

Respiration in Plants — NEET MCQs with Solutions

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Q1. Glycolysis occurs in the:

- (A) Mitochondrial matrix
- (B) Inner mitochondrial membrane
- (C) Chloroplast stroma
- (D) Cytoplasm

Q2. Anaerobic respiration in yeast produces:

- (A) Ethanol and CO_2
- (B) Lactic acid and NAD^+
- (C) Ethanol and H_2O
- (D) Pyruvate and ATP only

Q3. The net gain of NADH molecules during glycolysis per glucose molecule is:

- (A) 2 NADH
- (B) 4 NADH
- (C) 1 NADH
- (D) 3 NADH

Q4. Pyruvate kinase catalyzes the conversion of phosphoenolpyruvate (PEP) to pyruvate, resulting in:

- (A) Release of ADP and formation of PEP
- (B) Formation of ATP and pyruvate
- (C) Formation of NADH and CO_2
- (D) Hydrolysis of fructose-1,6-bisphosphate

Q5. Which step of glycolysis is considered the major regulatory and rate-limiting step?

- (A) Glucose → Glucose-6-phosphate (Hexokinase)
- (B) Glucose-6-phosphate → Fructose-6-phosphate (Phosphoglucose isomerase)
- (C) Fructose-6-phosphate → Fructose-1,6-bisphosphate (PFK-1)
- (D) Phosphoenolpyruvate → Pyruvate (Pyruvate kinase)

Q6. Fermentation occurs in the:

- (A) Mitochondrial matrix alongside Krebs cycle enzymes
- (B) Cytoplasm, using the same enzymatic machinery as glycolysis
- (C) Inner mitochondrial membrane
- (D) Intermembrane space of mitochondria

Q7. During alcoholic fermentation, CO_2 is released at which step?

- (A) Reduction of acetaldehyde to ethanol
- (B) Oxidation of NADH at the end of fermentation
- (C) Decarboxylation of pyruvate to acetaldehyde
- (D) Conversion of glucose to pyruvate during glycolysis

Q8. The total NADH produced from the link reaction per glucose molecule is:

- (A) 1 NADH
- (B) 4 NADH
- (C) 2 NADH
- (D) 6 NADH

Q9. The enzyme complex that catalyzes the link reaction is:

- (A) Hexokinase
- (B) Pyruvate kinase
- (C) Succinate dehydrogenase
- (D) Pyruvate dehydrogenase complex (PDC)

Q10. The total CO₂ released per glucose molecule from the Krebs cycle is:

- (A) Two
- (B) Three
- (C) Six
- (D) Four

Q11. The enzyme that catalyzes the first step of the Krebs cycle is:

- (A) Isocitrate dehydrogenase
- (B) Aconitase
- (C) Alpha-ketoglutarate dehydrogenase
- (D) Citrate synthase

Q12. The oxidation of isocitrate to alpha-ketoglutarate produces:

- (A) FADH₂ and no carbon loss
- (B) NADH and one molecule of CO₂
- (C) GTP and two molecules of CO₂
- (D) NADH only with no CO₂ release

Q13. During the electron transport chain, protons are actively pumped into the:

- (A) Mitochondrial matrix
- (B) Intermembrane space
- (C) Cytoplasm
- (D) Cristae lumen only at Complex II

Q14. The immediate driving force for ATP synthesis by ATP synthase is:

- (A) The flow of electrons through the membrane
- (B) The concentration of NADH in the matrix
- (C) The proton motive force (electrochemical gradient of H⁺)
- (D) The concentration of oxygen in the intermembrane space

Q15. Which of the following correctly distinguishes Complex I from Complex II in the ETC?

- (A) Complex I pumps protons; Complex II does not pump protons
- (B) Complex II pumps more protons than Complex I
- (C) Both Complex I and II pump equal numbers of protons
- (D) Complex I accepts electrons from FADH₂; Complex II accepts from NADH

Q16. Total CO₂ molecules released per glucose during complete aerobic respiration is:

- (A) 2
- (B) 4
- (C) 5
- (D) 6

Q17. As per NCERT Class 11 respiratory balance sheet, oxidation of one FADH₂ in the ETC yields how many ATP?

- (A) 2 ATP
- (B) 3 ATP
- (C) 4 ATP
- (D) 1 ATP

Q18. The actual ATP yield in living cells is lower than the theoretical maximum because:

- (A) Oxygen is consumed before all NADH is oxidized
- (B) Some glucose is lost as heat during glycolysis
- (C) The inner mitochondrial membrane is not perfectly impermeable; proton leakage and shuttle costs reduce yield
- (D) NADH is converted to FADH₂ during transport

Q19. A metabolic pathway that serves both catabolic and anabolic functions is called:

- (A) Amphibolic pathway
- (B) Anaplerotic pathway
- (C) Anabolic pathway
- (D) Oxidative pathway

Q20. Fatty acids are integrated into the respiratory pathway after being converted into:

- (A) Glucose-6-phosphate via glycolysis reversal
- (B) Pyruvate by direct oxidation
- (C) Acetyl-CoA via β -oxidation
- (D) Oxaloacetate via transamination

Q21. Succinyl-CoA, an intermediate of the Krebs cycle, is a precursor for the synthesis of:

- (A) Porphyrins including heme and chlorophyll
- (B) Glucose via gluconeogenesis
- (C) Glycerol for fat synthesis
- (D) Purines via the pentose phosphate pathway

Q22. If equal volumes of CO_2 are evolved and O_2 are consumed during respiration, the substrate being utilized is most likely:

- (A) Fat
- (B) Protein
- (C) Carbohydrate
- (D) Organic acid

Q23. RQ value greater than 1 indicates respiration of:

- (A) Proteins
- (B) Fats
- (C) Carbohydrates
- (D) Organic acids

Q24. The balanced equation for oxidation of tripalmitin (a fat) is: $2\text{C}_{51}\text{H}_{98}\text{O}_6 + 145\text{O}_2 \rightarrow 102\text{CO}_2 + 98\text{H}_2\text{O}$. The RQ of tripalmitin is approximately:

- (A) 1
- (B) 0.7
- (C) 1.3
- (D) 0.5

Answer key and explanations

Q1. Answer: (D) Cytoplasm

Glycolysis is a cytoplasmic process requiring no membrane-bound organelle — this is why it is common to both aerobic and anaerobic organisms. All subsequent aerobic steps occur inside mitochondria.

Q2. Answer: (A) Ethanol and CO_2

Yeast ferments pyruvate to ethanol and CO_2 via alcoholic fermentation. Lactic acid is the anaerobic product in animal muscle, not yeast — a classic NEET trap. Water is not a direct product of fermentation.

Q3. Answer: (A) 2 NADH

Two molecules of G3P are oxidized (one from each triose), each reducing one NAD^+ to NADH — yielding 2 NADH total per glucose. 4 NADH is a common wrong answer from students who confuse glycolysis yield with Krebs cycle yield.

Q4. Answer: (B) Formation of ATP and pyruvate

PEP donates its phosphate to ADP forming ATP (substrate-level phosphorylation) and pyruvate. Option A reverses the reaction — PEP is the substrate, not the product. This is the second substrate-level phosphorylation step per triose.

Q5. Answer: (C) Fructose-6-phosphate → Fructose-1,6-bisphosphate (PFK-1)

PFK-1 is the primary regulatory enzyme of glycolysis — it is allosterically inhibited by ATP and citrate, and activated by AMP. Option D (pyruvate kinase) is also irreversible and regulated, but PFK-1 is the committed, rate-limiting step. This distinction is the NEET trap.

Q6. Answer: (B) Cytoplasm, using the same enzymatic machinery as glycolysis

Fermentation is entirely cytoplasmic — both glycolysis and the subsequent fermentation steps use cytosolic enzymes. The mitochondrion is not involved at any stage of fermentation.

Q7. Answer: (C) Decarboxylation of pyruvate to acetaldehyde

CO₂ is released specifically during the pyruvate decarboxylase step (pyruvate → acetaldehyde). It is NOT released during reduction of acetaldehyde to ethanol. Option D is a trap — glycolysis does not release CO₂ (all 6 carbons of glucose are conserved in two pyruvates).

Q8. Answer: (C) 2 NADH

One glucose yields two pyruvate molecules; each pyruvate produces 1 NADH in the link reaction → 2 NADH per glucose. 4 NADH is the Krebs cycle yield — a frequent confusion in ATP/NADH accounting questions.

Q9. Answer: (D) Pyruvate dehydrogenase complex (PDC)

The pyruvate dehydrogenase complex (PDC) catalyzes oxidative decarboxylation of pyruvate. Pyruvate kinase catalyzes the last step of glycolysis (PEP → Pyruvate) — the most dangerous distractor because it also acts on pyruvate, but produces it rather than processing it.

Q10. Answer: (D) Four

Two CO₂ per turn × 2 turns per glucose = 4 CO₂ from Krebs cycle alone. Combined with 2 CO₂ from the link reaction, total CO₂ per glucose = 6 — matching the 6 carbons of glucose (complete oxidation). Option A is a trap for students who count only one turn.

Q11. Answer: (D) Citrate synthase

Citrate synthase catalyzes condensation of acetyl-CoA + OAA → citrate. Aconitase acts in the second step (citrate → isocitrate) — the most plausible wrong answer since it also acts on citrate, just not to form it.

Q12. Answer: (B) NADH and one molecule of CO₂

Isocitrate dehydrogenase catalyzes both an oxidation (NAD⁺ → NADH) and a decarboxylation (one CO₂ released) simultaneously — making this step structurally analogous to the link reaction. Option D is the most dangerous distractor: students recall NADH but forget the CO₂.

Q13. Answer: (B) Intermembrane space

Complexes I, III, and IV function as proton pumps, translocating H⁺ from the matrix into the intermembrane space, creating the electrochemical gradient. Complex II does NOT pump protons — this is a critical distinction. The proton gradient (matrix = low H⁺, intermembrane space = high H⁺) drives ATP synthase.

Q14. Answer: (C) The proton motive force (electrochemical gradient of H⁺)

The proton motive force — combining the pH gradient and membrane potential — drives protons through ATP synthase, powering ATP synthesis. Electrons do not flow through ATP synthase itself. Oxygen is the terminal electron acceptor at Complex IV, not a direct driver of ATP synthase.

Q15. Answer: (A) Complex I pumps protons; Complex II does not pump protons

Complex I (NADH dehydrogenase) oxidizes NADH and pumps 4H⁺ per electron pair into the intermembrane space. Complex II (succinate dehydrogenase) oxidizes FADH₂ but does NOT pump any protons — this is why FADH₂ yields less ATP than NADH. This is the most commonly confused distinction in ETC questions.

Q16. Answer: (D) 6

Two CO_2 are released per pyruvate during the link reaction ($2 \text{ pyruvate} \times 1 \text{ CO}_2 = 2$), and four CO_2 are released per glucose during two turns of the Krebs cycle ($2 \text{ turns} \times 2 \text{ CO}_2 = 4$), totaling 6 CO_2 . No CO_2 is released during glycolysis.

Q17. Answer: (A) 2 ATP

NCERT Class 11 uses the older P/O ratio: $1 \text{ FADH}_2 = 2 \text{ ATP}$. The revised chemiosmotic value is 1.5 ATP, but NCERT balance sheet uses 2 ATP. Since FADH_2 enters at Complex II (bypassing Complex I), fewer protons are pumped, yielding less ATP than NADH.

Q18. Answer: (C) The inner mitochondrial membrane is not perfectly impermeable; proton leakage and shuttle costs reduce yield

The theoretical yield assumes 100% coupling efficiency and no proton leakage. In reality, some protons leak across the inner mitochondrial membrane without passing through ATP synthase, and cytoplasmic NADH requires shuttle systems (malate-aspartate or glycerol-3-phosphate) that have energy costs. These reduce actual yield to $\sim 30\text{--}32 \text{ ATP}$.

Q19. Answer: (A) Amphibolic pathway

An amphibolic pathway participates in both breakdown (catabolism) and synthesis (anabolism). Option B (anaplerotic) refers specifically to reactions that replenish Krebs cycle intermediates — it is a subset concept, not a synonym for amphibolic.

Q20. Answer: (C) Acetyl-CoA via β -oxidation

Fatty acids undergo β -oxidation in the mitochondrial matrix, progressively cleaved into 2-carbon units released as acetyl-CoA, which then enters the Krebs cycle. Option B is a trap — pyruvate comes from glucose catabolism, not fatty acid breakdown. Fatty acids do not produce pyruvate.

Q21. Answer: (A) Porphyrins including heme and chlorophyll

Succinyl-CoA is a key precursor for porphyrin biosynthesis — including heme (in hemoglobin and cytochromes) and chlorophyll. This is a high-value amphibolic connection. Option B is a trap — succinyl-CoA cannot directly enter gluconeogenesis in animals as it cannot yield net oxaloacetate.

Q22. Answer: (C) Carbohydrate

Equal CO_2 and O_2 volumes give $\text{RQ} = 1$, which is the hallmark of carbohydrate oxidation. Option A (fat) gives $\text{RQ} \sim 0.7$; Option B (protein) ~ 0.8 ; Option D (organic acid) > 1 .

Q23. Answer: (D) Organic acids

Organic acids are already partially oxidized and oxygen-rich; they require less external O_2 relative to the CO_2 released, giving $\text{RQ} > 1$. Option C (carbohydrates) is wrong — RQ for carbs = 1 exactly.

Q24. Answer: (B) 0.7

$\text{RQ} = \text{CO}_2/\text{O}_2 = 102/145 \approx 0.703 \approx 0.7$. This is the standard NEET PYQ calculation for fat RQ . Option A (1) is the carbohydrate trap; Option D (0.5) represents an even more reduced substrate.

Respiration: where, what and how much

Step	Key fact
Glycolysis (EMP pathway)	Embden, Meyerhof and Parnas; in the cytoplasm; glucose $\rightarrow$ 2 pyruvate; net 2 ATP and 2 NADH
Alcoholic fermentation	Yeast: pyruvic acid decarboxylase and alcohol dehydrogenase $\rightarrow$ ethanol + CO_2 ; yeast is poisoned at about 13% alcohol
Lactic acid fermentation	Muscles: lactate dehydrogenase reduces pyruvate to lactic acid
Link reaction	In the mitochondrial matrix; pyruvate dehydrogenase needs Mg^{2+} , NAD^+ and coenzyme A; makes acetyl CoA, CO_2 and NADH

Krebs (TCA) cycle	Acetyl CoA + oxaloacetic acid → citric acid (citrate synthase); per turn: 3 NADH, 1 FADH ₂ , 1 ATP/GTP, 2 CO ₂
Electron transport system	Inner mitochondrial membrane; complex I (NADH dehydrogenase), complex II (FADH ₂), ubiquinone, cytochrome c, complex IV (cytochrome c oxidase); oxygen is the final acceptor
ATP synthase	Complex V with F ₀ (proton channel) and F ₁ (makes ATP)
ATP yield (NCERT)	NADH → 3 ATP; FADH ₂ → 2 ATP; net 38 ATP per glucose in aerobic respiration
Amphibolic pathway	Respiration both breaks down (catabolism) and supplies building blocks (anabolism)
RQ of carbohydrates	1
RQ of fats	Less than 1 — tripalmitin about 0.7
RQ of proteins	About 0.9
RQ of organic acids	More than 1