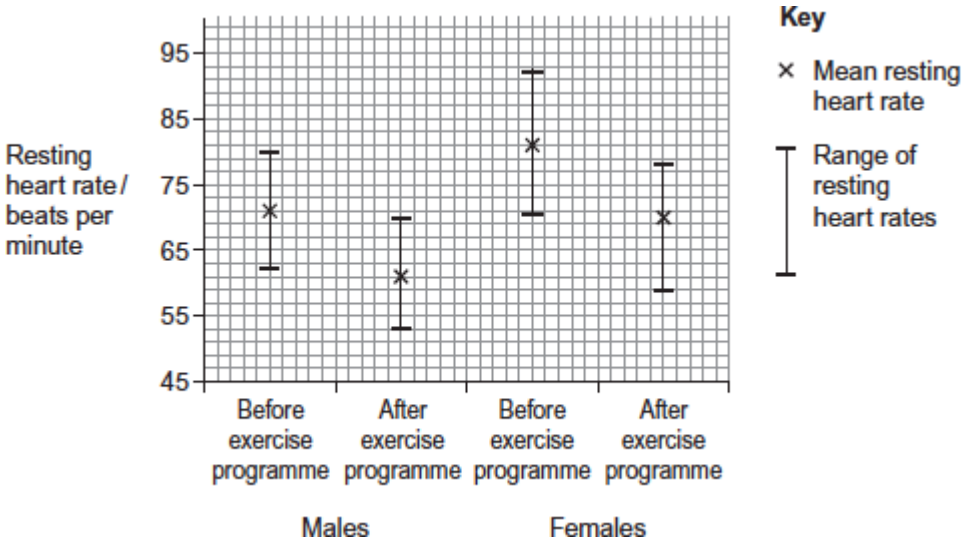
Exchange questions revision pack 216 minutes 140 marks

Q1.

Scientists investigated the effect of a 6-week exercise programme on the resting heart rate of males and females.

The scientists recruited a large group of male volunteers and a large group of female volunteers. They measured the resting heart rate of each volunteer before the exercise programme. Both groups took part in the same exercise programme. The scientists measured the resting heart rate of each volunteer after the exercise programme.

The scientists determined the mean resting heart rate and the range of resting heart rates for each group before and after the exercise programme. The graph shows their results.



(a) What was the range of the resting heart rates in males after the exercise programme?

_____

(1)

(b) Calculate the percentage decrease in the mean resting heart rate of females after the exercise programme. Show your working.

Answer = _____ %

(2)

(c) The scientists used the percentage change in the mean resting heart rate after the exercise programme to compare the results for males and females.

Explain why they used percentage change in the resting heart rate.

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(2)

(d) The scientists calculated the cardiac output of the volunteers before and after the exercise programme. In some volunteers, their cardiac output stayed the same, even though their resting heart rate decreased.

Explain how their cardiac output could stay the same even when their resting heart rate had decreased.

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(2)

(Total 7 marks)

Q2.

Ivabradine is a drug that slows heart rate. It is taken as a pill. Doctors investigated its value in reducing the resting heart rate of patients with coronary heart disease.

- They described their investigation as a large-scale, controlled trial. It was also carried out on people living in different areas.
- The results of the trial showed that ivabradine slowed heart rate.
- Angina is a pain in the chest. It results when insufficient oxygen is brought to the heart muscle during exercise. The doctors found that ivabradine reduced angina.

(a) The results of the ivabradine trial were reliable.

(i) Explain the importance of the ivabradine investigation being a large-scale trial.

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(1)

(ii) Explain the importance of the ivabradine investigation being carried out on people living in different areas.

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(1)

(b) The ivabradine investigation was a controlled trial. Suggest how the control group would have been treated.

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(2)

(c) An electrocardiogram is made by attaching recording electrodes to a person's chest. It shows the electrical changes that take place in a person's heart each time it beats. A sports physiologist produced electrocardiograms for a fit adult male.

Chart **X** shows an electrocardiogram from this man after 10 minutes of complete rest.
A cardiac cycle consists of the filling time and the contraction time. The filling time and the contraction time for one cardiac cycle are shown on this chart.

Chart **X**

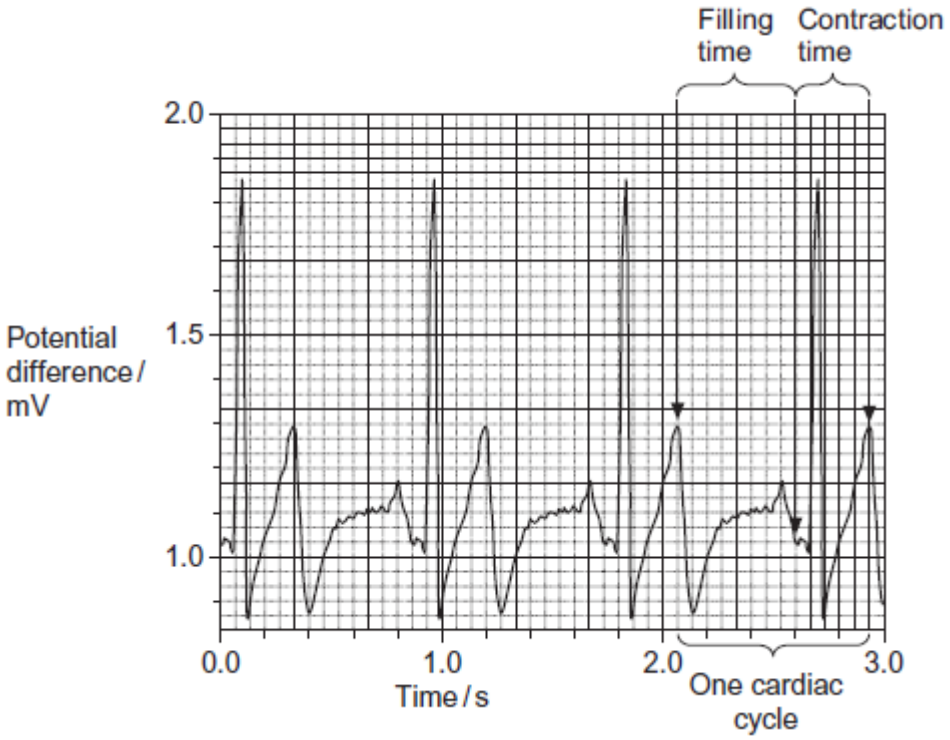
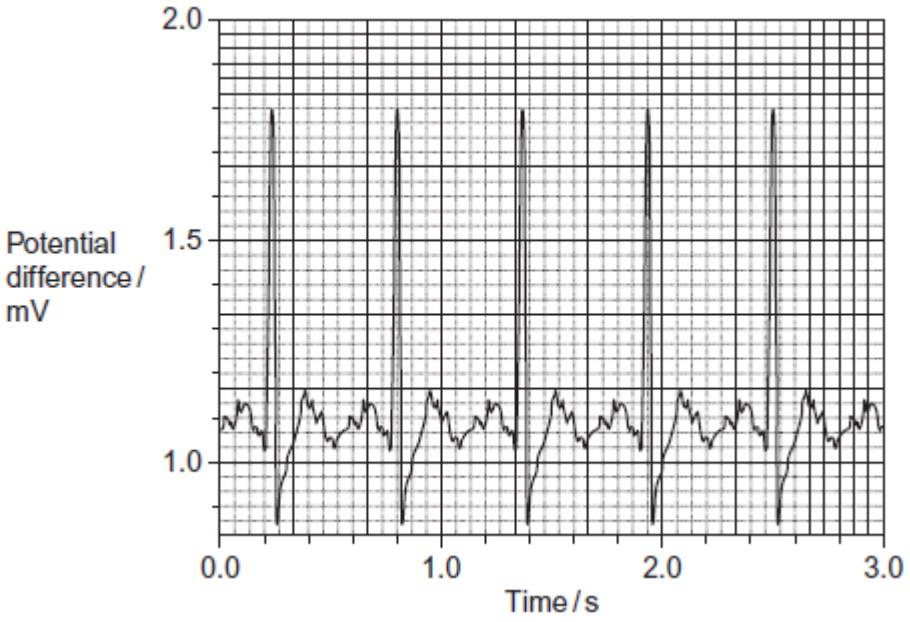


Chart **Y** shows an electrocardiogram from the same man immediately after a period of exercise.

Chart **Y**



Ivabradine slows heart rate.

(i) Use information from the charts above to explain why ivabradine increases the volume of blood entering the heart during a cardiac cycle.

_____

_____

(1)

(ii) Ivabradine reduces angina. Suggest how an increase in the volume of blood entering the heart reduces angina.

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(3)

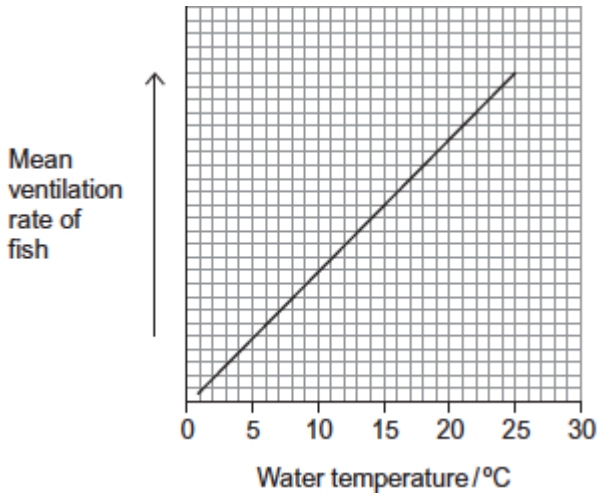
(Total 8 marks)

Q3.

A biologist investigated the effect of water temperature on the rate of ventilation of gills in a species of fish. She kept four fish in a thermostatically controlled aquarium and measured the mean ventilation rate by counting movements of their gill covers.

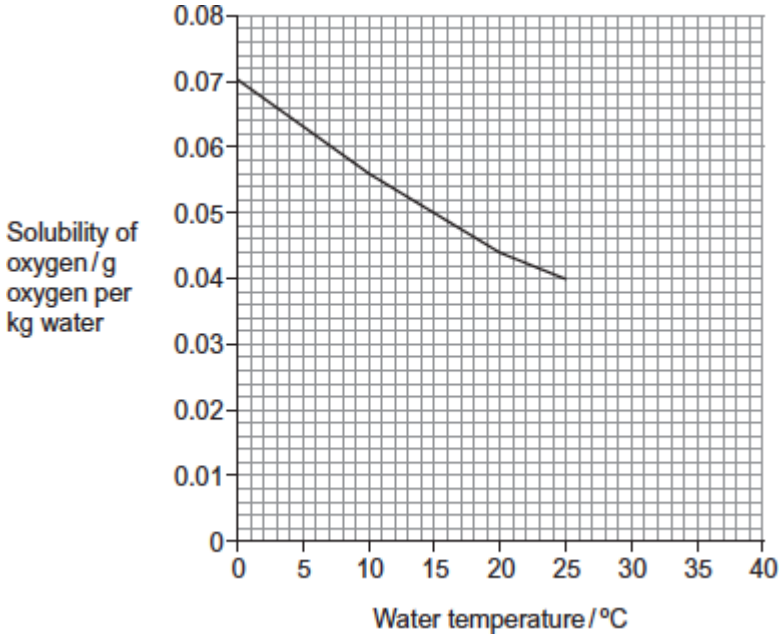
Her results are shown in **Figure 1**.

Figure 1



In this investigation, the biologist also monitored the concentration of oxygen in the water in the aquarium. The concentration of oxygen in water changes with temperature of the water. **Figure 2** shows how it changes.

Figure 2



(a) Suggest a difficulty of counting movements of gill covers as a method of measuring rate of ventilation in fish.

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_____

(1)

(b) The biologist concluded that there was a correlation between rate of ventilation of the gills and temperature of the water. A scatter diagram can be used to look for a correlation but, in this investigation, it was **not** the appropriate graph for her data. Explain why.

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_____

_____

(1)

(c) (i) Describe the relationship between temperature of water, oxygen in water and rate of ventilation.

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_____

_____

(1)

(ii) Use **Figure 1** and **Figure 2** to explain the advantage to the fish of the change in its rate of ventilation.

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(3)

(Total 6 marks)

Q4.

(a) (i) An arteriole is described as an organ. Explain why.

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(1)

(ii) An arteriole contains muscle fibres. Explain how these muscle fibres reduce blood flow to capillaries.

_____

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(2)

(b) (i) A capillary has a thin wall. This leads to rapid exchange of substances between the blood and tissue fluid. Explain why.

_____

_____

_____

(1)

(ii) Blood flow in capillaries is slow. Give the advantage of this.

_____

_____

_____

(1)

(c) Kwashiorkor is a disease caused by a lack of protein in the blood. This leads to a swollen abdomen due to a build up of tissue fluid.

Explain why a lack of protein in the blood causes a build up of tissue fluid.

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(3)

(Total 8 marks)

Q5.

Read the following passage.

Gluten is a protein found in wheat. When gluten is digested in the small intestine, the products include peptides. Peptides are short chains of amino acids. These peptides cannot be absorbed by facilitated diffusion and leave the gut in faeces

Some people have coeliac disease. The epithelial cells of people with coeliac disease do not absorb the products of digestion very well. In these people, some of the peptides from gluten can pass between the epithelial cells lining the small intestine and enter the intestine wall. Here, the peptides cause an immune response that leads to the destruction of microvilli on the epithelial cells.

Scientists have identified a drug which might help people with coeliac disease. It reduces the movement of peptides between epithelial cells. They have carried out trials of the drug with patients with coeliac disease.

Use the information in the passage and your own knowledge to answer the following questions.

(a) Name the type of chemical reaction which produces amino acids from proteins.

_____

(1)

(b) The peptides released when gluten is digested cannot be absorbed by facilitated diffusion (lines 2 – 3). Suggest why.

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(3)

(c) Explain why the peptides cause an immune response (lines 7 – 8).

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(1)

(d) Scientists have carried out trials of a drug to treat coeliac disease (lines 10 – 11). Suggest **two** factors that should be considered before the drug can be used on patients with the disease.

1. _____

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2. _____

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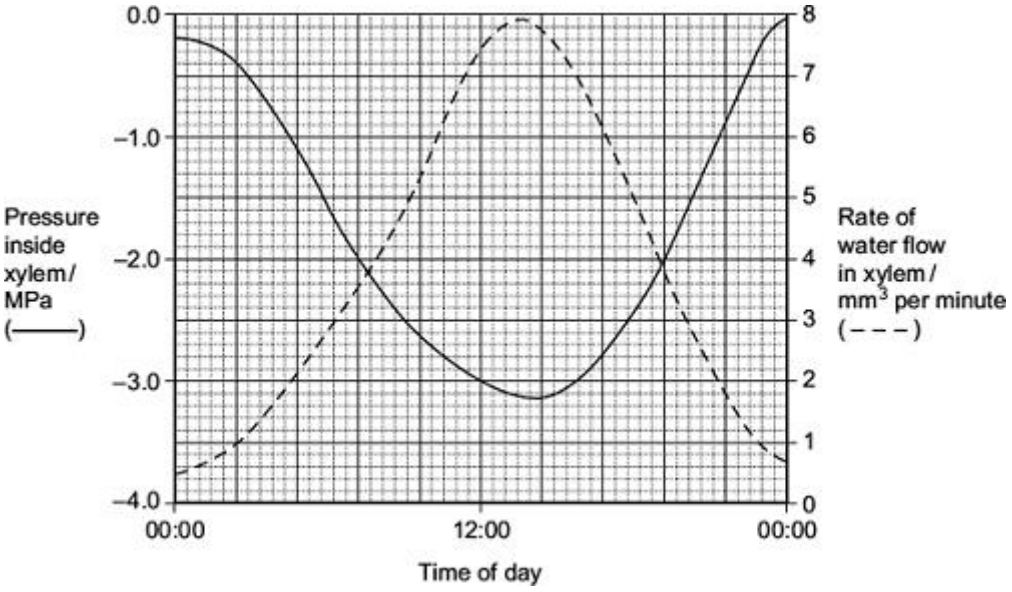
(2)

(Total 7 marks)

Q6.

(a) Scientists measured the rate of water flow and the pressure in the xylem in a small branch. Their results are shown in the graph.



(i) Use your knowledge of transpiration to explain the changes in the rate of flow in the xylem shown in the graph.

_____

_____

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(3)

(ii) Explain why the values for the pressure in the xylem are negative.

_____

_____

_____

(1)

(b) Doctors measured the thickness of the walls of three blood vessels in a large group of people. Their results are given in the table.

Name of vessel	Mean wall thickness /mm (± standard deviation)
Aorta	5.7 ± 1.2
Pulmonary artery	1.0 ± 0.2
Pulmonary vein	0.5 ± 0.2

(i) Explain the difference in thickness between the pulmonary artery and the pulmonary vein.

_____

_____

_____

(1)

(ii) The thickness of the aorta wall changes all the time during each cardiac cycle. Explain why

_____

_____

_____

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(3)

(iii) Which of the three blood vessels shows the greatest variation in wall thickness?
Explain your answer.

_____

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_____

(1)

(c) Describe how tissue fluid is formed **and** how it is returned to the circulatory system.

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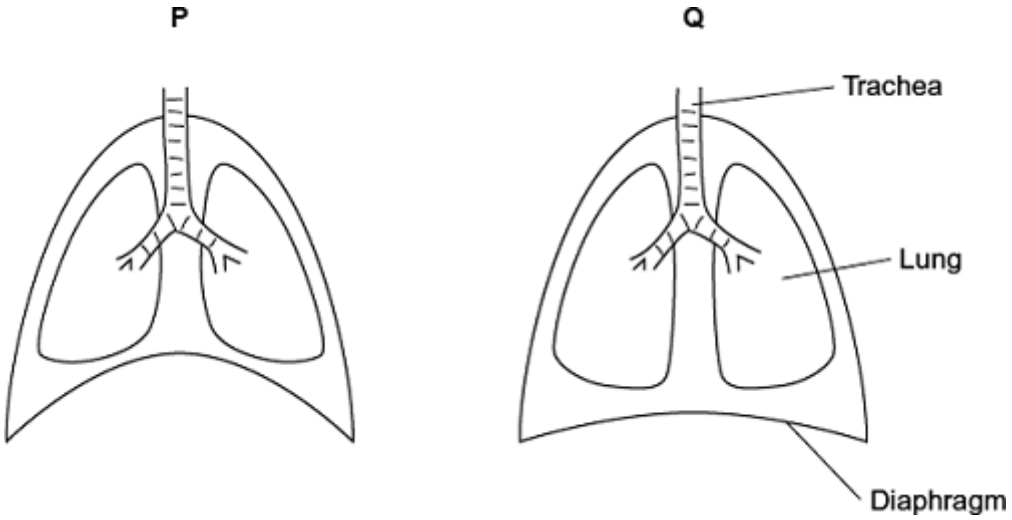
(6)

(Total 15 marks)

Q7.

The diagram shows the position of the diaphragm at times **P** and **Q**.



(a) Describe what happens to the diaphragm between times **P** and **Q** to bring about the change in its shape.

_____

_____

_____

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_____

(2)

(b) Air moves into the lungs between times **P** and **Q**. Explain how the diaphragm causes this.

_____

_____

_____

_____

_____

(3)

(c) Describe how oxygen in air in the alveoli enters the blood in capillaries.

_____

(2)
(Total 7 marks)

Q8.

Scientists compared the results of three investigations, **A**, **B** and **C**. These investigations were into the effect of drinking different amounts of alcohol on the risk of developing heart disease.

The graph shows the results of these investigations.

(a) Describe the relationship between increasing the number of alcoholic drinks per day and the risk of heart disease in investigation **A**.

(2)

(b) All the volunteers who took part in investigation **C** were aged between 40 and 50 years old. Explain how choosing volunteers of a similar age improved this investigation.

(1)

(c) A newspaper headline used the information in the graph to claim 'Alcohol is good

for you.' Evaluate this claim.

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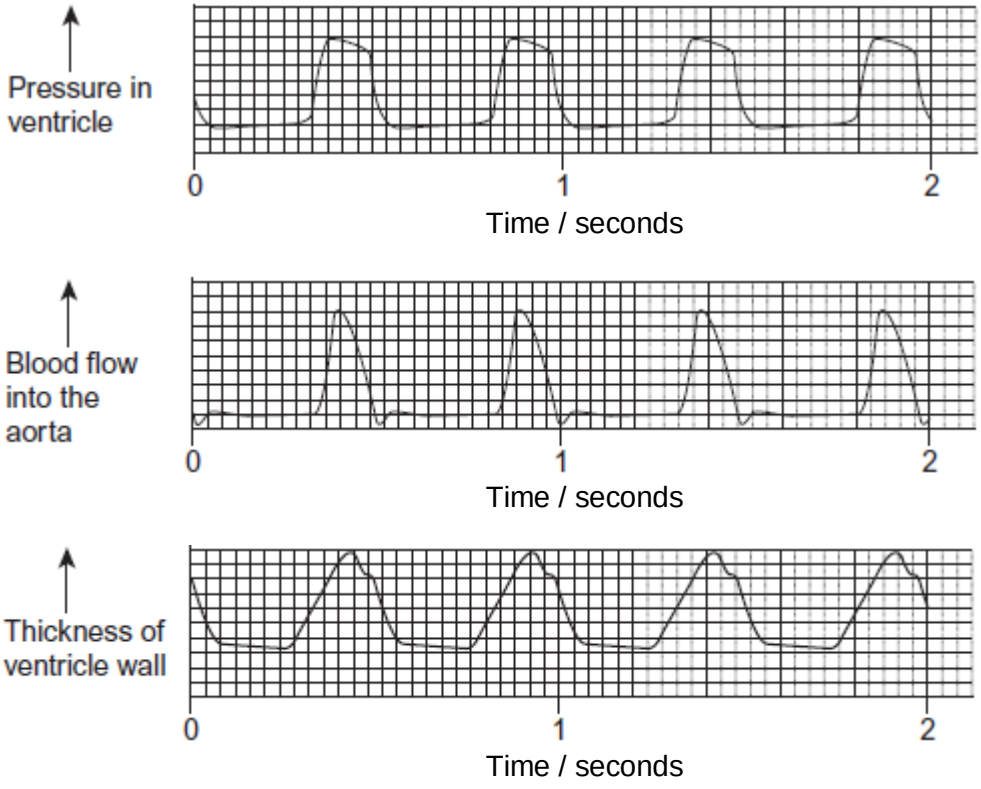
(3)

(Total 6 marks)

Q9.

The figure below shows recordings made from the heart of a dog.



(a) Use information from the figure to explain how the pressure in the dog's ventricle is related to blood flow into the aorta.

_____

_____

_____

_____

(2)

(b) Use information from the figure to explain how the pressure in the dog's ventricle is

related to the thickness of the ventricle wall.

_____

_____

_____

_____

(2)

(c) Use the figure to calculate the heart rate of the dog in beats per minute.
Show your working.

Heart rate _____ beats per minute

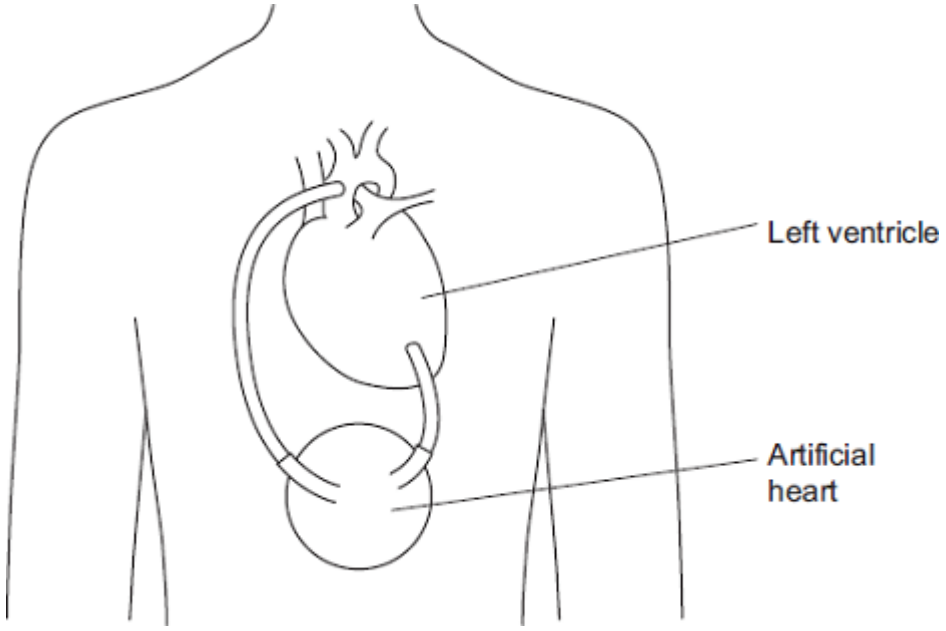
(2)

(Total 6 marks)

Q10.

Some people have a form of *heart failure* where their heart is not pumping blood as well as it used to. Some people with heart failure are given an artificial heart to improve circulation of blood from the left ventricle.
Figure 1 shows where this type of artificial heart is connected.

Figure 1



(a) Name the blood vessel to which the artificial heart is connected.

_____

(1)

(b) In these patients, the right ventricle still produces sufficient blood flow to keep the patient alive.

Suggest why the left ventricle requires the help of the artificial heart but the right ventricle does not.

_____

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_____

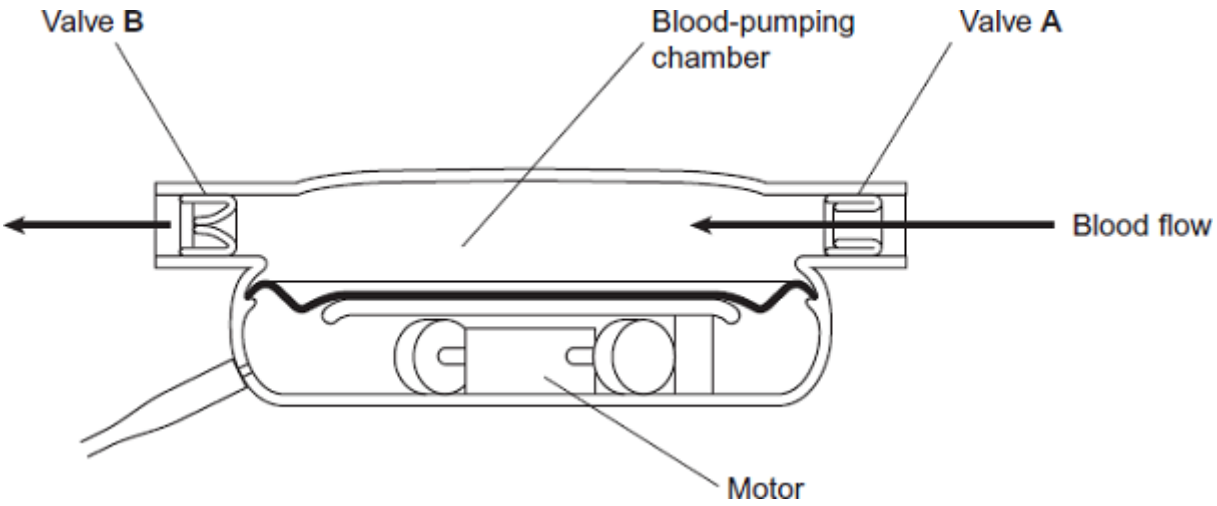
_____

_____

(2)

(c) **Figure 2** shows the internal structure of this type of artificial heart.

Figure 2



Valves **A** and **B** have the same functions as heart valves involved in the cardiac cycle. Name the heart valve that has the same function as:

valve **A** _____

valve **B** _____

(2)

(d) There are different designs of artificial heart. Doctors compared results for patients who received two different types of artificial heart, **X** and **Y.**

They recorded information 2 years after the artificial hearts were implanted. Their results are **shown in Figure 3**.

Figure 3

	Information recorded 2 years after artificial heart implanted		
Type of artificial heart	**Number of patients surviving without replacement of artificial heart**	**Number of patients surviving but who required repair or replacement of artificial heart**	**Number of patients who died**
X (119 patients)	62	13	44
Y (58 patients)	7	24	27

Which type of artificial heart was the more successful? Use calculations to support your answer.

_____

_____

_____

_____

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_____

(3)

(Total 8 marks)

Q11.

Scientists used fossil leaves from one species of pine tree to investigate whether changes in the concentration of carbon dioxide in the air over long periods of time had led to changes in the number of stomata in the leaves.

Their method is outlined below.

- They selected sites of different ages.
- They collected between 11 and 24 fossil leaves from each site.
- They found the mean number of stomata per mm^2 on the leaves from each site.
- They estimated the age of each sample by dating organic remains around the leaves at each site.

They compared results from the fossil leaves with leaves from the same species of pine tree growing today.

They knew the concentration of carbon dioxide in the air at different times in the past.

Their results are shown in the table.

Age of sample/years	Concentration of carbon dioxide in the air/%	Mean number of stomata per mm^2 (± standard deviation)
present day	0.0350	92 (±2)
5000	0.0270	87 (±4)
10 000	0.0250	95 (±2)
15 000	0.0205	108 (±6)
20 000	0.0195	115 (±4)
25 000	0.0188	118 (±6)
30 000	0.0190	130 (±6)

(a) The concentration of carbon dioxide in the air has changed with time. Use the data to describe how.

_____

_____

_____

_____

_____

(2)

(b) The scientists calculated the mean number of stomata per mm^2 and the standard deviation.

What does the standard deviation show?

_____

_____

_____

_____

_____

(2)

(c) The scientists found the age of the fossil leaves by dating the organic remains around them.
Would this have affected the accuracy of their data? Explain your answer.

_____

_____

_____

(1)

(d) 30 000 years ago the mean number of stomata per mm^2 on the lower epidermis of pine tree leaves was much higher than it is today. This would have enabled the plant to grow faster when the carbon dioxide concentration of the air was low.

Explain why.

_____

_____

_____

(1)

(e) A student who saw these results concluded that as the carbon dioxide concentration of the air had increased the number of stomata per mm^2 in leaves had decreased.
Do the results support this conclusion?

_____

_____

_____

_____

_____

_____

(3)

(f) The leaves of plants that grow in dry areas usually have a low number of stomata per mm^2. Use your knowledge of leaf structure to suggest **three** other adaptations that the leaves might have that enable the plants to grow well in dry conditions.

1. _____

2. _____

3. _____

(3)

(Total 12 marks)

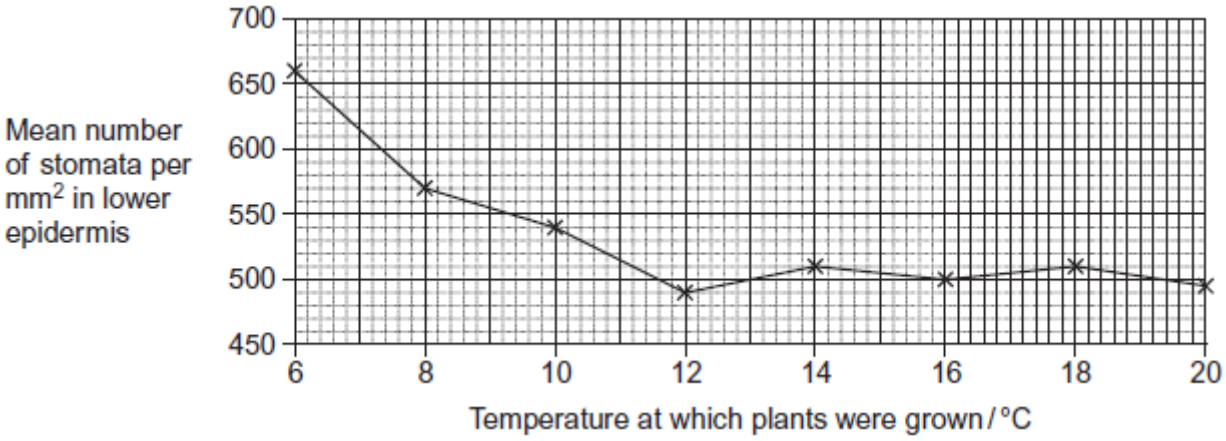
Q12.

Environmental factors can affect the density of stomata in the lower epidermis of leaves of plants of the same species.

Scientists investigated how growing plants at different temperatures affected the density of stomata in the lower epidermis of leaves. They grew plants of the same species from seeds.
Their method is outlined below.

- They took 8 trays containing soil and planted 50 seeds in each tray.
- They put each tray in a controlled environment at a different temperature.
- When the plants had grown from the seeds, they selected 20 fully grown leaves from the plants in each tray.
- They determined the mean number of stomata per mm^2 in the lower epidermis for each group of leaves.

Their results are shown in the graph.



(a) Give **three** environmental variables, other than temperature, that the scientists would have controlled when growing the plants.

1. _____

2. _____

3. _____

(3)

(b) The scientists used a range of temperatures from 6 to 20 °C.
Using their data, explain why they did not use temperatures above 20 °C.

_____

_____

_____

(1)

(c) The scientists only selected fully grown leaves from the plants.

Suggest why.

_____

_____

_____

(1)

(d) The plants grown at higher temperatures had a lower number of stomata per mm^2. This would be an advantage to the plant because the transpiration rate increases as the temperature increases.

Explain why the transpiration rate increases when the temperature increases.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

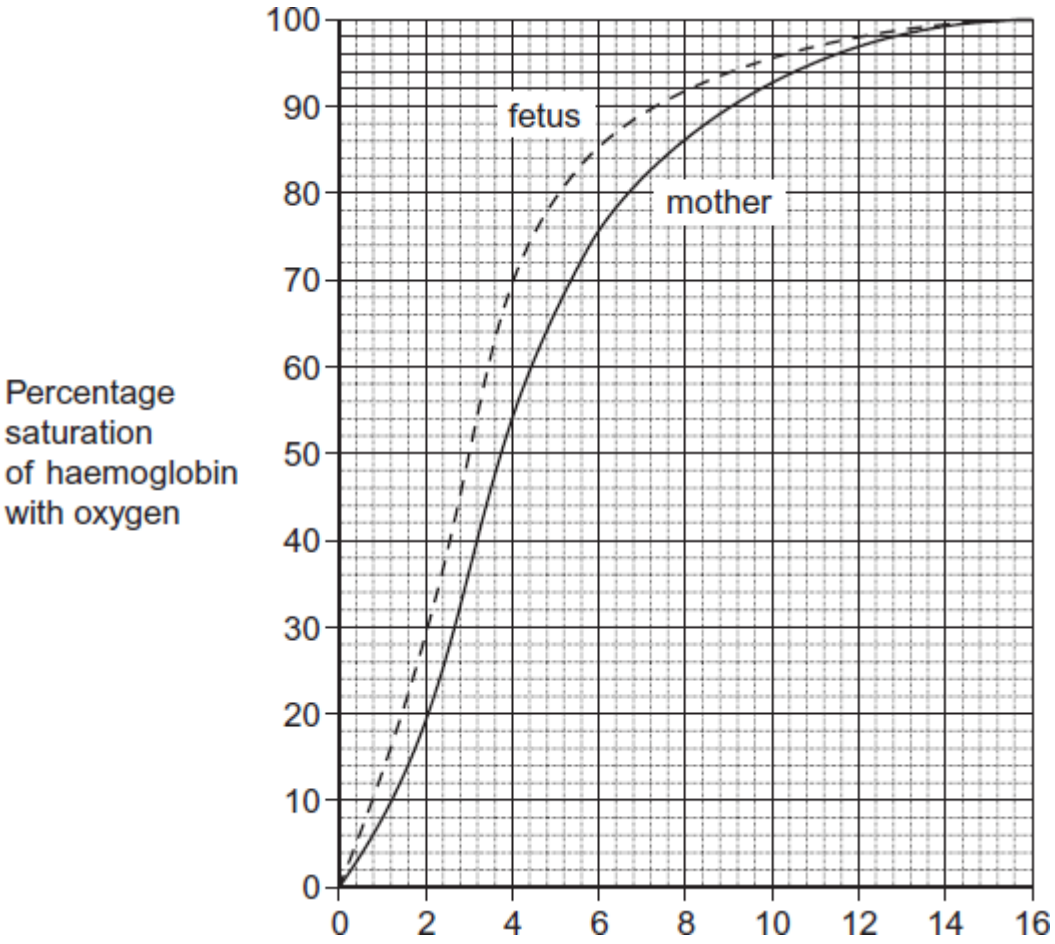
Q13.

(a) The table shows three statements about some biological molecules. Complete the table with a tick in each box if the statement is true for haemoglobin, cellulose or starch.

Statement	Haemoglobin	Cellulose	Starch
Has a quaternary structure			
Formed by condensation reactions			
Contains nitrogen			

(3)

The graph shows oxygen dissociation curves for the haemoglobin of a mother and her fetus.



(b) What is the difference in percentage saturation between the haemoglobin of the mother and her fetus at a partial pressure of oxygen (pO_2) of 4 kPa?

(1)

(c) The oxygen dissociation curve of the fetus is to the left of that for its mother. Explain the advantage of this for the fetus.

(2)

(d) After birth, fetal haemoglobin is replaced with adult haemoglobin. Use the graph to suggest the advantage of this to the baby.

_____

_____

_____

_____

_____

(2)

(e) Hereditary persistence of fetal haemoglobin (HPFH) is a condition in which production of fetal haemoglobin continues into adulthood. Adult haemoglobin is also produced.

People with HPFH do not usually show symptoms. Suggest why.

_____

_____

_____

(1)

(Total 9 marks)

Q14.

A scientist used grasshoppers to investigate the effect of composition of air on breathing rate in insects. He changed the composition of air they breathed in by varying the concentrations of oxygen and carbon dioxide.

The scientist collected 20 mature grasshoppers from a meadow. He placed the grasshoppers in a small chamber where he could adjust and control the composition of air surrounding them. The small chamber restricted the movement of the grasshoppers.

His results for three of the grasshoppers are shown in the table below in the form in which he presented them.

		Percentage of oxygen and carbon dioxide in different types of air breathed in by grasshoppers			
		A Air from atmosphere	**B Pure oxygen**	**C Gas mixture 1**	**D Gas mixture 2**
Gas	**Oxygen**	20.9	100.0	91.0	84.0
	Carbon dioxide	0.1	0.0	9.0	16.0
Breathing	**Grasshopper**	53	11	99	107

rate of grasshopper in different types of air / breaths per minute	**1**				
	Grasshopper 2	48	25	88	99
	Grasshopper 3	61	13	96	93

(a) The percentages of oxygen and carbon dioxide in Column **A** do **not** add up to 100% but in columns **C** and **D** they do.
Suggest **two** reasons for this difference.

1. _____

_____

2. _____

_____

(2)

(b) Use all the data to describe the effect of concentration of carbon dioxide on the breathing rate of grasshoppers.

_____

_____

_____

_____

_____

_____

(3)

(c) One of the different types of air was similar to the air in the meadow where the grasshoppers were collected. It provides data that might be used to calculate a mean breathing rate for grasshoppers in the meadow.

(i) Use the data to estimate the mean breathing rate of the three grasshoppers in the meadow. Show your working.

Mean breathing rate = _____ breaths per minute

(2)

(ii) The estimate does not provide a reliable value for the mean breathing rate of all insect species in the meadow.
Other than being an estimate, suggest and explain **three** reasons why this value would **not** be reliable.

1. _____

_____

_____

2. _____

_____

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3. _____

_____

_____

(3)

(Total 10 marks)

Q15.

(a) Describe and explain how the countercurrent system leads to efficient gas exchange across the gills of a fish.

_____

_____

_____

_____

_____

_____

(3)

(b) Amoebic gill disease (AGD) is caused by a parasite that lives on the gills of some species of fish. The disease causes the lamellae to become thicker and to fuse together.

AGD reduces the efficiency of gas exchange in fish. Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) The table below shows some features of gas exchange of a fish at rest.

Volume of oxygen absorbed by the gills from each dm^3 of water / cm^3	7
Mass of fish / kg	0.4
Oxygen required by fish / $cm^3\ kg^{-1}\ hour^{-1}$	90

(i) Calculate the volume of water that would have to pass over the gills each hour to supply the oxygen required by the fish. Show your working.

_____ dm^3

(2)

(ii) The volume of water passing over the gills increases if the temperature of the water increases. Suggest why.

_____

_____

_____

(1)

(Total 8 marks)

Q16.

A principle of homeostasis is the maintenance of a constant internal environment. An increase in the concentration of carbon dioxide would change the internal environment and blood pH.
Explain the importance of maintaining a constant blood pH.

_____

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(Total 3 marks)

Q17.

Scientists studied three species of plant.

They selected fully grown leaves from five different plants of each species.

For each leaf they measured:

- leaf surface area
- leaf thickness
- the number of stomata per mm^2.

The scientists' results are shown in the table below.

Plant species	Mean leaf surface area / mm^2	Mean leaf thickness / µm	Mean number of stomata per mm^2
A	218.0	191.5	380.0
B	17.0	296.3	136.0
C	2.2	354.8	419.0

(a) How did the scientists ensure they could make a valid comparison between leaves from different species?

_____

_____

(1)

(b) Describe a method you could use to find the surface area of a leaf.

_____

_____

_____

_____

_____

_____

(3)

(c) (i) Which species, **A** or **B**, would you predict grew in a drier environment?

Explain **one** feature that caused you to choose this species.

Species _____

Explanation _____

_____

_____

(1)

(ii) Other than the features of leaves in the table above, give **two** features of leaves of xerophytes.

For each feature explain how it reduces water loss.

Feature 1 _____

Explanation _____

_____

Feature 2 _____

Explanation _____

_____

(2)

(d) Species **C** has a high number of stomata per mm^2. Despite this it loses a small amount of water.

Use the data to explain why.

_____

_____

_____

(1)

(Total 8 marks)

Q18.

The mean internal diameter and the mean speed of blood flow for different human blood vessels are shown below in the table.

Blood vessel	**Mean internal diameter / mm**	**Mean speed of blood flow / mm s^{-1}**
Aorta	35	470
Coronary artery	4	380
Arteriole	0.03	110
Capillary	0.001	15
Vena cava	20	270

(a) Although the speed of blood flow in an arteriole is greater than speed of blood flow in a capillary, blood does **not** accumulate in the arterioles.

Explain why.

_____

_____

_____

(1)

(b) Other than causing slow blood flow, explain **one** advantage of capillaries being narrow.

_____

_____

_____

_____

(2)

(c) What factor limits the minimum internal diameter of the lumen of a capillary?

_____

_____

_____

(1)

(d) The volume of blood leaving the capillary network into the veins is less than the volume of blood entering from the arteries.

Explain why.

_____

_____

_____

(1)

(Total 5 marks)

Q1.

(a) 53−70 / 70-53 / 17 (beats per minute).

1

(b) 13.6 / 13.58 / 14;

If answer is incorrect, 1 mark for the principle of difference (11) divided by initial heart rate (81).

$\frac{70-81}{81}$ *or* $\frac{81-70}{81}$ *for 1 mark*

Ignore + or - signs

2

(c) 1. Allows comparison;
2. (Initial / resting) heart rates different (between males and females).

2

(d) 1. Cardiac output = stroke volume × heart rate

1. Accept CO = SV × HR

2. (So) stroke volume increases / increased size or volume of ventricles.

2. Neutral: more blood leaves heart

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

2 max

[7]

Q2.

(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]

Q3.

(a) Fish keep moving / swimming / movement of gill covers too fast to count (at higher temperatures).

Accept converse.

Reject personal errors e.g. with counting.

Neutral − 'water not clear' or 'difficult to see movement of gill covers'.

1

(b) 1. There is only one dependent variable / there are not two dependent variables / water temperature is the independent variable / breathing rate is dependent on water temperature;

Accept either approach for 1 mark.

For 'independent' accept 'manipulated'.

Reject −'need two continuous variables'.

2. Water temperature *plus* breathing rate are not both properties of fish
or
water temperature <u>*plus*</u> breathing rate are not both properties of water.

Accept reference to the 'two variables' (instead of water temperature plus breathing rate)

1 max

(c) (i) As (water) temperature increases, oxygen (concentration / solubility) falls and ventilation rate increases.

MP requires all 3 aspects before credit is possible. The correct context is required for each aspect so

e.g. do not reward

'as oxygen concentration falls, water temperature increases'

or

'as temperature increases, ventilation rate increases and oxygen concentration falls'.

1

(ii) 1. As concentration / solubility of oxygen falls
less <u>oxygen</u> flows over gills / less <u>oxygen</u> enters gills / less <u>oxygen</u> enters fish;

For MP1 and MP2 accept converse.

Both aspects needed for mark.

2. (As a result) <u>blood</u> oxygen (concentration) falls / is lower;

3. An increase in ventilation rate increases / maintains the flow of

oxygen / carbon dioxide across gills / into (or out of) fish;
Accept idea in relation to either gas or 'gas exchange'.

4. Maintains diffusion / concentration gradient(s) (in gills);
Gradient(s) relates to either / both gas(es).

5. To maintain oxygen supply to cells / tissues / organs / to maintain respiration.
Accept a named example of 'tissues' e.g. muscle.

3 max

[6]

Q4.

(a) (i) Made of (different) tissues / more than one tissue;

1

(ii) 1. (Muscle) contracts;
Assume that 'they' or 'it' = muscle

2. (Arteriole) narrows / constricts / reduces size of lumen / vessel / vasoconstriction;
Ignore: references to pressure
***Q** Correct context for muscle contracts, vessel constricts*

2

(b) (i) Short diffusion distance / pathway;
Accept: thin diffusion pathway

1

(ii) (More) time for exchange / diffusion (of substances);
Accept: example of more time for specific substance to be exchanged

1

(c) 1. Water potential (in capillary) not as low / is higher / less negative / water potential gradient is reduced;
Accept: 'blood or plasma' instead of 'capillary'

2. Less / no water removed (into capillary);
Accept converse: water remains in the tissue

3. By osmosis (into capillary);
***Q** Marking points 2. and 3. must be in the context of movement into the capillary*
Neutral: reference to more tissue fluid being formed as in the question stem
Neutral: reference to lymphatic drainage

3

[8]

Q5.

(a) Hydrolysis (reaction);
Accept phonetic spelling

1

(b) 1. Too big / wrong shape;
Wrong charge - neutral
Accept insoluble

2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);

3. Carrier / channel protein;
Accept carrier / channel protein not present

3

(c) Foreign / (act as) antigen / non-self;
Reject foreign cells

1

(d) 1. Dose to be given;
Accept: interaction with other drugs

2. No (serious) side effects;

3. How effective;

4. Cost of drug;

2 max

[7]

Q6.

(a) (i) 1. Stomata open;
Allow converse

2. Transpiration highest around mid-day as middle of day warmer / lighter;
2. Allow 'Sun is at its hottest'

3. (Increased) tension / water potential gradient;
Ignore 'pull, suck'

3

(ii) (Inside xylem) lower than atmospheric pressure / (water is under) tension;
Accept cohesion tension. Ignore vacuum

1

(b) (i) High pressure / smoothes out blood flow / artery wall contains more collagen / muscle / elastic (fibres) / connective tissue;
Accept converse for pulmonary vein
Incorrect function of artery disqualifies mark

1

(ii) 1. (Aorta wall) stretches because ventricle / heart contracts / systole / pressure increases;
1. Allow expand

2. (Aorta wall) recoils because ventricle relaxes / heart relaxes / diastole / pressure falls;
2. Allow spring back
Reject any reference to contract / relax in MP1 and 2

3. Maintain smooth flow / pressure;

3

(iii) Aorta 1.2 / largest SD;
Allow pulmonary vein provided candidate relates standard deviation to mean

1

(c) Formation

1. High blood / hydrostatic pressure / pressure filtration;

2. Forces water / fluid out;
2. Reject plasma, ignore tissue

3. Large proteins remain in capillary;

Return

4. Low water potential in capillary / blood;

5. Due to (plasma) proteins;

6. Water enters capillary / blood;

7. (By) osmosis;
7. Osmosis must be in correct context

8. Correct reference to lymph;

6 max

[15]

Q7.

(a) 1. Flatten / moves down;
1. Ignore: additional information about rib movements

2. (Diaphragm muscle) contracts;

2

(b) 1. Diaphragm contracts / moves down / flattens;
Ignore refs to rib movement

2. Increases volume (of thorax) and decrease in pressure;
2. Accept pressure lower than atmospheric pressure

3. Air moves from high to lower pressure / down pressure gradient;
3. Reject: by diffusion

3

(c) 1. Diffusion;

Accept down diffusion gradient

2. Across (alveoli) epithelium / (capillary) endothelium;
2. Accept: capillary epithelium / squamous cell

2 max

[7]

Q8.

(a) 1. (Risk) decreases, then increases;

2. (Risk) increases from 2 (drinks per day);
Accept increases risk above 3

2

(b) Age affects heart disease / age affects how alcohol affects the body;
Accept age affects results
Accept 'removes confounding variable'
Accept 'controlling a variable'

1

(c) *To gain 3 marks candidates must have mp1 and 2 from mps 2-5*

1. (True because) studies show decreased risk up to 3 drinks per day;
Accept any <u>evidence</u> from graph

1

2. (False because) eg all show an increased risk above 5 drinks / day, eg **A** and **B**, show increased risk (of heart disease) above 4 per day;
Accept any <u>evidence</u> from graph

3. Data only about heart disease / alcohol causes other diseases / social problems;

4. Amount of alcohol per drink may vary;

5. May be due to other factor

2 max

[6]

Q9.

(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 <u>thickening</u> 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]

Q10.

(a) Aorta;

1

(b) 1. Left ventricle pumps to whole body (except lungs) / pumps blood further;

Accept converse for right ventricle

Reject 'push'

2. Left ventricle does most work / produces a greater pressure / produces a greater force;

2

(c) 1. (Valve **A**) atrioventricular valve;

Accept bicuspid / mitral

2. Semi-lunar valve;

Accept aortic valve

Ignore references to left and right

2

(d) **X** because (no mark)

Accept other valid calculations - probabilities

1. 52.1% survived without replacement compared to 12.1% / difference of 40%;

If correct figures written in table, award marks

2. 10.9% required repair or replacement of artificial heart compared to 41.4% / difference of 30.5%;

<u>Max 2</u> if incorrect rounding of values

3. 37% died compared to 46.6% / difference of 9.6%;

OR

(X / Y = 119 divided by 58 = 2.05)

14.4; 49.2; 55.4;

Note that this ratio could be reversed i.e. 58 divided by 119 multiplied by numbers in top row

Accept rounded to 14; 49; and 55;

3

[8]

Q11.

(a) 1. The more recent the sample the greater the concentration;

Accept converse

This could be expressed by reference to time e.g. 'concentration has increased since 25 000 years ago

2. Increases most in last 5000 years / more or less constant / slight increase between 30 000 and 15 000 years ago;

2

(b) 1. Variation in data / spread of data;

Reject references to range e.g. 'range of data'

2. Around the mean;

Both marks are possible in the context of using the data

2

(c) 1. Yes as pine leaves not in organic matter of the same age;

2. No as organic matter would be the same age as the pine leaves;

Accept either approach

1 max

(d) Can get more CO_2 for photosynthesis;

More CO_2 enters leaf is insufficient.

Accept light-independent (reaction) as equivalent

1

(e) Any **three** from:

1. (Overall data show) negative correlation;

Do not allow description of correlation because in question stem

2. Little change in number of stomata in last 10 000 years;

3. Small sample size;

4. Only one species studied;

5. Other factors / named factor may have affected number of stomata;

6. Evidence does not support the conclusion between 30 000 and 25 000 years ago / between 5000 years ago and present day;

Accept reference to either one of these age ranges

7. Appropriate reference to standard deviations (in comparing means);
E.g. no overlap between 15 000 and 10 000 years ago

3 max

(f) Any **three** from :

1. Thick cuticle;
2. Small leaves / low surface area;
Accept other ways of describing 'small', e.g. 'needle-like'
3. Hairy leaves;
4. Sunken stomata;
5. Rolled leaves;

3 max

[12]

Q12.

(a) Any **three** from:

1. Light;
2. Carbon dioxide;
3. Type of soil;
4. Minerals / nutrients;
Accept named example
5. Water (in soil);
6. Humidity (of air);
7. pH (of soil)
8. Planting density;
Idea of equally spaced

3 max

(b) Already levelled out (before 20 °C);

1

(c) Young leaves (may) have different number of stomata (per mm^2) / number of stomata (per mm^2) changes during development (of leaf);
Accept reference to density of stomata

1

(d) Any **two** from:
Points 1 and 2 need context of 'more'

1. Molecules have more kinetic energy;
Accept KE
2. Faster diffusion of water / more evaporation of water (as temperature

increases in leaf);

For this point, diffusion must relate to movement of water

3. For this point, diffusion must relate to movement of water

2 max

[7]

Q13.

(a)

Statement	Haemo-globin	Cellulose	Starch
Has a quaternary structure	✓		
Formed by condensation reactions	✓	✓	✓
Contains nitrogen	✓		

One mark for each correct row

3

(b) 16;

1

(c) 1. Higher affinity / loads more oxygen at low / same / high partial pressure / pO_2;

2. (Therefore) oxygen moves from mother / to fetus;

2

(d) 1. Low affinity / oxygen dissociates;

Assume 'it' is adult haemoglobin

1. Accept: converse if 'fetal haemoglobin' is clearly stated

2. (Oxygen) to respiring tissues / muscles / cells;

*2. **Q**: Neutral 'respirate'*

2

(e) Enough adult Hb produced / enough oxygen released / idea that curves / affinities / Hb are similar / more red blood cells produced;

Neutral: 'adult Hb is also produced' as in the question stem

Reject: curves / affinities / Hb are the same

1

[9]

Q14.

(a) 1. Other gases / nitrogen / water vapour in atmosphere / **A**;
2. Only oxygen and carbon dioxide in gas mixtures / **C** and **D**;
3. Composition of / gases in **A** not controlled / composition of gas mixtures / **C** and **D** controlled.

2 max

(b) 1. Breathing rate *lowest* when no carbon dioxide / in (pure) oxygen / B;

Idea of 'lowest' must be stated.

2. (Generally) presence of carbon dioxide increases breathing rate / as concentration of carbon dioxide increases breathing rate increases / there is a positive correlation;

A general point incorporating all concentrations.

3. Breathing rate increases when (carbon dioxide) higher than 0.1% / concentration in atmosphere / A;

This MP requires a specific comparison to 0.1% or the atmospheric concentration.

Accept 'gas mixtures 1 and 2 / C and D' for 'higher carbon dioxide'.

4. Breathing rate of **grasshopper 3** falls in D / 16% / gas mixture 2 (whereas others increase).

Restating data alone is insufficient for any mark point.

3 max

(c) (i) 54;

OR

1. Correct data / column **A** chosen;

A correct answer of 54 gets 2 marks.

MP1 and MP2 allow a possible mark for an incorrect calculation or choice of wrong data.

2. Correct calculation of mean from data chosen;

Check − the three values must be from same column.

2 max

(ii) 1. Small sample / only 3 (grasshoppers)
so may not be representative (of all grasshoppers / insects);
2. Grasshoppers are not the only insects / species;
so genetic / behavioural / metabolic differences;
3. (Insects) not all mature / are at different stages of development / different sizes;
so different metabolic rates;
4. Movement not restricted / not at rest in meadow;
so (rate of) respiration higher;
5. (Naturally-occurring) carbon dioxide concentration lower in meadow;
so breathing rate lower;

Explanations required, therefore both parts of answer required for credit in each marking point.

Accept appropriate converse answers.

Accept 'respiration' for 'metabolism' and vice versa.

3 max

[10]

Q15.

(a) 1. Water and blood flow in opposite directions;

Accept: diagram if clearly annotated

2. Maintains concentration / diffusion gradient / equilibrium not reached / water always next to blood with a lower concentration of oxygen;

Must have the idea of 'maintaining' or 'always' in reference to concentration / diffusion gradient

Accept: constant concentration / diffusion gradient

3. Along whole / length of gill / lamellae;

Accept: gill plate / gill filament

3

(b) 1. (Thicker lamellae so) greater / longer <u>diffusion</u> distance / pathway;

***Q** Neutral: 'thicker' diffusion pathway*

2. (Lamellae fuse so) reduced surface area;

Accept: reduced SA:VOL

2

(c) (i) Correct answer of **5.1** or **5.14(2857)** (dm^3) = 2 marks;;

*Allow 1 mark max for an answer of **5** if the correct answer of **5.1** or **5.14(2857)** is **not** shown*

One mark for incorrect answers that show **36** or **0.4 × 90** or **90 ÷ 7;**

2

(ii) 1. Increased metabolism / respiration / enzyme activity;

Accept: enzymes work more efficiently

2. Less oxygen (dissolved in water);

Neutral: references to increased kinetic energy (of water molecules)

1 max

[8]

Q16.

(Maintaining constant pH to avoid)

1. Named protein / enzyme (in blood) sensitive to / affected by change in pH;

Accept converse for MP2 and MP3.

Named example should be a protein that might be affected (by change in pH) eg haemoglobin, carrier protein in plasma membrane.

Accept 'change in H^+ concentration' for 'change in pH'.

2. (Resultant) change of charge / shape / tertiary structure;

The change in charge idea relates to the enzyme / protein

and not the blood (plasma) or red blood cells.

'Denaturation' alone is insufficient.

3. Described effect on named protein or enzyme.
e.g. less oxygen binds with haemoglobin / less transport across membranes / fewer substrates can fit active site / fewer enzyme-substrate complexes.

Idea of 'less' or 'fewer' required. Ignore suggestion of 'no' or 'none'.

[3]

Q17.

(a) (Scientists) used fully grown leaves / used five plants of each (species).

Ignore other references to methodology. Reward only information provided in the Resource.

Do not accept reference to number of <u>leaves</u> − different plants were used.

1

(b) Either

1. Draw around leaf on graph paper;

Mark as a trio − MP1, MP2 and MP3 OR MP4, MP5 and MP6. Do not mix and match.

Both aspects needed for mark − drawing <u>and</u> type of paper.

2. Count squares (however described);

There is no reward for additional detail e.g. dealing with part squares.

3. Multiply by 2 (for upper and lower leaf surface);

OR

4. Draw around a leaf on paper of known mass (per unit area);

Both aspects needed for mark − drawing <u>and</u> mass of paper.

5. Cut out *and* weigh;
6. Multiply by 2 (for upper and lower leaf surface).

3

(c) (i) Species **B** (no mark)

1. Smaller surface area
so
less evaporation / less heat absorbed;

Correctly selected feature <u>and</u> the explanation required for 1 mark.

In all marking points − 'less water loss' is insufficient as an explanation but accept transpiration for evaporation or diffusion.

2. Thicker leaves
so
greater diffusion distance (for water);

Accept 'thicker leaves <u>so</u> more water storage'.

3. Fewer stomata / lower stomatal density
so

less diffusion / evaporation (of water);

4. Smaller surface area to volume ratio
so
less evaporation.

1 max

(ii) 1. Thick(er) cuticle
so
increase in <u>diffusion</u>
distance / slower (rate of) <u>diffusion</u>;
Feature <u>and</u> explanation needed for each mark.
Reject other features not related to leaves.
Reject features related to water storage.
'Cuticle' alone is insufficient (all leaves have a cuticle). Reject suggestion of 'less' diffusion, for idea of 'slower diffusion', an idea of rate is required.

2. Hairs on leaves
so
reduction in air movements / increase in humidity / decrease in water potential gradient;

3. Curled leaves
so
reduction in air movements / increase in humidity / decrease in water potential gradient;

4. Sunken stomata
so
reduction in air movements / increase in humidity / decrease in water potential gradient.

2 max

(d) Small leaves / surface area *so* (total) number of stomata is low.
Both aspects needed for mark.

1

[8]

Q18.

(a) 1. Many / more capillaries (than arterioles);
2. (Cross-sectional) area of capillaries (much) greater (than of arterioles).
*Note: maximum of **1** mark for this question*

1 max

(b) 1. Short pathway / short distance between blood and outside of capillary;
Reference to blood and cells required

2. Large surface area (of blood) in contact with walls of capillaries;
Idea is per unit volume of blood but candidates need not say this

3. Fast exchange / fast diffusion / fast osmosis.

Must relate to increased speed

2 max

(c) Width / size / diameter of blood cell.

Accept named blood cell

Reject platelet

Accept idea that below a certain diameter friction becomes too great for blood to flow

1

(d) (Fluid) in tissue fluid / (fluid) in lymph.

1

[5]