has three layers. Naming them in the order the filtrate crosses them, from the capillary lumen outward, they are:



(A) Podocyte slit diaphragm, basement membrane, fenestrated endothelium

(B) Fenestrated endothelium, mesangium, Bowman capsule

(C) Fenestrated endothelium, glomerular basement membrane, podocyte slit diaphragm

(D) Bowman capsule, proximal tubule, endothelium

Q12. The micturition reflex that contracts the detrusor muscle to empty the bladder is carried by parasympathetic fibres arising from which spinal cord segments?

(A) T10 to L2

(B) S2 to S4

(C) L1 to L2

(D) C3 to C5

Gastrointestinal, Endocrine and Neurophysiology

Q13. Loss of gastric intrinsic factor (secreted by parietal cells) leads to pernicious anaemia. Intrinsic factor is essential because it is required to:

(A) Digest dietary proteins in the stomach

(B) Allow absorption of vitamin B12 in the terminal ileum

(C) Emulsify dietary fats before pancreatic lipase acts

(D) Neutralise gastric acid entering the duodenum

Q14. Thyroid hormone (thyroxine, converted to the active T3) raises the basal metabolic rate mainly by:

(A) Increasing oxygen consumption and heat production across most body tissues

(B) Lowering the metabolic rate to conserve stored energy

(C) Acting only on skeletal muscle and no other tissue

(D) Reducing Na^{+}/K^{+} ATPase activity throughout the body

Q15. Damage confined to the cerebellum most characteristically produces:

(A) Complete paralysis of the opposite half of the body

(B) Impaired coordination and balance with preserved muscle strength

(C) Loss of all sensation below the level of the lesion

(D) A resting (pill-rolling) tremor with rigidity only

Detailed Solutions

Q1.

Solution

Concept – the phospholipase C second-messenger system: Gq-coupled receptors signal through membrane phospholipid breakdown.

Step 1 – name the enzyme and substrate: Activated Gq stimulates phospholipase C, which splits PIP_2 (phosphatidylinositol 4,5-bisphosphate).

Step 2 – name the two products: The two second messengers are **IP_3**, which releases Ca^{2+} from the endoplasmic reticulum, and **DAG**, which activates protein kinase C.

Why the other options are wrong:

- A, cAMP and cGMP: made by adenylyl cyclase and guanylyl cyclase, a different pathway.
- B, cAMP and calcium: cAMP is the Gs pathway messenger, not a PLC product.
- D, cGMP and nitric oxide: the NO-cGMP vasodilator pathway, unrelated to PIP_2.

Final Answer: IP_3 and DAG $\Rightarrow$ C

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – the absolute refractory period: It spans the upstroke and most of the spike of the action potential.

Step 1 – state the cause: During this window the voltage-gated sodium channels are **inactivated**, their inactivation gates shut.

Step 2 – why no second spike fires: Inactivated channels cannot reopen no matter how strong the stimulus, so a fresh action potential is impossible until they reset at more negative voltages.

Why the other options are wrong:

- A, potassium channels closed: K^+ channels are actually open, driving repolarisation.
- B, pump switched off: the Na-K pump keeps working and does not set the refractory period.

- C, hyperpolarised beyond threshold: that describes the later relative refractory period, not the absolute one.

Final Answer: The voltage-gated sodium channels are inactivated $\Rightarrow$ D

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – the cross-bridge cycle: Each cycle couples ATP handling to attachment and detachment of the myosin head.

Step 1 – locate the detachment step: The myosin head releases actin only when **a fresh ATP molecule binds** to the head after the power stroke.

Step 2 – what follows: ATP hydrolysis then re-cocks the head, priming it for the next attachment; without ATP the head stays bound (rigor).

Why the other options are wrong:

- A, calcium binds troponin: this exposes the binding site and starts, not ends, cross-bridge formation.
- B, ADP and Pi release: this drives the power stroke while the head is still attached.
- C, power stroke: the head is firmly bound to actin during it.

Final Answer: A fresh molecule of ATP binds to the myosin head $\Rightarrow$ D

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – megaloblastic anaemia: B12 and folate are needed for DNA synthesis in dividing cells.

Step 1 – link deficiency to cell size: When DNA synthesis lags but the cytoplasm keeps growing, erythroid precursors become large **megaloblasts**, giving a macrocytic anaemia.

Step 2 – confirm the marker: The blood film shows large oval red cells and hypersegmented neutrophils, the hallmark of megaloblastic anaemia.

Why the other options are wrong:

- A, microcytic hypochromic: typical of iron deficiency, not B12 or folate.
- C, aplastic: marrow failure of all lineages, a different mechanism.
- D, haemolytic: from red-cell destruction, not defective DNA synthesis.

Final Answer: Megaloblastic (macrocytic) $\Rightarrow$ B

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – distribution of blood volume: Different compartments hold very different shares of the total blood.

Step 1 – name the reservoir: The **systemic veins and venules** hold roughly two-thirds of the blood volume, acting as the body's capacitance reservoir.

Step 2 – why: Veins are thin-walled and highly compliant, so they store large volumes at low pressure.

Why the other options are wrong:

- A, systemic arteries: hold only about 13 percent at high pressure.
- B, heart chambers: contain a small fraction at any instant.
- C, pulmonary circulation: holds around 9 to 12 percent.

Final Answer: Systemic veins and venules $\Rightarrow$ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – the Fick principle: The oxygen taken up by the lungs must equal the blood flow multiplied by the oxygen extracted.

Step 1 – write the relation: Cardiac output $= \dfrac{\text{oxygen consumption}}{\text{arteriovenous oxygen difference}}$.

Step 2 – reasoning: Rearranging the conservation of oxygen (uptake = flow $\times$ extraction) isolates cardiac output.

Why the other options are wrong:

- B, heart rate $\times$ resistance: mixes unrelated quantities.
- C, pressure divided by heart rate: not a cardiac-output formula.

- D, stroke volume $\times$ viscosity: viscosity is not part of output.

Final Answer: Oxygen consumption divided by the arteriovenous oxygen difference $\Rightarrow$ A

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – baroreceptor afferent pathways: Two named cranial nerves carry the pressure signal to the medulla.

Step 1 – match receptor to nerve: The carotid-sinus baroreceptors travel in the **glossopharyngeal nerve (CN IX)**, and the aortic-arch baroreceptors travel in the **vagus nerve (CN X)**.

Step 2 – the destination: Both project to the nucleus tractus solitarius, adjusting sympathetic and parasympathetic output.

Why the other options are wrong:

- A, CN V and VII: trigeminal and facial, not baroreceptor afferents.
- B, CN VII and X: includes the wrong nerve for the carotid sinus.
- D, CN X and XII: XII is the hypoglossal, a motor nerve to the tongue.

Final Answer: CN IX and CN X $\Rightarrow$ C

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – atrioventricular conduction: The fibrous skeleton insulates the atria from the ventricles.

Step 1 – name the connection: The **AV node** (continuing as the bundle of His) is normally the sole path for the impulse across that fibrous ring.

Step 2 – functional value: Its conduction delay lets the atria finish emptying before the ventricles contract.

Why the other options are wrong:

- B, SA node: the pacemaker in the atrium, not a connection to the ventricles.
- C, foramen ovale: a fetal inter-atrial opening, closed after birth.

- D, coronary sinus: a venous drainage channel, not a conduction route.

Final Answer: The atrioventricular (AV) node $\Rightarrow$ A

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – the hypoxic ventilatory drive: Low arterial oxygen is detected outside the brain.

Step 1 – name the sensor: The **peripheral chemoreceptors in the carotid and aortic bodies** respond to a fall in arterial PO_2.

Step 2 – the threshold: They fire strongly only once PO_2 drops below about 60 mmHg, then boost ventilation.

Why the other options are wrong:

- B, central chemoreceptors: respond to CO_2 and H^+, not directly to low O_2.
- C, pulmonary stretch receptors: mediate the Hering-Breuer reflex, not oxygen sensing.
- D, irritant receptors: respond to noxious stimuli in the airways, not PO_2.

Final Answer: The peripheral chemoreceptors in the carotid and aortic bodies $\Rightarrow$ A

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – restrictive versus obstructive spirometry: The two patterns differ in how FVC and the FEV_1/FVC ratio change.

Step 1 – describe the restrictive pattern: Restrictive disease reduces lung expansion, so the **FVC is low**, but airflow is not blocked, so the **FEV_1/FVC ratio stays normal or is raised**.

Step 2 – contrast obstruction: Obstructive disease slows airflow, lowering FEV_1 more than FVC, so the ratio falls below 0.7.

Why the other options are wrong:

- A and D, reduced ratio: these describe an obstructive pattern.

- B, increased total lung capacity: seen in obstruction with air trapping, not restriction.

Final Answer: Reduced FVC with a normal or raised FEV_1/FVC ratio $\Rightarrow$ C

Answer: (C) Go Back to Q10

Q11.

Solution

Concept – the glomerular filtration barrier: The filtrate crosses three layers in a fixed order.

Step 1 – list them from the lumen outward: Fenestrated endothelium, then the **glomerular basement membrane**, then the **podocyte slit diaphragm**.

Step 2 – what each does: The fenestrae bar blood cells, the basement membrane repels anionic proteins, and the slit diaphragm gives the final size and charge sieve.

Why the other options are wrong:

- A, reversed order: lists the layers from outside in, opposite to the filtrate path.
- B, includes mesangium and capsule: these are not part of the filtration slit sequence.
- D, capsule and tubule: structures downstream of filtration, not the barrier.

Final Answer: Fenestrated endothelium, basement membrane, podocyte slit diaphragm $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – the micturition reflex: Bladder emptying is a sacral parasympathetic reflex.

Step 1 – name the segments: The parasympathetic outflow contracting the detrusor arises from spinal segments **S2 to S4** (the pelvic splanchnic nerves).

Step 2 – the action: These fibres contract the detrusor and relax the internal sphincter, expelling urine.

Why the other options are wrong:

- A, T10 to L2: sympathetic outflow that promotes storage, not voiding.
- C, L1 to L2: part of the sympathetic, not the voiding parasympathetic.
- D, C3 to C5: the phrenic nerve to the diaphragm, unrelated to the bladder.

Final Answer: S2 to S4 $\Rightarrow$ B

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – intrinsic factor and pernicious anaemia: Intrinsic factor is a carrier protein, not a digestive enzyme.

Step 1 – state its role: Intrinsic factor binds vitamin B12 and is required for its **absorption in the terminal ileum**; without it, B12 is lost and pernicious anaemia develops.

Step 2 – contrast with pepsin: Pepsin (from chief cells) digests dietary proteins; it plays no part in B12 uptake, which is why protein digestion is not the answer.

Why the other options are wrong:

- A, digest proteins: that is the job of pepsin, not intrinsic factor.
- C, emulsify fats: bile salts do this in the small intestine.
- D, neutralise acid: bicarbonate from the pancreas and duodenum does this.

Final Answer: Allow absorption of vitamin B12 in the terminal ileum $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – thyroid hormone and metabolic rate: Thyroid hormone is the main setter of the basal metabolic rate.

Step 1 – state the mechanism: T3 **increases oxygen consumption and heat production** in almost all tissues, partly by upregulating Na^+/K^+ ATPase and mitochondrial activity.

Step 2 – the result: This calorigenic action raises the BMR; hyperthyroid patients feel hot and lose weight, hypothyroid patients feel cold and gain weight.

Why the other options are wrong:

- B, lowers metabolic rate: the opposite of thyroxine's action.
- C, skeletal muscle only: thyroid hormone acts on nearly all tissues.
- D, reduces Na^+/K^+ ATPase: it upregulates this pump, raising oxygen use.

Final Answer: Increasing oxygen consumption and heat production across most tissues $\Rightarrow$ A

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – cerebellar function: The cerebellum coordinates movement and maintains balance.

Step 1 – state the deficit: A cerebellar lesion causes **ataxia**: incoordination, an unsteady wide-based gait and loss of balance, while raw muscle power stays intact.

Step 2 – the signs: Intention tremor, dysmetria (past-pointing) and dysdiadochokinesia appear because movements are no longer smoothed and timed.

Why the other options are wrong:

- A, contralateral paralysis: points to a corticospinal (motor cortex or internal capsule) lesion.
- C, loss of sensation: a sensory pathway lesion, not cerebellar.
- D, resting tremor and rigidity: a basal-ganglia (parkinsonian) picture, not cerebellar.

Final Answer: Impaired coordination and balance with preserved muscle strength $\Rightarrow$ B

Answer: (B) Go Back to Q15

Answer Key

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