

1.1 Exercise physiology: responses and recovery

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS cardiac output • stroke volume

Objective

Physiology: responses and recovery. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

■ What would explain this observation?

- Heart rate increases during a short exercise bout, then recovers. This time course connects energy demand, oxygen transport and cardiovascular regulation.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Cardiac output** is heart rate multiplied by **stroke volume**.
Ventilation supports gas exchange, while blood transport delivers oxygen to working tissues. ATP demand changes as muscle activity changes.
- cardiac output: Blood volume pumped per minute; stroke volume: Blood volume pumped per beat.



■ Choose evidence that can test it

- An acute response occurs during or soon after exercise. A training adaptation develops over repeated sessions. A lower post-exercise heart rate cannot alone establish greater fitness without comparable workload and participant conditions.
- Use voluntary informed participation, school supervision and an approved low-intensity protocol. Record baseline, a standardized workload and timed recovery measurements. Stop for discomfort and do not use maximal exertion or health diagnosis as a classroom task.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: heart rate is 120 beats per minute and stroke volume 80 millilitres per beat.
Cardiac output = heart rate $\times$ stroke volume = $120 \times 80 = 9,600$ millilitres per minute
= 9.6 litres per minute.

Example:

Heart rate is 100 beats/min and stroke volume is 70 mL/beat. Find cardiac output in L/min. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- A heart-rate monitor measures one response, not every dimension of performance. Hydration, stress, medication and recent activity can confound comparisons.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A single heart-rate reading proves a person fitness level. This claim is false: A heart-rate monitor measures one response, not every dimension of performance. Hydration, stress, medication and recent activity can confound comparisons.

Key:

Exercise physiology: responses and recovery: An acute response occurs during or soon after exercise. A training adaptation develops over repeated sessions. A lower post-exercise heart rate cannot alone establish greater fitness without comparable workload and participant conditions.

2 Practice

2.1 Which distinguishes a training adaptation from an acute response? Choose one answer.

- **A** It develops over repeated training sessions
- **B** It must occur within one heartbeat
- **C** It is unrelated to the body

[1]

2.2 Heart rate is 100 beats/min and stroke volume is 70 mL/beat. Find cardiac output in L/min. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A single heart-rate reading proves a person fitness level.

[2]

2.4 Blood volume pumped per minute: write the technical term.

[1]

3 Exam-style questions

3.1 Fictional records have $100 \text{ beats/min} \times 70 \text{ mL/beat}$ and 140×50 . Compare outputs and explain why heart rate alone cannot determine output or fitness. [4]

Solutions

2.1 A An acute response occurs during or soon after exercise. A training adaptation develops over repeated sessions. A lower post-exercise heart rate cannot alone establish greater fitness without comparable workload and participant conditions.

2.2 $\text{Output} = 100 \text{ beats/min} \times 70 \text{ mL/beat} = 7,000 \text{ mL/min} = 7 \text{ L/min}$.

2.3 False. A heart-rate monitor measures one response, not every dimension of performance. Hydration, stress, medication and recent activity can confound comparisons.

2.4 cardiac output. cardiac output means Blood volume pumped per minute.

3.1 Both give 7 L/min. Output is a product; stroke volume matters. These invented arithmetic examples do not diagnose fitness or health.