Worksheet 4 - Glycolysis and Lactate Fermentation

IB Biology C1.2 - Trimester assessment practice
SL core emphasis with IB-style questioning.

IB Biology C1.2	**Total marks:** 24
Suggested time: 50 minutes	**Name:** _____ **Class:** _____ **Date:** _____

Section A - Multiple choice

Q1. Which statement about glycolysis is correct? [1]

A. It occurs only in eukaryotes.

B. It requires oxygen to begin.

C. It occurs in the cytoplasm and produces pyruvate.

D. It directly produces carbon dioxide.

Q2. What is the net ATP yield of glycolysis per glucose molecule? [1]

A. 0

B. 1

C. 2

D. 4

Q3. Why is lactate formation useful when oxygen is absent? [1]

A. It produces more ATP than aerobic respiration.

B. It regenerates NAD so glycolysis can continue.

C. It removes all pyruvate from the body permanently.

D. It creates carbon dioxide for the Krebs cycle.

Section B - Short answer

Q4. Outline the main events of glycolysis. [4]

Q5. Explain why muscles can continue to work for a short time when oxygen becomes limiting. [3]

Section C - Data response / case study

During a sprint, muscle lactate concentration and ATP production from glycolysis were measured.

Table 1. Muscle metabolism during intense exercise

Time / s	Lactate / mmol dm^-3	ATP from glycolysis / relative units
0	1.0	1.0
20	2.8	1.6
40	4.6	1.8
60	6.2	1.8

Q6.

(a) State the overall trend in lactate concentration. [1]

(b) Explain why lactate concentration rises during intense exercise. [2]

(c) Why does glycolytic ATP production level off between 40 s and 60 s? [2]

(d) Explain why lactate formation does not provide a large ATP yield even though it allows continued glycolysis. [3]

Section D - Extended response

Q7. Explain how glycolysis combines phosphorylation, lysis, oxidation and ATP formation to release energy from glucose. [6]

Continue on extra paper if needed.

Answer key and marking guidance

Teacher guidance is indicative and is designed for classroom assessment practice rather than as an official IB markscheme.

Section A - Multiple choice

Q1. Correct answer: **C**. Award [1] for C only.

Q2. Correct answer: **C**. Award [1] for C only.

Q3. Correct answer: **B**. Award [1] for B only.

Section B - Short answer

Q4. Indicative answer:

- Glucose is phosphorylated using 2 ATP.
- The 6-carbon sugar is split into two 3-carbon triose phosphates.
- The triose phosphates are oxidised and reduced NAD is formed.
- ATP is produced and the final products are 2 pyruvate, 2 NADH and a net gain of 2 ATP.

Marking guidance: Award [1] each for phosphorylation, lysis, oxidation/NADH, ATP + pyruvate products.

Q5. Indicative answer:

- Glycolysis can continue without oxygen.
- Pyruvate is converted to lactate, regenerating NAD.
- This allows a small continued ATP production, although it cannot be sustained for long.

Marking guidance: Award [1] each for glycolysis without oxygen, NAD regeneration, small short-term ATP supply.

Section C - Data response / case study

Q6.

(a) **Answer:** Lactate concentration increases over time.

(a) **Marking guidance:** [1] increases

(b) **Answer:** Oxygen supply becomes insufficient for all pyruvate to enter aerobic respiration. Pyruvate is reduced to lactate, regenerating NAD so glycolysis can continue.

(b) **Marking guidance:** [1] insufficient oxygen, [1] pyruvate -> lactate regenerates NAD

(c) **Answer:** The glycolytic pathway is likely operating near its maximum rate under these conditions, or substrate availability and enzyme activity limit further increase.

(c) **Marking guidance:** [1] near maximum / limited pathway rate, [1] relevant cause such as substrate/enzyme limitation

(d) **Answer:** Lactate formation itself does not generate extra ATP. The only ATP obtained under these anaerobic conditions is the net 2 ATP from glycolysis, so total energy yield remains low.

(d) **Marking guidance:** [1] lactate step no extra ATP, [1] only glycolysis yields ATP, [1] net yield remains low

Section D - Extended response

Q7. Indicative content for a high-scoring response:

- Glucose is first phosphorylated using ATP, making it less stable.
- The phosphorylated hexose is split into two 3-carbon molecules.
- These triose phosphates are oxidised during later steps.
- NAD is reduced to NADH as hydrogen/electrons are removed.
- Energy released is used in substrate-level phosphorylation to make ATP from ADP.
- The pathway ends with two pyruvate molecules and a net gain of two ATP.

Suggested level guidance:

- 5-6: Scientifically accurate, well linked explanation using correct terminology and relevant examples or evidence.
- 3-4: Some correct biology with partial linkage between ideas; minor omissions or limited detail.
- 1-2: Limited or fragmented response with a few correct points only.

- 0: No relevant content.