



A-Level Biology

Control of Heart Rate

Mark Scheme

Time available: 56 minutes

Marks available: 46 marks

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Mark schemes

1.

- (a) 1. (Increased pressure) deforms / changes stretch-mediated sodium (ion) channel;
2. (Sodium channels open and) sodium ions flow in;
Accept Na⁺

3. Depolarisation (leading to generator potential).
Accept correct description of depolarisation

3

- (b) Value between 2.17:1 and 2.29:1;

Accept rounding up to 2.2 or 2.3

Accept: number without : 1

*Correct working showing answer but incorrect rounding in answer
line = 1*

Values between 117 to 119 and between 52 to 54 found but ratio wrong way round = 1 mark.

Wrong way round gives answer between 0.35:1 and 0.46:1

2

- (c) 1. Parasympathetic greater effect than sympathetic;

Ignore: descriptions of graph

2. Parasympathetic keeps heart rate down / lower / decreases heart rate (as blood pressure increases);

3. Sympathetic keeps heart rate up / higher / increases heart rate (as blood pressure increases);

2. and 3. Accept converse for blood pressure decreases

4. Parasympathetic greatest / greater effect at high blood pressure / sympathetic greatest effect at low blood pressure.

3 max

[8]

2.

- (a) 1. SAN sends wave of electrical activity / impulses (across atria) causing atrial contraction;

Accept excitation

2. Non-conducting tissue prevents immediate contraction of ventricles / prevents impulses reaching the ventricles;

3. AVN delays (impulse) whilst blood leaves atria / ventricles fill;

4. (AVN) sends wave of electrical activity / impulses down Bundle of His;

4. Allow Purkyne fibres / tissue

5. Causing ventricles to contract from base up;

5

- (b) 1. Atrium has higher pressure than ventricle (due to filling / contraction) causing atrioventricular valves to open;
Start anywhere in sequence, but events must be in the correct order.
 1. *Accept bicuspid, reject tricuspid*
 1. *Allow: blood passes through the valve = valve open / blood stopped from passing through the valve = valve closed*
2. Ventricle has higher pressure than atrium (due to filling / contraction) causing atrioventricular valves to close;
3. Ventricle has higher pressure than aorta causing semilunar valve to open;
Points 1, 2 and 3 must be comparative: eg higher 3. Allow aortic valve
4. Higher pressure in aorta than ventricle (as heart relaxes) causing semilunar valve to close;
 4. *Allow aortic valve*
5. (Muscle / atrial / ventricular) contraction causes increase in pressure;

5

[10]

3.

- (a) (i) **G**;
Neutral: name of blood vessel
- (ii) **E**;
Neutral: name of blood vessel
- (b) Pressure is greater below valve / in ventricle than (artery);
Must be comparative
Reject: pressure is greater in ventricle than atrium
Neutral: pressure in ventricle increases
Accept: E / F / named artery
Accept: converse argument

1

1

1

- (c) Allow atria to empty / contract / ventricles to fill;
 Before ventricles contract;
OR
 Delays contraction of ventricles;
 Until after atria have contracted / ventricles have filled;
Neutral: 'to pump blood'

2

- (d) (i) Two marks for correct answer of 91 / 90.9;;

One mark for incorrect answers which clearly show understanding of the relationship between $SV = CO / HR$;

Correct answer = 2 marks outright

5000 divided by 70, 55 or 15 = 1 mark for principle

2

- (ii) Increase in size or volume of heart / ventricles / increased heart muscle / increased strength of contraction / hypertrophy;

Cardiac output is the same (before and after training) so must be increase in stroke volume / more blood leaves heart in each beat;

Accept: increased strength of heart muscle

Neutral: heart muscle contracts more

Q *Do not allow 'heart is stronger'*

Neutral: more blood leaves the heart

If the term 'stroke volume' is not used, it must be defined

2

[9]

4.

- (a) 1. rate of respiration increases (in muscle cells);
2. carbon dioxide concentration increases / pH falls / H^+ increases / acidity increases;
3. chemoreceptors in aortic / carotid bodies / medulla (*accept reference to aorta / carotid arteries not sinus*);
4. (impulses to) medulla / cardioaccelerator centre;
5. increased frequency of impulses (*award only once*);
6. along sympathetic pathway to sinoatrial node / SAN (*not pacemaker*);

6

- (b) (i) through cardiac muscle;
to atrioventricular node;
along bundle of His / Purkyne fibres;

2 max

- (ii) sinoatrial node in the (right) atrium;
trace from healthy person is identical to the trace for the diseased heart in the region of the atria / only differences seen in trace for ventricles;

2

[10]

5.

- (a) (i) 0.3 s;

1

- (ii) 0.2 - 0.4 s;

1

- (b) thicker / more muscle in the left ventricle;

1

(c) Artery

1. thickest wall, enabling it to carry blood at high pressure / withstand pressure surges;
2. most elastic tissue, which smoothes out flow / maintains pressure;
3. most muscle which maintains pressure;
4. muscle in wall to control blood flow;

Vein

5. thin wall does not have to withstand high pressure;

Capillary

6. thin wall, allowing diffusion / exchange;
7. only endothelium present, allowing short diffusion pathway;

All vessels

8. have endothelium that reduces friction;

6 max

[9]