

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]