

Mark schemes

1

- (a) 1. Treat with insulin (injection/infusion);
2. (Control) diet/control sugar intake;
2. *Accept '(regular) exercise'*

2

- (b) 1. Damage to autonomic (nervous) system in diabetic rats;
2. (Could be) pressure receptors/baroreceptors (in arteries/aorta /carotid body) don't work as well;
3. Damage to medulla

OR

Change in (number of) impulses to/from medulla;

4. (When pressure drops damage to) sympathetic system, so doesn't speed up (enough);
5. (When pressure rises damage to) parasympathetic system, so doesn't slow down (enough);

*Accept answers in terms of what happens in healthy rats **only** if then qualified by statement these things don't happen/happen less in rats with diabetes*

1. Accept damage to ANS

2. Ignore reference to chemoreceptors

4 and 5. Appropriate system and effect on heart rate both needed

4 max

[6] (a) 21.59 / 21.6;

2

$19/88 \times 100 = 1$ mark

Accept for 1 mark - $19/69 \times 100 = 27.5\%$;

(only award if rounding correct)

Max 1 for incorrect rounding

Accept any number of significant figures

as long as the rounding is correct

2

- (b) 1. Electrical activity only through Bundle of His / AVN;
2. Wave of electrical activity passes over / through both ventricles at the same time;
For 'electrical activity' accept impulses / depolarisation / action potential
Reject messages/signals/information once only
2. *Accept 'wave of electrical activity passes through the Purkinje / Purkyne fibres / tissue'*

2

3

- (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] (a) 1. People swimming 100 m / group 1 had higher heart rates than

4

people swimming for 30 minutes / group 2;

2. (Trend is) as temperature increases heart rate increases for swimming 100 m / group 1;
3. No trend for swimming for 30 minutes / group 2;
4. (SD values show that) each set of results has little variation;
Four approaches but only 1 mark available

1 max

- (b) 1. Assumes that an increased HR is beneficial (whatever the temperature of the water);
2. (But) haven't measured the 'benefits' to health / increased heart rate may not be

'better';

3. No definition of better / flat out / better / flat out is subjective / based on opinion;
4. Only know the highest heart rate / time at highest heart rate not known;
5. Swimmers only tested once / only a short-term effect (on heart rate) / long-term effects are not known;
6. Distance covered in 30 minutes not known / might vary / time to complete 100 m not known / might vary / swimming ability might vary (among volunteers / between groups);
7. Groups may not be representative (of population);

4 max

[5]

5

- (a) 1. Ventricle pressure rises **then** blood starts to flow into aorta because pressure causes

(aortic / semilunar) valve to open;

*Accept times, eg ventricle pressure rises at 0.3 (25)
seconds, followed by blood flow into aorta at 0.35 / 0.4 seconds*

Idea of sequence is essential

Accept times

2. Ventricle pressure starts to fall **so** blood flow falls;

Idea of sequence is essential

2

- (b) 1. Thickness of wall increases **because** ventricle (wall) contracts;

Must be idea that increase in thickness is linked to contraction

Accept muscle for ventricle and systole for muscle contraction

2. Contraction **causes** the increase in pressure;

Accept thickening of wall

2

- (c) *2 marks for correct answer*

1. Between 120 ± 5 ;;

Length of cycles varies slightly

2. Length of cardiac cycle correct but final answer wrong;

Length of cardiac cycle = 0.45 - 0.52

2

[6]

6

- (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] (a) One suitable factor;

7

Not health or lifestyle

E.g. Age / no heart condition / not on medication;

Accept BMI / smokers / diet / fitness / race etc. – has to affect heart rate or blood pressure

1 max

- (b) Patients were at rest / not moving / not using muscles / in standardised position / controlled conditions;
- Accept same position as sleeping*
- Ignore relaxed*

1

- (c) 1. Caused by pressure / surge of blood;
Ignore pulse rate equals heart rate
2. From (one) contraction / beat of (left) ventricle / heart;
Reject right ventricle
Ignore pumps / pumping

2

- (d) 1. Monitor records heart rate over long period of time / all the time / more data collected;
Ignore reference to continuously as in stem
Ignore anomalies can be discarded
2. Anomalies in recording have less effect;
Ignore more accurate / reliable mean
3. Recording pulse rate for one minute only may give an anomalous / atypical result;
4. Errors when trying to count pulse for one minute / human error;
5. Monitor records HR over a range of activities during the day / pulse rate only records for a single set of conditions;

2 max

- (e) 1. Men with condition always have higher heart rates;
Accept blood pressure references for heart rate
2. But no direct measurements of blood pressure;
Accept – no stats analysis to show significance
3. Only one investigation / test / need more studies; *Ignore references to 'yes' and 'no' throughout*
4. Using different recording methods / conditions (in each case so cannot compare results);
5. Men without condition also have increased / higher heart rate in doctor's surgery;

2 max

[8]

8

1. SAN → AVN → bundle of His / Purkyne fibres;
1. *Mark for correct sequence*
2. Impulses / electrical activity (over atria);
3. Atria contract;
4. Non-conducting tissue (between atria and ventricles);
5. Delay (at AVN) ensures atria empty / ventricles fill before ventricles contract;

6. Ventricles contract from apex upwards;

5 max

[5] (a) 1. (Oxygen / carbon dioxide) detected by chemoreceptors / (pressure) detected by

9

baroreceptors;

2. Medulla / cardiac centre involved;
Accept a valid equivalent e.g. cardioacceleratory centre

3. More impulses to SAN / along sympathetic nerve;
Neutral: signals / messages
Accept: acceleratory nerve
Need idea of 'more impulses' directly, not by implication

3

(b) (i) 1. To ensure results are due to omega-3 / fatty acids (only) / not due to something else in the oil;

Neutral: Idea of comparing groups / results

2. Placebo linked to mental / psychological effect;
Neutral: reference to a control group / placebo (unqualified)

1 max

(ii) 1. Lower / greater change of heart rate for Group A;
Ignore references to methodology

2. (Differences) are real / reliable / significant / not due to chance;

3. As bars do not overlap / values are not shared;

3

[7] (a) (i) G;

10

Neutral: name of blood vessel

1

(ii) E;

Neutral: name of blood vessel

1

(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

- (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]

1. SAN initiates heartbeat / acts as a pacemaker / myogenic;

11

Q Must be in context

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

Reject: signals / electronic / messages / nerve impulses once only

3. AVN delays (electrical activity / impulses);

Neutral: reference to non-conducting tissue delaying impulses instead of the AVN

4. (Allowing) atria to empty before ventricles contract / ventricles to fill before they contract;

5. (AVN) sends wave of electrical activity / impulses down Bundle of His / Purkyne fibres;

6. (Causing) ventricles to contract (from base up) / ventricular systole;

5 max

[5] (a) Sends out electrical activity / impulses;

12

Initiates the heartbeat / acts as a pacemaker / (stimulates) contraction of atria;

Q Ignore reference to ventricles.

2

(b) Fluctuation and overall decrease;

Steep decrease first / after two years and then gradual decrease;

2

(c) Diet low in cholesterol / LDLs;

Less absorbed into blood / from intestines;

2

(d) Diet has greater effect in decreasing blood cholesterol concentration;

Difficult to judge effect of drug as it is used at same time as diet / drug is not used on its own;

Decrease in blood cholesterol concentration linked to reduced risk of heart disease;

Q Allow converse for third marking point.

2 max

[8] (a) B – It is the 2nd contraction / occurs (immediately) after A / occurs after atrium;

13

Larger / more force / more pressure;

2

(b)
$$\frac{60}{\text{time for 1 cycle}}$$

= 37 to 38

allow 1 mark if correct working shown

max 2

(c) (i) (Heart rate) reduced;
(Stroke volume) no effect;

2

(ii) Reduced because C.O. = H.R. x S.V. / connection argument based on reduced H.R;

1

(iii) Parasympathetic;

1

(d) (i) 1. Coordination via medulla (of brain) / cardiac centre;
2. (Increased) impulses along sympathetic (/ cardiac accelerator) nerve
3. To S.A. node / pacemaker;

4. More impulses sent from / increased rate of discharge of S.A. node /pacemaker;

Not "beats"; not "speeds up"

4

- (ii) In exercise – More energy release / more respiration / actively respiring muscles / for aerobic respiration;

Higher cardiac output – Increases O₂ supply (to muscles);

Increases glucose supply (to muscles);

Increases CO₂ removal (from muscles) /

lactate removal;

Increases heat removal (from muscles) /

for cooling;

If no "increase" – max 2 marks

3

[15]

- (a) 1. pressure receptors / baroreceptors / stretch receptors in aorta / carotid arteries / carotid

14

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2. send impulses to cardiovascular centre / medulla / cardio-inhibitory centre;

(reject signals / messages / electronic)

3. impulses via parasympathetic nerves / vagus; *(accept inhibitory nerve)*

4. to SAN;

5. release of ACh / inhibits SAN / decreases impulses from SAN;

6. decreases impulses to AVN / decreased stimulation of AVN / decreases impulses from AVN;

(any reference to signals / messages / electronic disqualifies points 3 and 5 only)

6

- (b) 1. inhibit impulses in sympathetic nerves / from cardio-acceleratory centre;
2. SAN not stimulated / noradrenaline not released so heart rate lowers / does not increase;
(accept inhibits / blocks synapses);

2

[8]

QWC 1

- (a) 1. rate of respiration increases (in muscle cells);

15

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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] (a) (i) 0.3 s;

16

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]