

Name	Date started	Target end date
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GCE A LEVEL – BIOLOGY UNIT 3 QUESTION PACK

1074 (Legacy BY4) + 1075 (Legacy BY5) · New spec Unit 3 Topic 4 · A2 unit, first sat 2017, 90 marks, 2h paper

REVISE

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BIOLOGY – UNIT 3 · RESPIRATION – GLYCOLYSIS & LINK REACTION

3.3 Respiration – glycolysis, the link reaction and the entry of pyruvate into the mitochondrion

Glycolysis as the cytoplasmic conversion of glucose to pyruvate (phosphorylation, lysis to triose phosphate, oxidation with NAD^+ , net 2 ATP), the entry of pyruvate into the mitochondrial matrix, and the link reaction producing acetyl coenzyme A, CO_2 and reduced NAD.

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~51 min

Derived from the legacy BY4 / BY5 papers' pace of ~1.3 min/mark, padded for long-prose answers (32 marks over 3 questions).

You are advised to **not** attempt to complete all of this in one sitting.

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC BY4 (and BY5, where relevant) papers (2008 modular spec, 2011–2017) that maps onto new-spec A2 Unit 3 Topic 4 (3.3).

Questions are ordered by source paper date.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – quality of written communication will affect marks. A calculator is allowed. Diagrams included in answers must be fully annotated.

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Q	Source	Max	Mark	Q	Source	Max	Mark
1	BY4 Jun 16 Q8	11		3	BY4 Jan 13 Q6	10	
2	BY4 Jun 17 Q5	11		Total			
						32	

Respiration – Glycolysis & Link Reaction – what the new spec asks

WJEC GCE A Level Biology (from 2015) · Unit 3: Energy, Homeostasis & the Environment · Topic 3.3.

Glycolysis – overview

- Occurs in the cytoplasm of all respiring cells.
- Glucose (6C) → 2 pyruvate (3C).
- Net gain: 2 ATP; produces 2 reduced NAD.

Glycolysis steps

- Phosphorylation: 2 ATP used to make hexose bisphosphate.
- Lysis: hexose bisphosphate splits into 2 triose phosphates.
- Oxidation: 2 NAD reduced; 4 ATP produced by substrate-level phosphorylation.

Link reaction

- Pyruvate moves into the mitochondrial matrix.
- Decarboxylated & oxidised: CO₂ lost, NAD reduced.
- Acetyl (2C) joins coenzyme A → acetyl CoA enters Krebs cycle.

Why ATP yield is low so far

- Net 2 ATP from glycolysis; 0 ATP directly from link.
- Real value comes from the reduced NAD which feeds the ETC.
- Without oxygen, glycolysis is the only ATP source.

Respiration – Glycolysis & Link Reaction in one page

Quick-reference notes – revisit before each question.

Glycolysis steps

Glucose phosphorylated (uses 2 ATP)
→ hexose biphosphate.
Lysis → 2 triose phosphates.
Oxidation: 2 NAD reduced; 4 ATP made
(net 2 ATP).

Why phosphorylate first?

Traps glucose in cell.
Destabilises molecule, lowers
activation energy.
Investment of 2 ATP – gain 4 ATP later.

Link reaction

Pyruvate → matrix.
Pyruvate (3C) → CO₂ + acetyl (2C); NAD
reduced.
Acetyl + CoA → acetyl CoA.

Mitochondrion entry

Pyruvate carrier in outer membrane.
Specific transporter in inner
membrane.
Net energy cost – included in textbook
ATP totals.

Substrate-level phosphorylation

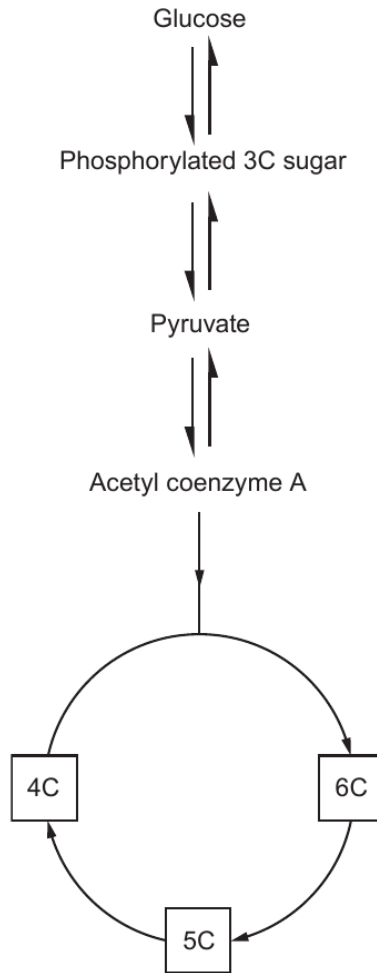
Direct P transfer from substrate to
ADP.
Glycolysis & Krebs make ATP this way.
Independent of O₂ / ETC.

Yield so far

Per glucose: 2 ATP (net), 2 NADH from
glycolysis.
Plus 2 NADH from link.
NADH yields ATP when fed into ETC.

8. The diagram below shows the stages of glycolysis and the Krebs cycle in respiration.

Examiner only



- (a) Using **labelled** arrows indicate clearly where **amino acids** and the **products of the hydrolysis of triglycerides** (lipids) enter the respiratory pathway. [3]
- (b) Describe the role of oxygen in aerobic respiration. [2]

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- (c) A piece of apparatus called a respirometer can be used to measure the rates of oxygen uptake and carbon dioxide production. Using these results, a respiratory quotient (RQ) can be calculated.
The RQ is defined as the ratio of carbon dioxide produced to oxygen consumed per unit time by an organism.

Examiner
only

$$\text{RQ} = \frac{\text{volume of CO}_2 \text{ produced}}{\text{volume of O}_2 \text{ consumed}} \text{ per unit time}$$

Table 1

Rate of oxygen consumption (cm ³ O ₂ min ⁻¹)	Rate of carbon dioxide production (cm ³ CO ₂ min ⁻¹)	RQ (Respiratory quotient)	Substrate being respired
2.55	2.21	0.87	
2.63	2.65	1.01	
2.23	1.55		

- (i) Calculate the missing value in the RQ column in the table above. [1]

Different respiratory substrates give different RQ values as can be seen in the table below.

Table 2

Substrate	RQ
Glucose	1.0
Amino acid	0.9
Triglycerides	0.7

- (ii) Complete the substrate column in Table 1 using the above information. [1]

(d) During a sprint an athlete's muscle cells may respire anaerobically to produce ATP.

(i) Name one other metabolic product of anaerobic respiration in muscle cells. [1]

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(ii) Where in a cell does anaerobic respiration occur? [1]

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(iii) Describe the importance of ATP to muscle cells. [1]

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.....

(e) Suggest what would happen to the RQ value if you were investigating anaerobic respiration in yeast and explain your answer. [1]

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only

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5. The link reaction connects glycolysis and the Krebs cycle.

Examiner
only

(a) (i) State precisely where the link reaction occurs.

[1]

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(ii) Describe the sequence of events in the link reaction.

[4]

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(b) Complete the table below for the Krebs cycle.

[2]

Product	Number produced per molecule of glucose
ATP	
CO ₂	
	6
	2

Glycolysis is regulated by slowing down or speeding up certain steps in the pathway by inhibiting or activating the enzymes that are involved. A common mechanism of regulating enzymes is allosteric control which is a type of non-competitive inhibition.

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(c) Explain how the action of a non-competitive inhibitor could inhibit glycolysis. [4]

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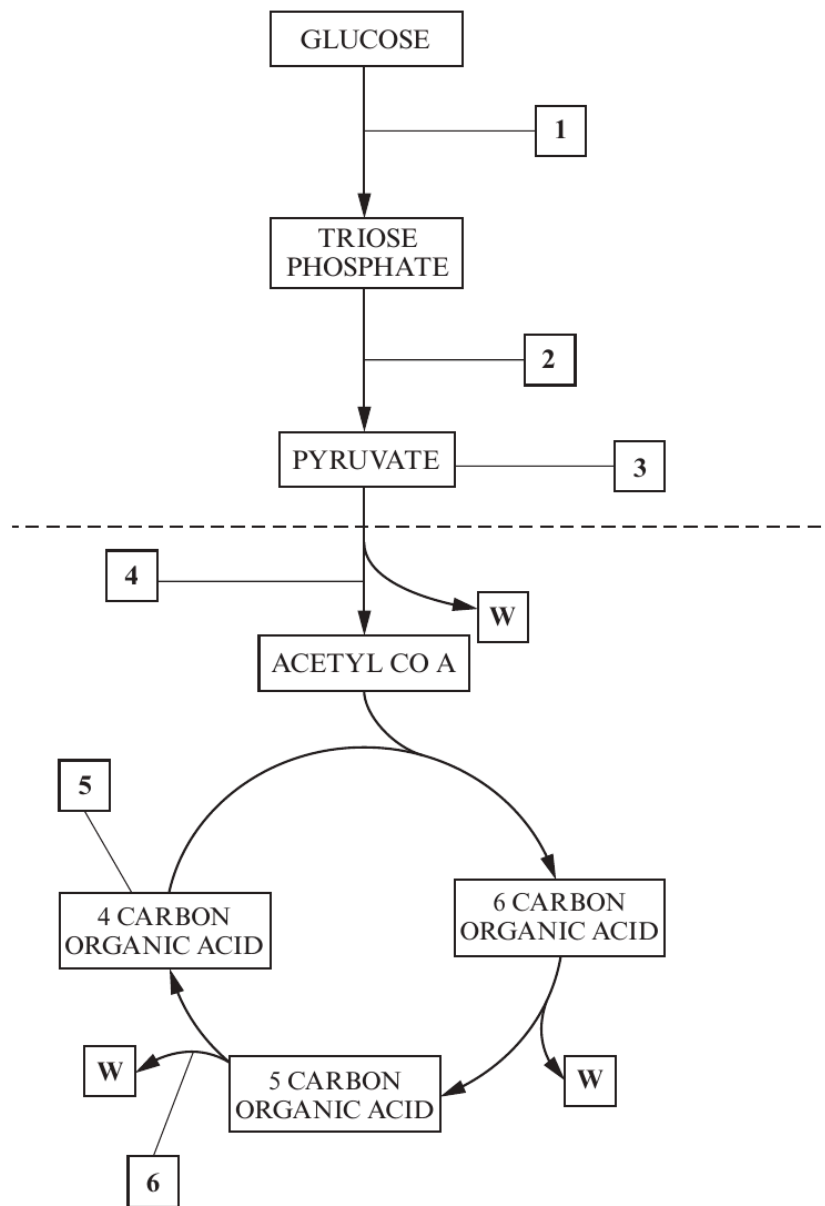
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6. The diagram shows an outline of three stages of aerobic respiration.



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- (a) (i) Name the three stages of respiration shown in the diagram opposite and state where in the cell they occur. [3]

Examiner only

<i>Name of stage of respiration</i>	<i>Where it occurs in the cell</i>

- (ii) Which of these stages will operate in the absence of oxygen? [1]

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- (b) (i) Identify substance **W** shown on the diagram opposite. [1]

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- (ii) Name the enzyme responsible for its production. [1]

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- (c) Use the numbers **1** to **6** from the diagram opposite to identify where the following events take place during respiration. The numbers can be used once, more than once, or not at all. [4]

Event	Point(s) on Diagram
Substrate-level phosphorylation occurs	
Glycerol can be converted to a 3C sugar which enters respiration at this point	
ATP is used in phosphorylation	

END OF QUESTION PACK

3 questions · 32 marks · ~51 min

Source: WJEC BY4 + BY5 (2008 modular spec, 2011–2017)

Curated for WJEC Biology 2015 spec A2 Unit 3 – Topic 4 (3.3)

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