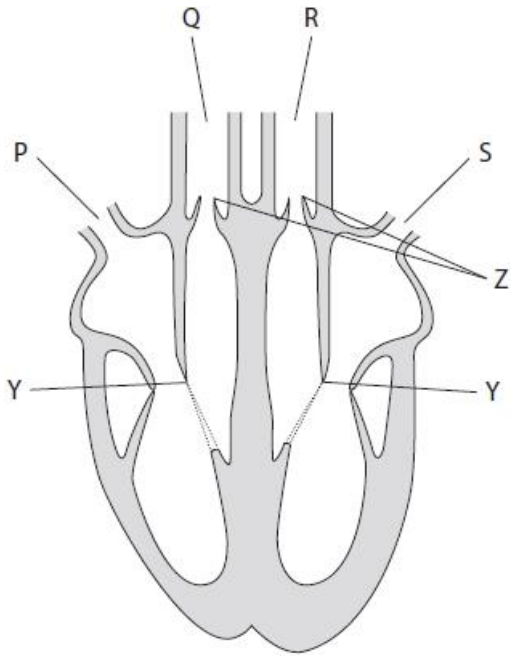
Questions

Q1.

The diagram shows a human heart and blood vessels.



(i) Give **one** reason why the heart is divided into left and right sides.

(1)

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(ii) State why there is a difference in the thickness of the muscle of the atria and the muscle of the ventricles.

(1)

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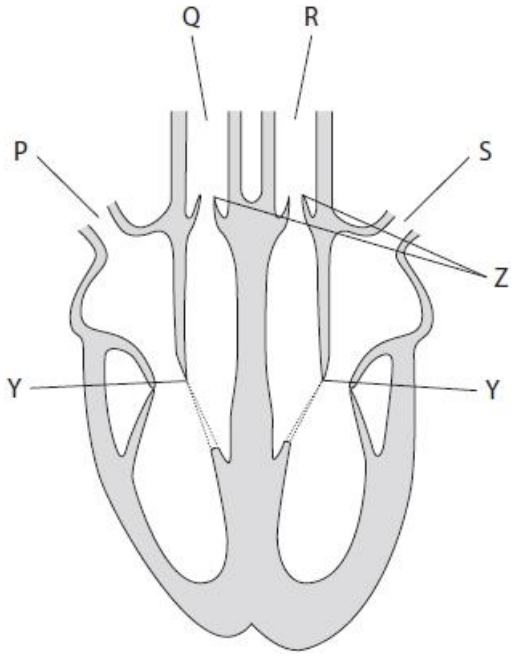
(Total for question = 2 marks)

Q2.

The diagram shows a human heart and blood vessels.



(i) Which blood vessel carries deoxygenated blood towards the heart?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** S

(ii) Which describes the state of the valves at Y and Z when the ventricles are in systole?

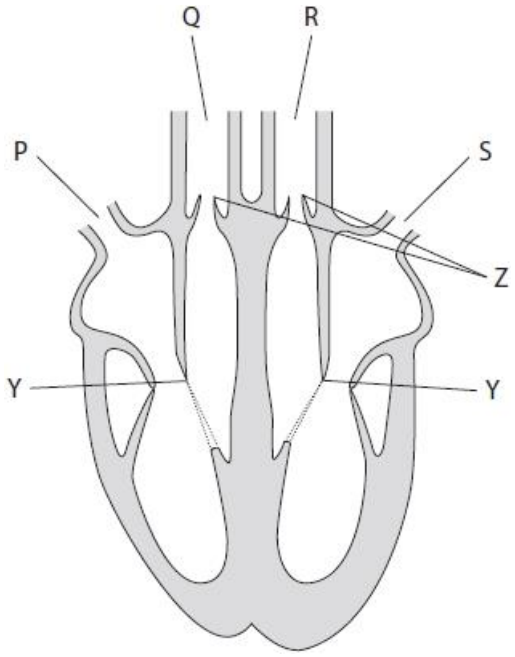
(1)

- ☒ **A** Y closed and Z closed
- ☒ **B** Y closed and Z open
- ☒ **C** Y open and Z closed
- ☒ **D** Y open and Z open

(Total for question = 2 marks)

Q3.

The diagram shows a human heart and blood vessels.



Describe how the structure of blood vessel R differs from the structure of blood vessel S.

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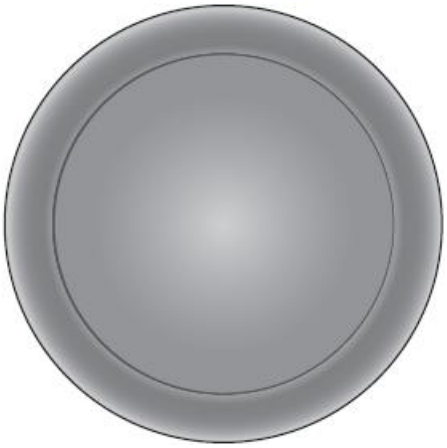
(Total for question = 3 marks)

Q4.

The diagram shows a magnified human red blood cell.



The actual diameter of this cell is 7.20 µm.

Calculate the magnification of this diagram.

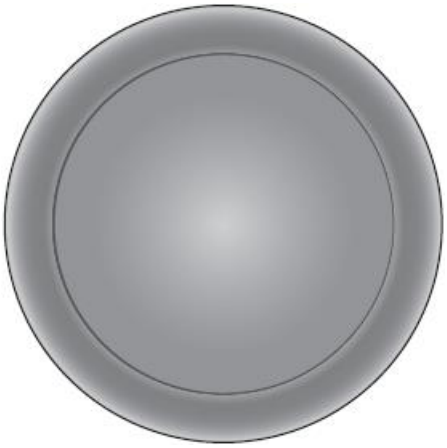
(2)

Answer .....

(Total for question = 2 marks)

Q5.

The diagram shows a magnified human red blood cell.



A regular sphere with a diameter of 7.20 μm has a surface area of 162.86 μm^2.

(i) Calculate the volume of a sphere with a diameter of 7.20 μm.

Use the formula $V = \frac{4}{3}\pi r^3$

Answer ..... μm^3

(2)

(ii) Explain how a red blood cell with the same diameter as this sphere enables it to carry out its functions in transporting gases in the blood.

(3)

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(Total for question = 5 marks)

Q6.

Hypoxia is an inadequate supply of oxygen to tissues and cells that restricts their function.

The normal partial pressures of oxygen vary from tissue to tissue.

The table shows the normal partial pressure of oxygen in two tissues.

Tissue	Partial pressure of oxygen / kPa
Pulmonary arterial blood	5.3
Other arterial blood	13.3

(i) Calculate the ratio of the partial pressures of oxygen in these two tissues.
Give your answer to one decimal place.

(1)

Answer .....

(ii) Explain why the partial pressures of oxygen in these two tissues are different.

(2)

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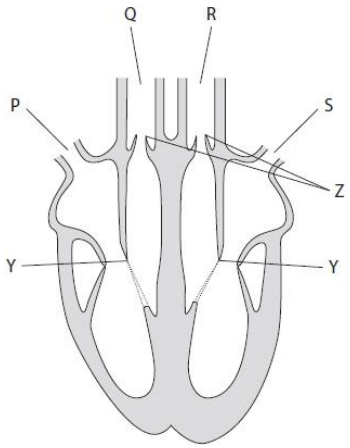
(Total for question = 3 marks)

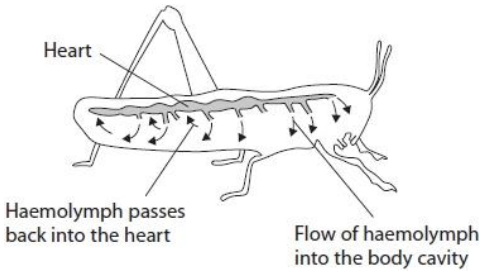
Q7.
The diagram shows a human heart and blood vessels.



The heart of an insect is a long tube with valves. It pumps fluid, called haemolymph, into the body cavity so that fluid bathes the body cells.

The haemolymph then passes back into the heart from the body cavity.

The diagram illustrates the circulatory system of an insect.



(i) Compare and contrast the structure of the circulatory system of an insect with the structure of the circulatory system of a mammal.

(4)

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(ii) Give **two** substances that are carried in the haemolymph for the growth of an insect.

(2)

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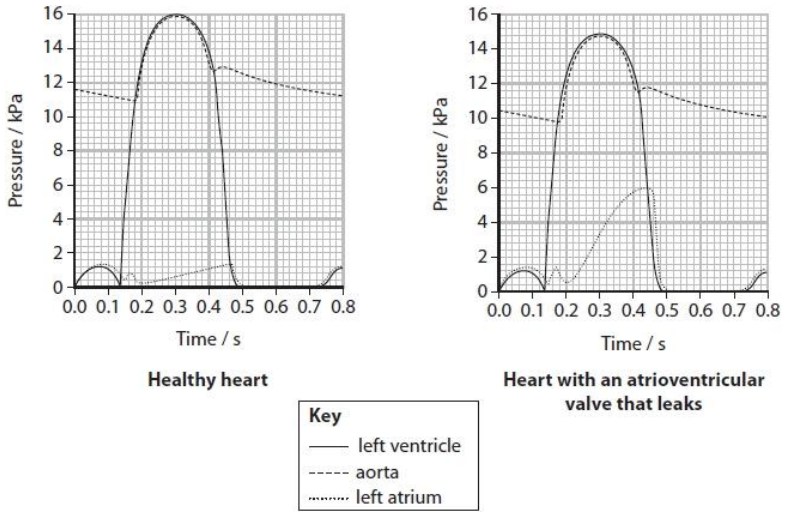
2 .....

(Total for question = 6 marks)

Q8.

The graphs show the pressure changes that occur in a healthy heart and the pressure changes that occur in a heart with an atrioventricular valve that leaks.



(i) An atrioventricular valve in the healthy heart has a surface area of 3.5 cm^2.

Determine the force that is applied to this atrioventricular valve when it closes.

Use the formula

$$\text{Pressure in kPa} = \frac{\text{Force in newtons}}{\text{Area in } m^2}$$

(3)

Answer ..... newtons

(ii) Explain why people with an atrioventricular valve that leaks find exercise difficult.

(4)

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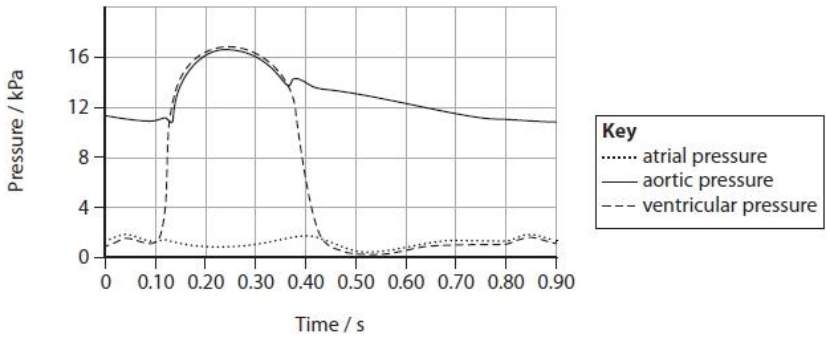
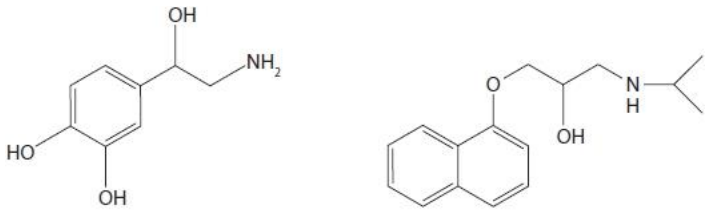
(Total for question = 7 marks)

Q9.

The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



The diagram shows two chemicals that affect the human heart rate.

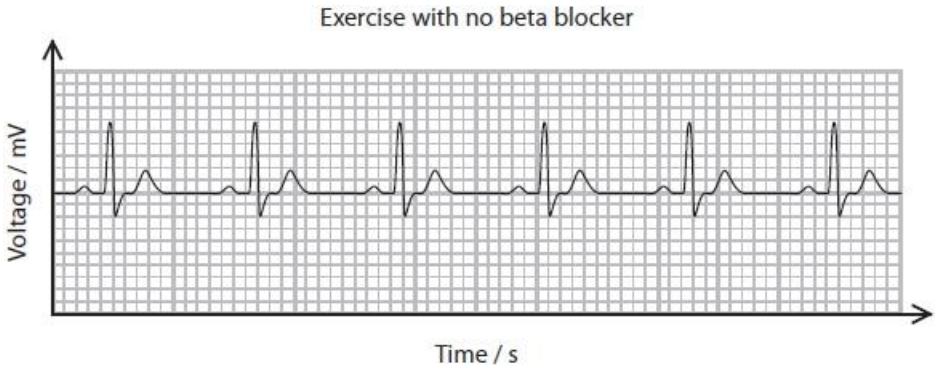


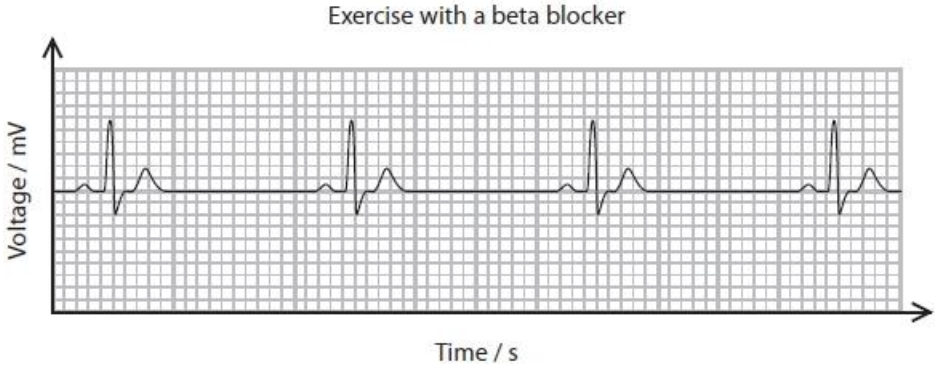
Noradrenaline Beta blocker

Beta blockers are drugs used to regulate the heart rate of some patients.

The effect of beta blockers on the heart rate during exercise was investigated.

The ECG traces show the heart rate of a person exercising before and after taking a beta blocker.





Analyse the information to explain the results of this investigation.

(3)

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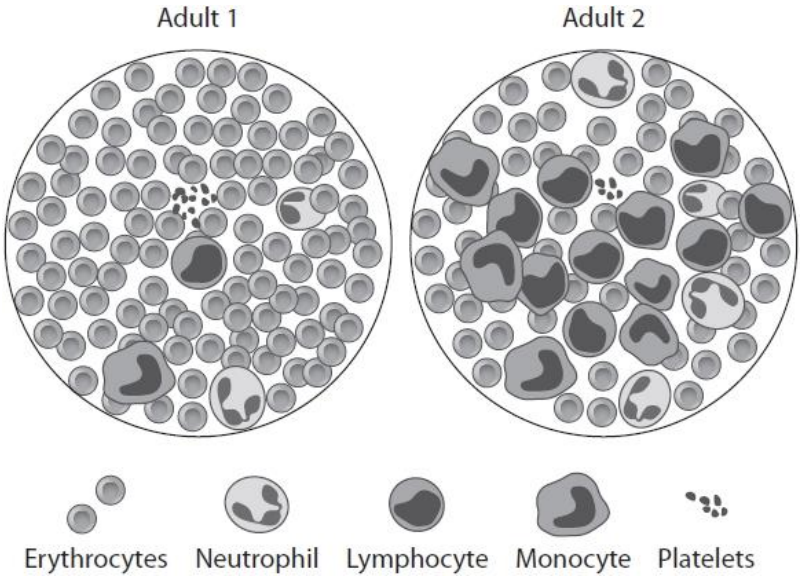
(Total for question = 3 marks)

Q10.

The diagrams show blood samples from two adult patients as seen using a microscope.



(i) The diameter of the monocyte in Adult 1 is 20 µm.
Calculate the magnification of the blood sample.

(2)

Answer .....

(ii) Compare and contrast the blood sample from Adult 1 with the blood sample from Adult 2.

(3)

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(iii) Explain the likely causes of the differences seen in the sample from Adult 2.

(2)

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(iv) Give one assumption that is made to enable a valid comparison between these two samples.

(1)

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(Total for question = 8 marks)

Q11.

Blood contains a variety of cells, plasma and clotting factors.

Smoking can increase the risk of blood clot formation.

An investigation was carried out to determine the effects of smoking on the contents of blood plasma.

In the first part of the investigation, blood samples were taken from male smokers and non-smokers aged between 35 and 50. All males were matched for health status, body mass and diet.

The concentration of fibrinogen in their blood plasma was measured.

The results are shown in the table.

Number of cigarettes per day	Sample size	Mean blood plasma concentration of fibrinogen / mg 100 cm^{-3}	Standard deviation
0	30	241.8	± 3.0
1 to 10	10	329.0	± 7.4
11 to 20	22	361.0	± 4.7
> 20	8	376.9	± 6.6

In the second part of the investigation, blood samples were taken from men aged between 35 and 50 just after waking.

Another blood sample was taken just after the men had smoked their first cigarette.

The concentration of thrombin present in both blood samples was measured.

The concentration of thrombin present in the blood of the non-smokers was also measured.

The results are shown in the table.

Group	Sample size	Mean thrombin concentration / arbitrary units	Standard deviation
Non-smokers after waking	9	56	± 1
Smokers after waking	10	121	± 47
Smokers after first cigarette	10	365	± 76

Analyse the data to explain why smoking can increase the risk of blood clot formation.

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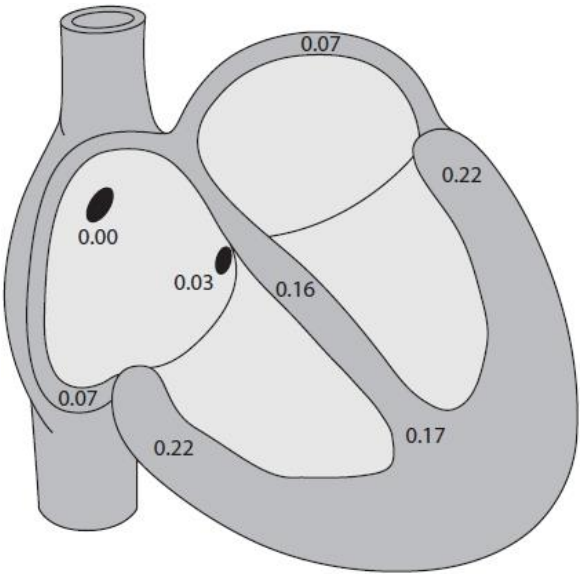
(Total for question = 4 marks)

Q12.

The diagram shows the time taken in seconds for an impulse to travel through the human heart.



Analyse the information to explain how the times shown in the diagram relate to the cardiac cycle.

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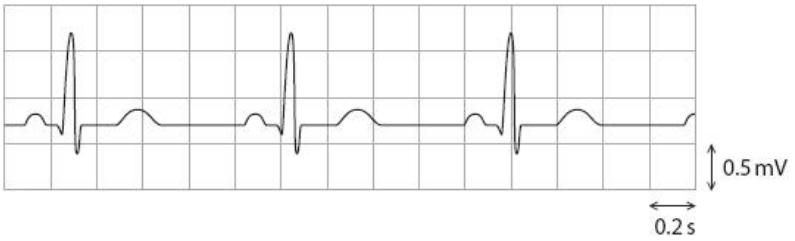
(Total for question = 5 marks)

Q13.

A person visited his doctor for a health check.

The doctor obtained an ECG trace to show the electrical activity of the person's heart.

The diagram shows part of this trace.



(a) The trace shows the P waves, T waves and QRS complexes.

Which of the following shows the electrical activity during ventricular systole?

(1)

☒ **A** P wave only

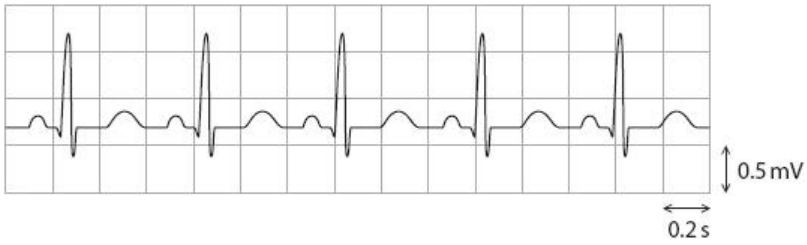
☒ **B** P and T wave

☒ **C** T wave only

☒ **D** QRS complex

(b) Twelve months later, the same person visited his doctor with symptoms of stress.

The doctor obtained another ECG trace.
The diagram shows part of this trace.



The doctor diagnosed that the person was suffering from stress.
Analyse the data in both ECG traces to comment on this diagnosis.

(3)

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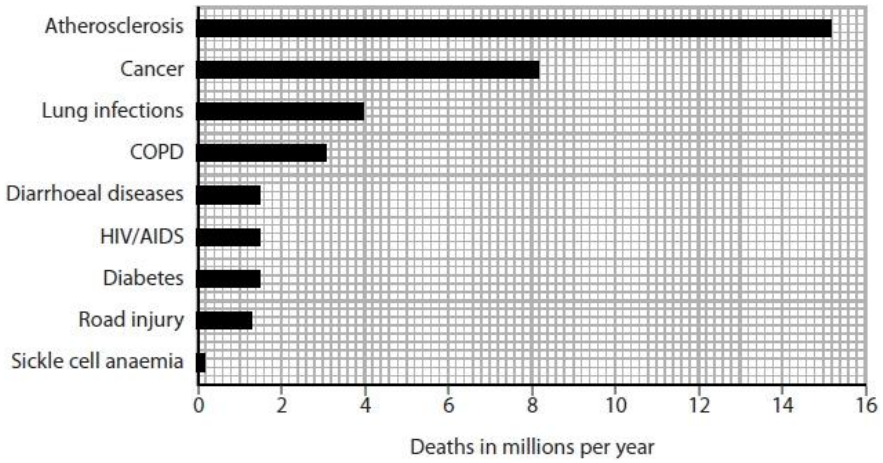
(Total for question = 4 marks)

Q14.

There are many disorders that affect the health of people.

The graph shows the number of people in the world who die each year from different health disorders.



The graph shows that atherosclerosis kills more people than any of the other disorders.

This is mainly due to its development in the coronary arteries.

(i) State the number of deaths caused by atherosclerosis.

Give your answer in standard form.

(1)

Answer .....

(ii) Describe how atherosclerosis develops in the coronary arteries.

(3)

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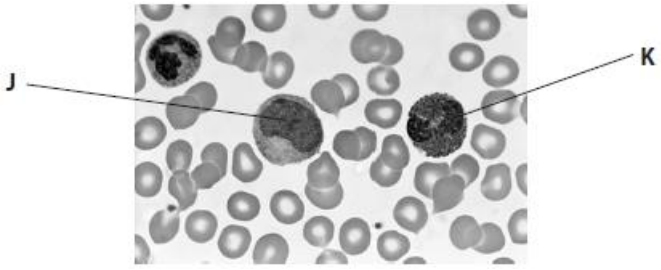
(Total for question = 4 marks)

Q15.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The photograph shows a blood smear from a healthy person, as seen using a light microscope.



(i) Which row of the table identifies the cells labelled **J** and **K**?

(1)

	Cell J	Cell K
☒ **A**	eosinophil	lymphocyte
☒ **B**	lymphocyte	neutrophil
☒ **C**	monocyte	eosinophil
☒ **D**	neutrophil	monocyte

(ii) Which is the approximate ratio of erythrocytes to leucocytes in this blood smear?

(1)

☒ **A** 1 : 50
☒ **B** 3 : 50
☒ **C** 50 : 1
☒ **D** 50 : 3

(Total for question = 2 marks)

Q16.

Blood is able to clot and prevent further blood loss from a cut.

Give **one** other function of blood clotting.

(1)

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(Total for question = 1 mark)

Q17.

Which row of the table gives the correct role of each of the blood components?

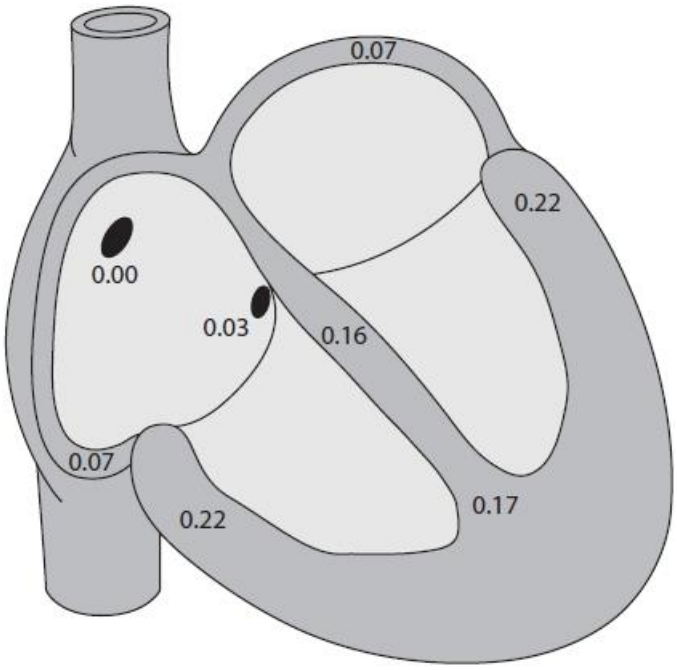
(1)

	Erythrocytes	Leucocytes	Platelets
☒ **A**	defence	transport	defence
☒ **B**	defence	defence	transport
☒ **C**	transport	defence	defence
☒ **D**	transport	transport	defence

(Total for question = 1 mark)

Q18.

The diagram shows the time taken in seconds for an impulse to travel through the human heart.



The mean heart rate of this heart was 72 beats per minute.

Calculate how long the ventricles are relaxed during one cardiac cycle.

(2)

Answer ..... s

(Total for question = 2 marks)

Q19.

Stroke volume is the volume of blood that leaves the left ventricle of the heart in each beat.

Cardiac output is the volume of blood that leaves the left ventricle each minute.

The table shows the relationship between heart rate, stroke volume and cardiac output in a person.

Heart rate / beats min^{-1}	Stroke volume / cm^3	Cardiac output / dm^3 min^{-1}
60	110	6.6
100	120	12.0
120	120	14.4
160	120	
175	120	21.0

Calculate the cardiac output for the heart with a stroke volume of 120 cm^3 and a heart rate of 160 beats min^{-1}.

(1)

Answer ..... dm^3 min^{-1}

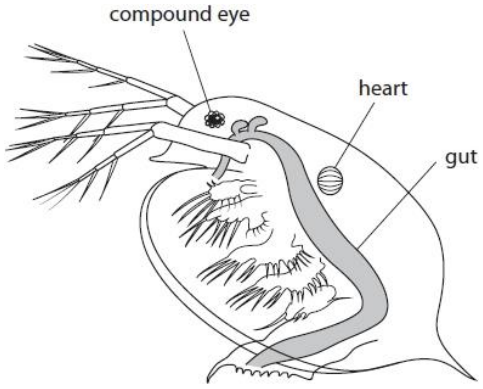
(Total for question = 1 mark)

Q20.

Water fleas are small animals that live in pond water.

A student observed a water flea using a light microscope.

The diagram shows the student's drawing of the water flea.



The water flea has a spherical heart with a diameter of 0.2 mm.

Cardiac output is the volume of blood pumped out of a heart in one minute.

The resting heart rate of a water flea is 200 beats min^{-1}.

The volume of a sphere is calculated using the formula

$$\frac{4}{3}\pi r^3$$

where $\pi = 3.142$

(i) Calculate the cardiac output of a water flea at rest using the formula

cardiac output = stroke volume × heart rate

(3)

Answer ..... $dm^3\ min^{-1}$

(ii) The cardiac output of a human heart at rest is 5.0 $dm^3\ min^{-1}$.

Give one reason why the cardiac output of a human heart at rest needs to be greater than the cardiac output of a water flea at rest.

(1)

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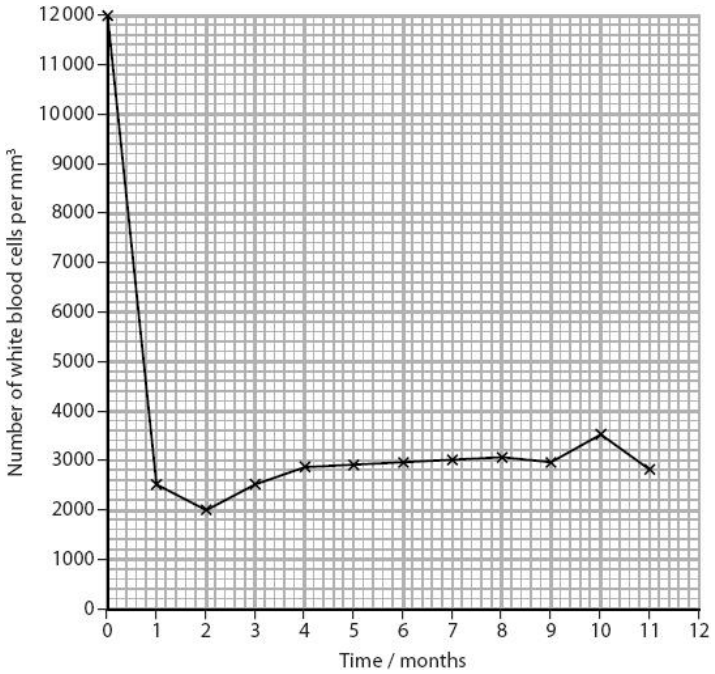
(Total for question = 4 marks)

Q21.

Cancer treatment using chemotherapy can affect the number of white blood cells in the body.

The graph shows the number of white blood cells in a patient during chemotherapy.



(i) Which of the following shows the white blood cell count in the blood of this patient at the start of treatment?

(1)

☒ **A** 12×10^3 per dm^3

☒ **B** 12×10^6 per dm^3

☒ **C** 12×10^9 per dm^3

☒ **D** 12×10^{12} per dm^3

(ii) Calculate the percentage change in the white blood cell count by the end of the first month of chemotherapy.

(2)

Answer .....

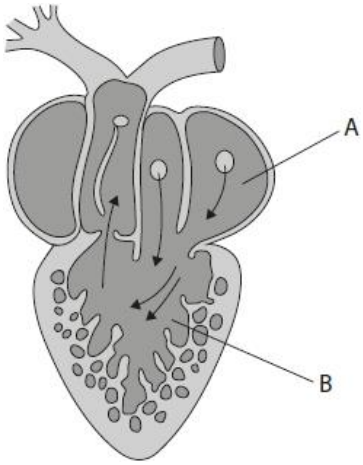
(Total for question = 3 marks)

Q22.

The structure of a frog heart is different from those of mammals and fish.

The diagram shows the structure of a frog heart.

The arrows show the direction of blood flow.



(i) Name the parts of the heart labelled A and B.

(2)

A .....

B .....

(ii) Compare and contrast the structure of the frog heart with the structure of the mammalian heart.

(3)

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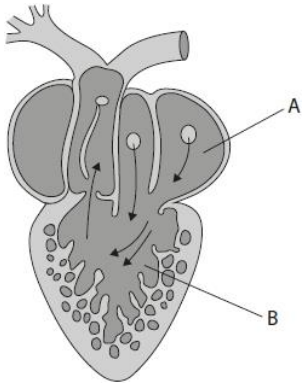
(Total for question = 5 marks)

Q23.

The structure of a frog heart is different from those of mammals and fish.

The diagram shows the structure of a frog heart.

The arrows show the direction of blood flow.



Amphibians, such as the frog:

- absorb oxygen through their lungs and through their moist skin
- have a lower metabolic rate than mammals
- have a double circulation system.

(i) State one difference between the double circulation system of the frog and that of the mammal.

(1)

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(ii) Explain how the circulatory system of the frog is adapted for the metabolism and gas exchange of the frog.

(4)

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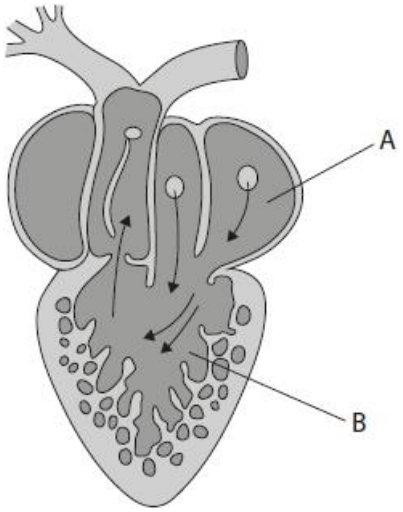
(Total for question = 5 marks)

Q24.

The structure of a frog heart is different from those of mammals and fish.

The diagram shows the structure of a frog heart.

The arrows show the direction of blood flow.



Describe the sequence of stimulation that occurs in a mammalian heart in one cardiac cycle.

(4)

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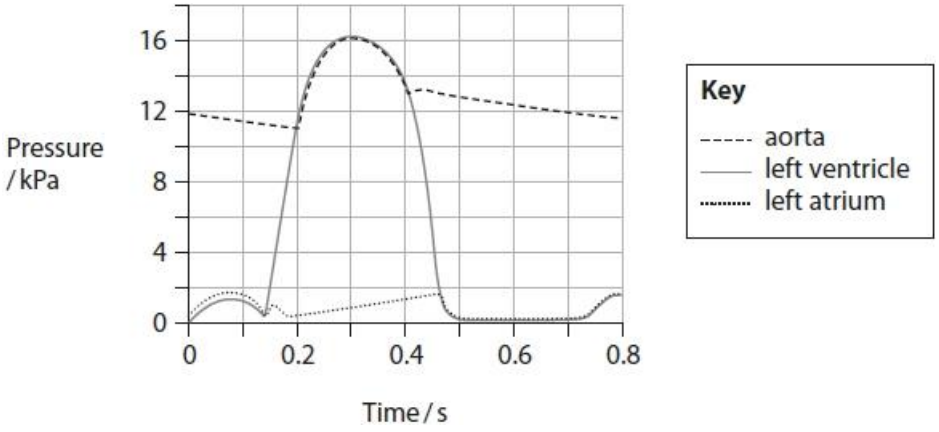
(Total for question = 4 marks)

Q25.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The graph shows the pressure changes in the left side of the heart during one contraction.



(i) At what time does the atrioventricular (bicuspid) valve close?

(1)

- ☒ **A** 0.14 s
- ☒ **B** 0.20 s
- ☒ **C** 0.45 s
- ☒ **D** 0.40 s

(ii) Which is the sequence of structures that an impulse passes through during one heart contraction?

(1)

- ☒ **A** atrioventricular node, bundle of His, sinoatrial node
- ☒ **B** atrioventricular node, sinoatrial node, bundle of His
- ☒ **C** sinoatrial node, bundle of His, atrioventricular node
- ☒ **D** sinoatrial node, atrioventricular node, bundle of His

(Total for question = 2 marks)

Q26.

Kidney dialysis machines are used to remove urea from the blood of patients who are suffering from kidney disease.

Anti-clotting drugs are given to patients to reduce the risk of blood clot formation whilst undergoing kidney dialysis.

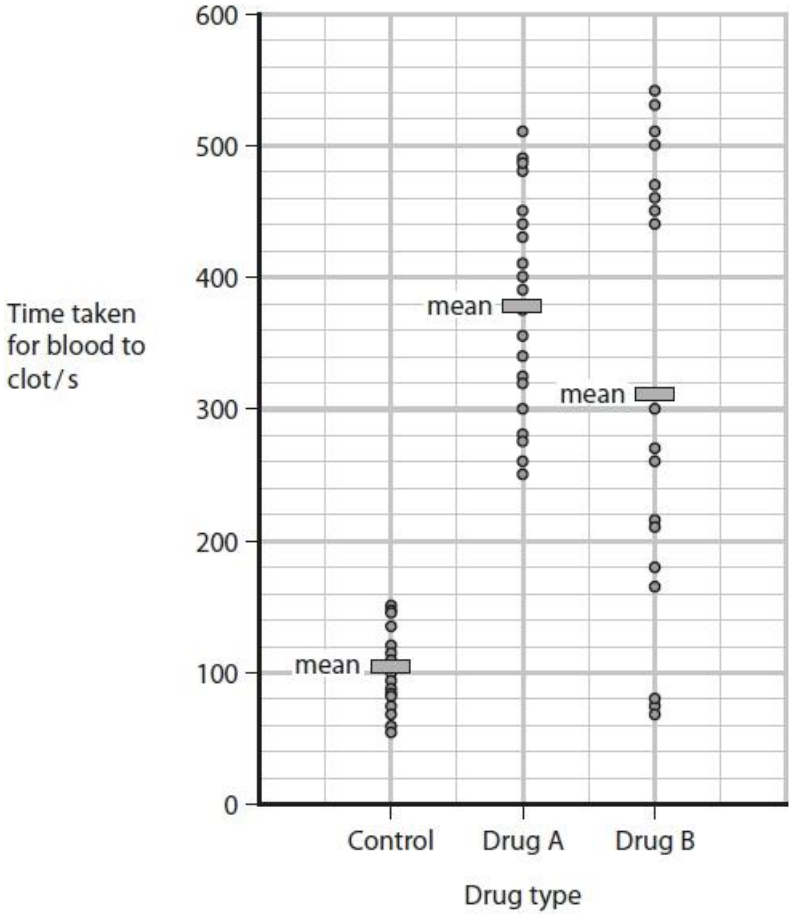
The potential use of two anti-clotting drugs, Drug A and Drug B, was investigated.

Blood samples were taken from 20 healthy adults and placed into test tubes.

The times taken for the blood samples to clot after addition of 2 mg dm^{-3} of Drug A were recorded.

This was repeated with Drug B and again with a control.

The results are shown in the graph.



It takes 40 minutes for Drug A to become inactive in a person and 110 minutes for Drug B to become inactive.

Analyse the data to discuss the use of Drug A and Drug B to prevent the formation of blood clots.

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(Total for question = 5 marks)

Q27.

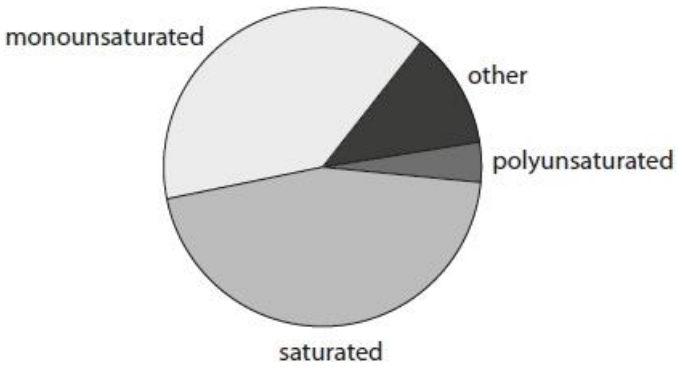
The structure of a lipid relates to its role in living organisms.

The type of lipid in the diet of a person can affect their risk of developing atherosclerosis.

The table shows the percentage content of different lipids in some products used to cook food.

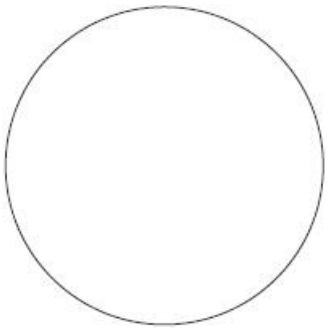
Product	Source of product	Saturated lipids	Monounsaturated lipids	Polyunsaturated lipids		Other lipids
				Omega-6	Omega-3	
Beef fat	animal	45	39	3	1	12
Butter	animal	52	24	2	1	21
Rapeseed oil	plant	7	59	20	9	5
Safflower oil	plant	10	15	75	0	0

(i) The pie chart shows the approximate ratio of the lipids in beef fat.



Complete the pie chart to show the approximate ratio of the lipids in safflower oil.

(1)



(ii) Calculate the difference in mass of polyunsaturated lipid in 500 g of safflower oil and 500 g of beef fat.

(2)

Answer ..... g

(iii) Explain why cooking food using plant products rather than animal products could lower the risk of developing atherosclerosis.

(2)

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(Total for question = 5 marks)

Q28.

The venom from some species of snake contains enzymes that affect the blood clotting process.

Factor Xa is a clotting factor present in human blood.

The table shows the effect of different masses of Factor Xa and snake venom on the time taken for blood to clot.

Mass added / μg	Time taken for blood to clot / s	
	Factor Xa added	Snake venom added
0.002	150	104
0.004	44	50
0.020	40	38
0.040	39	37

Describe the effect of snake venom on the time taken for the blood to clot.

(2)

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(Total for question = 2 marks)

Q29.

The mammalian circulatory system transports materials to and from cells.

State how the double circulatory system of mammals ensures a higher hydrostatic blood pressure than a single circulatory system.

(1)

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(Total for question = 1 mark)

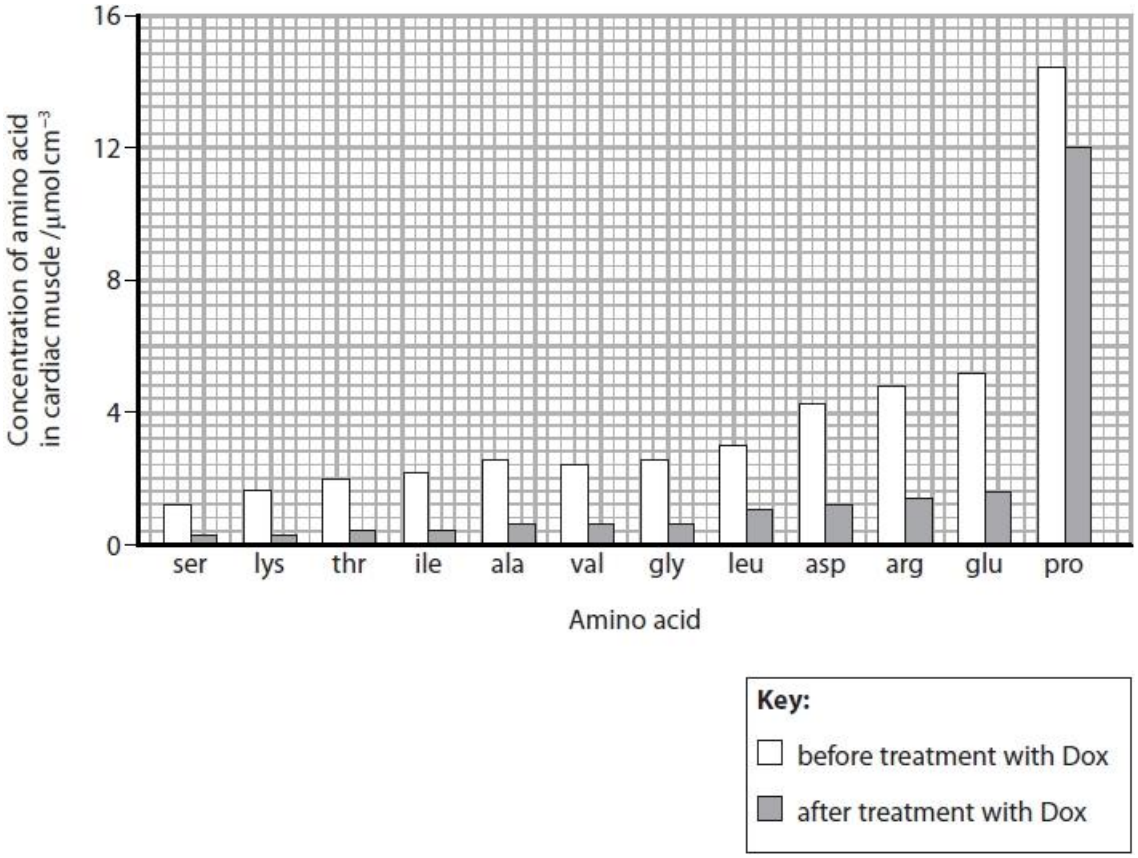
Q30.

Doxorubicin (Dox) is a drug used to treat cancer.

Weakening of the cardiac muscle is one side effect of using Dox.

The effect of Dox on the concentration of several amino acids in cardiac muscle was investigated.

The graph shows the results of this investigation.



The table shows some non-polar and polar amino acids.

Type	Amino acids
non-polar	ala, gly, ile, leu, pro, val
polar	arg, asp, glu, lys, ser, thr

* (i) Analyse the information to determine the effect of Dox on the concentration of these types of amino acid in cardiac muscle.

(6)

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(ii) Explain why a change in the concentration of amino acids results in the weakening of cardiac muscle.

(2)

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(iii) Explain how weakening of the cardiac muscle could affect a person.

(3)

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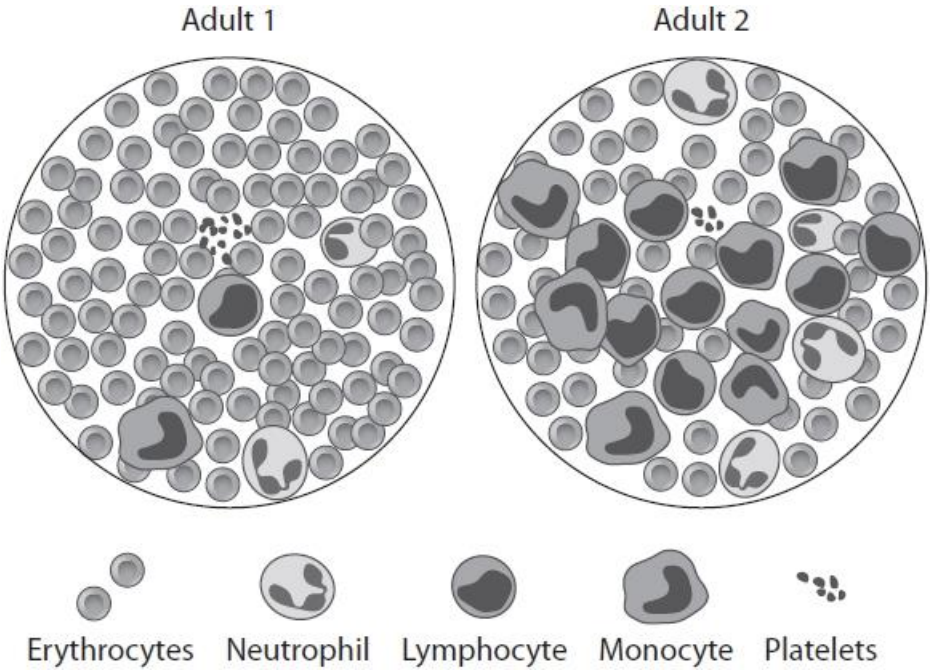
(Total for question = 11 marks)

Q31.

The diagrams show blood samples from two adult patients as seen using a microscope.



Explain why Adult 2 had symptoms of tiredness.

(3)

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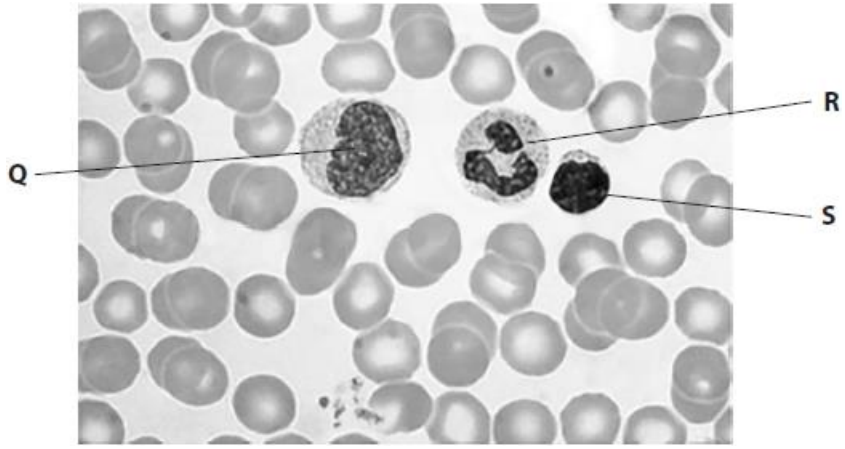
(Total for question = 3 marks)

Q32.

The diagram below shows some of the cells found in blood.



Describe the function of a neutrophil in defence.

(2)

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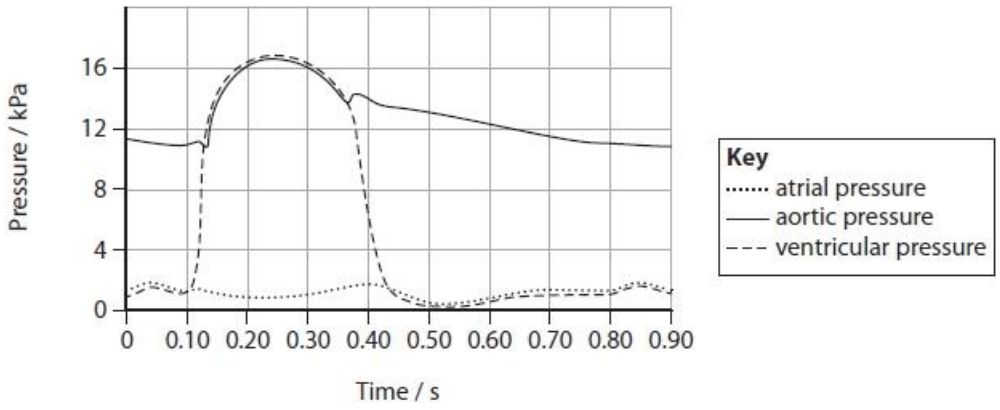
(Total for question = 2 marks)

Q33.

The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



(i) Calculate the heart rate.

(1)

Answer .....

(ii) During which time period does blood leave the left ventricle?

(1)

- ☒ **A** 0.10 s to 0.13 s
- ☒ **B** 0.10 s to 0.37 s
- ☒ **C** 0.13 s to 0.37 s
- ☒ **D** 0.13 s to 0.43 s

(iii) At which time does the valve between the atrium and the ventricle close?

(1)

- ☒ **A** 0.10 s
- ☒ **B** 0.13 s
- ☒ **C** 0.37 s
- ☒ **C** 0.43 s

(Total for question = 3 marks)

Q34.

Increased blood pressure is one risk factor associated with atherosclerosis.

A study investigated the effect of aspirin on the risk of having a heart attack or a stroke.

In the study, which lasted 10 years, 12 000 adults with one or more risk factors for atherosclerosis were used.

The adults were split into two equal sized groups.

Each adult in one group was given 100 mg of aspirin every day and each adult in the other group was given a placebo.

The list shows the results of this study:

- 4.29% of the people who received aspirin died
- 4.48% of the people who received the placebo died
- there was no effect on the incidence of strokes
- people who took the aspirin experienced twice the bleeding into the digestive system compared with people in the placebo group
- the numbers of people with bleeding into the digestive system in both groups was low.

(i) Explain how increased blood pressure increases the risk of atherosclerosis.

(4)

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(ii) Describe how **three** factors, other than increased blood pressure, can increase the risk of atherosclerosis.

(3)

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(iii) Calculate the total number of people who died in this study.

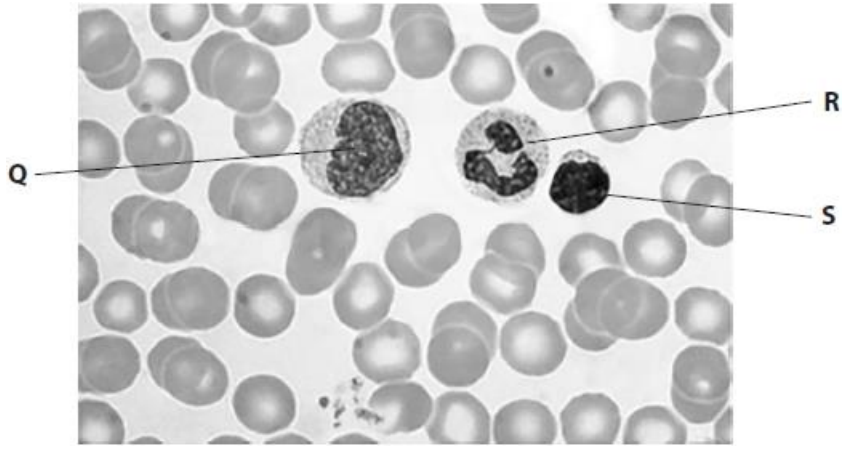
(2)

Answer .....

(Total for question = 9 marks)

Q35.

The diagram below shows some of the cells found in blood.



Which row of the table correctly identifies the cells labelled **Q**, **R** and **S** ?

(1)

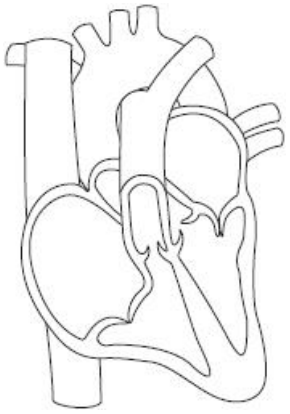
	Q	R	S
☒ **A**	erythrocyte	monocyte	neutrophil
☒ **B**	neutrophil	lymphocyte	monocyte
☒ **C**	monocyte	neutrophil	erythrocyte
☒ **D**	monocyte	neutrophil	lymphocyte

(Total for question = 1 mark)

Q36.

The mammalian circulatory system transports materials to and from cells.

The diagram shows a section through a mammalian heart during part of the cardiac cycle.



Which of the following statements is true for this stage in the cardiac cycle?

(1)

- ☒ **A** the pressure in the aorta is higher than the pressure in the left ventricle
- ☒ **B** the atrioventricular valves are open and the semilunar valves are closed
- ☒ **C** the pressure in the left ventricle is higher than the pressure in the left atrium
- ☒ **D** the atrioventricular node is about to send an impulse along the bundle of His

(Total for question = 1 mark)

Q37.

A mutation of the *F*2 gene causes thrombophilia, a condition that results in the production of excess prothrombin.

In this gene mutation, guanine is replaced with adenine.

(i) Name this type of mutation.

(1)

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(ii) People without this mutation have a 1 in 1000 risk of producing a blood clot in an artery.

The mutation increases this risk by 20 times.
State the probability of producing a blood clot for people with this mutation.

(1)

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(iii) Explain why thrombophilia increases the risk of producing a blood clot in an artery.

(3)

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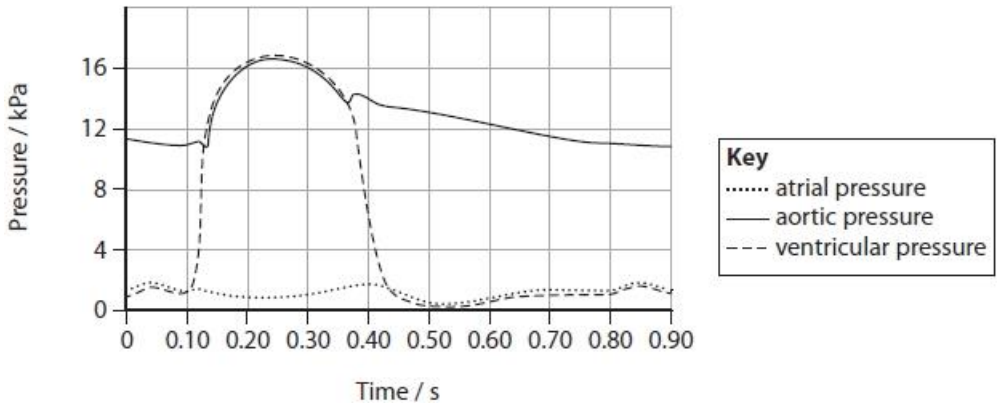
(Total for question = 5 marks)

Q38.

The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



Describe how myogenic stimulation brings about contraction of the atria and the ventricles.

(5)

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(Total for question = 5 marks)

Q39.

Stroke volume is the volume of blood that leaves the left ventricle of the heart in each beat.

Cardiac output is the volume of blood that leaves the left ventricle each minute.

The table shows the relationship between heart rate, stroke volume and cardiac output in a person.

Heart rate / beats min^{-1}	Stroke volume / cm^3	Cardiac output / dm^3 min^{-1}
60	110	6.6
100	120	12.0
120	120	14.4
160	120	
175	120	21.0

Analyse the data to explain the relationship between heart rate and cardiac output.

(2)

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(Total for question = 2 marks)

Q40.

Increased blood pressure is one risk factor associated with atherosclerosis.

A study investigated the effect of aspirin on the risk of having a heart attack or a stroke.

In the study, which lasted 10 years, 12 000 adults with one or more risk factors for atherosclerosis were used.

The adults were split into two equal sized groups.

Each adult in one group was given 100 mg of aspirin every day and each adult in the other group was given a placebo.

The list shows the results of this study:

- 4.29% of the people who received aspirin died
- 4.48% of the people who received the placebo died
- there was no effect on the incidence of strokes
- people who took the aspirin experienced twice the bleeding into the digestive system compared with people in the placebo group
- the numbers of people with bleeding into the digestive system in both groups was low.

Discuss whether patients at risk of a heart attack or stroke should take a 100 mg dose of aspirin every day.

(5)

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(Total for question = 5 marks)

Q41.

The venom from some species of snake contains enzymes that affect the blood clotting process.

State the role of platelets in the blood clotting process.

(1)

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(Total for question = 1 mark)

Q42.

Some animals have a single circulatory system and others have a double circulatory system.

Compare and contrast single and double circulatory systems.

(3)

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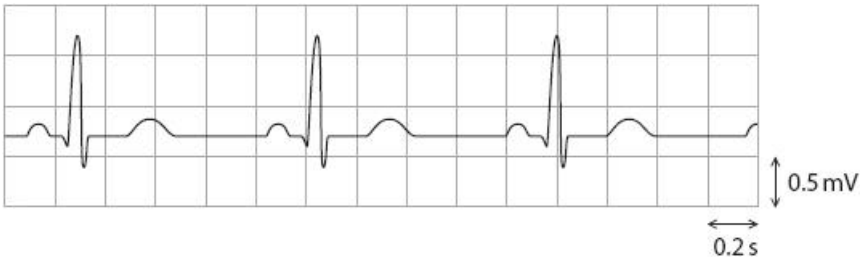
(Total for question = 3 marks)

Q43.

A person visited his doctor for a health check.

The doctor obtained an ECG trace to show the electrical activity of the person's heart.

The diagram shows part of this trace.



Stress increases blood pressure, which can damage blood vessels.

Explain why stress is a health risk.

(4)

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(Total for question = 4 marks)

Q44.

Stroke volume is the volume of blood that leaves the left ventricle of the heart in each beat.

Cardiac output is the volume of blood that leaves the left ventricle each minute.

The table shows the relationship between heart rate, stroke volume and cardiac output in a person.

Heart rate / beats min^{-1}	Stroke volume / cm^3	Cardiac output / dm^3 min^{-1}
60	110	6.6
100	120	12.0
120	120	14.4
160	120	
175	120	21.0

(i) Explain how electrical events during the cardiac cycle can lead to an increase in stroke volume.

(3)

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(ii) Explain why Olympic athletes who train for long distance events often have low resting heart rates.

(4)

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(Total for question = 7 marks)

Q45.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Which of the following is usually found in a greater concentration in lymph than in blood?

(1)

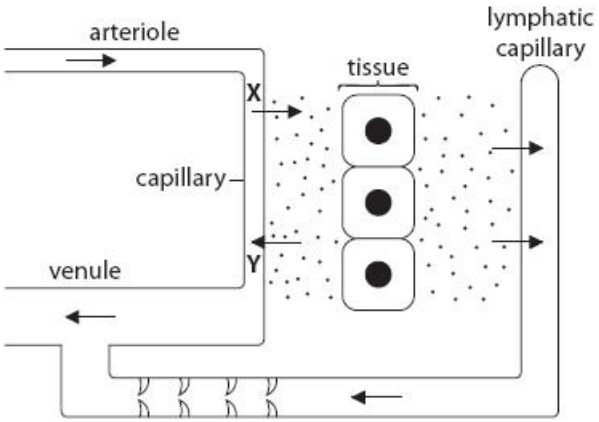
- ☒ **A** fatty acids
- ☒ **B** glucose
- ☒ **C** haemoglobin
- ☒ **D** oxygen

(Total for question = 1 mark)

Q46.

The production of tissue fluid is vital for cells in the human body.

The diagram shows the production and circulation of tissue fluid.



(i) Which of the following describes the pressures at **X** and **Y** in the diagram?

(1)

	Blood hydrostatic pressure / kPa		Plasma oncotic pressure / kPa	
	At X	At Y	At X	At Y
☒ A	3.3	2.0	3.3	2.0
☒ B	3.3	3.3	4.7	2.0
☒ C	4.7	2.0	3.3	3.3
☒ D	4.7	3.3	2.0	3.3

(ii) Compare and contrast the transport of fluid in a vein with its transport in a lymph vessel.

(2)

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(Total for question = 3 marks)

Q47.

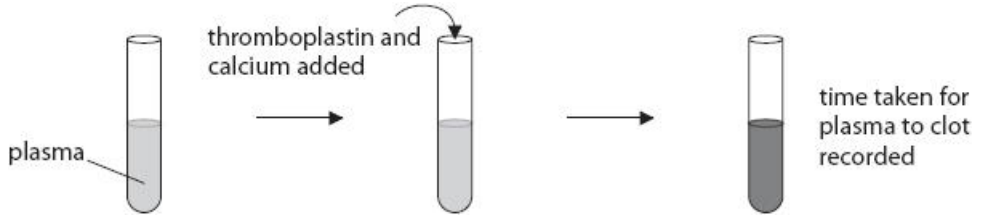
A farmer used anticoagulant bait to kill rats on his farm.

The anticoagulant prevents the activity of vitamin K that is needed for the synthesis of prothrombin.

The farmer's dog became ill with excessive bleeding in the gums.

A vet carried out a prothrombin test that measures the clotting time of blood plasma.

The diagram shows the test procedure with blood plasma from a healthy dog.



(a) (i) Give the reason why thromboplastin and calcium ions were added to the plasma samples.

(1)

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(ii) The clotting time for the plasma from the farmer's dog was 73 seconds. The clotting time for the plasma from the healthy dog was 12 seconds.
Explain the difference in these clotting times.

(3)

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(b) Give one way in which the vet could treat the farmer's dog to reduce the symptom of excessive bleeding in the gums.

(1)

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(c) The vet noticed that blood had collected in the lower part of the lungs of the farmer's dog.

Explain how this would affect the farmer's dog.

(2)

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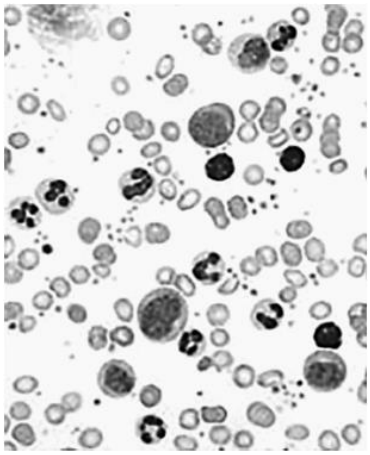
(Total for question = 7 marks)

Q48.

The photograph shows a blood smear.



Which row of the table gives the correct number of each type of white blood cell in this photograph?

(1)

	Number of lymphocytes	Number of monocytes	Number of neutrophils
☒ A	3	5	8
☒ B	3	8	5
☒ C	5	3	8
☒ D	8	5	3

(Total for question = 1 mark)

Q49.

Blood taken from a patient had an unusually high proportion of eosinophils.

Explain why this patient had an unusually high proportion of eosinophils.

(2)

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(Total for question = 2 marks)

Q50.

The venom from some species of snake contains enzymes that affect the blood clotting process.

(i) Which is a correct statement about enzymes?

(1)

☒ **A** enzymes decrease the activation energy of metabolic reactions and decrease reaction time
☒ **B** enzymes decrease the activation energy of metabolic reactions and increase reaction time
☒ **C** enzymes increase the activation energy of metabolic reactions and decrease reaction time
☒ **D** enzymes increase the activation energy of metabolic reactions and increase reaction time

(ii) Which components of the blood clotting process are active enzymes?

(1)

☒ **A** fibrin and thrombin
☒ **B** fibrinogen and thrombin
☒ **C** fibrinogen and thromboplastin
☒ **D** thrombin and thromboplastin

(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	• separate oxygenated blood from deoxygenated / left side generates a higher pressure for systemic circulation	**grad (1)**
(ii)	• ventricles have to generate more pressure / pump blood all around body or to the lungs whilst atria collect blood from body / lungs and pump it into ventricles	**grad (1)**

Q2.

Question Number	Answer	Mark
(i)	**The only correct answer is** **A P is the vena cava** **B** is not correct as Q is pulmonary artery **C** is not correct because R is the aorta **D** is not correct because S is the pulmonary vein.	**COMP (1)**
(ii)	**The only correct answer is** **B Y closed and Z open** A is not correct as Z is not closed C is not correct as Y is not open D is not correct as Y is not open	**COMP (1)**

Q3.

Question Number	Answer	Additional guidance	Mark
	A description that makes reference to **three** of the following: • R / aorta thicker (walls) (1) • R / aorta has a narrower / smaller lumen (1) • R / aorta contains more muscle / elastic tissue (1) • R / aorta contains (semi lunar) valves (1)	allow converse for descriptions of S pulmonary vein. Thicker muscular walls scores mp 1 and 3 allow R more elastic / elasticity	**EXP (3)**

Q4.

Question Number	Answer	Additional guidance	Mark
	A calculation which shows: measurement of diameter • conversion of measurement to μm and division of diagram size by actual size • 8750 – 8800 (2)	One mark for correct measurement allow 63 mm or 6.3 cm Example of calculation 63 ×1000 63000÷7.20 = 8750, accept 8800 to 2 sig fig Correct answer with no working gains full marks	**Grad (2)**

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	A calculation which shows: • correct substitution of values into formula (1) • calculation of volume (1) = 195.3 μm^3 to 195.5 μm^3 (2)	Example of calculation 4/3 ×3.142 x (3.6×3.6 ×3.6) 4/3 × 3.14 **× 46.656** **Allow 1 mark for** 4/3 × π × **46.656** **Or 1 mark for 4/3 x 3.142 x 46.656** = 195.33 μm^3 4/3 × 3.143 × 46.656 = 195.52 μm^3 Lots of answers 195.43 Correct answer with no working gains full marks	**Grad (2)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to three of the following points: • lower volume (for same diameter) / flatter / stacked so (more) can fit through (small) capillaries (1) • higher surface area (/ vol ratio) of red cell so faster / greater / more absorption / diffusion (of oxygen / carbon dioxide / gases) (1) • due to biconcave nature of red cell (curving inwards) (1) • contains heamoglobin (so more able) to **absorb** / **combine / bind with** oxygen / carbon dioxide as (carbaminohaemoglobin or as HCO_3^- ions) (1)	**Smaller so can fit through capillaries** **absorption /diffusion/** not just transport / carriage	**EXP (3)**

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	• (other : pulmonary) 2.5 : 1 / 2.5 / 1 : 0.4 / 0.4 (pulmonary : other) 1 : 2.5 / 2.5 / 0.4 : 1 / 0.4	**DO NOT ACCEPT** with units	(1) GRAD

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • (partial pressure of oxygen is low in) pulmonary artery is carrying deoxygenated blood to lungs (1) • (partial pressure of oxygen is high in) arterial blood is carrying oxygenated blood to the {body / cells / tissues} (1)	**NB** piece together **ACCEPT** deoxygenated as it has come back from the body **ACCEPT** oxygenated as it has been through lungs	(2) EXP

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to four from: similarities • both have hearts (1) • both have valves (1) differences • mammals closed system / has blood vessels (1) • mammal have a separate pulmonary circulation system (in insects, exchange of oxygen and carbon dioxide occurs in the tracheal system) (1) • mammal is a double circulatory system and insect is single (1)	accept converse for insect	**Exp (4)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that includes two of the following points : • glucose / amino acids / proteins / mineral ions / lipids / hormones (2)	**https://genent.cals.ncsu.edu/bugbytes/nutrition/** allow named carbohydrate / named amino acid / named mineral ion	**Exp (2)**

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct identification of pressure when the valve closes (1) • conversion of cm^2 into m^2 (1) • correct calculation of force (1)	Example of calculation: 0.8 kPa **Accept** reading between 0.6 – 0.8 **(one mark)** 0.00035 m^2 or 3.5×10^{-4} **(one mark) 0.00028 N** **(three marks)** **Accept** final answer between **0.00021 – 0.00028 Accept** correct standard form 2.1×10^{-4} to 2.8×10^{-4} Correct answer with no working gains full marks **ECF for mp 3** if either or both wrong graph reading / wrong area conversion	**3 exp**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following points: • pressure rises in the atrium during contraction (of ventricle) (1) • (because) blood is flowing back into the **atrium** (1) • lower pressure in aorta / lower pressure in ventricle / lower pressure in systemic (circulatory system) (1) • therefore less oxygenated blood flows to muscles / slower flow of oxygen to muscles (1) • so there is less respiration (in muscles) (1)	**Accept** pressure in atrium rises during systole **Accept** valve prevents backflow into **atrium** **Accept** less / slower (deoxygenated) blood to lungs **Accept** less ATP produced / more anaerobic respiration	**4 expert**

Q9.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • the heart rate is slower (1) • because noradrenaline and beta blocker are similar {shapes / structures} (1) • so beta blocker binds to noradrenaline receptors (1) • therefore {prevents / blocks} binding of noradrenaline (to receptors) (1)	**DO NOT ACCEPT** same shape	**(3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	• measure cell diameter • convert mm to µm and divide by 20 450 / 500 / 550 / 600 (2)	Example of calculation 10mm = 10 000 µm 10 000 ÷ 20 = 500 Correct answer with no working gains full marks **ACCEPT** one mark for 9mm / 10mm / 11mm / 12mm / 0.9cm / 1.0cm / 1.1cm / 1.2cm in working	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: Similarities: • both have {all cell types / erythrocytes / neutrophils / lymphocytes / monocytes / platelets / white blood cells / leucocytes} (1) • in both erythrocytes are most abundant (1) Differences: • adult 1 has more {erythrocytes / red cells / platelets} (1) • adult 1 has fewer {neutrophils / lymphocytes / monocytes / white blood cells / leucocytes} (1)	**ACCEPT** converse for all Mps **ACCEPT** adult 1 has 2 neutrophils while adult 2 has 4	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • more {neutrophils / lymphocytes / monocytes / white blood cells / leucocytes / phagocytes} caused by {infection / disease / pathogen / named pathogen / bacteria / virus / allergy / immune response / leukaemia / inflammation / smoking} (1) • fewer {erythrocytes / red cells} caused by {lack of iron / anaemia / inheritance / leukaemia / cancer} (1) • fewer platelets caused by {inheritance / leukaemia / anaemia / alcohol} (1)	**ACCEPT** other valid medical conditions for all Mps **ACCEPT** adult 1 lives at altitude	(2)

Question Number	Answer	Additional Guidance	Mark
(iv)	same {volume / dilution} of blood		(1)

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • increase in smoking leads to more thrombin **and** fibrinogen (1) • increases are significantly higher / no overlap over standard deviations (1) • so that thrombin converts fibrinogen into fibrin (1) • therefore fibrin forms clots (1)	ACCEPT correct description of a clot	(4)

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to five of the following: • {impulse / depolarisation / wave of excitation} starts at SAN / pacemaker (1) • takes 0.03s to travel to AVN (1) • atrial systole takes 0.07s / takes 0.07s for atria to contract (1) • delay at AVN (1) • {0.16s / 0.17s at septum / Bundle of His} / {0.17s / 0.22s at Purkyne fibres (1) • ventricular systole ends at 0.22s / ventricles {contract / depolarise} from base / upwards (1) • atrioventricular valves {open during atrial systole / atrial contraction} / {close during ventricular systole / ventricular contraction} (1)	**DO NOT ACCEPT** signal / message	**(5)**

Q13.

Question number	Answer	Mark
(a)	The only correct answer is D A is not correct because the P wave shows depolarisation of the atria B is not correct because the P wave shows depolarisation of the atria and the T wave represents repolarisation of the ventricles C is not correct because the T wave represents repolarisation of the ventricles	**(1)**

Question Number	Answer	Additional guidance	Mark
(b)	An answer that makes reference to three of the following: • heart rate is faster so person may have stress (1) • there are other reasons for an increased heart rate (1) • difference in heart rate may or may not be significant (1) • need to repeat ECG to confirm diagnosis (1)	Accept calculation of heart rates Eg: exercise / drugs / smoking / BMI / fitness / diet / atherosclerosis	(3)

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	• 1.52×10^7		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to three of the following: • damage to {endothelium} caused by {high blood pressure / toxins / smoking} (1) • inflammatory response and arrival of {macrophages / white blood cells} (1) • deposits of {cholesterol / calcium} (1) • formation of {atheroma / plaque} (1)	**DO NOT ACCEPT** fat / lipid	(3)

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	**C** monocyte | eosinophil	**A** is incorrect because cell J is not an eosinophil and cell K is not a lymphocyte **B** is incorrect because cell J is not a lymphocyte and cell K is not a neutrophil **D** is incorrect because cell J is not a neutrophil and cell K is not a monocyte	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	**D** 50 : 3	**A** is incorrect because there are about 50 erythrocytes and 3 leukocytes **B** is incorrect because there are about 50 erythrocytes and 3 leukocytes ie the ratio is the wrong way round **C** is incorrect because there are 3 leucocytes	(1)

Q16.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • prevent entry of {pathogen / named pathogen} (1)	allow prevent infection	(1)

Q17.

Question Number	Answer	Mark
	The only correct answer is C ***A*** *is not correct because erythrocytes transport oxygen and platelets prevent entry of bacteria* ***B*** *is not correct because erythrocytes transport oxygen and platelets prevent entry of bacteria* ***D*** *is not correct because leucocytes are involved in defence*	**(1)**

Q18.

Question Number	Answer	Additional Guidance	Mark
	• obtain duration of one heart beat by dividing number of seconds in one minute by heart rate (1) • subtract duration of ventricular systole (1)	Example of calculation 60 ÷ 72 = 0.83 / 0.833 0.83 – 0.06 = 0.77 / 0.773 0.83 – 0.05 = 0.78 / 0.783 Correct answer gains full marks, with no working shown	(2)

Q19.

Question Number	Answer	Additional Guidance	Mark
	• multiplication and conversion to dm^3	19.2	**(1)**

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	• calculation of volume (1) • calculation of cardiac output (1) • conversion to $dm^3\ min^{-1}$ (1) OR • change units for radius (1) • calculation of volume (1) • calculation of cardiac output (1)	$= \frac{4}{3} \times 3.142 \times 0.001$ $= 0.004189 \times 200$ $= 0.0000008379\ (dm^3\ min^{-1})$ **Accept** 8×10^{-7} / 8.4×10^{-7} / 8.38×10^{-7} / 8.379×10^{-7} / 0.0000008 / 0.00000084 / 0.000000838 Correct answer gains full marks, with no working shown. 8 / 8.4 / 8.38 / 8.379 to wrong power of 10 gets 2 marks Ecf if diameter used instead of radius 0.1mm = 0.001 dm $= \frac{4}{3} \times 3.142 \times 0.001$ $= 4.189 \times 10^{-9} \times 200\ (dm^3\ min^{-1}) = 8.38 \times 10^{-7}$ **Accept** 8×10^{-7} / 8.4×10^{-7} / 8.379×10^{-7} / 0.0000008 / 0.00000084 / 0.000000838 / 0.0000008379	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	more cells that need supply of {glucose / oxygen} (1)		**(1)**

Q21.

Question number	Answer	Mark
(i)	The only correct answer is C A is not correct because it fails to multiply correctly B is not correct because it fails to multiply correctly D is not correct because it fails to multiply correctly	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	• subtract 2500 from 12 000 (1) • divide answer by 12 000 and multiply by 100 to calculate percentage (1)	Example of calculation 12 000 – 2500 = 9500 ÷ 12 000 x 100 = 79 % Accept 79.2 / 79.17 / 79.167 / 79.16 recurring Correct answer gains full marks, with no working shown.	(2)

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	• **A** atrium (1) • **B** ventricle (1)	allow auricle	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to **three** of the following At least one similarity and one difference Similarities • both have 2 atria (1) • both have AV valves (1) • heart divided into upper and lower chambers / have atriaand ventricle (1) Differences • frog has 1 ventricle / undivided whilst mammal has 2ventricles / has septum (1) • frog has 3 chambers whilst mammal has 4 (1) • frog has no valves in arteries (1)		**(3)**

Q23.

Question Number	Answer	Additional guidance	Mark
(i)	• frog systemic circulation contains oxygenated blood from both lungs and skin / in frog blood from ventricle goes to lungs and body (1)		**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • low metabolic rate so require less oxygen / lungs allow frogsto be more active on land (1) • so mixing of blood in ventricle not limiting (1) • but blood has to go to two gas exchange surfaces (1) • moist skin allows oxygen to dissolve / skin provides largesurface area for gas exchange (1)		**(4)**

Q24.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to **four** of the following: • SAN acts as pacemaker (1) • impulse travels through heart muscle / fibres cause atrial contraction (1) • AVN delays transmission of impulse {to coordinate contraction of ventricle after atria} (1) • impulse spreads through Purkinje / Purkyne fibres via bundle of His (1) • ventricle contracts from apex (1)	initiates depolarization / depolarizationstarts at SAN	**(4)**

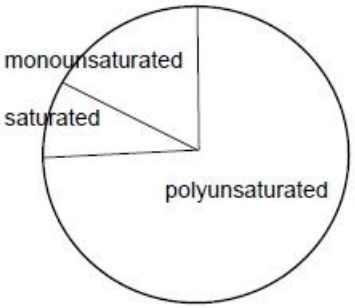
Q25.

Question Number	Answer	Additional Guidance	Mark
(i)	A 0.14 s *B is incorrect as the valve has already closed* *C is incorrect as the valve is open* *D is incorrect as the valve is open*		1
(ii)	D sinoatrial node, atrioventricular node, bundle of His *A is incorrect as the impulse starts at the* sinoatrial node *B is incorrect as the impulse starts at the* sinoatrial node *C is incorrect as the bundle of His is after the* atrioventricular node		1

Q26.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to 5 from: • the mean clotting time has increased for both drugs / for drug A and drug B (1) • there is little variation in the control group (1) • there is high variation with drug B (1) • drug B does not change clotting rate for some (blood types) as there is overlap with the controlgroup (1) • drug B has a slower clearance time so patients would be at risk of bleeding (1) • drug A would be better as it works for all samples and is cleared from body faster / will allow blood toclot sooner after dialysis (1)	piece together **Allow** low range in control group / withno drug **Allow** largest range / drug B has morespread / variation than drug A **Allow** drug A increased clotting timefor all samples as there is no overlapwith control	5

Q27.

Question Number	Answer	Additional Guidance	Mark
(i)	• pie chart drawn showing lipid content of safflower oil, labelled	 saturated section less than monounsaturated and polyunsaturated three quarters by eye	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	• percentage of polyunsaturated lipids in 500 g {beef / oil} calculated (1) • 355 (g) (1)	Example of calculation: (3 + 1) × (500 ÷ 100) = 20 75 × (500 ÷ 100) = 375 Correct answer with no working gains full marks	(2)
(iii)	An explanation that makes reference to the following: • because plant products will contain less {cholesterol / saturatedlipids} (than animal products) (1) • therefore there will be less cholesterol (in the blood stream) to {build up / form a plaque / form an atheroma} in an artery (1)	**ACCEPT** converse explanation **ACCEPT** more polyunsaturated lipids	(2)

Q28.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to two of the following: • {increasing mass / more} (snake venom) decreases clotting time (1) • {small mass / 0.002 µg} of snake venom has a shorter clotting time (than Xa) (1) • {larger masses / 0.004 µg and over / 0.02 and 0.04} has little effect on clotting time (1)	**ACCEPT** clotting time is faster converse **ACCEPT** takes less time / faster rate **ACCEPT** 0.004 µg has slight increase and 0.02 µg and 0.04 µg has slight decrease	**(2)**

Q29.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: blood passes through heart twice / pumped to lungs and body separately / blood pumped (again) after going through lungs (1)	IGNORE pumped to lungs and body without qualifying that it is separate	**(1)**

Q30.

Question Number	Indicative content
*(i)	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.

	Indicative content • Dox decreases the concentration of (all) amino acids shown • largest actual decrease is glu and asp (3.6 μmol cm^{-3}) • smallest actual decrease is ser (0.9 μmol cm^{-3})) • relative decrease is least for pro (16.67%) • relative decrease is greatest for asp (85.71%) • data not available for all amino acids • polar and non-polar amino acids are affected • polar amino acids affected most (total 14.4 μmol cm^{-3} compared to total 11.7 μmol cm^{-3} / mean 2.4 μmol cm^{-3} compared to mean 1.95 μmol cm^{-3}) • effect on non-polar amino acids is within a {narrower range for actual decrease / wider range for percentage decrease}

	Level 1 : comments on overall effect of Dox 1 mark = level 1 comment only 2 marks = level 1 comment backed up with figures / level 2 comment but no figures given Level 2 : comments on effect of Dox on polar and non-polar amino acids 3 marks = level 2 comment only / level 1 comment with a level 2 calculation (= actual decrease in concentration) 4 marks = level 2 comment backed up with a level 2 calculation Level 3 : comments about amino acids within the group of polar / non-polar amino acids 5 marks = level 3 comment / level 2 comment with a level 3 calculation (= percentage decrease in calculation) 6 marks = comment backed up with a level 3 calculation

Level 0	Marks	No awardable content
Level 1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The answer will contain basic information with some attempt to describe the data shown in the graph
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure between the graph and the different types of amino acids
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • a decrease in some amino acids may mean that {certain proteins cannot be formed / less protein made} (1) • if these proteins are involved in heart muscle structure then it will be weaker (1) • these proteins may affect heart muscle function (1)	ACCEPT named example e.g. actin, myosin, collagen ACCEPT named example e.g. collagen, haemoglobin, myoglobin, cytochromes	

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • heart will not be able to pump as well (1) • so less {oxygenated blood / oxygen} will be delivered to the {cells / tissues / organs / named example} (1) • example of a consequence of this (1)	ACCEPT less carbon dioxide removed / lowers blood pH e.g. less aerobic respiration, build-up of lactic acid / fatigue / breathlessness	

Q31.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • fewer {erythrocytes / red cells / less haemoglobin} to transport oxygen (1) • therefore {less respiration / more anaerobic respiration} (1) • therefore less {energy / ATP} (1)		**(3)**

Q32.

Question Number	Answer	Additional Guidance	Mark
	An description that makes reference to the following: • engulf / phagocytosis (1) • {digest / breakdown} {antigen / pathogen / bacteria / virus / microbe} (1)	IGNORE kill REJECT produce antibodies ACCEPT correct references to lysosomes / phagosomes	**(2)**

Q33.

Question Number	Answer	Additional Guidance	Mark
(i)	time of cardiac cycle read from graph and divided into 60	60 ÷ 0.8 = 75 (beats per minute)	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is C** ***A*** *is not correct because the aortic pressure is higher than the ventricular pressure* ***B*** *is not correct because the aortic pressure is higher than the ventricular pressure between 0.10 s to 0.13 s* ***D*** *is not correct because the aortic pressure is higher than the ventricular pressure between 0.37 s and 0.43 s*	**(1)**

Question Number	Answer	Mark
(iii)	**The only correct answer is A** ***B*** *is not correct because 0.13 s is when the semi-lunar valve opens* ***C*** *is not correct because 0.37 s is when the semi-lunar valve closes* ***D*** *is not correct because 0.43 s is when the atrio-ventricular valve opens*	**(1)**

Q34.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • damage to endothelium / lining (1) • therefore inflammatory response occurs (1) • therefore formation of {atheroma / plaque } in arteries (1) • therefore arteries are narrowed which reduces {blood flow / oxygen supply / glucose supply} • leads to (further) increase in blood pressure (1)	must mention arteries once Ignore blocked	(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to three of the following: • smoking damages arteries lining (1) • type 2 diabetes increases blood pressure (1) • high cholesterol / LDL levels increase therefore formation of {atheroma / plaque } in arteries (1) • lack of exercise / high fat diet (leads to obesity) (1) • inherited alleles from parents who had cvd (1)	ALLOW Sex / sex hormones / men more likely to develop arthrosclerosis ALLOW Age older more likely to develop arthrosclerosis	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	• mean of percentages calculated (1) • number of deaths calculated (1)	8.77 ÷ 2 = 4.385 (4.385×12 000)÷100 = 526 correct answer gains full marks allow one mark for x 12000 ÷100 or for x 6000 ÷ 100 or 4.29 % of 6000 = 257.4 and 4.48 % of 6000 = 268.8 = 526	(2)

Q35.

Question Number	Answer	Additional Guidance	Mark
	D (monocyte, neutrophil, lymphocyte)		(1)

Q36.

Question Number	Answer	Additional Guidance	Mark
	C (the pressure in the left ventricle is higher than the pressure in the left atrium)		(1)

Q37.

Question Number	Answer	Additional Guidance	Mark
(i)	substitution	Accept point mutation	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	1 in 50	Accept other correct probabilities e.g. 2% or 0.02	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • (excess prothrombin means) more thrombin (1) • therefore increased {conversion / catalysis} of fibrinogen to fibrin (1) • fibrin {is insoluble / traps blood cells / forms mesh / forms net} (1)	Accept if there is more fibrin it is more likely to clot	(3)

Q38.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to five of the following: • (myogenic means) no external nerve impulses / doesn't require nerve impulse / no stimulation from brain / generated from within heart (1) • (contraction initiated by) SAN (1) • {depolarisation / wave of excitation} causes {atria to contract / atrial systole} (1) • delay at the AVN (1) • (depolarisation) through the {bundle of His / Purkyne fibres} (1) • (depolarisation) causing {ventricle to contract / ventricular systole} from base/apex of heart (1)	**ACCEPT** no outside stimulation (needed to contract heart) **ACCEPT** impulses	(5)

Q39.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • {heart rate / beats per minute} increases cardiac output (1) • stroke volume stays the same at 120 (cm^3) / stroke volume stays the same after 100 bpm / stroke volume stops increasing / stroke volume reaches maximum / stroke volume less important than heart rate (1)	**IGNORE** stroke volume stays the same	**(2)**

Q40.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following yes as • 100 mg a high enough dose to benefit from reduced heart disease (1) • large study (1) • long time frame (1) no as • is 100 mg a low enough dose to prevent intestinal bleeding / may cause bleeding (1) • little difference between death rate between groups risk decreases by 2 in 1000 ie 0.2% (1) • but twice the levels of (gastrointestinal) bleeding (so no benefit) (1) • no effect on incidence of strokes (1) • no other lifestyle information provided / different patients had different risk factors (1) • no information on cause of death (1)	at least one from yes / and no	**(5)**

Q41.

Question Number	Answer	Additional Guidance	Mark
	form a {plug / mesh / scab / barrier / thrombus} to seal the {blood vessel / wound} / release {clotting factors / thromboplastin}	**ACCEPT** to stop bleeding / to prevent {infection / microorganisms entering} **DO NOT ACCEPT** prothrombin / thrombin / fibrinogen / fibrin	**(1)**

Q42.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to similarities • contain {fluid medium / blood} and {pump / heart } and {tubes or vessels} (1) and two of the following differences • heart has 1 or 2 chambers, double circulation has 3 or 4 chambers (1) • blood passes {through the heart} once per circulation, double circulation blood passes {through the heart} twice (1) • oxygenated and deoxygenated blood not separated, double circulation they are separated (1) • pressure is lower (due to delicate nature of gills) in single circulation (1) • single circulation is less effective at {delivering oxygen / removing carbon dioxide} (1)		**(3)**

Q43.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following: • damage to endothelium (1) • therefore inflammatory response occurs (1) • therefore formation of {atheroma / plaque / atherosclerosis} in arteries (1) • therefore arteries are narrowed which reduces {blood flow / oxygen supply / glucose supply} (1) • high blood pressure causes {heart disease / stroke} (1) or therefore arteries are narrowed which leads to (further) increase in blood pressure • therefore {heart disease / heart attack / stoke / angina / thrombosis / blood clots / aneurysm (1)	Ignore blocked	**(4)**

Q44.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that that makes reference to three of the following: • {more} (frequent) impulses (1) • from SAN to AVN to bundle of His / Purkyne fibres (1) • therefore more of the ventricles contract / greater contraction of ventricles / stronger contraction of the ventricles (1)	**IGNORE** frequency of contraction	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that that makes reference to four of the following: • more heart muscle / thicker ventricle walls (1) • therefore stroke volume increases / more blood per contraction (1) • therefore same {cardiac output} with fewer beats (1) • therefore sufficient supply {oxygen / glucose} (1) • allows respiration in cells (1)	**IGNORE** bigger hearts / stronger	**(4)**

Q45.

Question Number	Answer	Mark
	The only correct answer is A fatty acids ***B*** *is not correct because it is not found in greater concentration in lymph* ***C*** *is not correct because it is not found in greater concentration in lymph* ***D*** *is not correct because it is not found in greater concentration in lymph*	**(1)**

Q46.

Question number	Answer	Mark
(i)	The only correct answer is C A is not correct because the oncotic pressure cannot be lower at Y than it is at X B is not correct because the hydrostatic pressures are not the same at X and Y D is not correct because the hydrostatic and oncotic pressure at Y cannot be the same	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: <u>One similarity from:</u> • both have low pressure (1) • both have valves (1) • both use muscle squeezing to move fluid (1) <u>One difference from:</u> • faster flow in vein (1) • heart causes {mass flow / movement} in vein (1) • flow to heart in vein but to {glands / neck} in lymph (1)	Allow converse where appropriate	**(2)**

Q47.

Question Number	Answer	Additional guidance	Mark
(a)(i)	to convert prothrombin to thrombin (1)	Ignore to produce thrombin alone	(1)

Question Number	Answer	Additional guidance	Mark
(a)(ii)	An explanation that makes reference to the following: • plasma from the farmer's dog lacks vitamin K (activity) (1) • therefore less prothrombin to convert to thrombin (1) • therefore less fibrinogen converted to fibrin (1)	 Allow converse for healthy dog Accept prothrombin not converted to thrombin Ignore less thrombin alone Ignore less fibrin alone	(3)

Question Number	Answer	Additional guidance	Mark
(b)	• give {vitamin K / prothrombin / thrombin / coagulant / emetic / blood transfusion}	Ignore thromboplastin / fibrinogen / fibrin	(1)

Question Number	Answer	Additional guidance	Mark
(c)	An explanation that makes reference to two of the following: • less {surface area / fewer alveoli} (1) • therefore less {gas exchange / oxygen uptake / diffusion / absorption} (1) • therefore dog would have {fatigue / less energy / less respiration} (1)		(2)

Q48.

Question Number	Answer	Mark
	The only correct answer is A ***B*** *is not correct because there are 5 monocytes and 8 neutrophils* ***C*** *is not correct because there are 3 lymphocytes, 5 monocytes and 8 neutrophils* ***D*** *is not correct because there are 3 lymphocytes*	**(1)**

Q49.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • (bone marrow / body / patient / person) produces more cells / more released into blood (1) • because patient has {an allergy / allergic inflammation} (1) • because patient has a parasitic infection e.g. worms (1)	**Accept any two from :** asthma /tropical pulmonary eosinophilia / Loeffler syndrome / Churg-Strauss syndrome / atopic dermatitis / eosinophilic oesophagitis / hypereosinophilic syndromes / some malignancies / adverse drug reactions / allergic rhinitis / atopic asthma / atopic dermatitis	**(2)**

Q50.

Question Number	Answer	Mark
(i)	**The only correct answer is A** ***B*** *is not correct because enzymes decrease reaction time* ***C*** *is not correct because enzymes decrease activation energy* ***D*** *is not correct because enzymes decrease activation energy and decrease reaction time*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is D** ***A*** *is not correct because fibrin is not an enzyme* ***B*** *is not correct because fibrinogen is not an enzyme* ***C*** *is not correct because fibrinogen is not an enzyme*	**(1)**