

The heart, ventilation and exercise: practice questions

9 questions · 33 marks · mark scheme at the back

For Pearson Edexcel International AS Biology XBI11 and International A Level Biology YBI11. **A Level only** is IA2 content (Units 4 to 6), not needed for the International AS.

Name

Total / 33

1 UNIT 5 STYLE [5 marks]

Describe how the normal electrical activity of the heart coordinates the contraction of the atria and ventricles.

2 UNIT 5 STYLE [1 mark]

Cardiac muscle is described as myogenic. What does this mean?

- A. ☐ It contracts only when stimulated by motor neurones.
- B. ☐ It contracts and relaxes rhythmically without nervous stimulation.
- C. ☐ It contains no myosin filaments.
- D. ☐ It is controlled only by hormones.

The table shows measurements taken from the ECG traces of two patients. Calculate the heart rate of patient 2, and deduce which patient has tachycardia. Show your working.

ECG measurements	
Patient	Time between two successive R peaks (s)
1	0.85
2	0.48

Answer = ...

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A patient's ECG shows an irregular, fast rhythm with no clear P waves. Suggest what this indicates and explain how an ECG helps in the diagnosis of abnormal heart rhythms.

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A person has a stroke volume of 80 cm³ and a heart rate of 65 beats per minute at rest. When exercising, their heart rate increases to 160 beats per minute and their cardiac output is 19 200 cm³ min⁻¹. Calculate (a) the resting cardiac output and (b) the stroke volume during exercise.

Answer = ...

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6 UNIT 5 STYLE

[5 marks]

Explain how breathing rate and heart rate are increased during exercise.

7 UNIT 5 STYLE

[4 marks]

Explain how the release of adrenaline prepares the body for fight or flight.

8 UNIT 6 STYLE

[5 marks]

The table gives data taken from spirometer traces of a student at rest and after exercise. Calculate the respiratory minute ventilation at rest and after exercise, and the percentage increase in oxygen consumption.

Spirometer data			
Measure	At rest	After exercise	
Tidal volume (dm ³)	0.50	1.80	
Breathing rate (breaths per minute)	14	26	
Oxygen consumption (dm ³ min ⁻¹)	0.30	1.80	

Answer = ...

In a spirometer investigation, soda lime is placed in the circuit. Explain why, and give two precautions needed to keep the volunteer safe.

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [5]

- SAN (in right atrium wall) initiates / generates a wave of excitation / depolarisation
- wave spreads across both atria, causing them to contract
- non-conducting tissue between atria and ventricles prevents the wave passing straight to the ventricles
- AVN delays the wave, so atria empty before ventricles contract
- wave passes down the bundle of His (in the septum) to the apex
- Purkyne fibres carry the wave up the ventricle walls, so ventricles contract from the apex upwards
- Max 5

2. [1]

B B: cardiac muscle contracts and relaxes rhythmically without nervous stimulation.

3. [3]

- heart rate = $60 \div 0.48$
- 125 beats per minute (accept 125 bpm)
- patient 2 has tachycardia because their heart rate is above 100 beats per minute (patient 1 = 71 bpm)

4. [3]

- atrial fibrillation / irregular atrial activity
- ECG records the electrical activity of the heart
- changes in the timing / spacing / shape of waves (e.g. R-R interval, P wave) can be compared with a normal trace to identify a rhythm problem such as tachycardia, bradycardia or ectopic beats

5. [3]

- resting cardiac output = $80 \times 65 = 5200 \text{ cm}^3 \text{ min}^{-1}$
- stroke volume = cardiac output $\div$ heart rate = $19\,200 \div 160$
- 120 cm^3

6. [5]

- respiration in muscles produces more CO_2
- CO_2 lowers blood pH / chemoreceptors detect the change
- impulses sent to the ventilation centre / cardiovascular control centre in the medulla oblongata
- ventilation centre sends impulses to the diaphragm and intercostal muscles, so breathing is faster and deeper
- impulses along the sympathetic nerve to the SAN increase heart rate
- so oxygen delivered faster to muscles / CO_2 removed faster
- Max 5

7. [4]

- adrenaline binds to receptors on target cells
- increases heart rate / stroke volume, so more oxygen and glucose delivered to muscles
- liver converts glycogen to glucose, raising blood glucose for respiration
- bronchioles dilate / ventilation increases, so more oxygen enters the blood
- blood redirected to muscles by vasodilation to them and vasoconstriction elsewhere
- Max 4

8. [5]

- rest: $0.50 \times 14 = 7.0 \text{ dm}^3 \text{ min}^{-1}$
- exercise: $1.80 \times 26 = 46.8 \text{ dm}^3 \text{ min}^{-1}$
- increase in oxygen consumption = $1.80 - 0.30 = 1.50$
- $(1.50 \div 0.30) \times 100$
- 500 (%)

9. [4]

- soda lime absorbs the CO_2 breathed out
- so the fall in volume of the trace is due to oxygen being used / so the volunteer does not rebreathe CO_2
- precautions, one mark each, max 2:
- sterilise / use a clean mouthpiece
- check the volunteer has no health problem (e.g. asthma, heart condition) before exercise
- volunteer can stop at any time / stop if they feel dizzy or unwell
- keep flames away from the oxygen
- Max 4