

Exercise walk-through

5.1

Respiration, glycolysis to oxidative phosphorylation (statements 7.1–7.8, core practicals 15–16)

Pearson Edexcel · International A-Level · Biology

Four stages, one purpose

Stage	Where	Yield
Glycolysis	cytoplasm	2 ATP + 2 reduced NAD
Link reaction	matrix	CO ₂ + reduced NAD
Krebs cycle	matrix	ATP + reduced NAD + reduced FAD
Oxidative phosphorylation	cristae	most ATP; O ₂ to water

The sliding filament

Calcium : binds troponin, exposes actin binding sites



Attach : energised myosin head locks onto actin



Pull : the power stroke slides actin toward the centre



Detach : fresh ATP binds the head, which re-cocks for the next cycle

Recombinant DNA: cut, paste, select

Cut : the same restriction enzyme opens plasmid and gene



Paste : complementary sticky ends sealed by DNA ligase



Transform : heat shock carries plasmids into bacteria



Select : antibiotic marker - only transformants survive

Exercises 2.1·2.3

2.1 Name the stage of respiration that occurs in the cytoplasm and state its carbon-containing product. [2]

2.2 State the final electron acceptor of the electron transport chain and the molecule formed. [2]

2.3 Explain why the rate of respiration of a mammal falls sharply above 45 degrees Celsius. [2]

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2.1 Glycolysis; pyruvate.

2.2 State the final electron acceptor of the electron transport chain and the molecule formed. [2]

2.2 Oxygen; water.

2.3 Explain why the rate of respiration of a mammal falls sharply above 45 degrees Celsius. [2]

2.3 Above the enzymes' optimum, tertiary structure breaks down (denaturation); the enzymes of glycolysis, link reaction and Krebs no longer fit their substrates, so rate collapses.

Exercise 3.1

3.1 A student uses a respirometer with hydrogencarbonate indicator to follow respiration of three organisms. The table shows gas exchange per hour.

Organism	CO ₂ produced / mm ³	O ₂ consumed / mm ³
A	60	60
B	36	60
C	72	60

Calculate the RQ of each organism, identify the likely substrate in each case, and suggest what organism C's value above 1.0 indicates.

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3.1 A: $60/60 = 1.0$, carbohydrate. B: $36/60 = 0.6$, close to the lipid value 0.7 – lipid substrate. C: $72/60 = 1.2$, above 1.0: some anaerobic respiration is releasing extra CO₂ without oxygen consumption.

Exercises 3.2-3.3

3.2 Cyanide blocks the final electron carrier of the transport chain. Explain why cyanide poisoning stops ATP production by oxidative phosphorylation AND stops the Krebs cycle soon afterwards. [5]

3.3 During intense exercise a muscle cell's ATP demand rises tenfold while its oxygen supply rises only threefold. Explain how the cell keeps respiring, what accumulates, and why the muscle aches and recovers hours later. [6]

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3.2 With the final carrier blocked, electrons cannot leave the chain; reduced NAD and FAD cannot be reoxidised; without oxidised carriers there is no H^+ gradient and no chemiosmosis, so ATP synthesis stops. The Krebs cycle halts because its reduced NAD cannot be handed on – the carriers stay fully reduced.

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3.3 Oxygen too low for full aerobic respiration, glycolysis continues and pyruvate is reduced to lactate, regenerating NAD so glycolysis keeps making ATP. Lactate accumulates in the muscle; afterwards blood carries it to the liver where it is converted back to glucose, consuming oxygen – repaying the oxygen debt.