1. A small tube called a catheter can be inserted into the blood system through a vein. It can be threaded through the vein and into and through the heart until its tip is in the pulmonary artery. A tiny balloon at the tip can then be used to measure the pressure changes in the pulmonary artery. The diagram shows a section through the heart with the catheter in place. The graph shows the pressure changes recorded in the pulmonary artery.
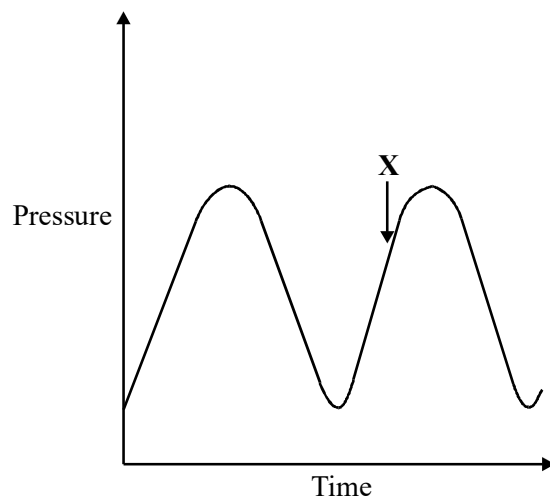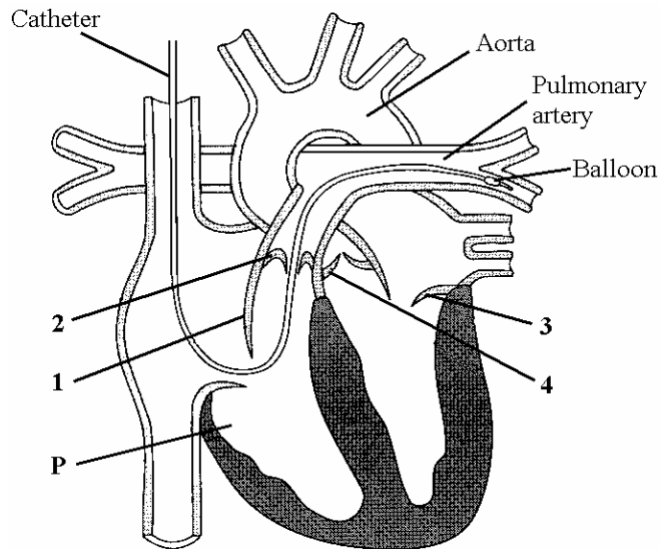
(a)   Name the chamber of the heart labelled **P**.

    ....

    (1)

(b)   Complete the table by placing ticks in the appropriate boxes to show which of valves **1** to **4** will be open and which closed at time **X** on the graph.

Valve	Open	Closed
1		
2		
3		
4		

(2)

(c)   Sketch a curve on the graph to show the pressure changes which you would expect if the pressure in the aorta were measured at the same time.

(2)
(Total 5 marks)

2.   The graph shows pressure changes in the left ventricle, left atrium and aorta.

Blood pressure / k Pa

Time / s

——— Left ventricle   - - - - Left atrium   · · · · · Aorta
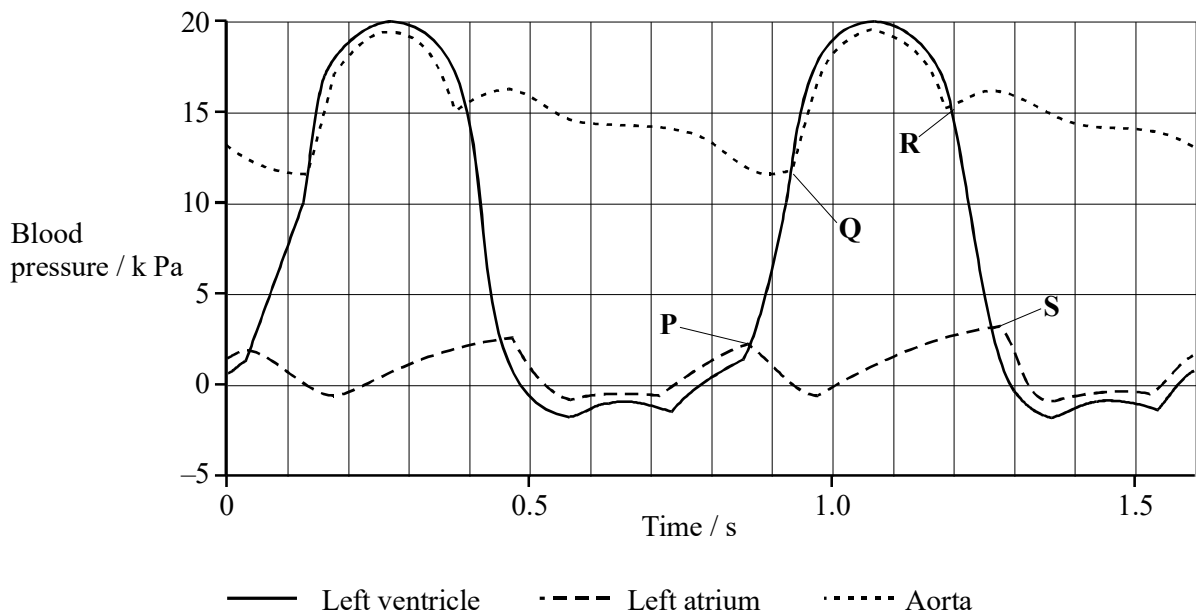
(i)   Which letter on the graph corresponds to each of the following?

	Letter
Aortic (semilunar) valve opens	
Blood starts to enter the left ventricle	
Bicuspid (atrioventricular) valve closes	

(3)

(ii)   Assuming a steady rate of beating of the heart, calculate the pulse rate per minute for this person.

Answer: ....

(1)
(Total 4 marks)

3. The graph shows changes in the volume of blood in the left ventricle as the heart beats.
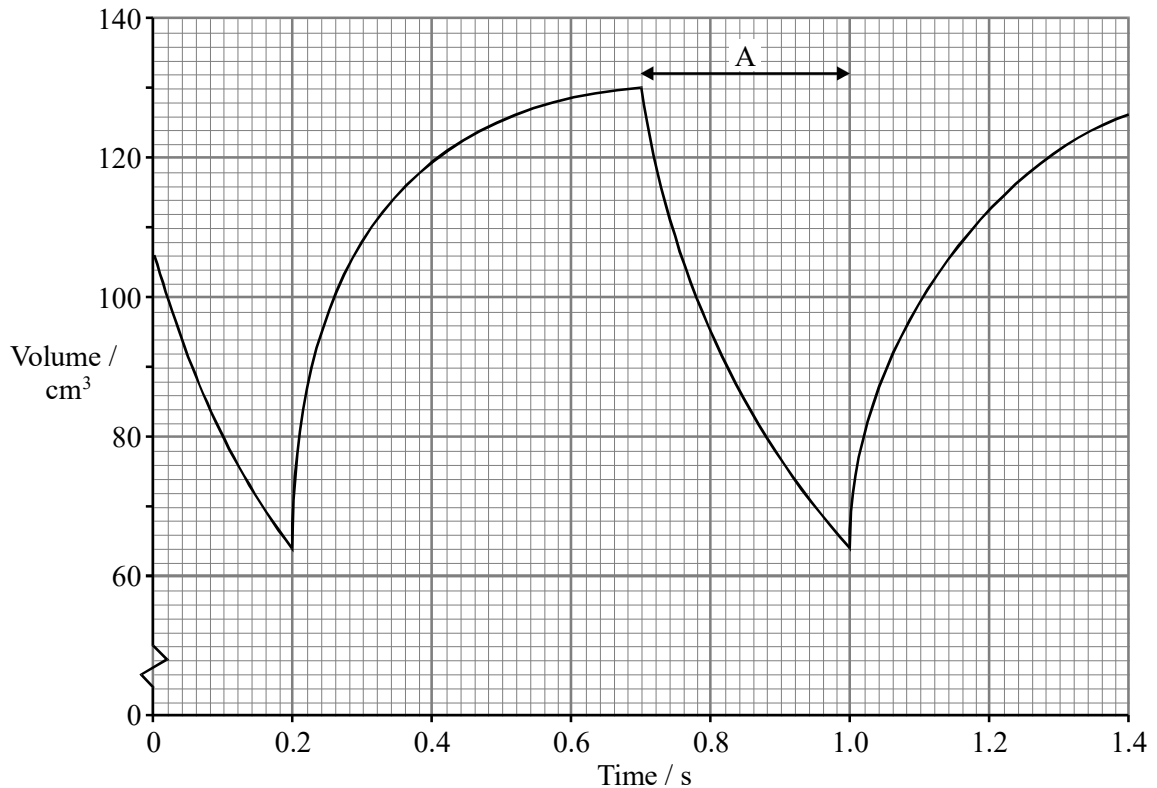
(a) (i) The horizontal line labelled **A** on the graph shows when blood is leaving the ventricle. Explain, in terms of blood pressure, why blood does not flow back into the atrium during this period.

....

....

....

....

(2)

(ii) Draw a horizontal line on the graph, to show the period in one cardiac cycle when the muscle in the wall of the ventricle is relaxed. Label this line with the letter **B**.

(1)

(b) (i) Draw a horizontal line on the graph to show one complete cardiac cycle. Label this line with the letter **C**.

(1)

(ii) Use line **C** to calculate the number of times the heart beats in one minute. Show your working.

Answer ....

(2)

(c) The table shows the blood flow to different parts of the body at rest and during a period of vigorous exercise.

Part of the body	Rate of blood flow/cm^3 minute^{-1}	
	at rest	during exercise
Brain	750	750
Heart muscle	300	1 200
Gut and liver	3 000	1 400
Muscle	1 000	16 000
All other organs (except lungs)	1 550	1 550

(i) Use the figures in the table to calculate the cardiac output at rest.

Answer ....

(1)

(ii) Give **two** ways in which cardiac output is increased during a period of vigorous exercise.

1..

....

2..

....

(2)

(d) Describe the parts played by the sinoatrial node (SAN) and the atrioventricular node (AVN) in controlling the heart beat.

....

....

....

....

....

(6)
(Total 15 marks)

4. (a) Describe how muscles in the thorax (chest) cause air to enter the lungs during breathing.

....

....

....

....

....

....

(3)

(b) An athlete exercised at different rates on an exercise bicycle. The table shows the effects of exercise rate on his breathing rate and tidal volume.

Exercise rate / arbitrary units	Breathing rate / breaths minute^{-1}	Tidal volume / dm^3
0	14.0	0.74
30	15.1	1.43
60	15.3	1.86
90	14.5	2.34
120	15.1	2.76
150	14.8	3.25
180	21.5	3.21
210	25.7	3.23

(i)   The athlete cycled at the particular exercise rate for 5 minutes before the relevant readings were taken. Explain why the readings were taken only after the athlete had been cycling for 5 minutes.

....

....

(1)

(ii) Calculate the total volume of air taken into the lungs in one minute at an exercise rate of 120 arbitrary units.

Volume of air = ...

(1)

(iii)   Give **two** conclusions that can be drawn from the figures in the table.

1 ....

....

2 ....

....

(2)
(Total 7 marks)

5.   When a stethoscope is placed on the chest wall, sounds are heard as the heart beats. These heart sounds are caused by valves shutting. The diagram shows the heart sounds from a resting person.
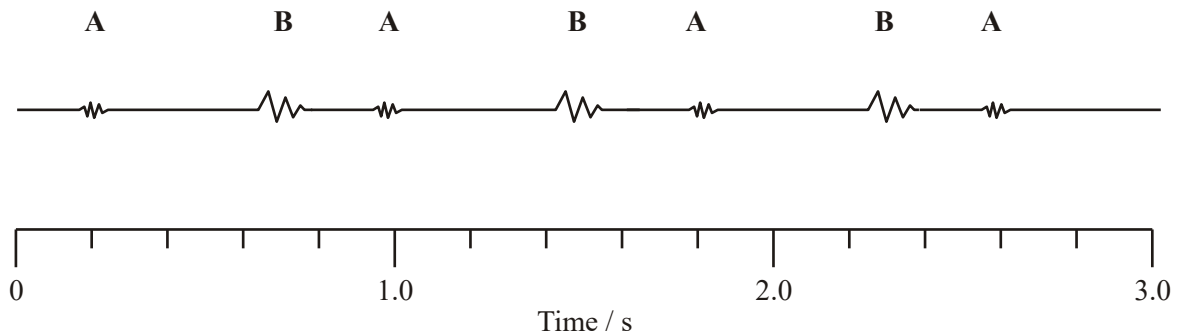
(a)   (i)   The sounds labelled **A** on the diagram are made by the closing of the valves at the entrance to the arteries. What makes the sounds labelled **B**?

....

....

(1)

(ii)   Explain what causes the valve to shut when sound **A** is heard.

....

....

(1)

(b) In this person, the stroke volume is 70 cm^3. Calculate the cardiac output. Show your working.

Cardiac output .... cm^3 per minute

(3)
(Total 5 marks)

6. (a) The graph shows the changes in pressure which take place in the left side of the heart.
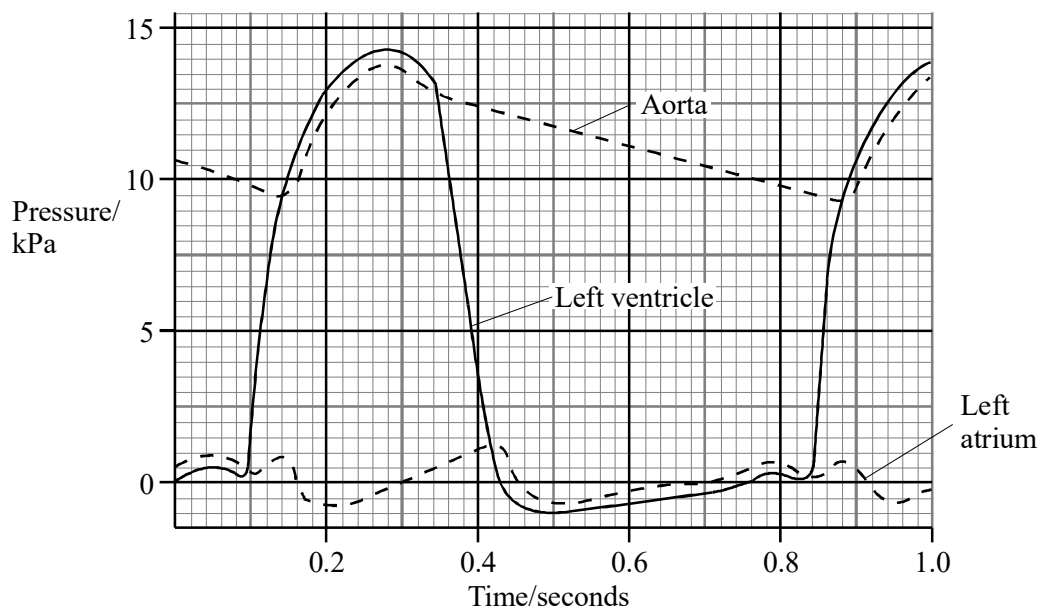
(i) Use the graph to calculate the heart rate in beats per minute. Show your working.

Answer ....

(2)

(ii) The atrioventricular valve closes at 0.1 seconds.
Explain the evidence from the graph which supports this statement.

....

....

(1)

(b) The blood pressure in the aorta is higher than in the pulmonary artery.
Explain what causes the blood pressure in the aorta to be higher.

....

....

(1)
(Total 4 marks)

7. The diagram shows the pathways in the heart for the conduction of electrical impulses during the cardiac cycle.

A

B

Contraction of ventricles starts here

(a) The table shows the blood pressure in the left atrium, the left ventricle and the aorta at different times during part of a cardiac cycle.

Time / s	Blood pressure / kPa		
	Left atrium	Left ventricle	Aorta
0.0	0.5	0.4	10.6
0.1	1.2	0.7	10.6
0.2	0.3	6.7	10.6
0.3	0.4	17.3	16.0
0.4	0.8	8.0	12.0

(i) At which time is blood flowing into the aorta?

....….

(1)

(ii) Between which times are the atrioventricular valves closed?

....….

(1)

(b) The maximum pressure in the left ventricle is higher than the maximum pressure in the right ventricle. What causes this difference in pressure?

....

....

(1)

(c) The information below compares some features of different blood vessels.

		Blood vessel		
		Artery	**Capillary**	**Vein**
Property	Mean diameter of vessel	4.0 mm	8.0 μm	5.0 mm
	Mean thickness of wall	1.0 mm	0.5 μm	0.5 mm
		Relative thickness (shown by length of bar)		
Tissues present in wall	Endothelium			
	Elastic tissue			
	Muscle			

Use the information to explain how the structures of the walls of arteries, veins and capillaries are related to their functions.

....

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(6)
(Total 9 marks)

8. Enzymes can be used as analytical reagents. The drawing shows a plastic strip dipped into a patient's sample of urine to test for the presence of glucose.
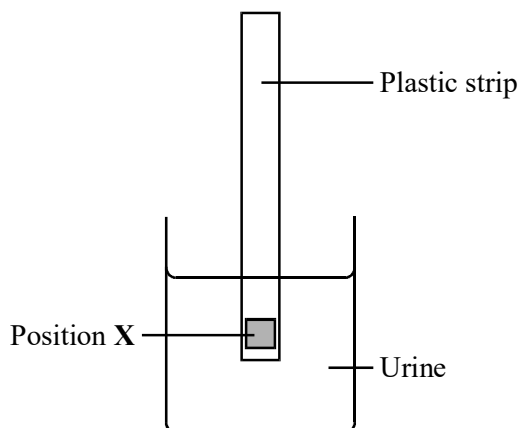
The test involves two enzymes which catalyse the following reactions:

glucose + oxygen $\xrightarrow{\text{Enzyme } \mathbf{A}}$ gluconic acid + hydrogen peroxide

colourless dye + hydrogen peroxide $\xrightarrow{\text{Enzyme } \mathbf{B}}$ coloured substance + water
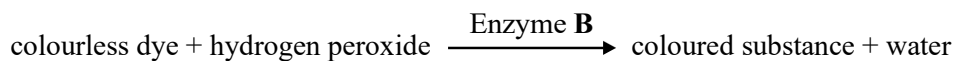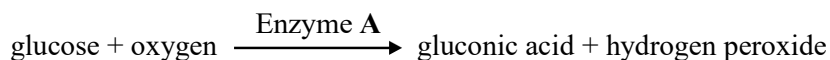
(a) (i) Which of the substances in the equations are located at position **X** on the plastic strip?

....

....

(1)

(ii) Name

Enzyme **A** ....

Enzyme **B** ....

(2)

(iii) Explain the need for two different enzymes in this test.

....

....

....

(1)

(b)   In this test, no colour change was observed at the end of the plastic strip. What does this suggest about the person from whom the sample was obtained?

....

....

(1)

(c)   Glucose is a reducing sugar which can also be detected by a biochemical test such as the Benedict's test. Suggest an advantage of using the enzyme-based method for determining the concentration of glucose in a sample of urine.

....

....

(1)
(Total 6 marks)

9.   (a)   During a cardiac cycle, a wave of electrical activity spreads from the sino-atrial node. Describe how the spread of this wave of electrical activity results in

(i)   the ventricles only contracting after they have filled with blood;

....

....

(1)

(ii)   the contraction of the ventricles starting at the apex of the heart.

....

....

(1)

(b)   The graphs show some of the pressure and volume changes that take place in the left side of the heart during part of a cardiac cycle.
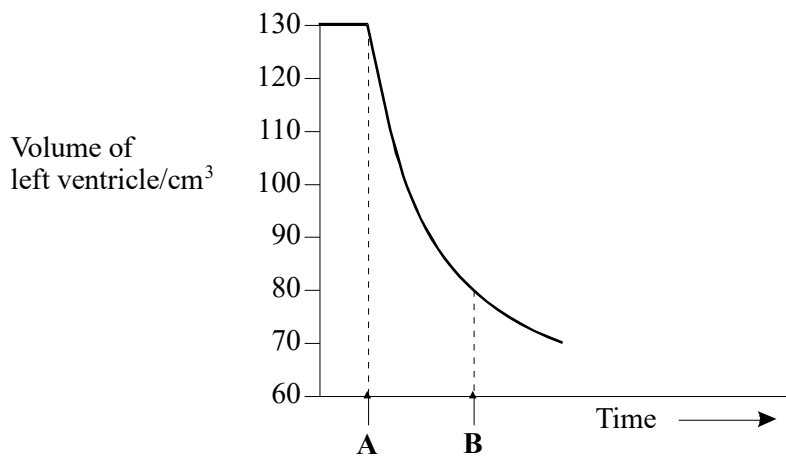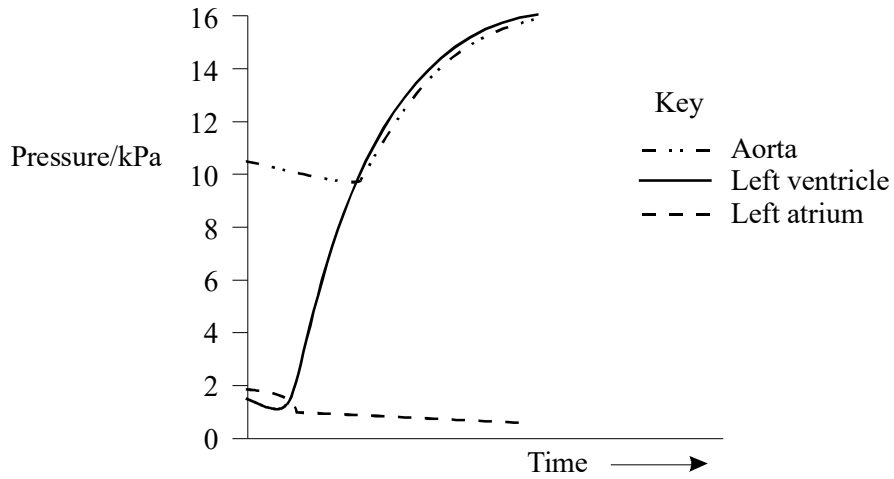
Using information from the graphs, describe the events which produce the change in volume of blood in the ventricle between times **A** and **B**.

....

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....

....

(3)
(Total 5 marks)

10. The diagrams show the left side of the heart at two stages in a cardiac cycle.
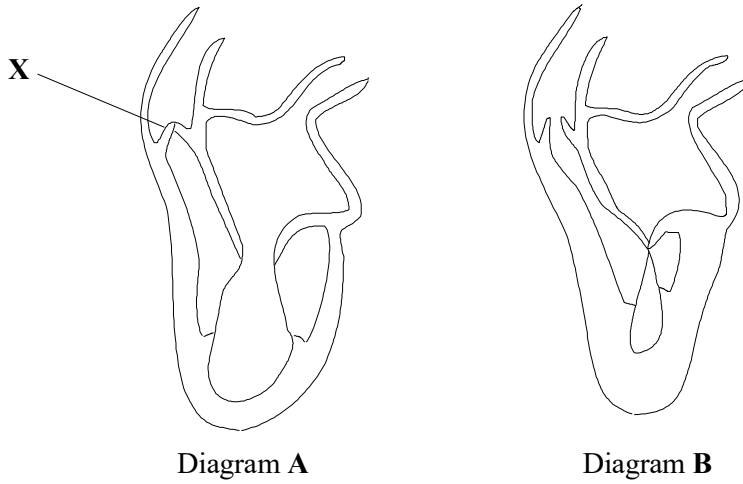
Diagram **A**   Diagram **B**

(a) Name the structure labelled **X.**

    ....

    (1)

(b) Describe **two** pieces of evidence in Diagram **B** which indicate that the ventricle is emptying.

    1 ....

    ....

    2 ....

    ....

    (2)

(c) The cardiac output is the volume of blood that one ventricle pumps out per minute.   The resting heart rate of an athlete often decreases as a result of training, even though the cardiac output remains the same.   Suggest an explanation for this.

    ....

    ....

    (1)

(d)   During exercise the rate of blood flow to heart muscle increases from 270 cm^3 per minute to 750 cm^3 per minute.

    (i)   Calculate the percentage increase in rate of blood flow to heart muscle during exercise. Show your working.

Answer .... %

(2)

    (ii)   Explain the advantage of the increase in the rate of blood flow to heart muscle during exercise.

....

....

....

....

(2)
(Total 8 marks)

11. (a) The graph shows the changes in pressure which take place in the left side of the heart.
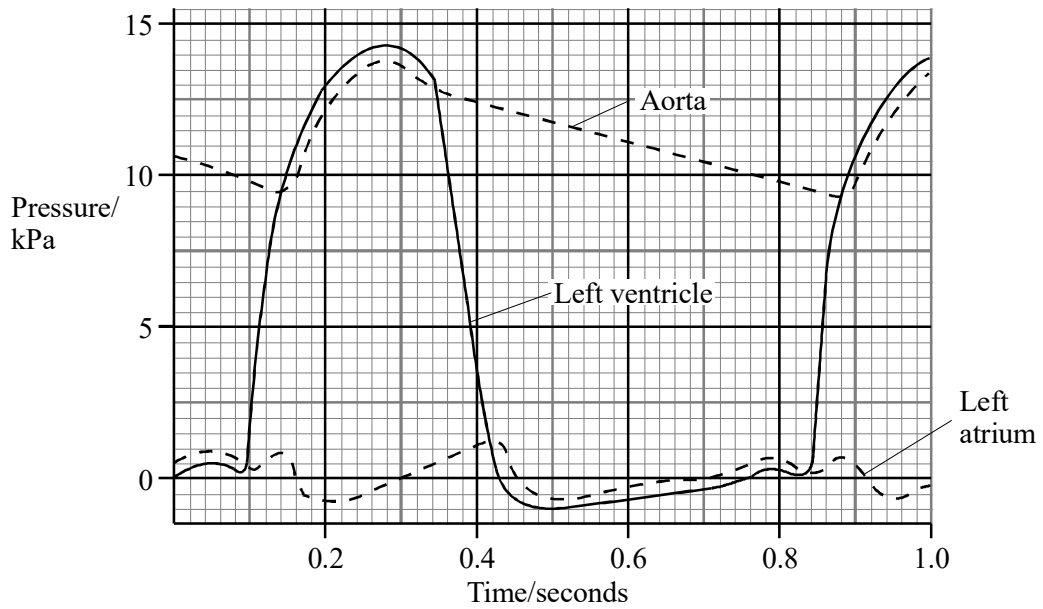
(i) Use the graph to calculate the heart rate in beats per minute. Show your working.

Answer ....

(2)

(ii) The atrioventricular valve closes at 0.1 seconds.
Explain the evidence from the graph which supports this statement.

....

....

(1)

(b) The blood pressure in the aorta is higher than in the pulmonary artery.
Explain what causes the blood pressure in the aorta to be higher.

....

....

(1)
(Total 4 marks)

12. The graph shows changes in pressure in the aorta, left ventricle and left atrium during one heart beat.
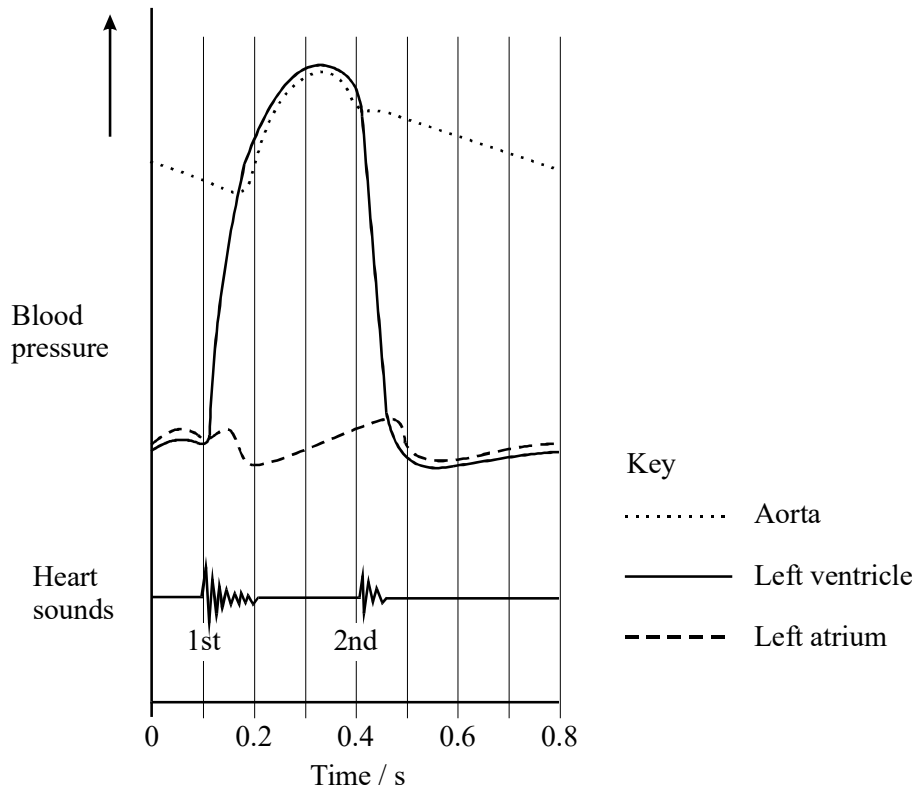
(a) The maximum pressure in the left atrium is lower than the maximum pressure in the left ventricle. What causes this difference in maximum pressure?

....

....

(1)

(b) A stethoscope can be used to listen to the sounds made by the heart.

(i) What is the evidence from the graph that the first heart sound is caused by the atrioventricular valve closing?

....

....

(1)

(ii)   What causes the second heart sound? Give the reason for your answer.

....

....

....

....

(2)
(Total 4 marks)

13.   The diagram shows the pathways in the heart for the conduction of electrical impulses during
the cardiac cycle.

(a)   The table shows the blood pressure in the left atrium, the left ventricle and the aorta at
different times during part of a cardiac cycle.

Time / s	Blood pressure / kPa		
	Left atrium	Left ventricle	Aorta
0.0	0.5	0.4	10.6
0.1	1.2	0.7	10.6
0.2	0.3	6.7	10.6
0.3	0.4	17.3	16.0
0.4	0.8	8.0	12.0

(i)   At which time is blood flowing into the aorta?

        ....…..

(1)

(ii)   Between which times are the atrioventricular valves closed?

        ....…..

(1)

(b)   The maximum pressure in the left ventricle is higher than the maximum pressure in the right ventricle. What causes this difference in pressure?

       ....

       ....

(1)

(c)   The information below compares some features of different blood vessels.

		Blood vessel		
		Artery	**Capillary**	**Vein**
Property	Mean diameter of vessel	4.0 mm	8.0 µm	5.0 mm
	Mean thickness of wall	1.0 mm	0.5 µm	0.5 mm
		Relative thickness (shown by length of bar)		
Tissues present in wall	Endothelium			
	Elastic tissue			
	Muscle			

Use the information to explain how the structures of the walls of arteries, veins and capillaries are related to their functions.

....

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....

(6)
(Total 9 marks)

14. The graph shows the changes in pressure which take place in the aorta of a mouse during several heartbeats.
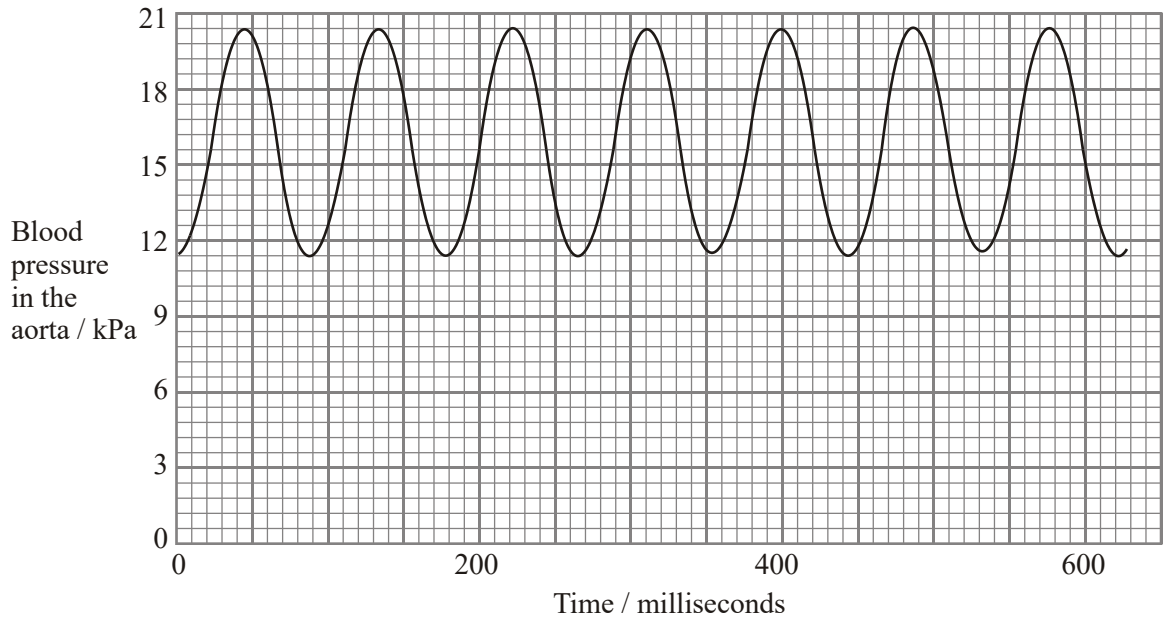
(a) Which chamber of the heart produces the increase in pressure recorded in the aorta?

....

(1)

(b) The pressure of blood in the aorta decreases during each heartbeat but does not fall below 10 kPa. Explain what causes the pressure of blood to

(i) decrease during each heartbeat;

....

....

(1)

(ii) stay above 10 kPa.

....

....

....

....

(2)

(c)   The heart rate of a mouse is much higher than the heart rate of a human. Use the graph to calculate the heart rate of the mouse. Show your working.

Heart rate = ... beats per minute

(2)

(d)   The cardiac output is the volume of blood pumped by a heart in one minute. The stroke volume is the volume of blood pumped by a heart in a single heartbeat.

cardiac output = stroke volume × heart rate

The cardiac output for a mouse with a heart rate of 550 beats per minute is 16.6 cm^3 per minute. Calculate the stroke volume for this mouse. Show your working.

Stroke volume = ... cm^3

(2)
(Total 8 marks)

15. (a) The diagram shows a section through the heart at one stage of the cardiac cycle.
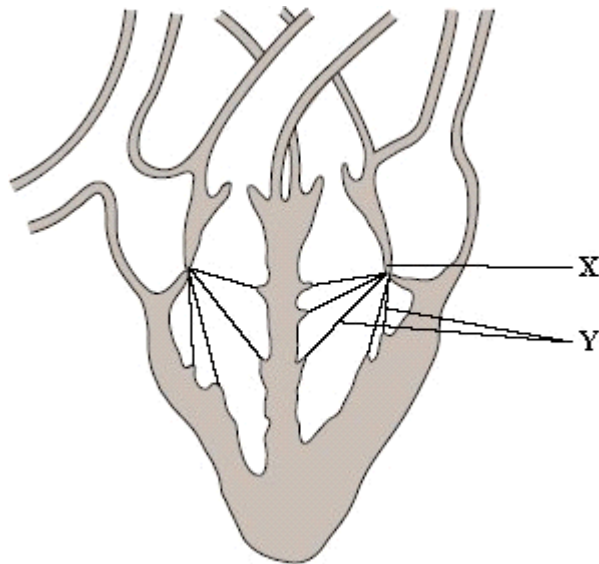
(i) Name the structure labelled **X**.

....

(1)

(ii) Suggest how the structures labelled **Y** help to maintain the flow of blood in one direction through the heart.

....

....

....

....

(2)

(b)   The chart shows the actions of the atria and the ventricles during a complete cardiac cycle. Different stages have been given letters and a time scale added.

Stage		
A	**B**	**C**

Atria	Contract-ing	Relaxing	
Ventricles	Relaxing	Contracting	Relaxing

```
0.0     0.1     0.2     0.3     0.4     0.5     0.6     0.7     0.8
```
Time / seconds
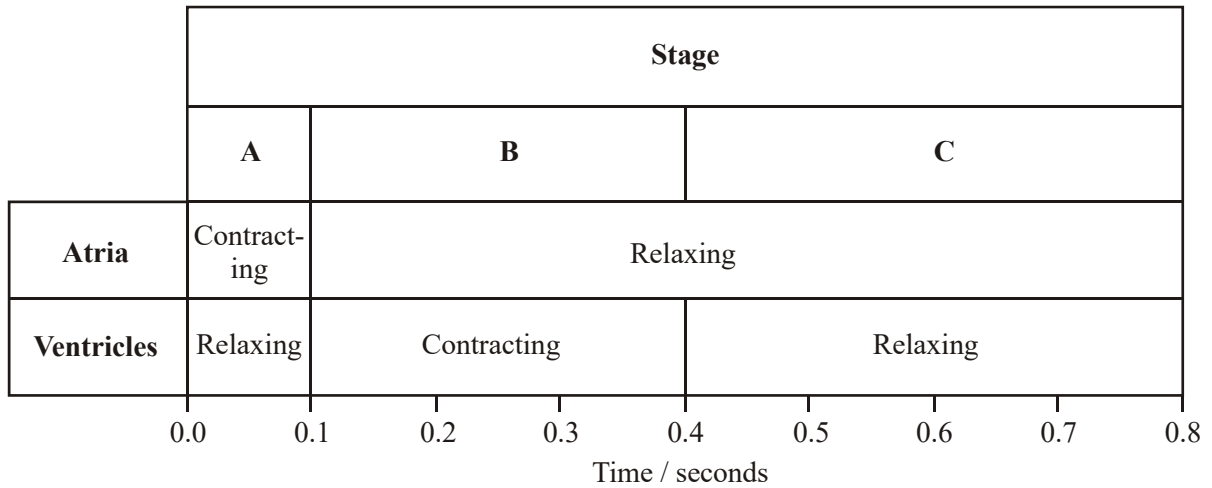
(i)   Give the letter of the stage which is shown in the diagram of the heart.

....

(1)

(ii)   The heart beats for one minute at the rate shown by the chart. Calculate the total time the ventricles are relaxed during one minute. Show your working.

Answer .... seconds

(2)
(Total 6 marks)

16. The graph shows changes in pressure in different parts of the heart during a period of one second.
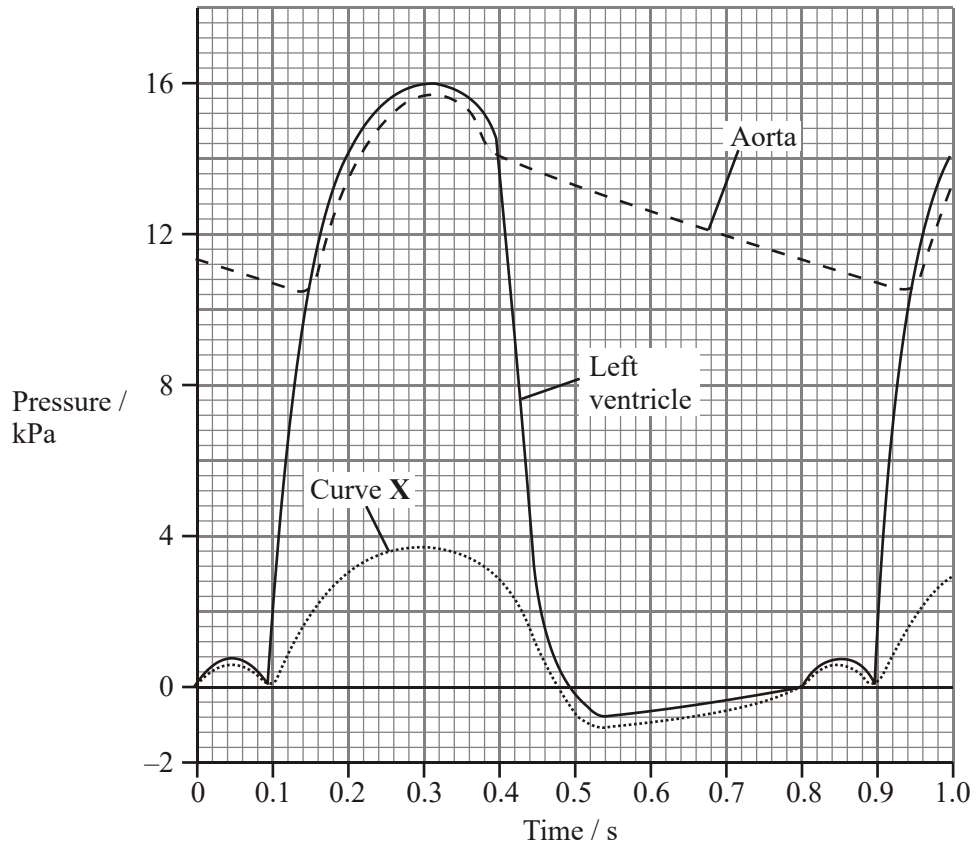
(a)   (i)   At what time do the semilunar valves close?

....

(1)

(ii)   Use the graph to calculate the heart rate in beats per minute.
        Show your working.

Answer .... beats per minute

(1)

(iii) Use the graph to calculate the total time that blood flows out of the left side of the heart during one minute when beating at this rate. Show your working.

Answer .... seconds

(1)

(b) What does curve **X** represent? Explain your answer.

X =...

Explanation ....

....

(2)

(c) The volume of blood pumped out of the left ventricle during one cardiac cycle is called the stroke volume.

The volume of blood pumped out of the left ventricle in one minute is called the cardiac output. It is calculated using the equation

Cardiac output = stroke volume × heart rate

After several months of training, an athlete had the same cardiac output but a lower resting heart rate than before. Explain this change.

....

....

....

....

(2)
(Total 7 marks)

17. (a) Explain the link between atheroma and the increased risk of aneurism.

....

....

....

....

....

....

....

....

(4)

(b) Cigarette smoking and a diet high in saturated fat increase the risk of myocardial infarction. Explain how.

....

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....

....

....

....

(6)
(Total 10 marks)

18. An antigen called PSA is present in the blood of men in the early stages of prostate cancer. There is a blood test for PSA. The test uses monoclonal antibodies to PSA. The stages in the test are shown in the diagram.

Well in
test plate

Antibodies to PSA
bound to well
in test plate

Blood from patient added.
PSA binds to antibody.
Other antigens do not bind

The well is washed
to remove unbound
antigens

Enzyme

Antibody

Antibody with enzyme
attached is added. This
only binds to the first
antibody if PSA is
present

The second antibody
binds to the antibodies
with PSA attached. The
well is washed to remove
unbound antibodies

Colourless substrate
for enzyme added

Enzyme converts
colourless substrate
to coloured product

(a)   (i)   What is an antigen?

....

....

....

....

(2)

(ii)   What is a *monoclonal* antibody?

....

....

....

....

(2)

(b)   (i)   Explain why this test detects prostate cancer, but not any other disease.

....

....

....

....

(2)
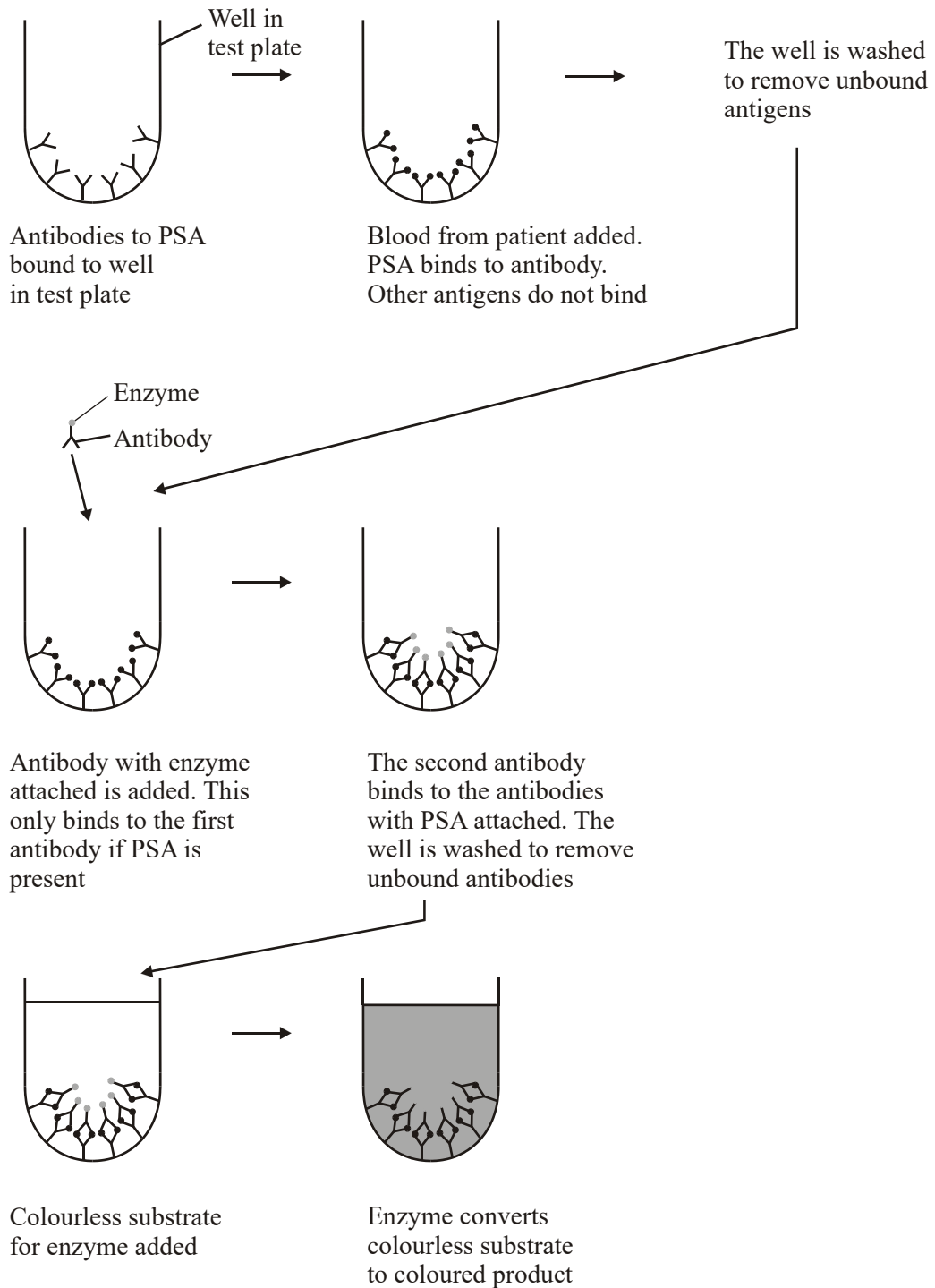
(ii)   Explain why there will not be a colour change if the blood sample does not contain PSA.

....

....

....

....

(2)
(Total 8 marks)

19. (a) (i) Explain the meaning of the term *atheroma*.

....

....

(1)

(ii) Explain why atheroma may lead to a blood clot.

....

....

....

....

(2)

(b) The diagram shows an external view of the heart. The position of a blood clot is marked.
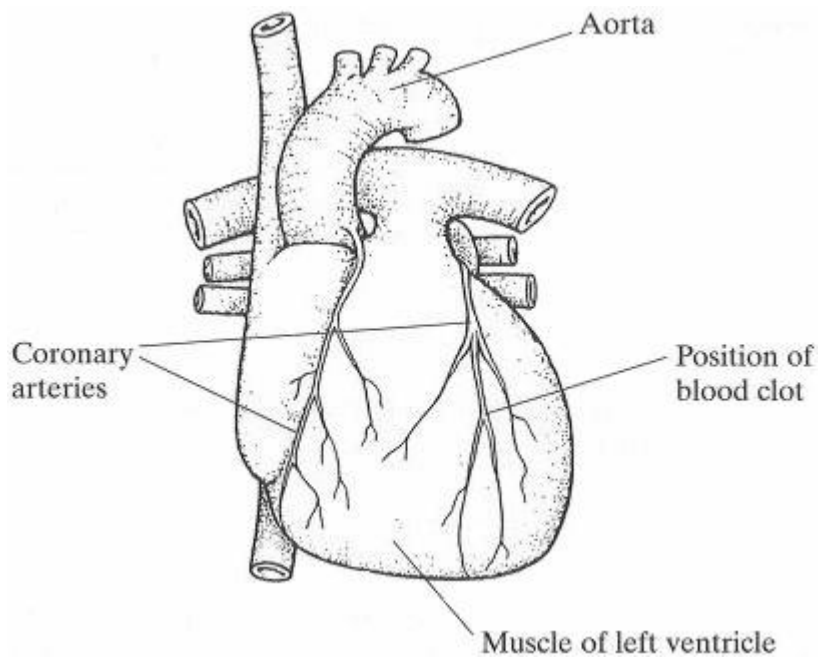
(i) On the diagram, shade the area of the heart muscle which is likely to die as a result of the blood clot.

(1)

(ii)   Explain why this area of the heart muscle is likely to die.

....

....

(1)

(c)   High blood pressure is a risk factor associated with damage to the circulatory system. Suggest **two** ways in which prolonged high blood pressure may affect the arteries.

1 ....………...…...…

...........………..

2 ....………...............................…..

...........………..

(2)
(Total 7 marks)

20.   The photographs show sections through alveoli of healthy lung tissue and lung tissue from a person with emphysema. Both photographs are at the same magnification.

Biophoto Associates, Science Photolibrary
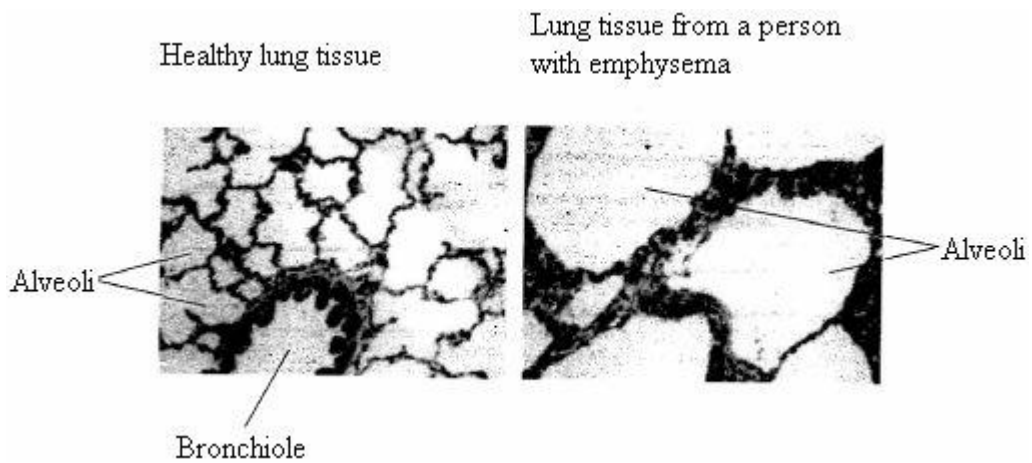
(a)   Give two differences that can be seen between the healthy lung tissue and the lung tissue from the person with emphysema.

1 ....

....

2 ....

....

(2)

(b)   People with emphysema may find it difficult to climb stairs. Explain why.

....

....

....

....

....

....

(3)
(Total 5 marks)

21.   Smoking is a risk factor associated with coronary heart disease. Smoking is known to raise the concentration of fibrinogen in the blood, promote the aggregation of platelets and reduce the ability of arteries to dilate.

Use this information to:

(a)   explain the effect of smoking on blood pressure;

....

....

....

....

(2)

(b)   explain how smoking might lead to the formation of a blood clot.

....

....

....

....

....

....

(3)
(Total 5 marks)

22.   Coronary heart disease is a major cause of death in the western world.

(a)   The diagram shows an external view of a human heart with a blood clot in one of the
main coronary arteries.
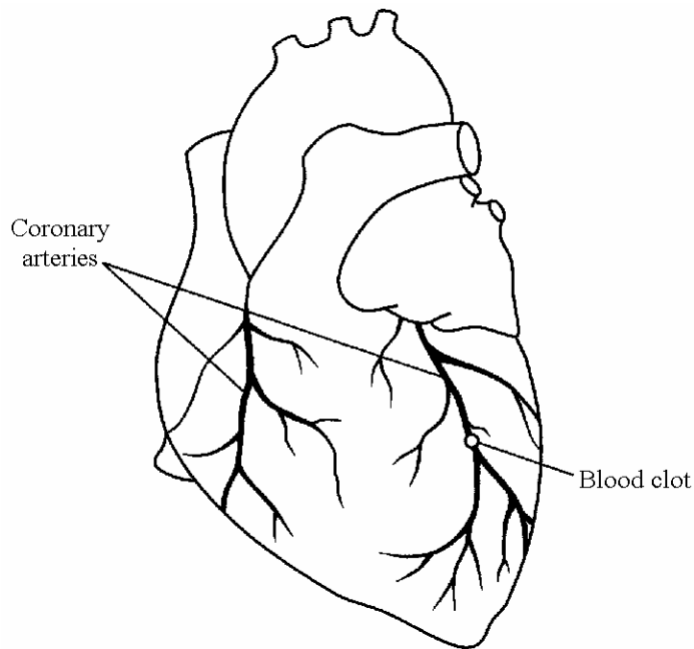
(i) Shade, on the diagram, the area of heart muscle which is likely to receive a reduced supply of blood because of the blood clot.

(1)

(ii) Explain why a blood clot in a coronary artery is likely to result in a heart attack.

....

....

....

....

....

....

(3)

(b) Three important risk factors associated with coronary heart disease are cigarette smoking, high blood pressure and a high plasma cholesterol level. Explain how each of the three factors increases the risk of heart disease

....

....

....

....

....

(6)

(c)   The graph gives information about the effects of cigarette smoking, plasma cholesterol concentrations and high blood pressure on the incidence of heart disease in American men

Key

--------- Smoker: high blood pressure
- - - - - Non–smoker: high blood pressure
- · - · - · - Smoker: low blood pressure
———— Non–smoker: low blood pressure
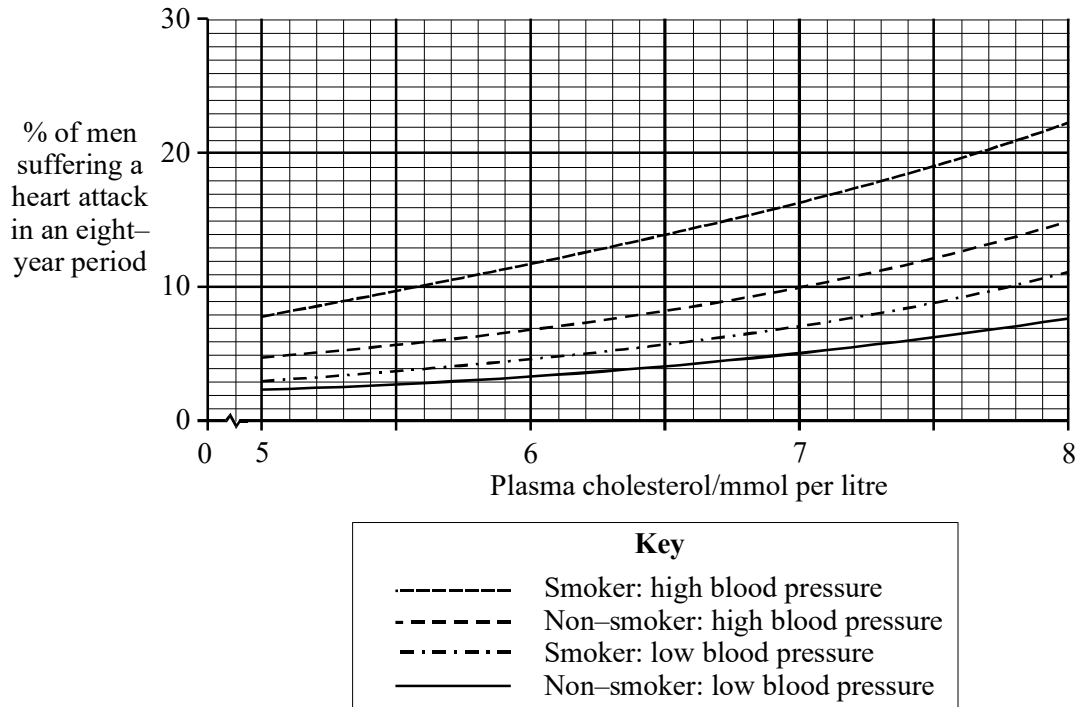
(i)   A non-smoker with low blood pressure has a plasma cholesterol concentration of 5 mmol per litre. Over a period of time this concentration increases to 8 mmol per litre. By how many times has his risk of heart disease increased? Show your working.

Answer...

(2)

(ii) Two non-smoking men with low blood pressure both have plasma cholesterol concentrations of 5 mmol per litre. One of them starts to smoke and the plasma cholesterol concentration of the other increases to 7 mmol per litre. Which man is now at the greater risk from heart disease? Explain your answer.

....

....

....

....

....

....

(3)
(Total 15 marks)

23. Melanoma is a malignant skin cancer. The graph shows the incidence of melanoma in the UK between 1970 and 1990.
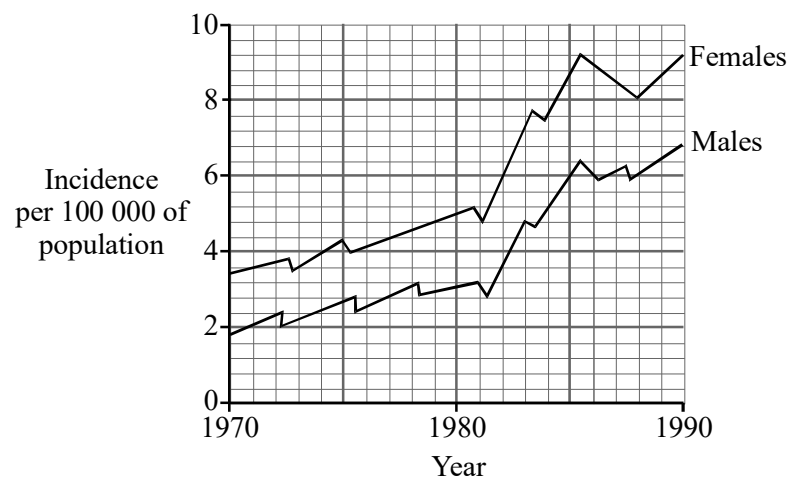
(a)   Explain what is meant by *malignant*.

....

....

....

....

....

(2)

(b)   (i)   Over the period shown, the incidence of melanoma has increased. Give **two** other
                conclusions that can be drawn from the graph, about the incidence of melanoma.

                ....

                ....

                ....

                ....

(2)

        (ii)   In a population of 1 million people where half were male and half were female,
                how many people developed melanoma in 1980? Show your working.

Answer = ...

(2)

(iii) Melanoma is more common in fair-skinned people living in sunny parts of the world than in the UK. Explain why.

....

....

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(2)
(Total 8 marks)

24. The table shows some information about the incidence of high blood pressure and heart attacks in the UK.

Sex	Condition	Percentage of people affected in each age group						
		16-24 years	25-34 years	34-44 years	45-54 years	55-64 years	65-74 years	74-80 years
Male	high blood pressure	0.5	1.5	3.5	6.0	17.0	22.5	18.5
	heart attack			0.1	0.2	1.1	2.4	3.2
Female	high blood pressure	0.7	1.6	3.8	7.8	20.5	27.9	26.9
	heart attack			0.1	0.3	0.6	0.7	1.8

(a) Use the pattern of data in the table to describe:

(i) **two** similarities between males and females;

1 ....

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2 ....

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(ii)   **two** differences between males and females.

1 ....

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2 ....

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(4)

(b)   People have been advised to reduce their cholesterol intake as a part of a healthy life style. The graph shows information about mean daily intake of cholesterol.
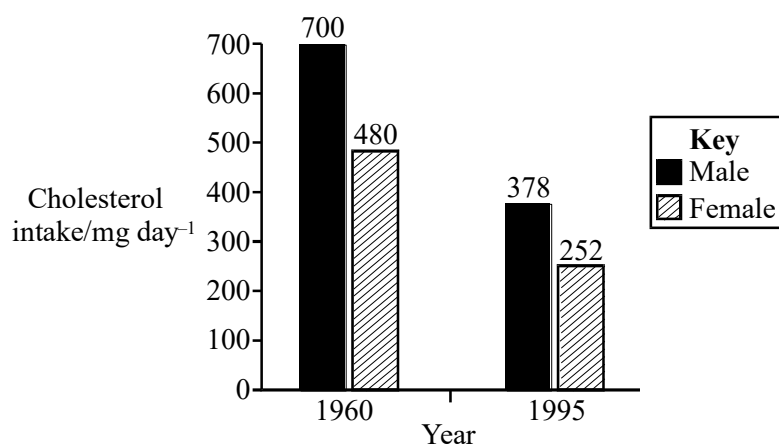
Calculate which group, male or female, shows the greater percentage reduction in cholesterol intake between 1960 and 1995. Show your working.

(2)

(c)   Explain how smoking and a high blood cholesterol concentration increase the risk of developing coronary heart disease.

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(6)
(Total 12 marks)

25.   (a)   What is *atheroma*?

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(2)

(b)   Describe how atheroma can lead to an aneurysm.

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(2)
(Total 4 marks)

26.   The table shows the number of deaths from various causes in a group of individuals of the same age. Individuals were identified as smokers or non-smokers.

Cause of Death	Number of deaths among smokers	Number of deaths among non-smokers
Total deaths (all causes)	7316	4651
Coronary artery disease	3361	1973
Strokes	556	428
Aneurysm	86	29
Lung cancer	397	37
Other causes	2916	2184

(a)   Why was it necessary for the smokers and the non-smokers to be the same age?

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(2)

(b)   Do the figures in the table show that smokers were more likely to have died from a stroke than non-smokers? Use suitable calculations to support your answer.

(3)

(c)   The bar chart shows the risk of developing lung cancer in relation to the number of cigarettes smoked per day before stopping, and the number of years since giving up smoking.
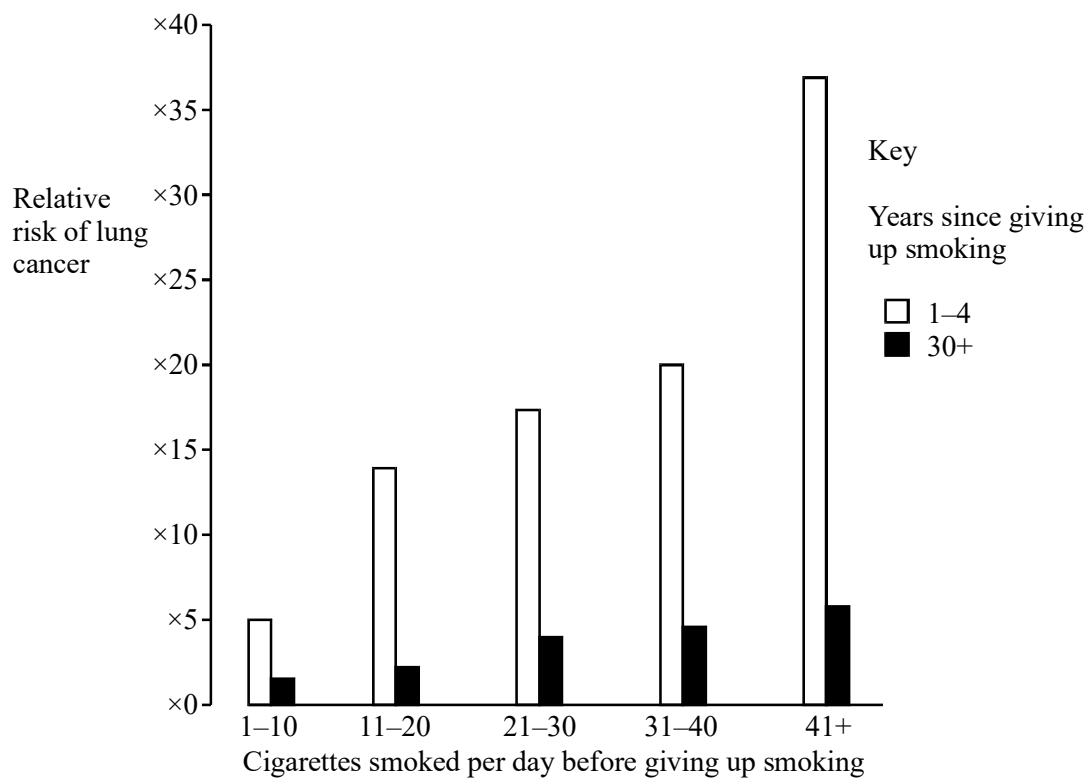
(i)   Give **two** conclusions that can be drawn from the information in the bar chart.

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(2)

(ii)   Explain what is meant by "relative risk" on the y-axis of the bar chart.

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(2)

(d)   Explain what is meant by a malignant tumour and describe how exposure to cigarette
smoke may result in the formation of a malignant tumour.

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(6)
(Total 15 marks)

27.   (a)   (i)   What is an *antigen*?

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(2)

(ii) Myeloid leukaemia is a type of cancer. Monoclonal antibodies are used in treating it. A monoclonal antibody will bind to an antigen on a myeloid leukaemia cell. It will not bind to other types of cell. Explain why this antibody binds only to an antigen on a myeloid leukaemia cell.

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(2)

(b) Calichaemicin is a substance which is very toxic and kills cells. Scientists have made a drug by joining calichaemicin to the monoclonal antibody that attaches to myeloid leukaemia cells. Explain why this drug is effective in treating myeloid leukaemia.

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(2)
(Total 6 marks)

28.
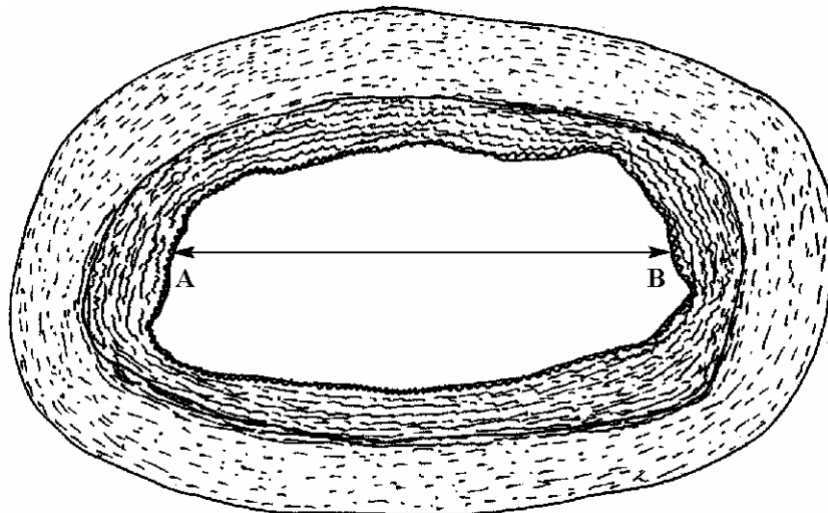
Figure 1

(a) **Figure 1** shows a section through a healthy coronary artery. The actual diameter of the lumen of the artery along line AB is 1.94 mm. Explain how you would calculate the magnification of this drawing.

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(1)

(b) **Figure 2** shows a section through a coronary artery from a person with atheroma.
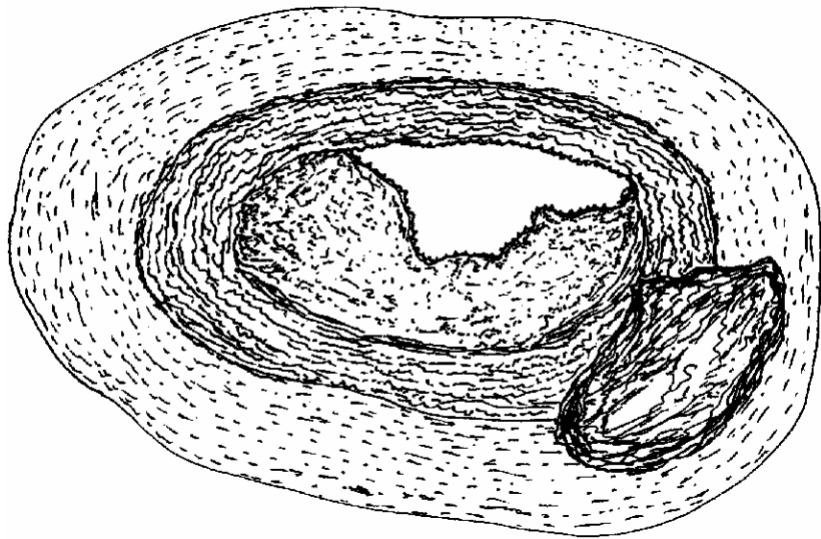
Figure 2

(i) Give **two** ways in which the artery of the person with atheroma differs from the artery of the healthy person.

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(2)

(ii)   Describe and explain how atheroma can lead to myocardial infarction.

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(3)
(Total 6 marks)

29.   (a)   Some tumours are benign and some are malignant.

(i)   Give **one** way in which a benign tumour differs from a malignant tumour.

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(1)

(ii)   Describe **two** ways in which both types of tumour may cause harm to the body.

1 ....

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2 ....

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(2)

(b)   (i)   Explain the link between sunbathing and skin cancer.

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(2)

(ii) Suggest why fair-skinned people are at a greater risk of skin cancer than dark-skinned people when sunbathing.

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(1)

(iii) Suggest why people with a family history of cancer are at a greater risk of cancer than those with no family history of cancer.

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(1)
(Total 7 marks)

30. Lung cancer, chronic bronchitis and coronary heart disease (CHD) are associated with smoking. **Tables 1** and **2** give the total numbers of deaths from these diseases in the UK in 1974.

Table 1 Men

Age/years	Number of deaths (in thousands)		
	lung cancer	chronic bronchitis	coronary heart disease
35 - 64	11.5	4.2	31.7
65 - 74	12.6	8.5	33.3
75+	5.8	8.1	29.1
Total (35 - 75+)	29.9	20.8	94.1

Table 2 Women

Age/years	Number of deaths (in thousands)		
	lung cancer	chronic bronchitis	coronary heart disease
35 - 64	3.2	1.3	8.4
65 - 74	2.6	1.9	18.2
75+	1.8	3.5	42.3
Total (35 - 75+)	7.6	6.7	68.9

(a) (i) Using an example from the tables, explain why it is useful to give data for men and women separately.

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(2)

(ii) Data like these are often given as percentages of people dying from each cause. Explain the advantage of giving these data as percentages.

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(2)

(b)   Give **two** factors, other than smoking, which increase the risk of coronary heart disease.

Factor 1 ....

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Factor 2 ....

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(2)
(Total 6 marks)

31. An antigen called PSA is present in the blood of men in the early stages of prostate cancer. There is a blood test for PSA. The test uses monoclonal antibodies to PSA. The stages in the test are shown in the diagram.

Well in test plate

Antibodies to PSA bound to well in test plate

Blood from patient added. PSA binds to antibody. Other antigens do not bind

The well is washed to remove unbound antigens

Enzyme

Antibody

Antibody with enzyme attached is added. This only binds to the first antibody if PSA is present

The second antibody binds to the antibodies with PSA attached. The well is washed to remove unbound antibodies

Colourless substrate for enzyme added

Enzyme converts colourless substrate to coloured product

(a) (i) What is an antigen?

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(2)

(ii) What is a *monoclonal* antibody?

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(2)

(b) (i) Explain why this test detects prostate cancer, but not any other disease.

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(2)

(ii) Explain why there will not be a colour change if the blood sample does not contain PSA.

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(2)
(Total 8 marks)

32. (a) Describe how atheroma may form and lead to a myocardial infarction.

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(6)

(b) The bar chart shows the number of males aged 19-64 admitted to English hospitals with a myocardial infarction within five days of the England football team losing to Argentina by penalty shoot-out in the 1998 World Cup.

(i) Suggest how the expected number of admissions might have been calculated.

PMT

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(2)

(ii)   Describe the difference between the observed and expected numbers of males experiencing a myocardial infarction over the six days.

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(2)

(c)   Explain how repeated stress, such as that involved in watching a penalty shoot-out, may lead to a myocardial infarction.

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(2)

(d)   A group of male football supporters was shown a video recording of a football match.
At the end of the first half, they were each given a beta blocker. The graph shows the
heart rate of a typical individual from the investigation.
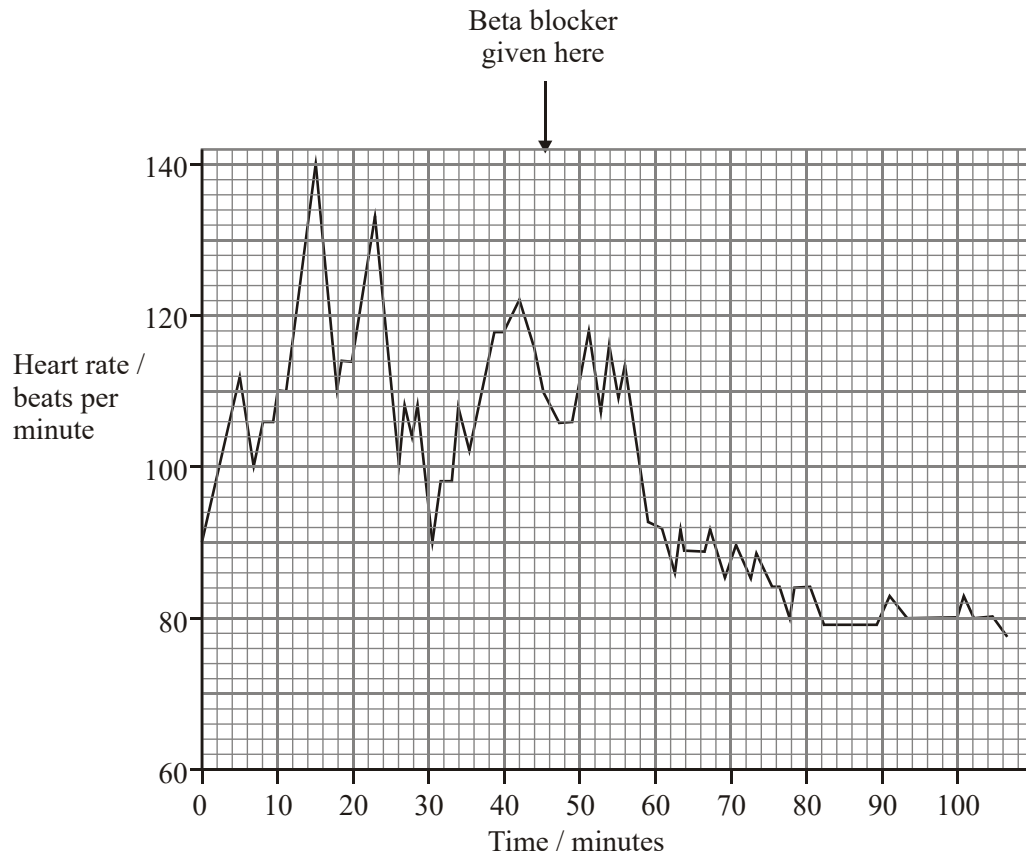
Describe and explain the effect of the beta blocker on the heart rate of this person.

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(3)
(Total 15 marks)

33. (a) Describe how an atheroma is formed and how it can lead to a myocardial infarction.

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(6)

(b) Warfarin is a drug that inhibits blood clotting. A trial was carried out using 508 patients aged 30 or over who were at risk of thrombosis. They were randomly assigned to two groups. One group received warfarin and a control group received a dummy pill containing no medication (a placebo). The results obtained were as follows:

Treatment	Number in group	Number developing thrombosis after treatment was started
Warfarin	255	14
Placebo	253	37

(i)   Explain what is meant by *randomly* assigning patients into two groups.

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(1)

(ii)   Why is it necessary for the control group to receive a placebo instead of warfarin?

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(1)

(iii) Calculate the reduction in percentage risk of thrombosis for the patients given warfarin. Show your working.

(2)

(c) The graph shows the clotting time for samples of blood which have had different amounts of heparin added.
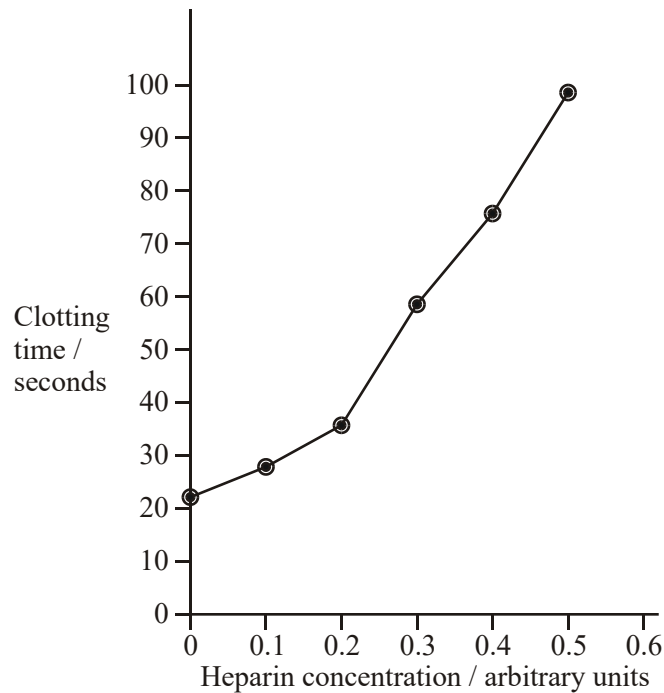
(i) Describe the effect of adding heparin to samples of blood.

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(2)

(ii) Heparin is added to samples of blood used for blood transfusion. This stops clots forming. Explain why it is important that blood used for transfusion does not introduce blood clots into the patient.

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(1)
(Total 13 marks)

34. Read the following passage.

Herpes viruses cause cold sores and, in some cases, genital warts. Scientists are well on the way to producing an antibody which will counteract herpes infection. This antibody works by sticking to the virus and blocking its entry into cells. It has proved very effective in animal tests.

5   One drawback with this approach, however, is that antibodies are at present produced using hamster ovary cells. This method is expensive and only produces limited amounts. A new technique is being developed to produce antibodies from plants. It involves introducing the DNA which codes for the required antibody into crop plants such as maize.

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

(a)   (i)   What is an antibody?

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(2)

(ii)   Describe how antibodies are produced in the body following a viral infection.

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(6)

(b)　Describe how the antibody gene could be isolated from an animal cell and introduced into a crop plant such as maize (lines 7-8).

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(4)

(c)　Taking a course of these antibodies from plants to treat a herpes infection would not produce long-term protection against disease. Explain why.

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(2)

(d)　Explain **one** advantage of using antibodies from plants to treat a disease, rather than antibodies produced in an experimental animal (lines 5-6).

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(1)
(Total 15 marks)

35. (a) Describe how atheroma is caused and how it may result in a myocardial infarction.

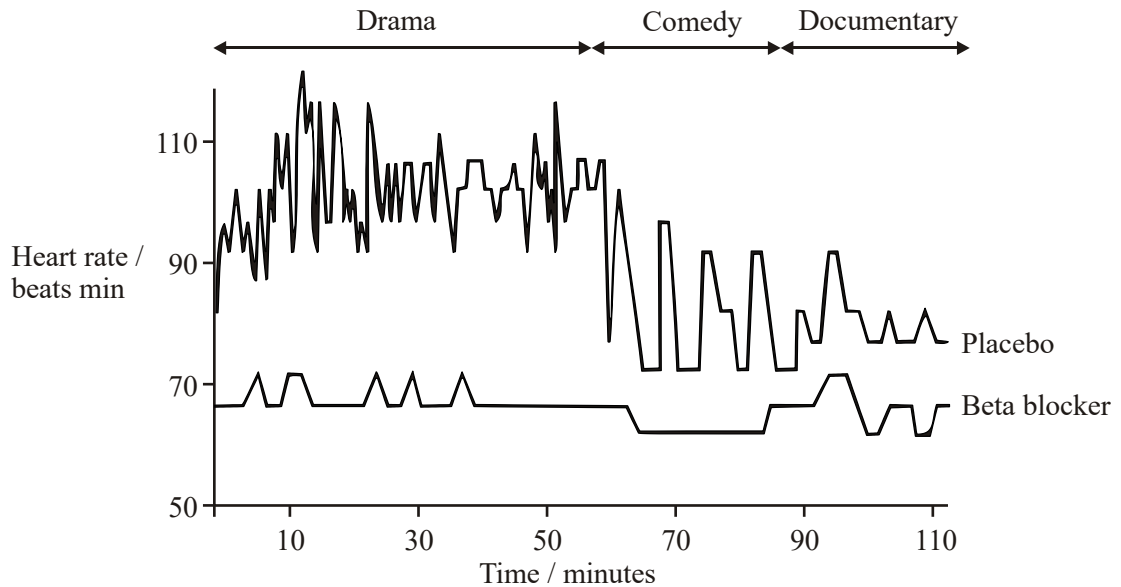..

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(6)

(b)   The graph shows the heart rates of two men with hypertension. They were watching television. One of the men had taken a beta blocker and the other had taken a placebo (dummy pill).

(i)   Use the graph to describe the effects of the beta blocker on heart rate.

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(2)

(ii) In this investigation, it was important that neither man knew which type of pill he had taken. Suggest why.

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(1)

(c)   The table shows the results of an investigation into the effects of prescribing beta
blockers to patients who had suffered a myocardial infarction.

Patient age at time of myocardial infarction / years	Under 60	60 – 69
Percentage reduction in mortality within the next 2 years compared with groups who had taken a placebo		

(i)   Give **one** conclusion which may be drawn from these data.

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(1)

(ii)   Explain how the percentage reduction in mortality would have been calculated.

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(2)
(Total 12 marks)

36.   (a)   Explain the link between atheroma and the increased risk of aneurism.

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(4)

(b) Cigarette smoking and a diet high in saturated fat increase the risk of myocardial infarction. Explain how.

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(6)
(Total 10 marks)

37. (a) (i) What is atheroma?

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(2)

(ii)   Atheroma makes it more likely that a blood clot will form. Describe how a blood clot may lead to a myocardial infarction.

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(3)

(b)   The graph shows the relationship between the amount of dairy fat eaten and the deaths from coronary heart disease (CHD) in different countries.

Number of deaths per 100 000 from coronary heart disease

Amount of dairy fat eaten per day / g
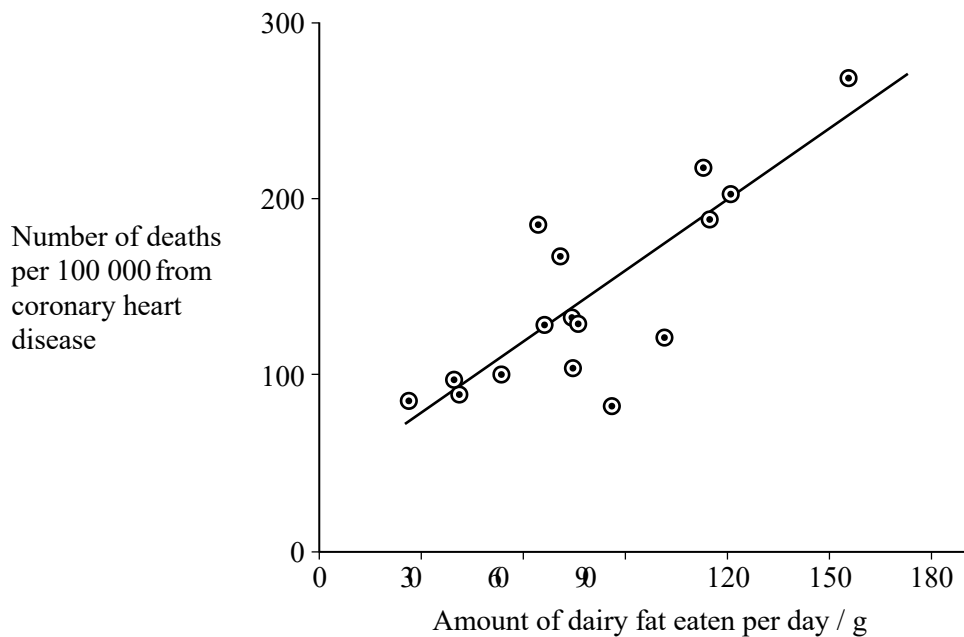
(i)   The number of deaths is given per 100 000 people. Explain why.

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(2)

(ii)   Does the evidence from the graph show that eating dairy fat causes coronary heart
       disease? Explain your answer.

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(2)
(Total 9 marks)

38. (a)   The sinoatrial node (SAN) is in the right atrium of the heart. Describe the role of the
              sinoatrial node.

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(2)

Ten years ago, a woman was found to have a high concentration of cholesterol in her blood. As a result, she was put on a special diet. She has been on this diet ever since. Four years after starting the diet, she started taking a drug to lower her blood cholesterol. The graph shows the concentration of cholesterol in her blood over the ten-year period.
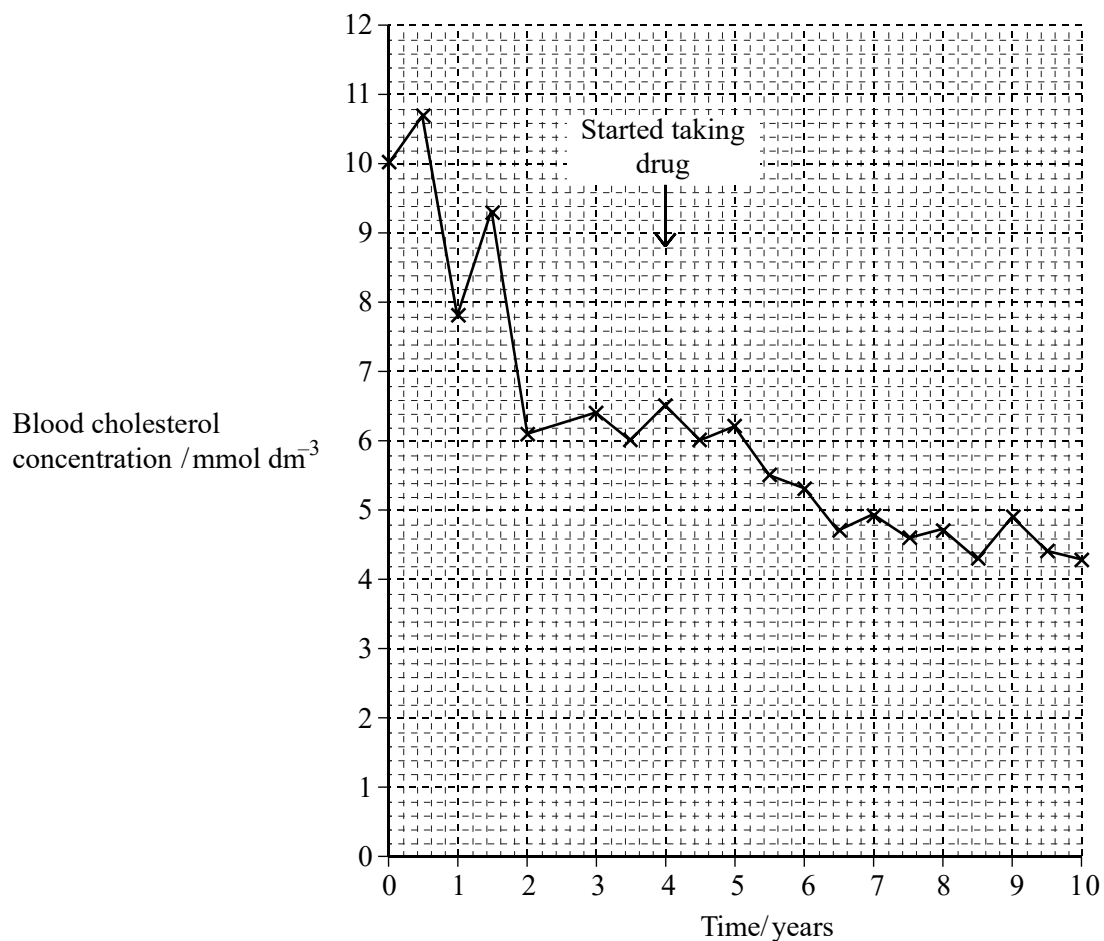
(b)   Describe how the concentration of cholesterol in her blood changed over the ten-year period.

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(2)

(c) Explain the overall change in cholesterol concentration in the blood in the first two years.

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(2)

(d) Use the graph to evaluate the success of the special diet and of the drug in reducing the risk of coronary heart disease.

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(2)
(Total 8 marks)

39. (a) A thin surface and a diffusion gradient are both features of gas exchange surfaces. Describe how these are achieved at the gas exchange surfaces of

(i) a mammal;

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(3)

(ii)   a leaf.

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(3)

(b)   Explain how excess water loss from the gas exchange surface is prevented in

(i)   a mammal;

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....

(ii)   a leaf.

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(2)
(Total 8 marks)

40. Peeled potatoes were cut into two sizes of cubes - $1cm^3$ ($1cm \times 1cm \times 1cm$) and $27cm^3$ ($3cm \times 3cm \times 3cm$). After weighing, twenty-seven of the $1cm^3$ cubes were placed in one beaker of distilled water, and one $27cm^3$ cube was placed in another beaker. One hour later the cubes were removed and their surfaces carefully dried. They were then reweighed. The results are shown in the table.

	Small cubes	**Large cube**
Volume of cube / cm^3	1	27
Surface area of cube / cm^2	6	54
Number of cubes in beaker	27	1
Surface area : volume ratio of one cube		
Total mass of cubes at start / g	52.75	52.97
Total mass after 1 hour in water / g	55.31	53.55
Increase in mass / g	2.56	0.58
Percentage increase in mass		

(a) Complete the table to show

   (i) the surface area : volume ratio for each size of cube;

   (ii) the percentage increase in mass after 1 hour in water.

   (2)

(b) (i) Why did the experimenter use twenty-seven small cubes?

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   (1)

(ii)   Explain, in terms of water potential, why the potato cubes increased in mass when placed in the distilled water.

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(2)

(iii)   The percentage increase in mass of the smaller cubes was greater than the percentage increase in mass of the large cube.   Explain the difference.

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(1)
(Total 6 marks)

41.   Read the following passage.

Several diseases are caused by inhaling asbestos fibres. Most of these
diseases result from the build up of these tiny asbestos fibres in the lungs.

One of these diseases is asbestosis. The asbestos fibres are very small and
enter the bronchioles and alveoli. They cause the destruction of phagocytes
and the surrounding lung tissue becomes scarred and fibrous. The fibrous   5
tissue reduces the elasticity of the lungs and causes the alveolar walls to
thicken. One of the main symptoms of asbestosis is shortness of breath
caused by reduced gas exchange.

People with asbestosis are at a greater risk of developing lung cancer. The time
between exposure to asbestos and the occurrence of lung cancer is 20–30 years.   10

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

(a)   Destruction of phagocytes (lines 4–5) causes the lungs to be more susceptible to infections. Explain why.

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(2)

(b)   (i)   The reduced elasticity of the lungs (lines 6–7) causes breathing difficulty. Explain how.

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(2)

(ii)   Apart from reduced elasticity, explain how changes to the lung tissue reduce the efficiency of gas exchange.

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(4)

(c) (i) Doctors did not make the link between exposure to asbestos and an increased risk of developing lung cancer for many years. Use information in the passage to explain why.

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(1)

(ii) Give **one** factor, other than asbestos, which increases the risk of developing lung cancer.

....

(1)
(Total 10 marks)

42. (a) Give **two** features common to the gas exchange surfaces of bony fish and of mammals, and explain how each feature allows rapid and efficient uptake of oxygen.

Feature 1 ....

Explanation ....

....

Feature 2 ....

Explanation ....

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(2)

(b)   **Graph 1** shows how lung volume of a human changes during inspiration and expiration.
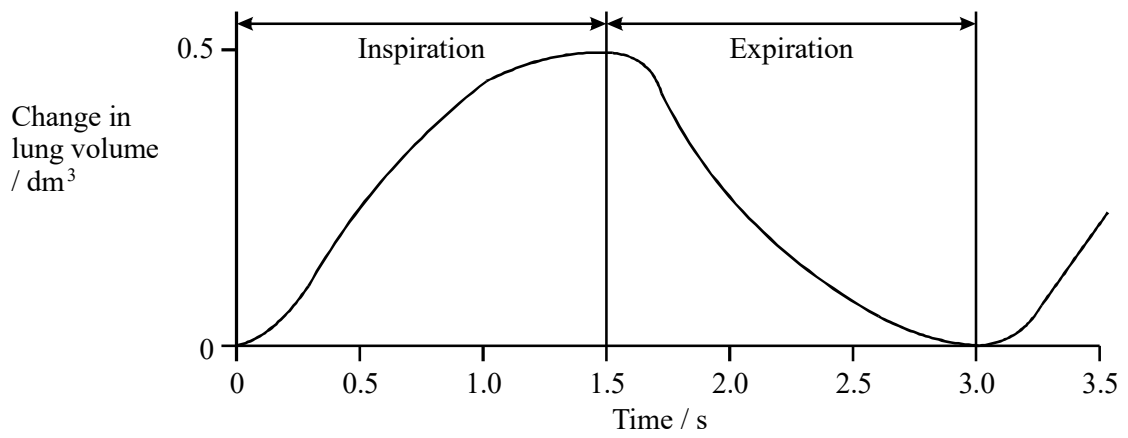
Graph 1

(i)   Sketch, on **Graph 2**, a curve to show the changes in alveolar pressure during inspiration.
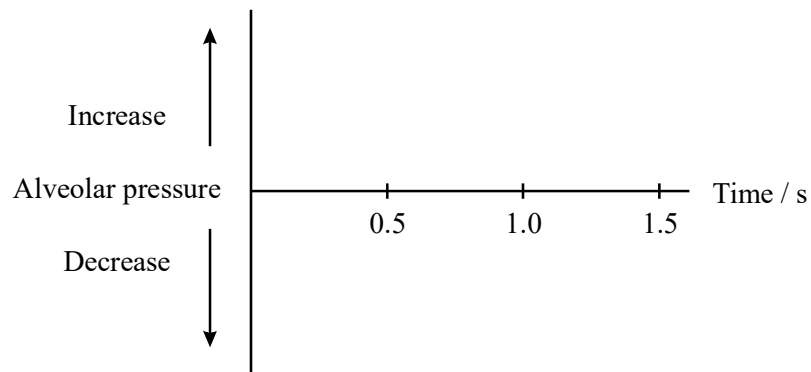
Graph 2

(2)

(ii)   Use **Graph 1** to calculate the rate of breathing in breaths per minute.

Answer ……………………… breaths per minute

(1)
(Total 5 marks)

43. The drawing shows some of the structures involved in ventilating human lungs.
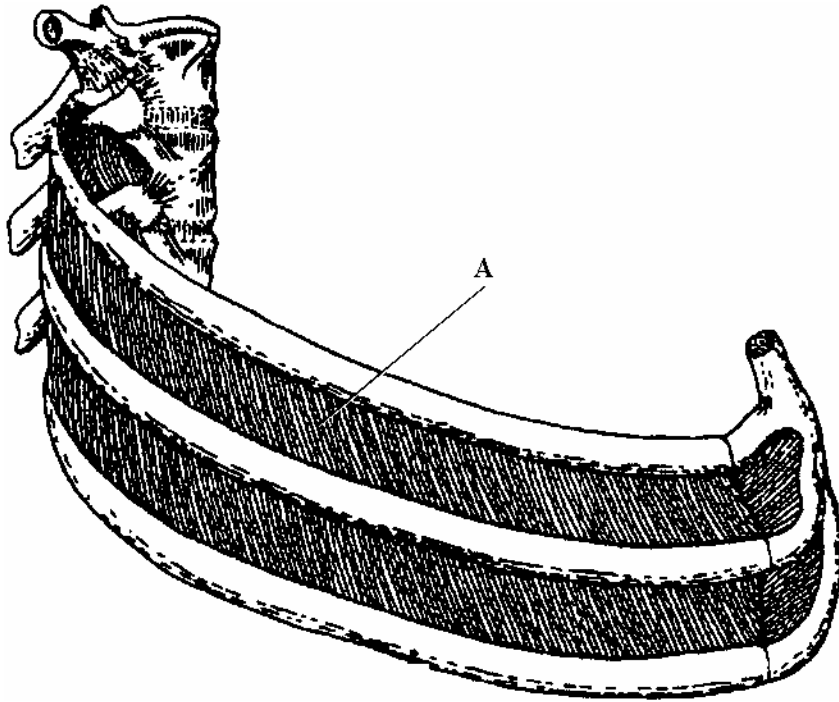
(a) Name structure **A** ....

(1)

(b) (i) Describe the role of structure **A** in inspiration.

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(3)

(ii)   Explain how ventilation increases the rate of gas exchange in the alveoli.

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(2)
(Total 6 marks)

44.   Some South American earthworms seem to have attained the maximum size allowed by the
laws of physics and physiology for land-dwelling earthworms. They are about 2.5 cm in
diameter and 2 m in length.

Earthworms obtain their oxygen by diffusion through the skin. The maximum amount of
oxygen that can enter the bloodstream is 0.06 cm^3 of oxygen per cm^3 of worm per hour.

Assuming the worm is moderately active, this is just sufficient to meet the respiratory needs of
an earthworm 2.5 cm in diameter.

(a)   Apart from the number of blood vessels, explain **one** way in which an earthworm's skin
is adapted for efficient gas exchange.

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(2)

(b) Oxygen diffuses through the whole surface of an earthworm's skin.
Calculate the maximum volume of oxygen absorbed in one hour by a worm 1m in length
and 2.5 cm in diameter. Assume that the shape of the worm is a perfect cylinder. The
formula for the volume of a cylinder is $\pi r^2 l$ where r is the radius of the cylinder and l its
length. Show your working. ($\pi = 3.14$)

Volume of oxygen .... cm^3

(2)

(c) Some aquatic worms have "feathery" external gills, richly supplied with blood vessels.
Explain how these gills increase the theoretical maximum size attainable by an aquatic
worm.

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(2)
(Total 6 marks)

45. (a) Describe how air is taken into the lungs.

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(3)

The volume of air breathed in and out of the lungs during each breath is called the tidal volume. The breathing rate and tidal volume were measured for a cyclist pedalling at different speeds. The graph shows the results.
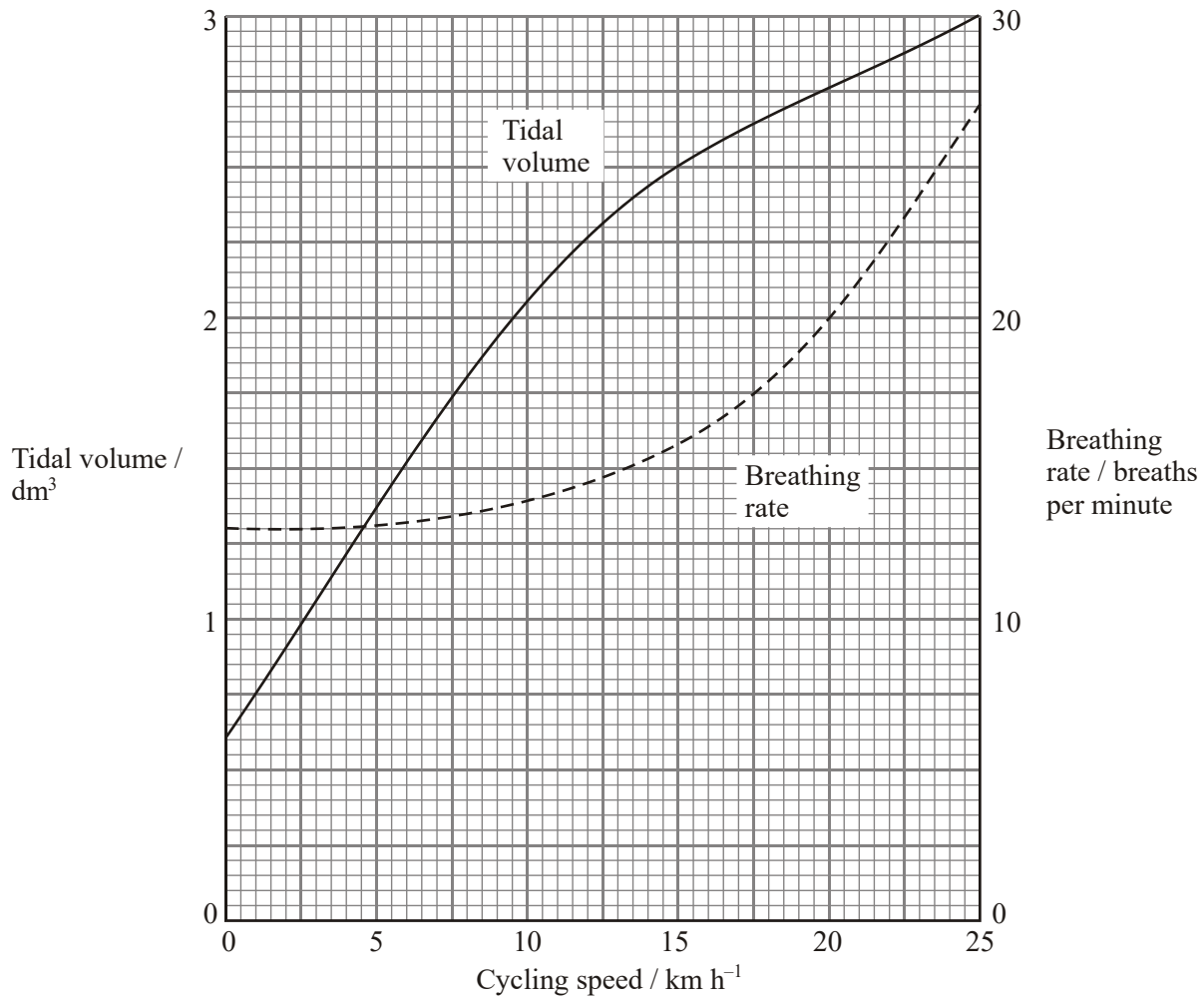
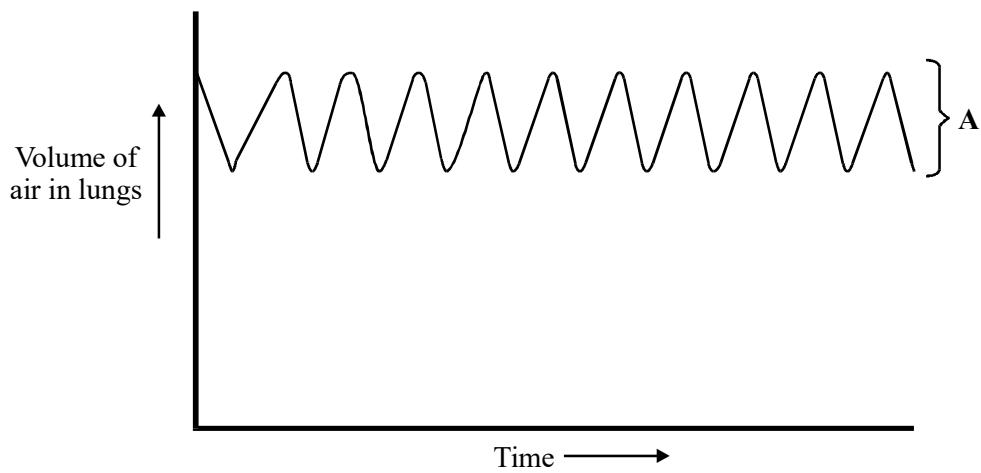
(b)   Describe the **two** curves.

(i)   Tidal volume ....

....

....

(ii)   Breathing rate ....

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....

(2)

(c)   Calculate the total volume of air breathed in and out per minute when the cyclist is cycling at 20 km h^{-1}. Show your working.

.... dm^3

(2)
(Total 7 marks)

46.   The graph shows the pattern of breathing in a person sitting at rest.

(a)   (i)   What is the name given to the volume of air labelled **A**?

....

(1)

(ii)   Explain how you would calculate the volume of air taken into the lungs in one minute.

....

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(1)

One way in which hospitals test how well the lungs are working is to measure the gas transfer factor. This is done by measuring the uptake of carbon monoxide from a single breath of air containing 0.3% carbon monoxide.

(b) (i) By what process would carbon monoxide pass from the air in the alveoli to the blood in the lung capillaries?

....

(1)

(ii) Suggest why carbon monoxide is used for this test.

....

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(2)

(c) Interstitial lung disease is a disease in which the alveolar walls become thicker. Explain why the gas transfer factor would be low in a person who had interstitial lung disease.

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(1)
(Total 6 marks)

47. Fick's law shows how some factors affect the rate of diffusion.

$$\text{Rate of diffusion is proportional to } \frac{\text{surface area} \times \text{difference in concentration}}{\text{thickness of exchange surface}}$$

(a) Describe **one** adaptation of the alveolar epithelium which allows efficient diffusion.

....

....

(1)

(b)   Emphysema is a condition in which the walls between the alveoli break down and enlarge
        the air spaces. The blood of a person with emphysema contains a higher concentration of
        carbon dioxide than the blood of a healthy person. Use Fick's law to explain why.

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                                                                                                                               (2)

(c)   The table shows some measurements made on people living at two different altitudes.

Altitude/m	Concentration of oxygen in blood in arteries/ cm^3 per 100 cm^3	Number of red blood cells in 1 mm^3 of blood
150	18.3	5.3×10^6
3700	19.9	5.9×10^6

        (i)   The concentration of oxygen in the blood in the arteries of people living at 3700m
                is higher than in the arteries of people living at 150 m. Use the information in the
                table to explain why.

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                                                                                                                               (2)

(ii)   People who move from low to high altitude are often breathless at first.
Suggest why this breathlessness disappears after living at high altitude for several
weeks.

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(2)
(Total 7 marks)

48.   (a)   Fick's law describes the effects of various factors on the rate of diffusion. These factors
are:

$$A = \text{surface area}$$
$$(C_1 - C_2) = \text{difference in concentration}$$
$$t = \text{thickness of exchange surface}$$

Use A, $(C_1 - C_2)$ and t to complete the equation representing Fick's law.

Rate of diffusion is proportional to   ————————————

(1)

(b)   (i)   There are about 150 000 000 alveoli in a human lung. Explain how this makes gas
exchange very efficient.

....

....

(1)

(ii) The capillaries in the lungs are very small in diameter. As a result, blood travels through them slowly. Explain **two** ways in which the small diameter of the capillaries results in the efficient transfer of oxygen from the alveoli to the red blood cells.

1 ....

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2 ....

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(3)

(c) During a breath, little of the air contained in alveoli at the top of the lungs is replaced. Explain how this makes gas exchange inefficient in these alveoli.

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(2)
(Total 7 marks)

49. (a) Describe how muscles in the thorax (chest) cause air to enter the lungs during breathing.

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(3)

(b) An athlete exercised at different rates on an exercise bicycle. The table shows the effects of exercise rate on his breathing rate and tidal volume.

Exercise rate / arbitrary units	Breathing rate / breaths minute^{-1}	Tidal volume / dm^3
0	14.0	0.74
30	15.1	1.43
60	15.3	1.86
90	14.5	2.34
120	15.1	2.76
150	14.8	3.25
180	21.5	3.21
210	25.7	3.23

(i) The athlete cycled at the particular exercise rate for 5 minutes before the relevant readings were taken. Explain why the readings were taken only after the athlete had been cycling for 5 minutes.

....

....

(1)

(ii) Calculate the total volume of air taken into the lungs in one minute at an exercise rate of 120 arbitrary units.

Volume of air = ...

(1)

(iii) Give **two** conclusions that can be drawn from the figures in the table.

1 ....

....

2 ....

....

(2)
(Total 7 marks)

50. Gas exchange surfaces allow efficient diffusion of gases. Fick's law states:

Rate of diffusion is proportional to $\dfrac{\text{surface area} \times \text{difference in concentration}}{\text{thickness of exchange surface}}$

(a) In the gill of a fish, describe how

(i) a large surface area is provided;

....

....

(1)

(ii) a concentration gradient is maintained.

....

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(2)

(b)   Land-dwelling insects lose water from their gas exchange surface. Use Fick's law to explain why they lose less water when the air is humid.
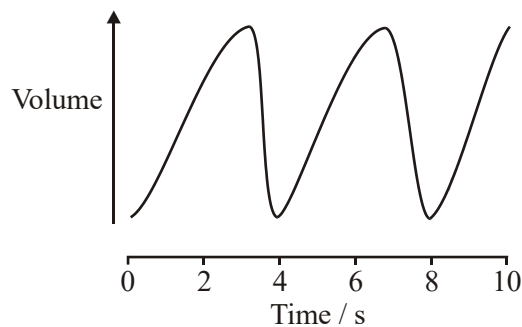
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(2)
(Total 5 marks)

51.   A person was sitting at rest and breathing normally. A recording was made of the changes in the volume of air in his lungs over a ten-second period. The diagram shows this recording.

(a)   Describe the part played by muscles in bringing about the change between 3 and 4 seconds.

....

....

(1)

(b)   Describe how an increase in lung volume leads to air entering the lungs.

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(1)

(c)   (i)   Give the equation which represents Fick's law.

(1)

(ii)   Use Fick's law to explain how breathing helps to ensure efficient gas exchange.
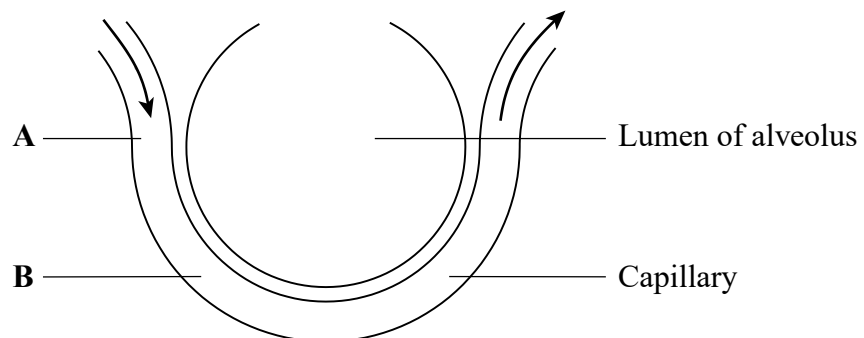
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(2)
(Total 5 marks)

52.   The diagram shows part of an alveolus and a capillary.

A ——————— Lumen of alveolus

B ——————— Capillary

10μm

(a)   The rate of blood flow in the capillary is 0.2 mms^{-1}.

Calculate the time it would take for blood in the capillary to flow from point **A** to point **B**.
Show your working.

Answer .... seconds

(2)

(b)   The rate of diffusion of oxygen is affected by the difference between its concentration in
the alveolus and its concentration in the blood.

(i)   Circulation of the blood helps to maintain this difference in oxygen concentration.
Explain how.

....

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(1)

(ii)   During an asthma attack, less oxygen diffuses into the blood from the alveoli.
Explain why.

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(2)

(c)   Scientists investigated a new drug to treat asthma. People with asthma took part in a trial. They were divided into two groups, an experimental group and a control group.

(i)   It was important to have a control group in this trial. Explain why.

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(1)

(ii)   People in the experimental group were given the drug in an inhaler. Describe how the control group should have been treated.

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(2)
(Total 8 marks)

53.   Read the following passage.

Several diseases are caused by inhaling asbestos fibres. Most of these diseases result from the build up of these tiny asbestos fibres in the lungs.

One of these diseases is asbestosis. The asbestos fibres are very small and enter the bronchioles and alveoli. They cause the destruction of phagocytes and the surrounding lung tissue becomes scarred and fibrous. The fibrous   5
tissue reduces the elasticity of the lungs and causes the alveolar walls to thicken. One of the main symptoms of asbestosis is shortness of breath caused by reduced gas exchange.

People with asbestosis are at a greater risk of developing lung cancer. The time between exposure to asbestos and the occurrence of lung cancer is 20–30 years.   10

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

(a)   Destruction of phagocytes (lines 4–5) causes the lungs to be more susceptible to infections. Explain why.

....

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(2)

(b)   (i)   The reduced elasticity of the lungs (lines 6–7) causes breathing difficulty. Explain how.

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(2)

(ii)   Apart from reduced elasticity, explain how changes to the lung tissue reduce the efficiency of gas exchange.

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(4)

(c) (i) Doctors did not make the link between exposure to asbestos and an increased risk of developing lung cancer for many years. Use information in the passage to explain why.

....

....

(1)

(ii) Give **one** factor, other than asbestos, which increases the risk of developing lung cancer.

....

(1)
(Total 10 marks)

54. Emphysema is a disease that affects the alveoli of the lungs and leads to the loss of elastic tissue. The photographs show sections through alveoli of healthy lung tissue and lung tissue from a person with emphysema. Both photographs are at the same magnification.
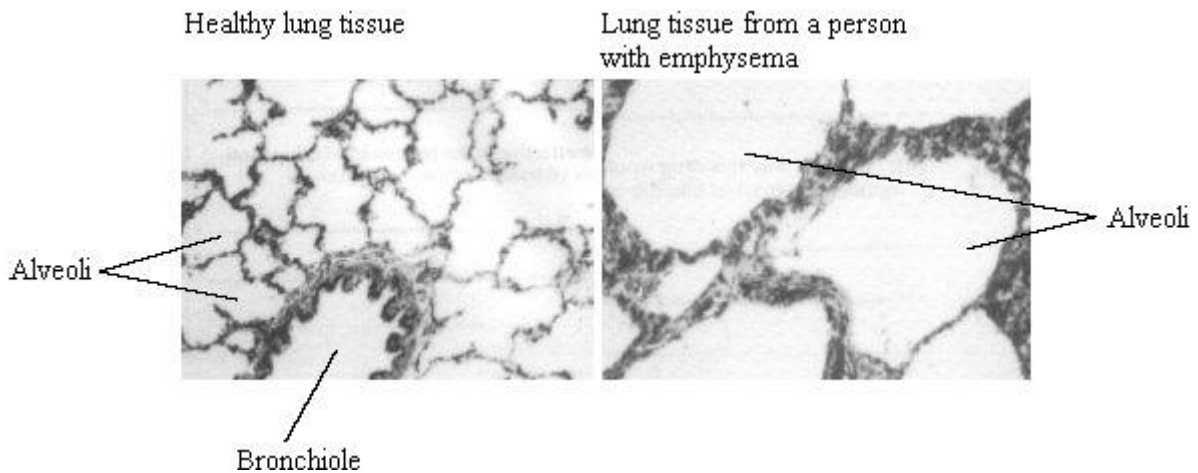
Source: Biophoto Associates, Science Photo Library

Using the evidence given above and your own knowledge, explain why a person with emphysema is unable to do vigorous exercise.

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(Total 4 marks)