

## Mark schemes

**Q1.**

- (a) 1. Renal vein;  
2. Vena cava to right atrium;  
3. Right ventricle to pulmonary artery;

3

- (b) 1. Vein;  
2. Wide(r) lumen

**OR**

Thinner wall;

2

- (c) 1. (Plasma) proteins remain;  
*Accept albumin/globulins/fibrinogen for (plasma) protein*  
2. (Creates) water potential gradient

**OR**

Reduces water potential (of blood);

3. Water moves (to blood) by osmosis;  
4. Returns (to blood) by lymphatic system;

4

**[9]****Q2.**

- (a) 1. Only use single lines/do not use sketching (lines)/ensure lines are continuous/connected;  
2. Add labels/annotations/title;  
3. Add magnification/scale (bar);  
4. Draw all parts to same scale/relative size;  
5. Do not use shading/hatching;

**2 max**

- (b) 1. Blood vessel **X** – artery/arteriole **and**  
Blood vessel **Y** – vein/venule;  
2. (Difference in) lumen size

**OR**

(Difference in) wall thickness;

*Ignore name of blood vessel, eg. (pulmonary) artery*

2

- (c) 1. Carry/wash sharp instruments by holding handle

**OR**

Carry/wash sharp instruments by pointing away (from body)/down;

*Accept for 'instruments', a suitable named example,  
eg. scalpel*

2. Disinfect instruments/surfaces;

*Accept for 'instruments', a suitable named example,  
eg. scalpel*

*Accept for 'disinfect', sanitise OR use antiseptic*

3. Disinfect hands

**OR**

Wash hands with soap (and water);

*Accept for 'disinfect', sanitise OR use antiseptic*

4. Put organ/gloves/paper towels in a (separate) bag/bin/tray to dispose;

2 max

[6]

**Q3.**

- (a) 1. Muscle contracts;

2. Constricts/narrows arteriole/lumen;

*Accept decreases for constricts/narrows*

*Accept vasoconstriction for 1 mark*

2

- (b) (Ventricles and arteries)

1. Ventricle (muscles) relaxed

**OR**

Arteries recoiled;

*Accept references to ventricle, artery or atrium  
(singular)*

*Accept no muscle activity*

**OR**

*Diastole*

**OR**

*Arteries smoothing blood flow*

2. No (blood) backflow (into ventricles)

**OR**

No blood movement to/in/from arteries;

*Accept flow/pumped for movement*

(Atria and ventricles)

3. Atria (muscle) contracted;

4. Blood movement from atria (into ventricles);

*Accept flow/pumped for movement*

4

- (c) Vena cava;

1

- (d) 2 marks for correct answer = 130 (beats min<sup>-1</sup>);;

1 mark for correct stroke volume = 104

2

[9]

#### Q4.

- (a) 1. Aortic/semi-lunar valves is closed;

*Accept 'aorta valve' or 'valve to the aorta' or 'valve between the aorta and the ventricle'.*

*Do not accept S-L/A-V valve.*

2. Because pressure in aorta higher than in ventricle;

*Accept 9-10kPa in ventricle and 13kPa in aorta.*

*Ignore incorrect figures.*

2

- (b) 1. Elastic recoil (of the aorta wall/tissue);

*Reject muscle contracting.*

*Ignore reference to muscle relaxing.*

2. Smooths the blood flow

**OR**

Maintains rate of blood flow

**OR**

Maintains blood pressure;

*Ignore reference to preventing backflow of blood.*

2

- (c) 1. Peaks/contractions at the same/similar time

OR

Same/similar pattern;

*Mark the answer as a whole.*

*Accept 'shape (of curve)' for 'pattern'.*

2. Lower pressure;

2

(d) 167 (beats minute<sup>-1</sup>)

OR

164 (beats minute<sup>-1</sup>)

OR

171 (beats minute<sup>-1</sup>);

*Full answers*

*166.6 recurring, 164.383562, 171.428571*

*Accept any number of decimal places as long as rounding correct.*

1

[7]

### Q5.

(a) 1. Increases dissociation of oxygen;

*Accept unloading/ release/reduced affinity for dissociation*

2. For aerobic respiration at the tissues/muscles/cells

**OR**

Anaerobic respiration delayed at the tissues/muscles/cells

**OR**

Less lactate at the tissues/muscles/cells;

2

(b) 1. (Time) 10 minutes;

2. (Ratio) 1.6875(:1);

Allow 1 mark for correct ratio calculated from wrong time

*For the ratio accept any correct rounding*

2

(c) 1. Increase in breathing (rate);

*Award mark points 1 and 2 **OR** 3 and 4*

*Allow more breaths per minute*

*Reject more BPM*

2. Similar/same  $p\text{CO}_2$  per breath, but more breaths;  
**OR**
3. Increase in tidal volume;  
*Accept each breath is deeper*
4. Similar/same  $p\text{CO}_2$  per breath, but increased volume per breath; 2
- (f) 1. (EPO) causes blood to thicken;  
*Accept descriptions of thickening, eg more viscous*
2. (The thickened blood) could block the coronary arteries  
**OR**  
(The thickened blood) slows blood flow  
**OR**  
(The thicker blood) could cause clots;  
*Reject atheroma/plaque (forms)*  
*Accept could cause thrombus/embolus* 2
- (g) 1. Some cyclists will gain a bigger advantage/increase  
**OR**  
Cyclists with a haematocrit of 50% would not be able to gain an advantage;  
*Accept use of the data, or suitable calculations, eg some may have an 8% increase, others 0%*  
*Some cyclists might naturally have a haematocrit over 50% (and so not be allowed to compete)*
2. There are health risks (associated with) taking EPO;  
*Accept dangerous side-effects of taking EPO, or examples of health risks* 2
- [15]

**Q6.**

- (a) 1. Increases/more oxygen dissociation/unloading  
**OR**  
Decreases haemoglobin's affinity for  $\text{O}_2$ ;  
*Accept more readily*  
*Accept releases more  $\text{O}_2$*
2. (By) decreasing (blood) pH/increasing acidity;  
*Reject if reference made to active site*

2

- (b) 1. High(er) affinity for  $O_2$  (than haemoglobin)  
**OR**  
 Dissociates oxygen less readily  
**OR**  
 Associates more readily;  
*Accept holds  $O_2$  at lower  $ppO_2$*
2. Allows (aerobic) respiration when diving/at low(er)  $pO_2$   
**OR**  
 Provides oxygen when haemoglobin unloaded  
**OR**  
 Delays anaerobic respiration/lactate production;  
*Accept acts as an oxygen store*

2

- (c) Correct answer for 2 marks

10.8 to 11 (mins)

**OR**

10 minutes and 48 seconds = 2 marks;;

Accept for 1 mark, 10.48 minutes

**OR**

Reference to 2057.7 to 2058 ( $10\,700 \div 5.2$ , time oxygen would last if its mass was 1 kg)

**OR**

Reference to 56 to 56.3 ( $10700 \div 190$ , oxygen in 1 kg of seal)

**OR**

Reference to 988 ( $5.2 \times 190$ , oxygen used  $\text{min}^{-1}$  by the seal)

**OR**

Incorrect answer with correct answer shown in working

2

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## Q7.

- (a) Valve **A**

(Left) atrioventricular

Chamber **B**

Left ventricle;

*Reject right side in either context*

*Accept mitral/bicuspid for Valve **A**.*

*Reject tricuspid for Valve **A***

*Ignore AV for Valve **A***

1

- (b) Accept any **two** suitable safety precautions for 1 mark, eg;

Use a sharp scalpel/scissors

Wash hands/wear gloves

Disinfect bench/equipment

Cover any cuts

Cut away from self/others/on a hard surface

Safe disposal

*Ignore take care with scalpel/scissors or keep away from fingers*

*Ignore goggles*

1 max

- (c) 1. Pressure in (left) atrium is higher than in ventricle/**B** causing valve to open;  
**OR**  
 (When) pressure above valve is higher than below valve it opens;  
*Ignore pressure in front of/behind valve*  
*As long as direction of opening/closing of valve is correct, ignore 'semi lunar'*

2. Pressure in (left) ventricle/B is higher than in atrium **causing** valve to close;  
**OR**  
 (When) pressure in below valve is higher than above valve it closes;  
*Accept cords/tendons prevent valve turning inside out*  
*Ignore pressure in front of/behind valve*  
*As long as direction of opening/closing of valve is correct, ignore 'semi lunar'*

2

- (d) 1. More impulses/action potentials along sympathetic (nervous system pathway/branch);  
*Ignore signals/information/ messages*  
*Idea of more impulses/action potentials is required*

2. To SAN increasing the heart rate (seen in **Figure 2**);

2

- (e) 73

(this is the *best* answer since all numbers quoted in the question are to 2 s.f.)

*(73.4375)*

*Accept 73.4 / any correct rounding*

1

- (f) **Group to be given**

1. Sugar solution (only)

**OR**A drink with sugar (**and** no caffeine);*Accept 'glucose' for sugar**Ignore named drinks unless qualified**Ignore 'sugar' by itself**Ignore references to use of a placebo tablet***Reason**

2. To show/prove that sugar (alone) is not causing the increases (in HR)

**OR**

To show that sugar does not have an effect;

*Accept 'to see the effect of sugar'*

2

**[9]****Q8.**

- (a) D;  
G;  
F;

3

- (b) Coronary arteries;

*Accept coronary artery**Ignore aorta, arteriole and capillary**Reject coronary veins**Do not accept coronary by itself**Accept phonetic spelling*

1

**Q9.**

- (a) 1. Binding of first oxygen changes tertiary / quaternary (structure) of haemoglobin;

*Ignore ref. to 'positive cooperativity' unqualified**Ignore ref. to named bonds**Accept conformational shift caused*

2. Creates / leads to / uncovers second / another binding site

**OR**

Uncovers another iron / Fe / haem group to bind to;

*Reject ref. to active site*

2

**Q10.**

- (a)

	open	closed
Semi-lunar valves	2	3



Atrioventricular valves	4	1
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One mark for each correct column

General marker

2

- (b) (Acceptable range is) 6315.79 to 6400;

Allow one mark for  $(SV = 120 - 40 =) 80 \text{ (cm}^3\text{)}$

**OR**

$(1 \text{ cycle} = 1.24 - 0.48 =) 0.76 \text{ (s)}$

**OR**

$79 / 80 \text{ (beats minute}^{-1}\text{)}$

2

- (c) 1. Contraction of ventricle(s) produces **high** blood / hydrostatic pressure;  
 2. (This) forces water (and some dissolved substances) out (of blood capillaries);  
     1. Do not accept contraction / pumping of the heart  
     1. Reject blood / plasma / tissue fluid forced out

2

- (d) Excess tissue fluid cannot be (re)absorbed / builds up;

The idea of excess is important

Accept 'drained' for absorbed

1

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### Q11.

- (a) First oxygen binds (to Hb) causing change in shape;  
 (Shape change of Hb) allows more O<sub>2</sub> to bind (easily) / greater saturation with O<sub>2</sub>

**OR**

Cooperative binding;

2

- (b) 1. (HbA has) lower affinity for O<sub>2</sub> at low partial pressures;  
**OR**  
 (HbA has) lower affinity for oxygen at pp found in tissues;  
 2. Easier unloading of O<sub>2</sub> for (aerobic) respiration;

2

- (c) 1. A large/significant increase in HbF;  
 2. (HbF has) higher affinity for O<sub>2</sub> (than faulty HbA);  
 3. Higher proportion of HbF in blood so more oxygen carried;  
**OR**  
 More oxygen carried after treatment;

3

[7]