

### 3.4 ORGANISMS AND SUBSTANCE EXCHANGE – MASS TRANSPORT IN ANIMALS (2) – MARK SCHEMES

#### Q1.

- (a) 1. Haemoglobin carries oxygen / has a high affinity for oxygen / oxyhaemoglobin;  
2. Loading / uptake / association in lungs;  
3. at high p.O<sub>2</sub>;  
4. Unloads / dissociates / releases to respiring cells / tissues;  
5. at low p.O<sub>2</sub>;  
6. Unloading linked to higher carbon dioxide (concentration);  
*6. Ignore reference to incorrect pH in relation to effect of higher carbon dioxide concentrations for marking point*
- 6
- (b) 1. Allows comparison;  
*Do not credit 'temperature affects results' on its own;*  
2. (Different temperature) affects enzymes;  
*2. Allow reference to denaturation of enzymes.*  
3. (Different temperature) affects respiration / metabolism;  
4. (Different temperature) affects amount of dissolved oxygen;
- 2 max
- (c) 1. Increases then levels out / stops increasing / fluctuates slightly;  
2. At 5 (cm<sup>3</sup> dm<sup>-3</sup>) / 320 (cm<sup>3</sup> g<sup>-1</sup>h<sup>-1</sup>);  
*Allow description of 'fluctuates slightly' in terms of candidate quoting figures after 320.*
- 2
- (d) 1. *Chronimus longistylus* has higher uptake at low (oxygen) concentrations;  
*Chronimus longistylus has higher uptake to (oxygen concentration of) 2 / lower uptake after 2; (= 2 marks)*  
2. (Higher uptake) up to 2 cm<sup>3</sup> dm<sup>-3</sup>;  
*2. Award mark if candidate uses figures from table e.g. higher at concentration 1 (220) or concentration 2 (285). Higher uptake at concentration 1 or 2 = 2 marks.*
- 2
- (e) (i) More (than in African) lost via gills in Australian lungfish / less (than African) lost via lungs in Australian lungfish;
- 1
- (ii) 1. More / most exchange is via lungs (in African lungfish);  
*1. Allow converse for first point.*  
2. Gills will not function / function less efficiently (in air);  
*2. Allow water is required for gills to function.*
- 2

**Q2.**

- (a) (i) Healthy volunteers have 'normally' functioning vessels;

**OR**

Blood vessel / lumen / diameter not affected by other factors / is of normal size;

*Accept: a valid ethical argument*

*e.g. treatment does not harm healthy volunteers*

*Reject: ref. to change in artery thickness*

*Accept: converse arguments for unhealthy volunteers*

*Must be related to this investigation*

*Neutral: to ensure that that the results are due to the independent variable*

1

- (ii) Avoids bias / selection (by scientists);

*Neutral: ref. to having the same number / gender / age of people in each group;*

1

- (b) (i) Same as experimental group;

Chocolate with no flavenoids;

*Neutral: no dark chocolate*

*Neutral: placebo*

*Reject: milk chocolate*

*Neutral: ref. to fair testing*

2

- (ii) (To ensure that results are) not due to some other substance in the chocolate / due to flavenoids (only);

*Must be related to this investigation*

*Neutral: to ensure that the results are due to the independent variable*

*Neutral: to show results are not due to other factors*

*Neutral: to show results are only due to the chocolate*

*Neutral: to compare results for people who did and did not have flavenoids*

1

[5]

**Q3.**

- (a) (i) **G**;

*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]

#### **Q4.**

- (a) (i) 1. Removes water vapour / moisture / saturated air;

2. Increases water potential gradient / more diffusion / more evaporation;

2

- (ii) 1. Increases kinetic energy so water molecules move faster;

2. Increases diffusion / evaporation;

2

- (b) (i) Positive correlation / as light intensity increases so does rate of water movement / follows same pattern / directly proportional;

1

- (ii) 1. Stomata open and photosynthesis increases / transpiration

increases;

2. More water pulled up due to cohesion between water molecules / by cohesion tension;

2

- (iii)
1. Water pulled up trunk / moves up at fast rate under tension;
  2. Sticking / adhesion (between water and) cells / walls / pulls xylem in;  
*Adhesion is not a specification requirement.*  
*Accept cohesion in this context*

2

(c) **Elastic tissue**

1. Elastic tissue stretches under pressure / when heart beats then recoils / springs back;
2. Evens out pressure / flow;  
*Do not allow credit for expands / contracts / relaxes in this context.*  
*From a marking viewpoint ignore all specific references to arteries and arterioles. Consider all points as applying to both.*  
2 Do accept controls

**Muscle**

3. Muscle contracts to reduce diameter of lumen / vasoconstriction / constricts vessel;
4. Changes flow / pressure;

**Epithelium**

5. Epithelium smooth;
6. Reduces friction / blood clots / less resistance;

6

[15]

**Q5.**

- (a) More than one polypeptide / chain;  
*Ignore references to haem / other groups*

1

- (b) (i) 141;

1

- (ii)
1. Stop / start sequences;
  2. Non coding DNA (in the gene) / introns / multiple repeats / junk DNA;  
*Do not credit "some bases repeated"*
  3. Two chains / a non-coding strand / complementary base pairs;

4. Addition of base by mutation;

2 max

- (c) Different primary structure / amino acids / different number of polypeptide chains;

*Question is about haemoglobin so do not credit differences in DNA*

1

- (d) 1. Low partial pressure of oxygen in lungs;  
2. (Llama) haemoglobin able to load more oxygen / (llama) haemoglobin saturated (at low / particular partial pressure of oxygen);

3. Higher affinity for oxygen;

*The terms used in the graph (or near approximations) should be used in this answer.*

*Ignore references to unloading*

*The answer must relate to llamas*

3

[8]

### Q6.

- (a) 0.1 and 0.5;

Pressure in ventricle greater (than pressure in atrium);

*Both figures must be correct.*

*Comparison needed.*

2

- (b) 1. (Ventricle has) thick wall / more muscle;

2. So contractions are stronger / harder;

*Neutral: Contracts to produce more pressure.*

*Neutral: Pump harder.*

*Neutral: Reference to a need to pump blood further / round the body.*

2

- (c) 85 / 86 / 85.7;

*Ignore additional decimal places*

1

[5]

### Q7.

- (a) More red blood cells;

More haemoglobin;

2

- (b) Given (only) salt solution;

(Otherwise) treated the same way;

*Accept: 'Placebo' in salt solution.*

*Reference to salt solution is essential for first marking point.*

2

- (c) Allows comparison to be made;  
 Different masses / weights (of volunteers) / different weeks / lengths of treatment;  
*Accept: 'Both were different' for one mark.*  
*Neutral: Size for second marking point.* 2
- (d) To determine (most effective) dose / length of treatment / to find the most cost effective treatment;  
 Investigate long term effect / toxicity / side effects;  
*Do not credit marks for descriptions of the information in the table in terms of dose and length of treatment.* 2
- (e) More haemoglobin / more red blood cells;  
 (More) oxygen can be absorbed / transported (for) respiration / to respiring tissues / cells;  
 (More) energy released / more ATP for muscle contraction;  
 Delays anaerobic respiration / delays build up of lactate / lactic acid;  
*Reject: 'Energy produced or made' but allow 'energy made in form of ATP'.* 4
- (f) Large sample / wide range (of individuals tested);  
 Random (sampling);  
 Tested at different times / more than once;  
 Mean / average value determined;  
 Idea of establishing a range for the normal concentration / reference to use of standard deviation; 2 max
- (g) Blood thicker / denser / more viscous / more 'concentrated' / heart contraction greater / increases volume of blood;  
*Accept: More blood cells in same volume / 'space'.*  
*Neutral: 'more red blood cells' / 'more blood' on its own.*  
*Neutral: 'Heart pumps / beats more / harder'.* 1

[15]

**Q8.**

- (a) (i) plasma; 1
- (ii) tissue fluid; 1
- (b) fluid Y contains little / no protein; *reject blood cells* molecules too large (to pass through capillary wall);

**OR**

fluid Y contains less glucose;  
some will have entered tissue cells;  
accept any other biologically correct difference marked in a similar way.

2 max

- (c) hydrostatic pressure / blood pressure / arterial pressure;  
greater than osmotic effect which forces molecules / fluid out;  
*ignore references here to diffusion or osmosis.*

2

[6]

### Q9.

- (a) (Blood) plasma;

1

- (b) More / larger proteins / less urea / carbon dioxide / more glucose / amino acids / fatty acids / oxygen / high(hydrostatic) pressure;

*Q Reference to blood cells / water potential = neutral*

*Q No Protein should not be credited*

1

- (c) (i) Contracts;

*Q Do not accept pumping of heart / heart beating*

1

- (ii) Loss of fluid / volume;

Friction / resistance (of capillary wall);

*Q Reference to a narrow lumen is not sufficient to gain a mark unless friction or resistance is mentioned.*

1 max

- (d) Water potential (in capillary) not as low / is higher / less negative / water potential gradient is reduced;

More tissue fluid formed (at arteriole end);

Less / no water absorbed (into blood capillary) by osmosis; (into blood capillary);

*Q The last two marking points must be in context of movement into the blood capillary*

3

[7]

### Q10.

- (a) 1. Large surface area provided by lamellae / filaments increases diffusion / makes diffusion efficient;;

*Q Candidates are required to refer to lamellae or filaments.*

*Do not penalise for confusion between two*

2. Thin epithelium / distance between water and blood;

3. Water and blood flow in opposite directions / countercurrent;

4. (Point 4) maintains concentration gradient (along gill) / equilibrium not reached / as water always next to blood with lower concentration of

oxygen;

5. Circulation replaces blood saturated with oxygen;
6. Ventilation replaces water (as oxygen removed);

6

- (b) Mixing of air and water (at surface);

Air has higher concentration of oxygen than water;

Diffusion into water;

Plants / seaweeds near surface / in light;

Produce oxygen by photosynthesis;

2 max

- (c) Not much oxygen near sea bed;

Toadfish haemoglobin (nearly) saturated / loads readily at / has higher affinity for oxygen at low partial pressure (of oxygen);

2

- (d) The chimpanzee and the bonobo are more closely related (than to the gorilla);

They have identical amino acids / one of the amino acids is different in the gorilla;

2

[12]

### Q11.

- (a) Sends out electrical activity / impulses;  
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]

### Q12.



(a) Arrows on all five vessels in correct direction;

1

(b) E;

1

(c)

Feature	Vessel C	Vessel E
Valves	Absent	Present
(Relative) thickness of walls	Thicker	Thinner
Elastin / elastic tissue / fibres	More	Less
Muscle	More	Less
Lumen	Narrow	Wide

*Two marks for two correct rows*

*Accept any pair of contrasting terms with same meaning as those used.*

2 max

(d) Contracts;

(Causing) vasoconstriction / narrows lumen;

2

(e) (Elastic tissue) stretches when pressure is high;

Springs back / recoils / returns to normal;

*Q Do not credit references to contracting, relaxing or expanding*

2 max

[8]

### Q13.

(a) (i) Faster / greater / more effective response in children;

*Do not accept children have more haemoglobin*

1

(ii) Use line of best fit;

1

Extrapolate / extend line (and read from graph);

*Allow calculation using rate of increase per day = one mark.  
However for both marks this must be linked to line of best fit.*

1

(iii) More than one polypeptide chain;

*Allow many polypeptide chains.*

*'Haemoglobin has four polypeptide chains' must be in correct context to gain mark.*

1

(b) (i) Has same water potential;

*Allow converse for effect of using distilled water or a*

*concentrated solution.*

1

No (net) water movement / osmosis;

1

Cells will not swell / burst / change size;

*No osmotic lysis = two marks*

1

- (ii) Pernicious anaemia (cells) greater range / spread / variation of diameters / widths;

Some pernicious anaemia (cells) wider than 9 ( $\mu\text{m}$ ) / some less than 5.5 ( $\mu\text{m}$ ) / without pernicious anaemia none more than 9 ( $\mu\text{m}$ ) / none less than 5.5 ( $\mu\text{m}$ );

Pernicious anaemia (cells) peak / most frequent at 8.5 ( $\mu\text{m}$ ) / peak / most frequent at higher diameter / / without pernicious anaemia peak / most frequent at 7 ( $\mu\text{m}$ ) / peaks at lower diameter;

*There are several alternatives for marking points 2 and 3*

2 max

[9]

#### Q14.

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

#### Q15.

- (a) Increase in / more carbon dioxide;
- Curve moves to the right / depressed;
- Q Any reference to haemoglobin increasing affinity for oxygen disqualifies second mark point.*

2

- (b) (i) More haemoglobin;

So can load / pick up more oxygen (in the lungs);

**Q** *Second mark point must relate to idea of loading oxygen.  
Answers referring only to transport of oxygen should not be credited this mark.*

2

(ii) (Haemoglobin) has lower affinity for oxygen / more oxygen released;

In / to the cells / tissues;

2

[6]

### Q16.

(a) (i) Protein on (surface of) chlamydia;

That initiates an immune response (in mice) / causes antibody production;

*Neutral "foreign protein"*

*Do not accept glycoprotein.*

*2. Accept description of initiating immune response.*

2

(ii) 1. Antibodies / memory cells against chlamydia (protein / antigen) are present;

2. Protein on heart (muscle) similar to chlamydia protein / antigen so T cells / antibodies (attack heart muscle cells);

*2. Look for idea that both proteins are similar*

*2. Detail of what is attacking the heart muscle cells*

2

(b) **FOR**

1. Prevents / reduces heart disease / attacks;

2. Cheaper to vaccinate than treat heart disease;

**AGAINST**

3. Vaccination costly;

4. Don't know frequency of chlamydia infection;

5. Research in mice might not be replicated in humans / humans might have a different protein;

6. Vaccine could cause heart disease or immune response against heart (muscle);

*2 max for arguments against*

*Accept other valid answers*

3 max

[7]

### Q17.

(a) Diet including saturated fats leads to higher plasma cholesterol concentrations;  
Higher in all age groups;

But sample size is very small;  
Standard deviations overlap / suggest wide variation;

3 max

- (b) The sex of individual is a risk factor for high cholesterol;  
To remove a / one variable / to establish a fair test;

2

- (c) Monkeys and humans closely related therefore similar conclusions might be drawn;  
High concentrations of plasma cholesterol lead to an increased risk of cardiovascular disease in humans;  
Don't know if diet has the same effect in monkeys (as in humans) / could have different effects because not the same species;

3

[8]

### Q18.

- (a) Loading / uptake / association of oxygen at high  $p.O_2$ ;

In lungs (haemoglobin) is (almost) fully saturated / in lungs haemoglobin has a high affinity for oxygen;

Unloads / releases / dissociates oxygen at low  $p.O_2$ ;

Unloading linked to higher carbon dioxide concentration;

*Allow converse for second marking point in tissues i.e.*

*haemoglobin has low affinity / releases most of its oxygen.*

*Mark for haemoglobin having high affinity for oxygen must be 'in lungs'.*

3 max

- (b) (i) Larger the mammal the more to the left / steeper / 'higher' is the curve / the higher the affinity for oxygen;

*Allow converse.*

*Ignore references to Bohr shift*

1

- (ii) Smaller mammal has greater surface area to volume ratio;

Smaller mammal / larger SA:Vol ratio more heat lost (per unit body mass);

*Allow converse explanation for larger mammals or lower surface area to volume ratio.*

Smaller mammal / larger SA:Vol ratio has greater rate of respiration / metabolism;

*Allow suitable named mammal as alternative to smaller or larger mammal.*

Oxygen required for respiration so (haemoglobin) releases more oxygen / oxygen released more readily / haemoglobin has lower affinity;

4

[8]

### Q19.

- (a) High(er) affinity for oxygen / absorbs / loads more oxygen;

At lower partial pressure (of oxygen) / lower pO<sub>2</sub>;

*Accept: Loads oxygen 'quicker', 'more readily', 'higher saturation', use of figures from graph for first point.*

*Neutral: References to unloading.*

2

- (b) 1. (Hydrostatic) pressure lower in capillary / blood / higher in tissues / tissue fluid;
2. Water (returns);
3. By osmosis;
4. Water potential lower / more negative in blood / capillary / higher / less negative water potential in tissues / via water potential gradient;
5. Due to protein (in blood);
6. (Returns) via lymph (system / vessels);

*First marking point must be in context of between blood and tissue fluid.*

*Neutral: References to hydrostatic pressure and water potential at arteriole end of capillary.*

3 max

[5]

## Q20.

- (a) Endothelium / epithelium;

*Allow endothelial / epithelial*

*Reject: epidermis / endodermis*

1

- (b) Measurement divided by 8;

1

Allow answer in range of 3-3.3 for two marks;

*Correct answer gains 2 marks.*

1

- (c) (i) Stretches / 'expands' under high pressure / when ventricle contracts / systole and recoils / 'springs back' under low pressure / when ventricle relaxes / diastole;

*Q References to aorta contracting or relaxing negates marks for stretch and recoil.*

Smooths blood flow / maintains blood pressure / reduces pressure surges;

*Stretch and recoil without reference to blood pressure etc. = one mark.*

*Stretch and recoil to smooth blood flow etc. = two marks*

*Ignore references to aorta withstanding blood pressure or not being damaged.*

2

- (ii) (Muscle) contracts;

*'It' in answer = muscle*

1

(Arteriole) constricts / narrows / alters size  
of lumen / reduces / regulates blood flow (to capillaries);  
*Allow converse (muscle) relaxes and (arteriole) dilates etc /  
increase blood flow etc.*  
*Ignore references to pressure*

1

(d) (i) Large / increase in (total) cross sectional area / friction / resistance;

1

(ii) (More) time for exchange of substances;

1

[9]

### Q21.

(a) Records every heart beat / does not miss heart beats / gives more precise / accurate measurements;

*Qualified reference to human error e.g. in counting*

1

(b) (i) 1. 67 / 69.2 / the same;

*All that is required here is a connection to be established  
between heart rate and pulse rate*

2. There is one surge in pressure / pulse each time the heart contracts / beats;

2

(ii) Two marks for correct answer in range 90.0 – 113.0;;

One mark for incorrect answer in which duration of one heart beat is clearly identified as between 0.53 and 0.66 seconds;

2

(c) Allow two marks for quantitative statement: e.g. filling time decreases from  $0.55 \pm 0.1$  to  $0.30 \pm 0.1$  s;;

Allow one mark for qualitative statement: e.g. Filling time decreases;

*Accept other quantitative statements such as those based on  
proportion of cardiac cycle*

2

(d) One mark for more general answer, e.g. increase exercise;

*This is the general principle. Detail may vary if centre uses  
different exercise*

Two marks for detailed answer, e.g. increase frequency / duration of exercise;;

*Reject comments not related to method used*

2

[9]

### Q22.

(a) Amino acid / amino acids ;

*If anything else is given as well do not award mark.*

1

(b) (i) 1. Affects one monomer / amino acid;

*i.e. What is affected*

2. Not found in all active sites;

*i.e. Where it is found.*

2. *Must relate to active site. Enzyme is insufficient.*

2

(ii) 1. **X**;

2. Enzyme in both pathways;

2. *Award independently*

2

(c) 1. Occupies / blocks / binds to active site;

*i.e. What it does in terms of the active site.*

2. Substrate will not fit / does not bind / no longer complementary to / enzyme-substrate complex not formed;

1. *Ignore references to change in shape and shape of aspirin molecule.*

*Ignore reference to competitive inhibitor i.e. Consequence required*

2

[7]

### Q23.

(a) correct answer: 77 - 78 ;; *allow 75 - 80* = 2 marks

OR Use of 55 AND 17 saturation / fall = 38; = 1 mark

OR (Fall = y % +) use of  $\frac{200y}{98}$  ; = 1 mark

2

(b) (in exercise) - faster respiration rate meaning more CO<sub>2</sub> production;

CO<sub>2</sub> is acidic / forms carbonic acid / lactic acid production;

release of H<sup>+</sup> ions;

3

[5]

### Q24.

(a) The muscle in the wall / sphincter contracts;

*Accept converse*

Reducing blood flow / narrowing / closing arteriole;

*The muscle to which the candidate is referring must be clearly in the wall of the arteriole.*

2

(b) (i) Blood flow increased in humans / reduced in seals;

1

(ii) Less oxygen / blood taken to muscles;

*None is incorrect*

(More) oxygen available for organs / brain;

Can stay under water longer (without breathing);

max 2

**Q25.**

- (a) (i) Identifies anomalies / minimises effect of anomalies / unusual results / results more likely to be representative / more reliable mean;  
*Accept likely to see side effects* 1
- (ii) Minimises / avoids regional bias / effects;  
*This is the basic principle. Accept examples that make this basic point, e.g.*  
*There may be factors that affect people living in different areas* 1
- (b) 1. Treated the same as those on ivabradine / experimental group;  
2. Given dummy pill / placebo;  
*Do not accept: given no pill* 2
- (c) (i) Increases filling time; 1
- (ii) 1. Maximum / large amount of blood leaves heart / ventricles / increases stroke volume / cardiac output;  
*Must be in context of blood leaving the heart*  
2. More blood / more oxygen to heart muscle / heart tissue;  
*Accept wall of heart*  
3. Via coronary arteries; 3 max

[8]

**Q26.**

- (a) B – It is the 2<sup>nd</sup> contraction / occurs (immediately) after A / occurs after atrium;  
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 O<sub>2</sub> supply (to muscles);  
 Increases glucose supply (to muscles);  
 Increases CO<sub>2</sub> removal (from muscles) / lactate removal;  
 Increases heat removal (from muscles) / for cooling;

*If no “increase” – max 2 marks*

3

[15]

**Q27.**

- (a) 0.1 – 0.6 seconds;  
 Volume (in left ventricle) increasing / ventricle filling;

2

- (b) (i) 2 marks for correct answer of 75 (beats) per minute;  
 1 mark if heart beat correctly identified as lasting 0.8 seconds;

2

- (ii) 70 cm<sup>3</sup>;

1

- (c) Multiply them;

1

- (d) 750;

*Accept a small increase – up to 800 cm<sup>3</sup>*

1

- (e) (i) 4 : 1 / 4;  
*Ratio must be expressed in simplest terms*

1

- (ii) 18 cm<sup>3</sup>;

1

[9]

**Q28.**

- (a) 0.01 / 0.0105;  
*(allow 1 mark for 52 500 / 5 000 000)*

2

- (b) (at the tissues at low pp oxygen) the shrew’s haemoglobin is less saturated with oxygen / has reduced affinity;  
 oxyhaemoglobin dissociates more readily / haemoglobin releases oxygen more readily / more oxygen released;  
 allowing greater demand / respiration rate;

**Q29.**

- (a) (i) 1 Reduces heart rate;  
 2 Keeps heart rate stable / reduces variation in heart rate;  
 3 Nullifies external stimulus;  
*Individual points must be supported with information from the graph*  
*If no information quoted max 1 mark*
- (ii) To ensure change in heart rate due to beta blocker and not person's behaviour / knowing may affect heart rate;
- (b) (i) Beta blockers reduce mortality (following myocardial infarction) / Greater reduction in the older group;
- (ii)

$$\frac{\text{Deaths with placebo} - \text{deaths with beta blocker}}{\text{Deaths with placebo ;}}$$

$$\frac{\text{Extra deaths}}{\text{deaths with placebo}}$$

x100;

2

[6]

**Q30.**

- (a) made of (different) tissues / specified tissues;
- (b) (i) 20  $\mu\text{m}$  as it consists of endothelium only / does not contain muscle, connective tissues and elastic tissue;  
*(consider other answers and credit understanding.)*
- (ii) 1 mark calculation derived from diameter - (2  $\times$  wall thickness) / answer of 3mm;  
 2 marks 2mm / 2000 $\mu\text{m}$ ;
- (c) stretches as a result of high pressure / surge of blood; then recoils;

1

1

2

2

[6]

**Q31.**

- (a) 0.1 / 0.9 (s);
- (b) Two marks for correct answer of 75 (beats per minute);

1

- One mark for incorrect answer based on cardiac cycle taking 0.8 seconds; 2
- (c) (i) Pressure in ventricle higher than pressure in atria; 1
- (ii) Prevents backflow of blood / prevents flow from ventricles to atria; 1
- (d) Increase (in stroke volume) as blood pressure increases, remains constant / plateaus; after 3 kPa / when stroke volume = 82cm<sup>3</sup> 2
- (e) Two marks for correct answer of 80;  
One mark for incorrect answer recognising that ventricle contracts once every cardiac cycle / stroke volume = 70 cm<sup>3</sup> 2
- (f) 1 Muscles (surrounding veins) contract and press on (walls of) vein and squeezes blood along veins;
- 2 Valves prevent backflow / ensure flow in one direction;
- 3 Systole / contraction of heart pumps blood (through arteries) into veins / residual arterial pressure / negative pressure in chest due to inspiration;
- 4 Recoil of heart muscle during diastole / after contraction;
- 5 Draws blood from veins into atria;  
*Accept sucks*
- 6 Wide lumen little resistance / friction 6
- [15]

**Q32.**

- (a) (i) **C** and **D**; 1
- (ii) left ventricle with thicker wall / more muscle / (muscle in) left ventricle contracts more forcefully / beats more strongly; 1
- (b) higher in atria / lower in ventricles;  
atrioventricular valves / valves between atria and ventricles open;  
*(position of valves must be identified.*  
*Do not accept an unqualified reference to valves.*  
*Assume pronouns refer to atria.)* 2
- (c) (i) allows blood to pass into ventricles / from atria / so that atria can empty; before ventricles contract; 2
- (ii) ventricle contracts from base / upwards;  
blood pushed through **B** and **C** / arteries / all blood ejected; 2
- [8]

**Q33.**

- (a) (variation in) temperature will affect the solubility of oxygen / rate of respiration / use of oxygen by cells / diffusion / gas exchange;  
*to gain credit point made must concern oxygen* 1
- (b) (i) there is no difference between the partial pressure of oxygen in the two groups / the partial pressure of oxygen is the same in each group; 1
- (ii) results may have been due to chance and statistical test allows us to determine the probability of this / of the difference between results being significant;  
enables acceptance or rejection of null hypothesis;  
*The key points here are chance and probability used in the correct context.* 2
- (c) **A**;  
because partial pressure of oxygen only reduced when zinc in water / in **Y** / because when injected zinc / in **X** has no effect on partial pressure of oxygen in blood; 2
- (d) less oxygen transport to cells / in fish / in blood;  
anaerobic respiration;  
lactic acid produced / less carbon dioxide removed (from gills);  
more H<sup>+</sup>; 3 max
- (e) (i) copper;  
calculation based on comparing concentration in woodlice with that in leaves;  
*accept any suitable method here, giving marks for the method and explanation. For example, calculating ratio of concentration in woodlice to concentration in leaves.* 2
- (ii) not absorbed from gut / passes out in faeces / egested / urine / excreted; 1
- (iii) woodlice eat large amount of leaves;  
copper stored / accumulates in body; 2
- (f) (i) mutation; 1
- (ii) (as a component of) nucleic acids / DNA / RNA / nucleotides;  
phospholipids;  
ATP / ADP; 2 max
- (iii) arsenic-tolerant plants would not be able to take up phosphates / take up a little phosphate;  
since likely to involve same mechanism / same carrier / protein;  
(process of ) growth would be poorer than non-tolerant plants; 3

**[20]****Q34.**

- (a) (i) the atrioventricular / mitral / bicuspid / tricuspid valves (closing);

1

- (ii) pressure in artery greater than pressure in ventricle; 1
- (b) correct answer 5250 = 3 marks;  
*where answer incorrect:*  
 one heart beat identified as taking 0.8 s;  
 heart rate calculated as 75 (beats per minute);  
 cardiac output = heart rate x stroke volume;  
*marking points to be awarded independently but onus on candidate to show clearly what has been done* 3
- [5]

**Q35.**

- (a) (i) Left ventricle; 1
- (ii) Thick muscle / thick walls;  
*Accept more muscle / more muscular.*  
*Ignore stronger muscle.* 1
- (b) (i) 85.7 / 86;  
*Accept 85*  
*Ignore additional decimal places.* 1
- (ii) Two marks for correct answer of 7905 - 7998;  
*Accept either formula or illustration with figures from table.*  
 One mark for incorrect answer in which candidate provides evidence of multiplying heart rate by stroke volume; 2
- (c) 1. Closed open;  
 2. Open closed; 2
- [7]