INI CET Biochemistry

Sample Paper – 9

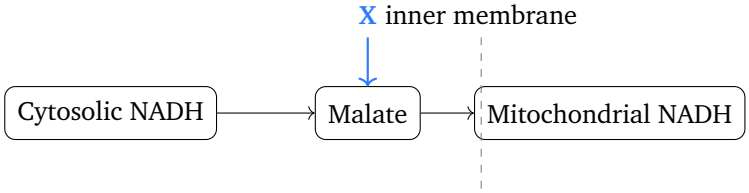
Duration: 14 Minutes **Maximum Marks: 15**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Best Response), modelled on the Biochemistry content of **INI CET** (Institutes of National Importance Combined Entrance Test) conducted by AIIMS New Delhi.
- The **15-question** length matches the number of Biochemistry 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.

Carbohydrate Metabolism

Q1. The transport system shown, which carries reducing equivalents from cytosolic NADH into the mitochondrion by way of a malate carrier so that they can be oxidised by the respiratory chain, is the:



(A) Glycerophosphate shuttle

(B) Citrate-pyruvate shuttle

(C) Malate-aspartate shuttle

(D) Carnitine shuttle

Q2. The single most powerful allosteric activator of glycolysis in the liver, formed from fructose-6-phosphate by the kinase activity of the bifunctional enzyme PFK-2, is:

(A) Citrate

(B) ATP

(C) AMP

(D) Fructose-2,6-bisphosphate

Q3. Hepatic glycogenolysis is switched on by glucagon and adrenaline mainly through a rise in which intracellular second messenger?

(A) Inositol trisphosphate (IP_3)

(B) Calcium ions

(C) Cyclic GMP (cGMP)

(D) Cyclic AMP (cAMP)

Lipid Metabolism

Q4. Which pair of polyunsaturated fatty acids are the two truly essential fatty acids that the human body cannot synthesise and must obtain from the diet?

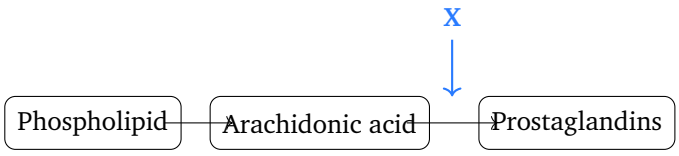
(A) Palmitic acid and stearic acid

(B) Linoleic acid and alpha-linolenic acid

(C) Oleic acid and palmitoleic acid

(D) Arachidonic acid and stearic acid

Q5. In the eicosanoid pathway shown, the enzyme marked **X**, which converts arachidonic acid to prostaglandins and is irreversibly inhibited by aspirin, is:



(A) Lipoxygenase

(B) Phospholipase A_2

(C) Thromboxane synthase

(D) Cyclooxygenase (COX)

Amino Acid and Protein Metabolism

Q6. Which set consists entirely of essential (indispensable) amino acids and includes the three branched-chain amino acids?

(A) Valine, leucine, isoleucine and lysine

(B) Alanine, glycine, serine and proline

(C) Glutamate, aspartate, glutamine and asparagine

(D) Tyrosine, cysteine, glycine and serine

Q7. A growing child, a pregnant woman and a patient recovering from surgery typically show which nitrogen balance state, in which nitrogen intake exceeds nitrogen loss?

(A) Negative nitrogen balance

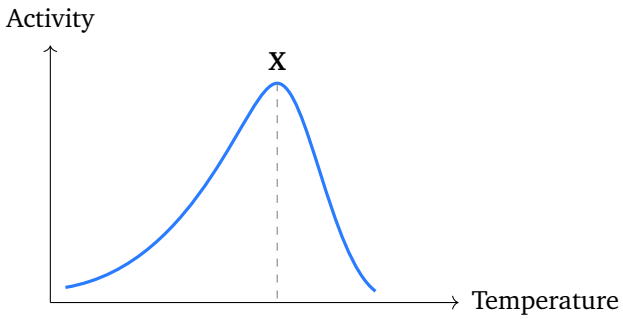
(B) Nitrogen equilibrium

(C) Positive nitrogen balance

(D) Zero nitrogen turnover

Enzymes, Vitamins and Coenzymes

Q8. The curve shows enzyme activity plotted against temperature. The peak marked **X**, beyond which activity falls sharply because the enzyme denatures, represents the:



(A) Optimum temperature

(B) Melting temperature of the substrate

(C) Isoelectric point

(D) Michaelis constant

Q9. In a metabolic pathway, the end product switching off the first (committed) enzyme of its own pathway is an example of:

(A) Feedback (end-product) inhibition

(B) Competitive inhibition

(C) Covalent modification

(D) Zymogen activation

Q10. Glutathione peroxidase, a key antioxidant enzyme that detoxifies hydrogen peroxide, requires which trace element as an essential part of its active site?

(A) Zinc

(B) Copper

(C) Selenium

(D) Manganese

Molecular Biology and Genetics

Q11. The ability of DNA polymerase to remove a wrongly paired nucleotide immediately after adding it, thereby proofreading the new strand and ensuring replication fidelity, is due to its:

(A) 5′ to 3′ exonuclease activity

(B) Endonuclease activity

(C) 3′ to 5′ exonuclease activity

(D) Helicase activity

Q12. The stretch of adenine nucleotides added to the 3′ end of a eukaryotic mRNA, which increases its stability and helps its export from the nucleus, is the:

(A) 5′ cap

(B) Poly-A tail

(C) Kozak sequence

(D) Shine-Dalgarno sequence

Q13. Which laboratory technique uses gel electrophoresis followed by transfer to a membrane and hybridisation with a labelled probe to detect a specific DNA sequence?

(A) Northern blotting

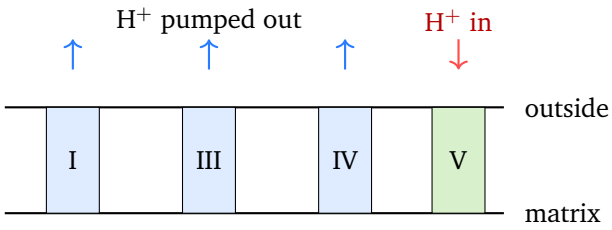
(B) Southern blotting

(C) Western blotting

(D) ELISA

Bioenergetics, Nucleotides and Clinical Biochemistry

Q14. In the scheme shown, respiratory-chain complexes pump protons out of the matrix, and ATP synthase then makes ATP as the protons flow back in down their gradient. This proton-motive mechanism of ATP synthesis is the:



(A) Chemiosmotic theory

(B) Substrate-level phosphorylation

(C) Lock-and-key theory

(D) Fluid mosaic model

Q15. Reusing a preformed pyrimidine base such as uracil by attaching it to PRPP, rather than building the pyrimidine ring from scratch through the de novo route, is an example of the:

(A) De novo synthesis pathway

(B) Salvage pathway

(C) Degradation pathway

(D) Beta-oxidation pathway

Detailed Solutions

Q1.

Solution

Concept – NADH shuttles into mitochondria: The inner mitochondrial membrane is impermeable to NADH, so cytosolic reducing equivalents need a shuttle.

Step 1 – read the figure: Cytosolic NADH reduces oxaloacetate to malate, malate crosses the membrane, and inside the matrix it is oxidised back to regenerate NADH.

Step 2 – name the shuttle: This malate carrier route is the **malate-aspartate shuttle**, which preserves the electrons as mitochondrial NADH for complex I.

Why the other options are wrong:

- A, glycerophosphate shuttle: delivers electrons to $FADH_2$/coenzyme Q, not via malate.
- B, citrate-pyruvate shuttle: exports acetyl units for fatty acid synthesis, not reducing equivalents.
- D, carnitine shuttle: carries long-chain fatty acids into the matrix, not NADH.

Final Answer: Malate-aspartate shuttle $\Rightarrow$ C

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – allosteric control of glycolysis: A signal molecule tells the liver whether to run glycolysis or gluconeogenesis.

Step 1 – identify the molecule: **Fructose-2,6-bisphosphate** is made from fructose-6-phosphate by the kinase (PFK-2) domain of the bifunctional enzyme.

Step 2 – its action: It is the most potent activator of PFK-1, driving flux through glycolysis, and it simultaneously inhibits fructose-1,6-bisphosphatase.

Why the other options are wrong:

- A, citrate: an allosteric *inhibitor* of PFK-1.
- B, ATP: an inhibitor that signals a high energy charge.
- C, AMP: an activator, but far weaker than fructose-2,6-bisphosphate and not the PFK-2 product asked for.

Final Answer: Fructose-2,6-bisphosphate $\Rightarrow$ D

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – hormonal control of glycogen breakdown: Glucagon and adrenaline act through a G-protein-coupled cascade.

Step 1 – trace the signal: Both hormones activate adenylate cyclase, which raises **cyclic AMP (cAMP)**.

Step 2 – the downstream effect: cAMP activates protein kinase A, which phosphorylates and activates glycogen phosphorylase, driving glycogenolysis.

Why the other options are wrong:

- A and B, IP_3 and calcium: the second-messenger arm used by alpha-adrenergic/G_q signalling, not the main glucagon route.
- C, cGMP: works through nitric-oxide/guanylate-cyclase signalling, unrelated to glycogenolysis.

Final Answer: Cyclic AMP (cAMP) $\Rightarrow$ D

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – essential fatty acids: Humans lack the desaturases needed to insert double bonds beyond carbon 9.

Step 1 – identify the pair: Linoleic acid (omega-6) and **alpha-linolenic acid** (omega-3) cannot be made in the body and must come from the diet.

Step 2 – why they matter: They are precursors of arachidonic acid and other long-chain PUFAs used to build eicosanoids and membranes.

Why the other options are wrong:

- A, palmitic and stearic acid: saturated fats the body synthesises readily.
- C, oleic and palmitoleic acid: monounsaturated fats made by our own desaturases.
- D, arachidonic and stearic acid: arachidonic acid can be made from linoleic

acid, so it is only conditionally essential; stearic acid is non-essential.

Final Answer: Linoleic acid and alpha-linolenic acid $\Rightarrow$ B

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – the eicosanoid (prostaglandin) pathway: Arachidonic acid released from membrane phospholipids is the branch point.

Step 1 – identify X: The enzyme converting arachidonic acid to prostaglandins is **cyclooxygenase (COX)**.

Step 2 – clinical link: Aspirin irreversibly acetylates COX, blocking prostaglandin and thromboxane synthesis, which explains its anti-inflammatory and antiplatelet effects.

Why the other options are wrong:

- A, lipoxygenase: makes leukotrienes, the other arachidonic-acid branch.
- B, phospholipase A_2: releases arachidonic acid from phospholipid (the step before X).
- C, thromboxane synthase: acts downstream, converting a prostaglandin endoperoxide to thromboxane.

Final Answer: Cyclooxygenase (COX) $\Rightarrow$ D

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – essential amino acids: Nine amino acids, including the three branched-chain ones, cannot be synthesised by humans.

Step 1 – check the set: Valine, leucine and isoleucine are the branched-chain amino acids, and **lysine** is also essential, so option A is all-essential.

Step 2 – confirm the others fail: A single non-essential member in a set disqualifies it.

Why the other options are wrong:

- B, alanine, glycine, serine, proline: all non-essential.

- C, glutamate, aspartate, glutamine, asparagine: all non-essential.
- D, tyrosine, cysteine, glycine, serine: tyrosine and cysteine are only conditionally essential, glycine and serine are non-essential.

Final Answer: Valine, leucine, isoleucine and lysine $\Rightarrow$ A

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – nitrogen balance: Comparing nitrogen taken in with nitrogen excreted defines three states.

Step 1 – match the situation: Growth, pregnancy and recovery all build new tissue, so intake exceeds loss, giving **positive nitrogen balance**.

Step 2 – contrast the states: Equilibrium means intake equals loss (healthy adult); negative balance means loss exceeds intake (starvation, trauma, burns).

Why the other options are wrong:

- A, negative nitrogen balance: net protein loss, the opposite situation.
- B, nitrogen equilibrium: the steady state of a stable healthy adult, not net growth.
- D, zero nitrogen turnover: not a real physiological state; protein turnover never stops.

Final Answer: Positive nitrogen balance $\Rightarrow$ C

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – effect of temperature on enzymes: Activity rises with temperature until the protein starts to unfold.

Step 1 – read the graph: Activity climbs, peaks at X, then drops steeply as heat denatures the enzyme; the peak is the **optimum temperature**.

Step 2 – extend the idea: Each enzyme also has an optimum pH; both optima reflect the conditions giving maximum catalytic activity.

Why the other options are wrong:

- B, melting temperature of the substrate: irrelevant; it is the enzyme, not the substrate, that denatures.
- C, isoelectric point: the pH of zero net charge, not a temperature.
- D, Michaelis constant: a substrate-concentration term, not a point on a temperature curve.

Final Answer: Optimum temperature $\Rightarrow$ A

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – regulation of metabolic pathways: Pathways are often controlled at their first committed step.

Step 1 – name the mechanism: When the end product inhibits that first enzyme, it is **feedback (end-product) inhibition**, a form of allosteric regulation.

Step 2 – why it is efficient: Shutting the committed step prevents wasteful build-up of intermediates once enough product is present.

Why the other options are wrong:

- B, competitive inhibition: an inhibitor competes with substrate at the active site, not end-product control of a pathway.
- C, covalent modification: regulation by phosphorylation or similar, a different mechanism.
- D, zymogen activation: converting an inactive precursor to an active enzyme.

Final Answer: Feedback (end-product) inhibition $\Rightarrow$ A

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – trace elements in antioxidant enzymes: Certain enzymes need a specific metal or metalloid at the active site.

Step 1 – name the element: Selenium sits in glutathione peroxidase as selenocysteine and is essential for its activity.

Step 2 – the function: Glutathione peroxidase uses reduced glutathione to convert hydrogen peroxide to water, protecting cells from oxidative damage.

Why the other options are wrong:

- A, zinc: cofactor of carbonic anhydrase and Cu-Zn superoxide dismutase, not glutathione peroxidase.
- B, copper: found in cytochrome c oxidase and Cu-Zn SOD.
- D, manganese: cofactor of mitochondrial superoxide dismutase.

Final Answer: Selenium $\Rightarrow$ C

Answer: (C) Go Back to Q10

Q11.

Solution

Concept – proofreading by DNA polymerase: Fidelity depends on removing wrong nucleotides as they are added.

Step 1 – identify the activity: The enzyme reverses direction to excise the mismatched base using its **3′ to 5′ exonuclease** activity.

Step 2 – why this matters: This proofreading lowers the error rate dramatically, keeping replication accurate.

Why the other options are wrong:

- A, 5′ to 3′ exonuclease: removes RNA primers/damaged bases ahead of the enzyme, not proofreading.
- B, endonuclease: cuts within a strand, a repair/restriction function, not proofreading.
- D, helicase: unwinds the double helix and does not remove nucleotides.

Final Answer: 3′ to 5′ exonuclease activity $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept – eukaryotic mRNA processing: The 3′ end of a mature mRNA is modified for stability.

Step 1 – name the modification: A **poly-A tail** of many adenine residues is added to the 3′ end by poly-A polymerase.

Step 2 – its role: It protects the transcript from rapid degradation, aids export

from the nucleus and supports efficient translation.

Why the other options are wrong:

- A, 5′ cap: added to the opposite (5′) end, not the 3′ end.
- C, Kozak sequence: a translation-initiation context sequence, not a nucleotide tail.
- D, Shine-Dalgarno sequence: a prokaryotic ribosome-binding site, absent from eukaryotic mRNA.

Final Answer: Poly-A tail $\Rightarrow$ B

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – blotting techniques: The target molecule names the blot: DNA, RNA or protein.

Step 1 – match the target: Detecting a specific **DNA** sequence by electrophoresis, membrane transfer and probe hybridisation is **Southern blotting**.

Step 2 – remember the rule: Southern = DNA, Northern = RNA, Western = protein.

Why the other options are wrong:

- A, Northern blotting: detects RNA, not DNA.
- C, Western blotting: detects proteins using antibodies.
- D, ELISA: an antibody-based assay for antigens/antibodies, not a DNA blot.

Final Answer: Southern blotting $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – how the ETC drives ATP synthesis: Electron flow is coupled to ATP synthesis through a proton gradient.

Step 1 – read the figure: Complexes I, III and IV pump protons out of the matrix, building an electrochemical gradient; ATP synthase (complex V) makes ATP as protons flow back in.

Step 2 – name the theory: This coupling of the proton-motive force to phosphorylation is Peter Mitchell's **chemiosmotic theory**.

Why the other options are wrong:

- B, substrate-level phosphorylation: makes ATP directly from a high-energy intermediate, without a proton gradient.
- C, lock-and-key theory: describes enzyme-substrate specificity, not ATP synthesis.
- D, fluid mosaic model: describes membrane structure, not energy coupling.

Final Answer: Chemiosmotic theory $\Rightarrow$ A

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – salvage versus de novo synthesis: Cells can either recycle preformed bases or build rings from small precursors.

Step 1 – classify the process: Reusing an intact base such as uracil by joining it to PRPP is the **salvage pathway**.

Step 2 – why it is efficient: Salvage is energetically cheaper than the de novo route, which assembles the pyrimidine ring stepwise from carbamoyl phosphate and aspartate.

Why the other options are wrong:

- A, de novo synthesis: builds the ring from scratch, the opposite of reusing a preformed base.
- C, degradation pathway: breaks bases down (for pyrimidines, to soluble products), not building nucleotides.
- D, beta-oxidation pathway: a fatty acid catabolic route, unrelated to nucleotides.

Final Answer: Salvage pathway $\Rightarrow$ 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