

2023 Bi H2 Q6

Section: Metabolism and Survival

Topic: Cellular Respiration

Question Summary

Short diagram question on aerobic respiration. Identify key stages, locations, ATP yield, and the role of oxygen. Also outline what happens when oxygen is not available.

Worked Solution

(a) Name the three main stages of aerobic respiration

- Glycolysis
- Citric acid cycle (Krebs cycle)
- Electron transport chain (ETC)

(b) State where each stage occurs in the cell

- Glycolysis: cytosol
- Citric acid cycle: mitochondrial matrix
- ETC: inner mitochondrial membrane (cristae)

(c) ATP yield and where most ATP is made

- Glycolysis net yield: 2 ATP per glucose
- Citric acid cycle direct yield: 2 ATP per glucose (as GTP/ATP)
- Most ATP is made by oxidative phosphorylation at the ETC using

energy from NADH and FADH₂

(d) Role of oxygen in aerobic respiration

- Oxygen is the final electron acceptor at the end of the ETC
- It combines with electrons and hydrogen ions to form water
- This removal of electrons maintains electron flow and drives ATP synthesis

(e) What happens when oxygen is not available (fermentation)

- ETC stops because oxygen is unavailable as final electron acceptor
- NADH cannot offload electrons, so cells regenerate NAD⁺ by fermentation
- In animal cells: pyruvate is reduced to lactate; in yeast: pyruvate is converted to ethanol and CO₂
- Only glycolysis continues, yielding 2 ATP per glucose

Final Answers

- (a) Glycolysis; Citric acid cycle; Electron transport chain
- (b) Cytosol; Mitochondrial matrix; Inner mitochondrial membrane
- (c) Most ATP at ETC via oxidative phosphorylation (glycolysis 2 ATP; CAC 2 ATP)
- (d) Oxygen is final electron acceptor forming water, allowing ETC to operate
- (e) Fermentation regenerates NAD⁺ (lactate in animals; ethanol and CO₂ in yeast); only 2 ATP per glucose

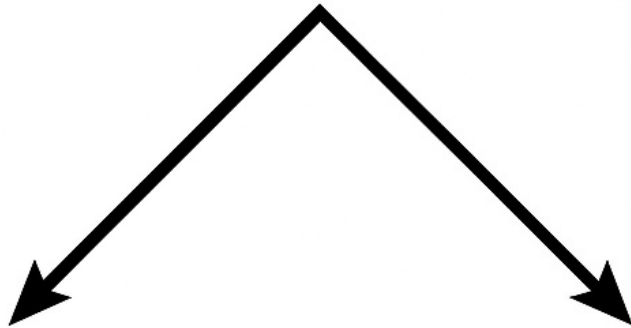
Revision Tips

- NADH and FADH₂ carry high energy electrons from glycolysis and the citric acid cycle to the ETC
- Proton gradients across the inner membrane power ATP synthase
- Without oxygen, oxidative phosphorylation stops and ATP yield drops sharply

Glucose



Pyruvate



Yeast

Ethanol + CO₂

Lactate

Animals