

Exercise walk-through

5.3

Cardiac and ventilation control (statements 7.12–7.15, core practical 17)

Pearson Edexcel · International A-Level · Biology

Four stages, one purpose

Stage	Where	Yield
Glycolysis	cytoplasm	2 ATP + 2 reduced NAD
Link reaction	matrix	CO ₂ + reduced NAD
Krebs cycle	matrix	ATP + reduced NAD + reduced FAD
Oxidative phosphorylation	cristae	most ATP; O ₂ to water

Recombinant DNA: cut, paste, select

Cut : the same restriction enzyme opens plasmid and gene



Paste : complementary sticky ends sealed by DNA ligase



Transform : heat shock carries plasmids into bacteria



Select : antibiotic marker - only transformants survive

Check yourself

Your turn

Why is the human insulin gene made from mRNA before inserting into bacteria?

- A. bacteria cannot splice introns, and mature mRNA has none
- B. mRNA is more stable than DNA
- C. mRNA is double-stranded and easier to cut
- D. restriction enzymes only cut RNA

Exercises 2.1·2.3

2.1 State what is meant by a myogenic muscle. [1]

2.2 Name the structure where the heartbeat is initiated. [1]

2.3 Calculate cardiac output for stroke volume 95 cm^3 at 130 beats per minute, in $\text{dm}^3 \text{ min}^{-1}$. [2]

Exercises 2.1·2.3

2.1 State what is meant by a myogenic muscle. [1]

2.1 A muscle whose contraction is initiated within the muscle itself, not by nerve impulses.

2.2 Name the structure where the heartbeat is initiated. [1]

2.2 The sino-atrial node.

2.3 Calculate cardiac output for stroke volume 95 cm^3 at 130 beats per minute, in $\text{dm}^3 \text{ min}^{-1}$. [2]

2.3 $95 \times 130 = 12\,350 \text{ cm}^3 \text{ min}^{-1} = 12.35 \text{ dm}^3 \text{ min}^{-1}$.

Exercises 3.1·3.2

3.1 Describe how the heartbeat is initiated and coordinated through the chambers of the heart, naming the structures in order. [5]

3.2 During exercise a runner's cardiac output rises from $5.6 \text{ dm}^3 \text{ min}^{-1}$ while heart rate rises from 70 to $140 \text{ beats min}^{-1}$. Calculate both stroke volumes and explain which factor - heart rate or stroke volume - has contributed more to the rise in cardiac output. [5]

Exercises 3.1·3.2

3.1 Describe how the heartbeat is initiated and coordinated through the chambers of the heart, naming the structures in order. [5]

3.1 The sino-atrial node fires and the wave spreads across both atria, causing atrial systole; the impulse reaches the atrio-ventricular node, delayed briefly to let the atria empty; it travels down the Purkyne fibres to the ventricle walls, causing ventricular systole from the apex upward.

3.2 During exercise a runner's cardiac output rises from 5.6 to 17.5 dm³ min⁻¹ while heart rate rises from 70 to 140 beats min⁻¹. Calculate both stroke volumes and explain which factor - heart rate or stroke volume - has contributed more to the rise in cardiac output. [5]

3.2 Rest: $5\,600/70 = 80\text{ cm}^3$; exercise: $17\,500/140 = 125\text{ cm}^3$. Heart rate doubled (x2) while stroke volume rose by factor 1.56; both contribute, heart rate slightly more.

Exercise 3.3

3.3 Explain why the ventilation rate increases when blood carbon dioxide concentration rises, naming the receptors, the control centre and the effector. [5]

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3.3 Chemoreceptors in the medulla and arteries detect rising CO₂ (as carbonic acid, lowering pH); the ventilation centre in the medulla sends more frequent impulses; to the intercostal muscles and diaphragm; deeper and faster breathing expels CO₂ faster, restoring pH.