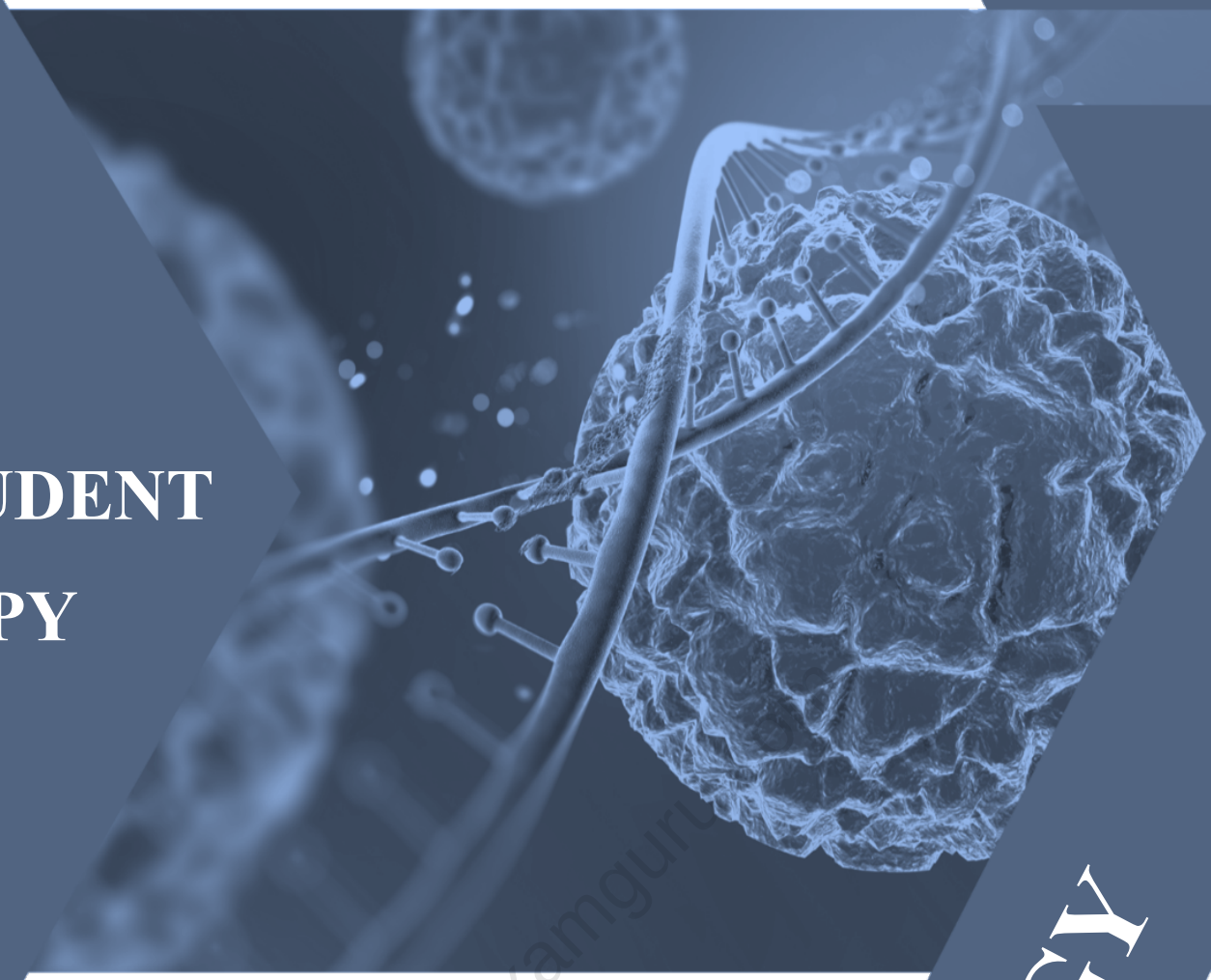

STUDENT COPY

HEADS-UP
REACH FOR THE STARS

IGCSE BIOLOGY

TOPICAL PRACTICE QUESTIONS

PAPER 4

VOL. 2

2020 EDITION

CHAPTERS 8-12

Chapter 8: Transport in Plants

1 Fig. 4.1 shows a cross section of part of a stem of buttercup, *Ranunculus*.

Fig. 4.2 is an outline drawing of one vascular bundle from the stem of *Ranunculus*.

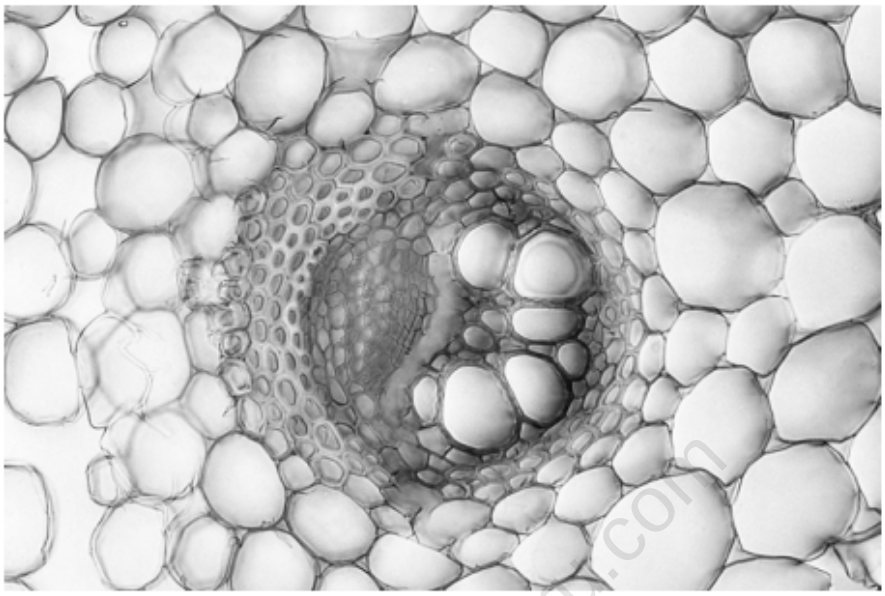

Fig. 4.1

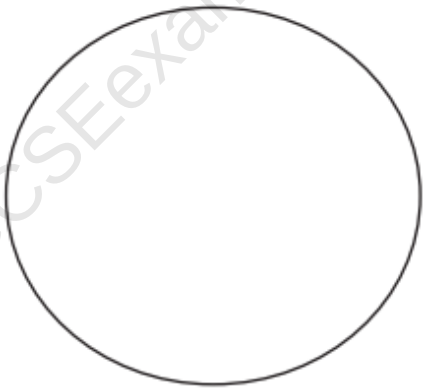

Fig. 4.2

(a) Draw **and** label the position of the xylem and the phloem in the outline of the vascular bundle in Fig. 4.2. [2]

(b) Name the carbohydrate that is transported in the phloem.

..... [1]

(c) Substances transported in the phloem are carried upwards in the stem at some times of the year and downwards at other times.

Explain why substances are transported in the phloem upwards at one time of the year **and** downwards at another.

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.....

.....

..... [4]

(d) Define the term *transpiration*.

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.....

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..... [3]

(e) The rattan palm is a plant that climbs on rainforest trees to heights of about 40 metres.

Explain how water is moved to the tops of tall plants, such as the rattan palm.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

2 This question is about transport in plants.

(a) Two pea plants, **D** and **E**, were supplied with substances containing the radioactive isotopes, carbon-14 (^{14}C) or phosphorus-32 (^{32}P), as shown in Fig. 4.1.

A leaf of plant **D** was exposed to radioactive carbon dioxide.

Plant **E** was placed into a solution containing radioactive phosphate ions.

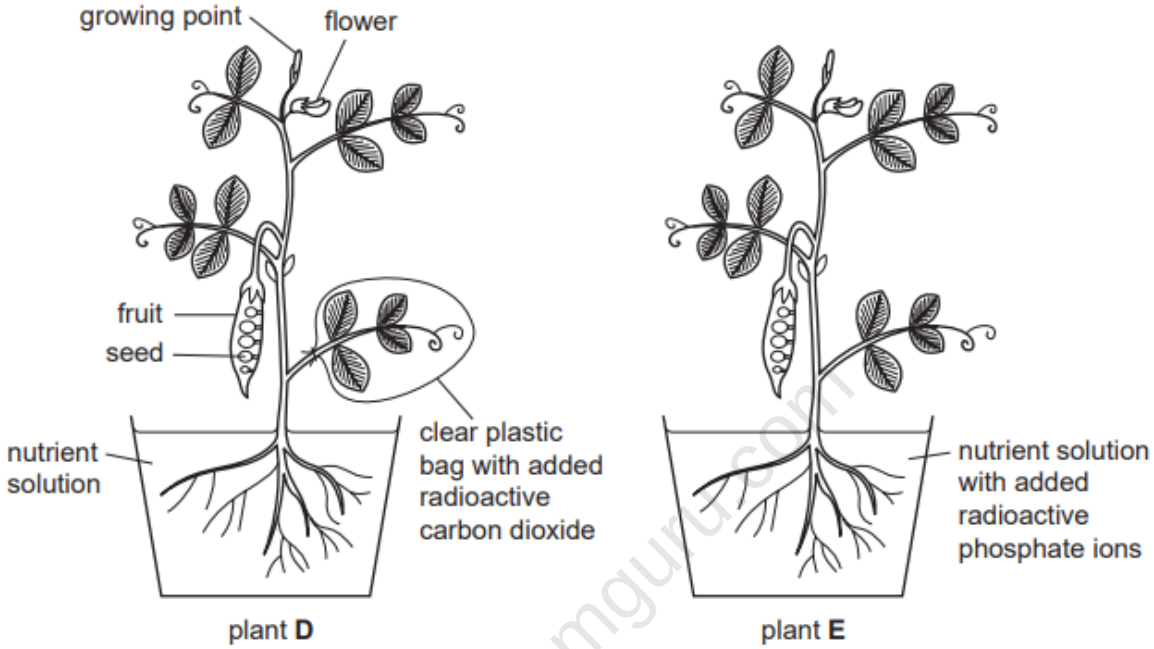

Fig. 4.1

After several hours the plants were analysed for the presence of the radioactive isotopes.

Sucrose containing ^{14}C was found throughout plant **D**.

Compounds containing ^{32}P were found throughout plant **E**.

Complete Table 4.1 to show:

- the tissue in which each substance is transported;
- **one** possible sink for each substance.

Table 4.1

pea plant	**D**	**E**
substance transported	sucrose	phosphate ions
transport tissue		
sink		

[4]

(b) State **one** substance, **other than sucrose**, that is produced in leaves and translocated to other parts of the plant.

..... [1]

(c) Outline how sucrose is produced from carbon dioxide in pea plants.

.....

.....

.....

.....

.....

.....

..... [3]

(d) State **two** uses of sucrose within a pea plant.

1 .....

2 ..... [2]

(e) Explain how ions, such as phosphate ions, are absorbed by plant roots.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 13]

3 Leaves are made of tissues.

(a) Define the term *tissue*.

.....

.....

.....[1]

Fig. 4.1 is a photograph of a transverse section of a leaf, showing the upper and lower surfaces.

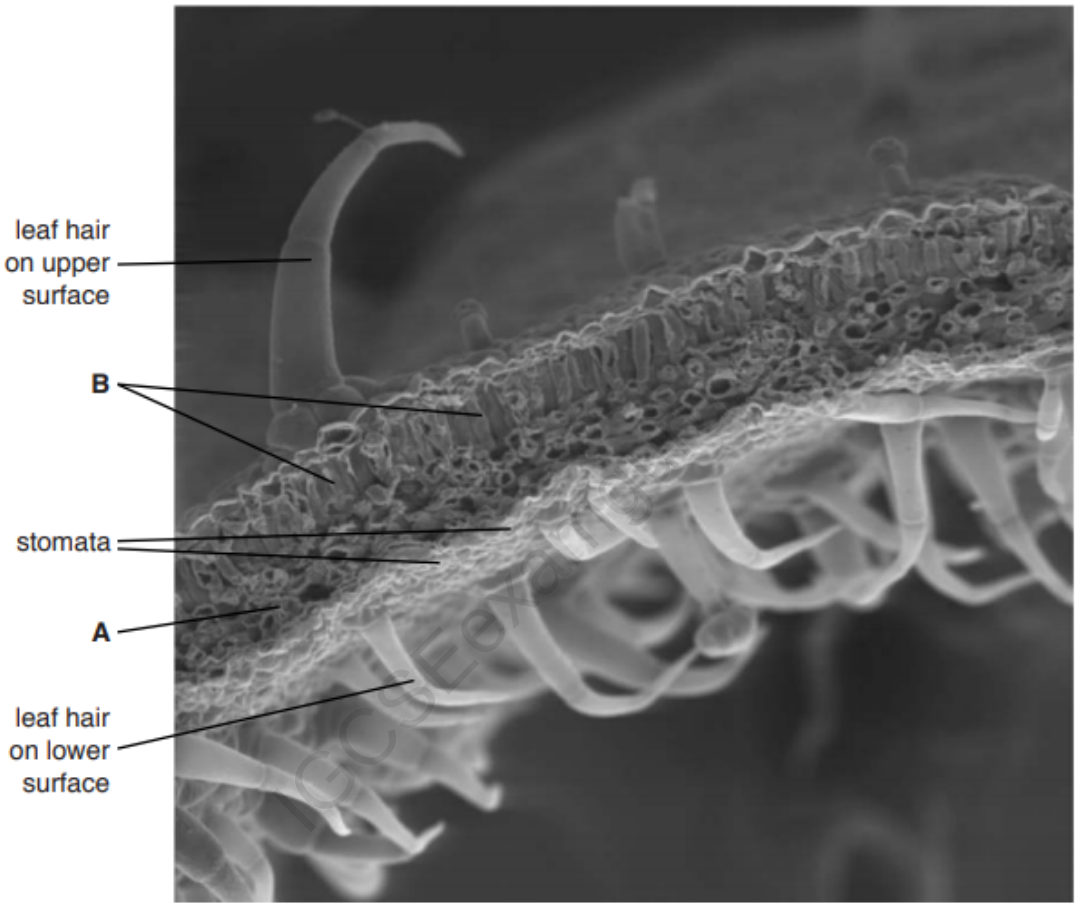

Fig. 4.1

(b) Name:

(i) tissue **A**

.....[1]

(ii) the process by which gases travel through the stomata.

.....[1]

(c) Describe how root hair cells differ from the cells labelled **B** in Fig. 4.1.

.....

.....

.....

.....

.....[2]

(d) Outline how water that has entered a root hair cell reaches the stomata.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(e) Leaf hairs, shown in Fig. 4.1, help to increase the humidity near the leaf surface.

(i) Compare the leaf hairs on the upper leaf surface with the leaf hairs on the lower leaf surface.

.....

.....

.....[1]

(ii) Explain the importance of increasing humidity near the leaf surface.

.....

.....

.....

.....

.....[2]

[Total: 12]

4 Water moves into plants from the soil and exits through the leaves.

(a) Explain how water moves from the soil into the root.

.....

.....

.....

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.....

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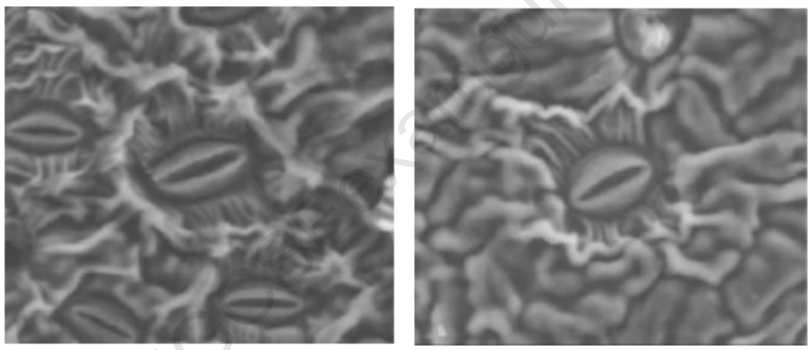
.....[4]

Water reaches the leaves from the roots through the xylem. Fig. 4.1 shows images of stomata on the lower surfaces of leaves of two varieties of olive plant, **A** and **B**. Both are shown at the same magnification.



A B

Fig. 4.1

(b) (i) Describe the function of stomata.

.....

.....

.....

.....

.....[2]

(ii) Compare the density of stomata between the two varieties of olive plant, **A** and **B**, shown in Fig. 4.1.

.....

.....

.....

.....

.....[2]

(iii) Under identical environmental conditions the rate of water uptake in plant **A** is higher than plant **B**.

Explain why.

.....

.....

.....

.....

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.....

.....[3]

(c) The density of stomata is an example of a leaf adaptation to the environmental conditions.

State **two** other adaptations of leaves for survival in a **dry** environment.

.....

.....

.....

.....

.....[2]

(d) Water lost from the leaves enters the atmosphere.

Describe how water is recycled from the atmosphere back to the roots.

.....

.....

.....

.....

.....[2]

[Total: 15]

Chapter 9: Transport in Animals

1 Fig. 4.1 shows a vertical section of a human heart.

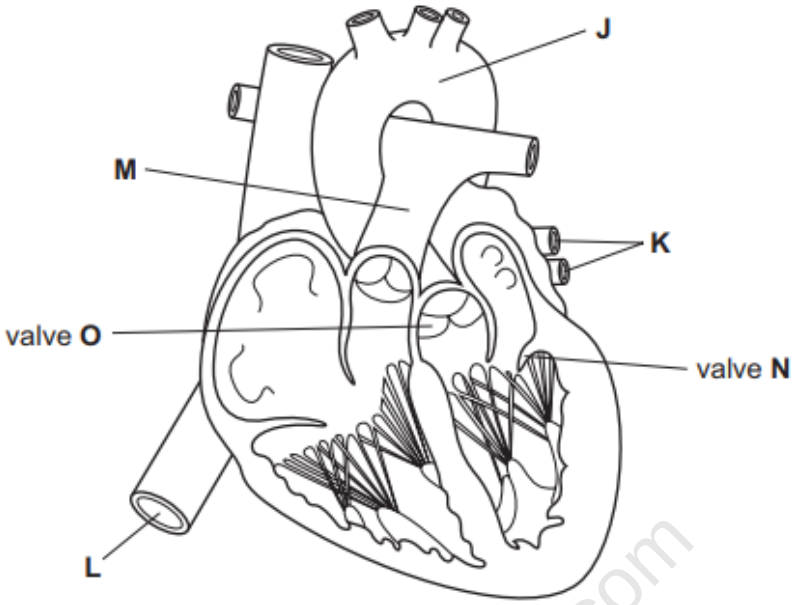

Fig. 4.1

(a) Identify the blood vessels labelled **J** to **M**.

J .....

K .....

L .....

M ..... [4]

(b) Sensors that detect changes in blood pressure were placed into the blood vessels surrounding the heart. Recordings were taken at the times when the ventricles contracted and when they relaxed.

The blood pressures recorded are shown in Table 4.1.

Table 4.1

blood vessel	blood pressure / kPa	
	contraction of the ventricles	relaxation of the ventricles
J	16.0	10.0
K	0.3	0.3
L	0.3	0.3
M	2.0	0.5

(i) Explain why the pressure in blood vessel **J** is greater than the pressure in blood vessel **M**.

.....

.....

.....

.....

..... [2]

(ii) Explain why the pressure in blood vessels **K** and **L** is much less than the pressure in blood vessels **J** and **M**.

.....

.....

.....

..... [2]

(c) Explain how the valves at **N** and **O** maintain one-way flow of blood through the heart.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) Other than in the heart, state where valves similar to those at **O** are found in the circulatory system.

.....

..... [1]

[Total: 13]

2 Blood flows through the hepatic portal vein from some organs to the liver.

Fig. 2.1 shows the hepatic portal vein and these organs.

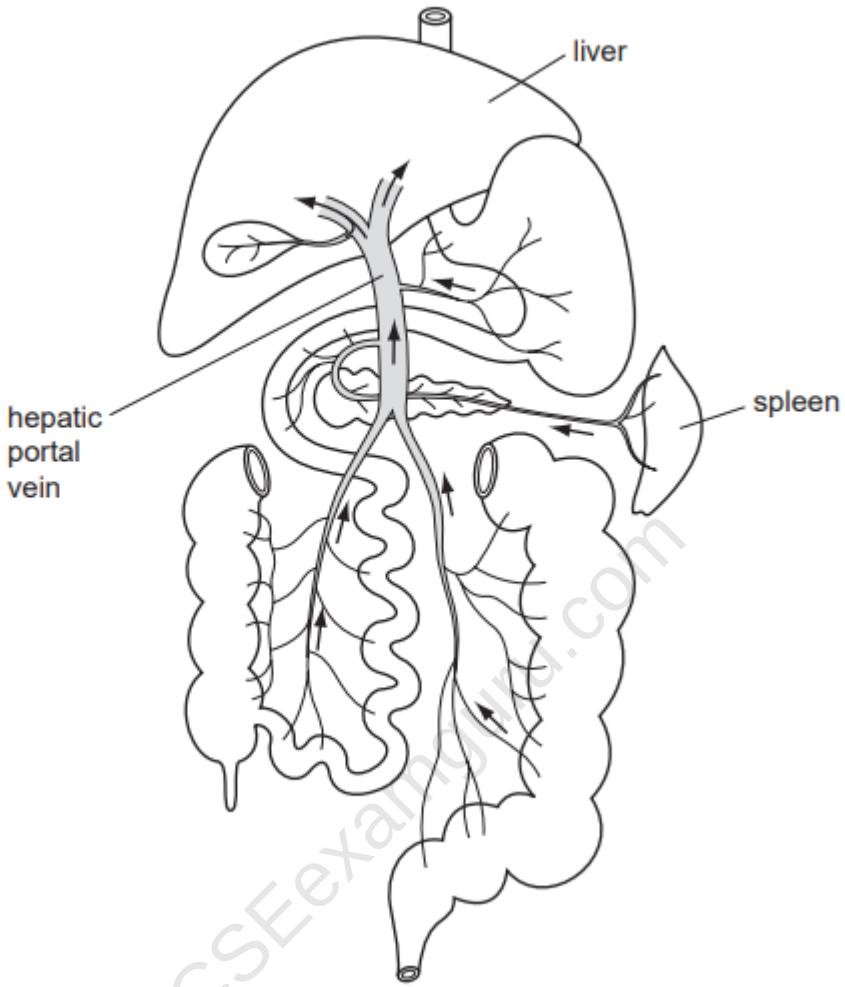

Fig. 2.1

(a) Blood in the hepatic portal vein is deoxygenated.

Explain why the blood in the hepatic portal vein is deoxygenated rather than oxygenated.

.....

.....

..... [2]

(b) Name **four** organs, **other than** the spleen, that are shown in Fig. 2.1 and from which blood flows into the hepatic portal vein.

1 .....

2 .....

3 .....

4 ..... [4]

(c) Describe the role of the hepatic portal vein in the transport of absorbed nutrients.

.....

.....

.....

.....

.....

..... [3]

(d) Explain how the liver is involved in regulating the composition of the blood **and** in protecting the body against toxic substances.

.....

.....

.....

.....

.....

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.....

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.....

.....

..... [5]

(e) The spleen contains lymphatic tissue which is full of phagocytes and lymphocytes.

Describe how phagocytes **and** lymphocytes protect the body against the spread of disease-causing organisms.

phagocytes .....

.....

.....

.....

lymphocytes .....

.....

.....

..... [4]

[Total: 18]

3 Blood is distributed through the body of a mammal in blood vessels. The blood supply to muscles changes considerably at the start and at the end of exercise.

Fig. 4.1 shows a cross section of a blood vessel as seen with an electron microscope.

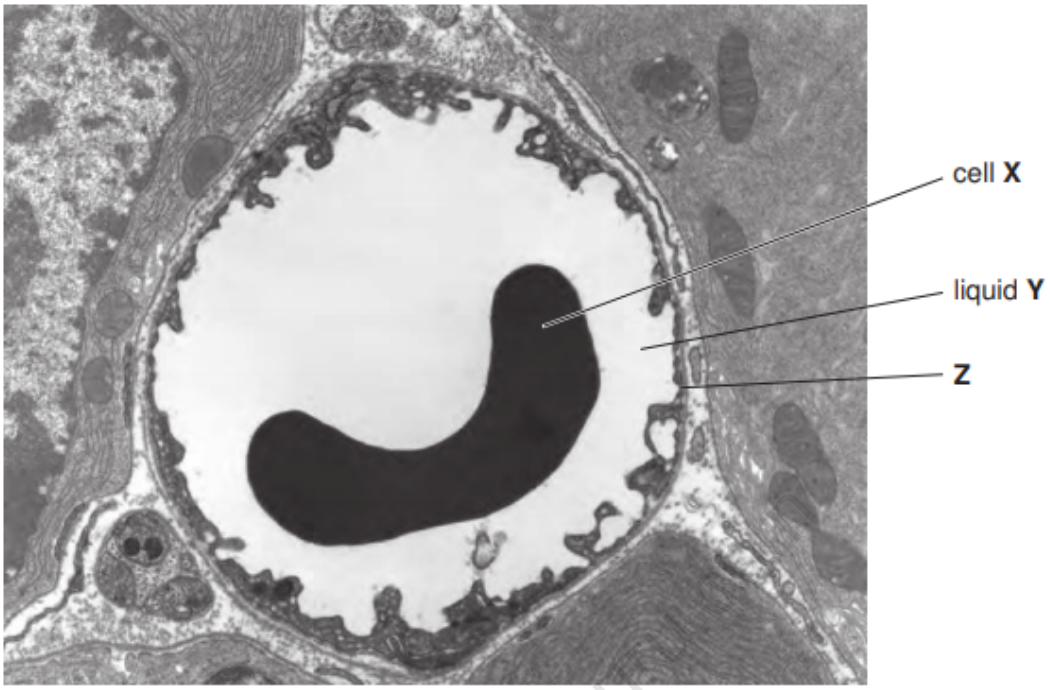

Fig. 4.1

(a) Name:

(i) cell **X**;

..... [1]

(ii) liquid **Y**;

..... [1]

(iii) the type of blood vessel shown in Fig. 4.1.

..... [1]

(b) State **three** substances that move across the wall of the blood vessel at **Z**.

1 .....

2 .....

3 ..... [3]

(c) Table 4.1 shows the distribution of blood to different organs at rest and during exercise.

Table 4.1

regions of the body	blood flow / cm^3 per minute		percentage change / %
	at rest	during strenuous exercise	
heart muscle	250	750	200
kidneys	1 200	600	-50
skeletal muscles	1 000	12 500	
skin	400	1 900	375
liver and alimentary canal	1 400	600	-57
brain	750	750	0
others	600	400	-33
total	5 600	17 500	213

(i) Calculate the percentage change in the blood supply to the skeletal muscles.

Show your working.

Write your answer in Table 4.1.

[1]

(ii) Explain why it is necessary for the blood supply to muscles to increase during exercise.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(iii) The volume of blood to different organs varies as shown in Table 4.1.

During exercise, blood flow to the skin increases and to the kidneys decreases.

Describe the changes that occur in blood vessels to cause blood flow to increase **and** to decrease.

increase blood flow .....

.....

.....

.....

.....

decrease blood flow .....

.....

.....

.....

..... [4]

[Total: 16]

4 Table 4.1 shows the composition of blood plasma.

Table 4.1

component	concentration in the plasma
adrenaline/ng dm^{-3}	10 – 100
fibrinogen/g dm^{-3}	1.7 – 4.0
glucose/mg dm^{-3}	700 – 1000
hydrogencarbonate ions/g dm^{-3}	1.1 – 1.4
insulin/μg dm^{-3}	0.33 – 0.40
lactic acid/mg dm^{-3}	50 – 200
sodium ions/g dm^{-3}	3.1 – 3.4
urea/mg dm^{-3}	70 – 200

(a) From Table 4.1, name:

(i) an excretory product

..... [1]

(ii) a plasma protein.

..... [1]

(b) **(i)** State what could cause the lactic acid concentration in the blood to increase to 200 mg dm^{-3}.

..... [1]

(ii) State the function of fibrinogen.

..... [1]

(iii) State **two** effects that a concentration of adrenaline of 100 ng dm^{-3} might have on the body.

.....

..... [2]

(c) Table 4.1 shows that the glucose concentration varies between 700 and 1000 mg dm^{-3}. Describe the role of the liver in regulating the concentration of glucose in the body.

.....

.....

.....

.....

..... [3]

(d) Lymphocytes and phagocytes are white blood cells.

A woman had some blood tests taken before and during a bacterial infection.

Table 4.2 shows the number of white blood cells in the two blood samples.

Table 4.2

white blood cells	mean number of cells per mm^3 of blood	
	before infection	during infection
lymphocytes	1300	3500
phagocytes	2000	7500

(i) Calculate the percentage increase in lymphocytes that occurred during the bacterial infection.
Show your working and give your answer to the **nearest whole number**.

answer .....% [2]

(ii) Describe the role of phagocytes in defence against disease.

.....

.....

.....

.....

.....

..... [3]

(iii) Describe the roles of white blood cells in tissue rejection.

.....

.....

.....

.....

.....

.....[3]

[Total: 17]

5 Mammals have a double circulatory system. Blood flows between:

- the heart and the lungs
- the heart and the rest of the body (systemic circulation).

(a) Fig. 4.1 shows a cross-section of an artery.

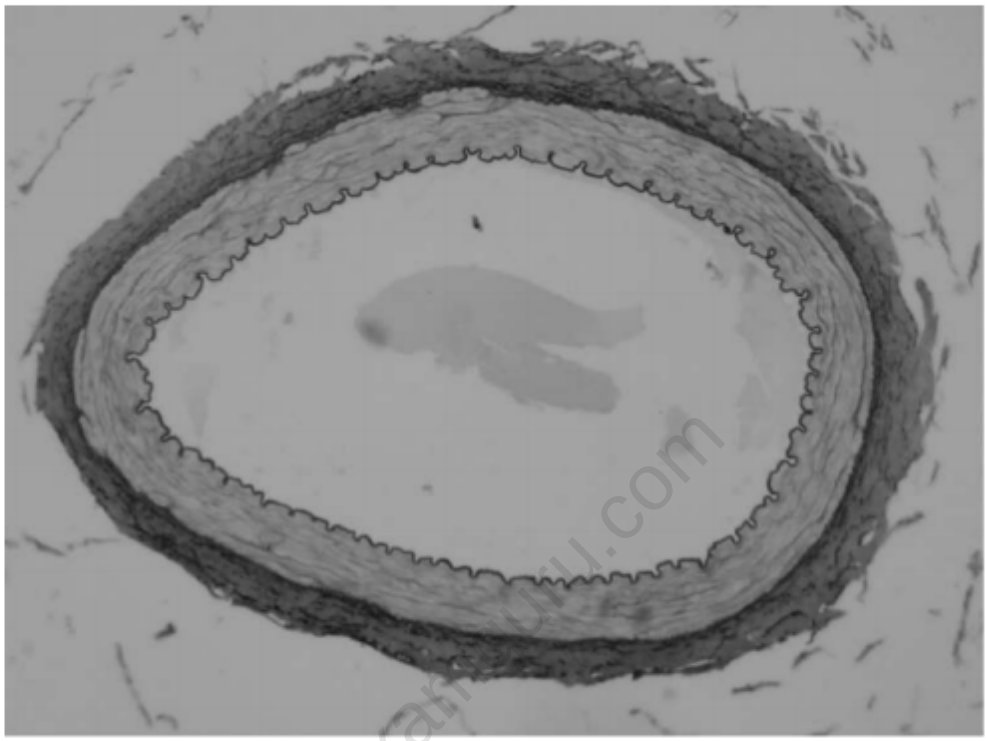

Fig. 4.1

Explain how the structure of an artery, as shown in Fig. 4.1, is related to its functions.

.....

.....

.....

.....

.....

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.....

.....[4]

(b) Fig. 4.2 shows the total cross-sectional area of the blood vessels in the systemic circulation. It also shows the changes that occur in blood pressure and the speed (velocity) of blood in the different blood vessels.

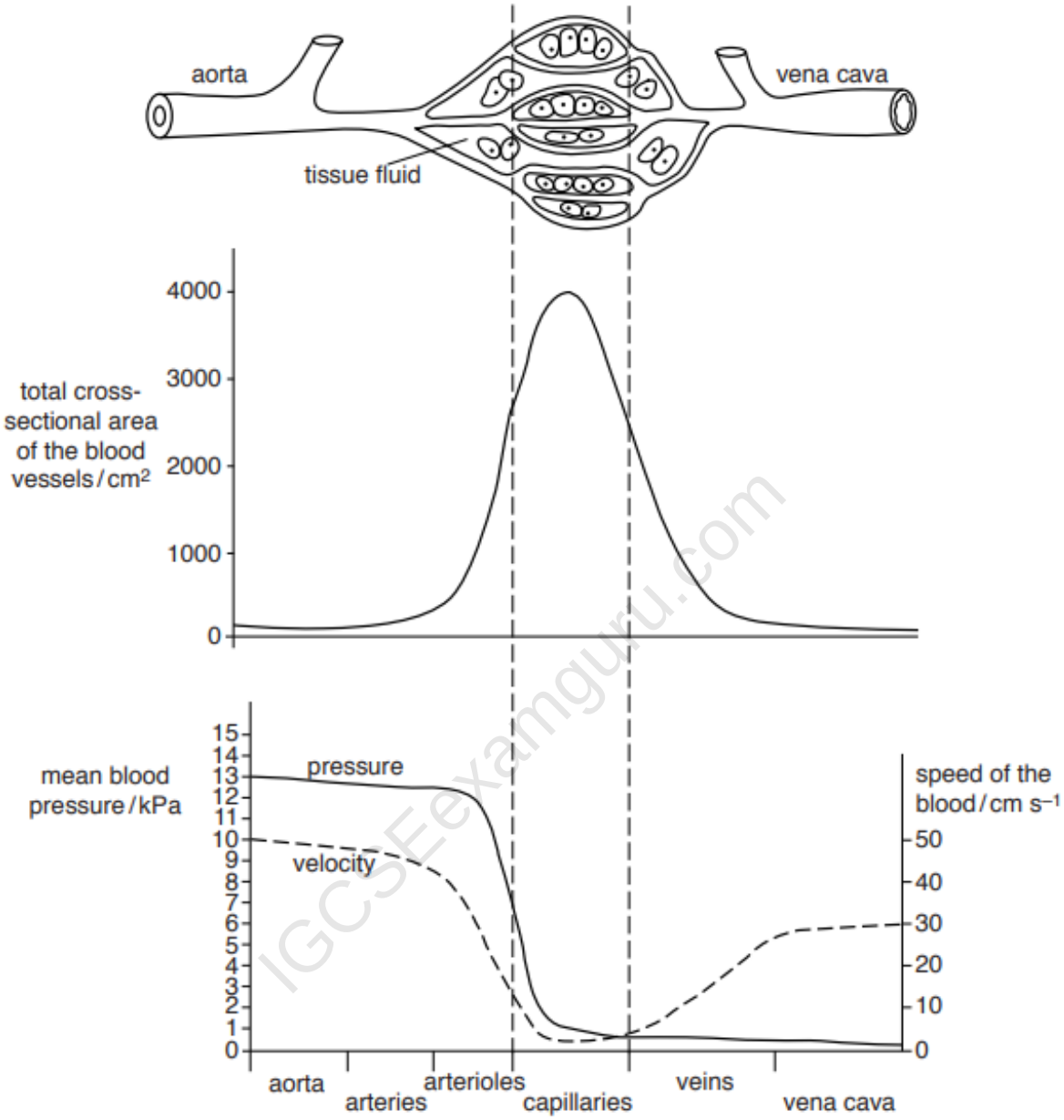

Fig. 4.2

(i) State the maximum mean blood pressure in the aorta.

.....[1]

(ii) Describe how mean blood pressure and speed of blood change with cross-sectional area of blood vessels, as shown in Fig. 4.2.

blood pressure .....

.....

.....

.....

speed of blood .....

.....

.....

.....[3]

(c) Describe how substances move from the blood in the capillaries into the tissue fluid.

.....

.....

.....

.....

.....

.....[3]

(d) Blood flows from arteries into arterioles before entering capillaries.

Explain the role of the arterioles in the skin when a person is very cold.

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.....

.....

.....[3]

[Total: 14]

6 Mammals have a double circulation system.

(a) Explain what is meant by a double circulation system.

.....

.....

.....[1]

(b) Table 5.1 shows some of the main organs in a mammal and the vessels that deliver blood and take it away.

Complete the table.

Table 5.1

organ	blood vessel	
	delivers blood	takes blood away
heart	1 ..... 2 ..... vein	1 aorta 2 ..... artery
lungs	pulmonary artery	.....
liver	1 hepatic artery 2	hepatic vein
kidney	..... artery	..... vein

[5]

(c) Table 5.2 shows the blood pressure in the different blood vessels that supply and drain a muscle in the leg.

Table 5.2

blood vessel	mean blood pressure/kPa
aorta	13
femoral artery	12
distributing/muscular artery	9
arteriole in muscle	6
capillary in muscle	4–1.3
venule in muscle	1.1
femoral vein	< 1.0

(i) The table shows that the mean blood pressure decreases from 13 kPa in the aorta to 6 kPa in the arterioles.

Explain why blood pressure must decrease in the arterioles before entering the capillaries.

.....

.....

.....

.....

.....[2]

(ii) Explain how blood returns to the heart in the femoral vein against the pull of gravity.

.....

.....

.....

.....

.....

.....

.....[3]

(d) Fig. 5.1 shows a section across part of an artery.

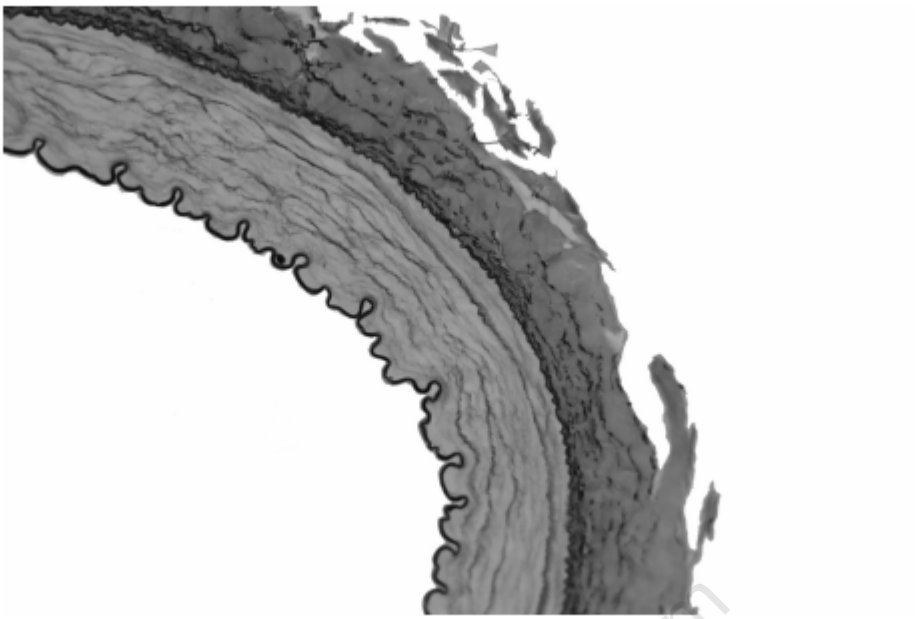

Fig. 5.1

With reference to Fig. 5.1, explain how the structure of an artery is related to its function.

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.....

.....

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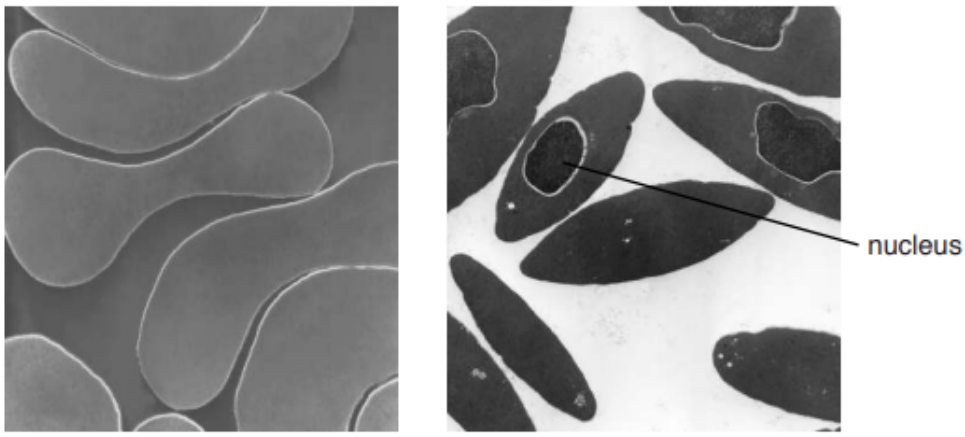
.....

.....

.....[3]

[Total: 14]

7 Fig. 3.1 shows images of red blood cells from a human, **A**, and a bird, **B**.



A B

Fig. 3.1

(a) State the function of red blood cells.

.....

.....

..... [1]

(b) There is a nucleus present in each of the red blood cells of the bird, as shown in Fig. 3.1.

(i) State the function of a nucleus.

.....

.....

..... [1]

(ii) Human red blood cells do not contain a nucleus.

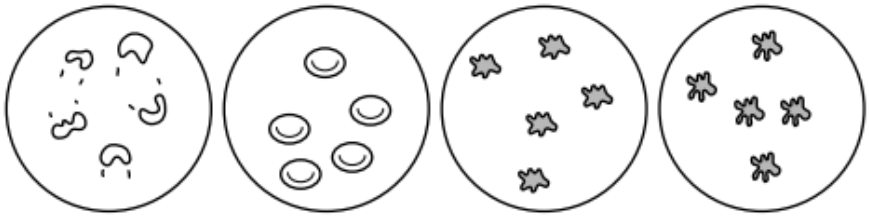
State an advantage of this.

.....

.....

..... [1]

Red blood cells from humans were placed into three test-tubes. Each test-tube contained a salt solution of a different concentration. A sample was taken from each test-tube and viewed using a microscope. The results are shown in Fig. 3.2.



salt concentration / mol dm^{-3}	0.10	0.15	0.20	0.25

Fig. 3.2

(c) (i) Describe the appearance of the red blood cells in the 0.15 mol dm^{-3} salt solution and the red blood cells in the 0.20 mol dm^{-3} salt solution.

0.15 mol dm^{-3} .....

.....

0.20 mol dm^{-3} .....

.....

[2]

(ii) The red blood cells in the 0.10 mol dm^{-3} salt solution burst.

Explain why the red blood cells burst.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Suggest why a plant cell in 0.10 mol dm^{-3} salt solution would not burst.

.....

.....

..... [1]

(d) Some people in accidents lose a lot of blood. Doctors give patients fluid to replace lost blood.

(i) Use the information in Fig. 3.2 to predict and explain the concentration of fluid replacement given to patients who have lost blood.

prediction .....

explanation .....

.....

.....

[2]

(ii) Describe the process of blood clotting.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 14]

41/ON 2017

1 Fig. 1.1 and Fig. 1.2 show two images of villi.

Fig. 1.1 shows a surface view of many villi viewed through a scanning electron microscope.

Fig. 1.2 shows a section of one villus viewed through a light microscope.

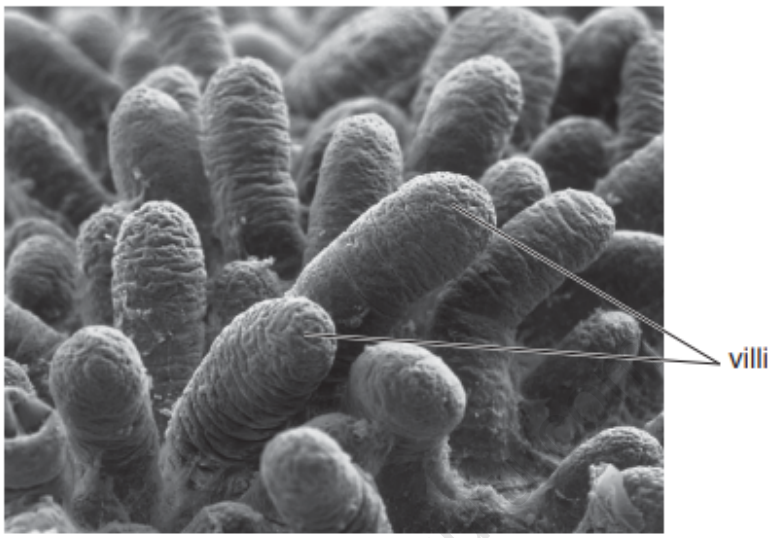


Fig. 1.1

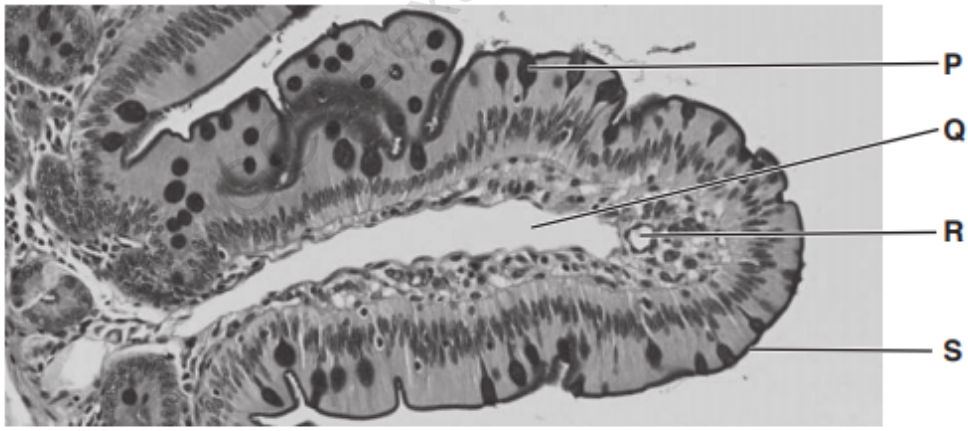


Fig. 1.2

Villi are found in the small intestine.

(a) State the function of villi.

.....

.....[1]

(b) Identify and describe **two** of the labelled components of a villus.

Use the letters in Fig. 1.2 in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Some infections in the small intestine can cause diarrhoea.

(i) Describe the effects of diarrhoea on the body.

.....

.....

.....

.....

.....[2]

(ii) State the treatment for the effects of severe diarrhoea.

.....[1]

(d) **(i)** Blood transports nutrients.

State the component of the blood that transports nutrients.

.....[1]

(ii) The nutrients in the blood can be used to become part of cells.

State the name of this process.

.....[1]

(iii) Amino acids are an example of a type of nutrient transported in the blood.

State **two** examples of larger molecules found in cells that are made from amino acids.

1 .....

2 .....
[2]

[Total: 12]

42/MJ 2016

2 Fig. 2.1 is an electron micrograph showing the bacteria, *Vibrio cholerae*.

Fig. 2.1

(a) **(i)** Bacteria are prokaryotes.

State **two** distinguishing features of all prokaryotes.

1 .....

2 .....

[2]

(ii) The bacteria shown in Fig. 2.1 each have a flagellum.

Suggest the function of the flagellum in bacteria.

.....

.....

..... [1]

(b) *V. cholerae* is the pathogen that causes cholera. Vaccination is used to control the spread of cholera during an outbreak.

Explain how vaccination can control the spread of diseases.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Many years ago scientists discovered that *V. cholerae* secretes a toxin. Fig. 2.2 shows the results of an experiment to measure the flow of chloride ions out of human cells with and without the toxin.

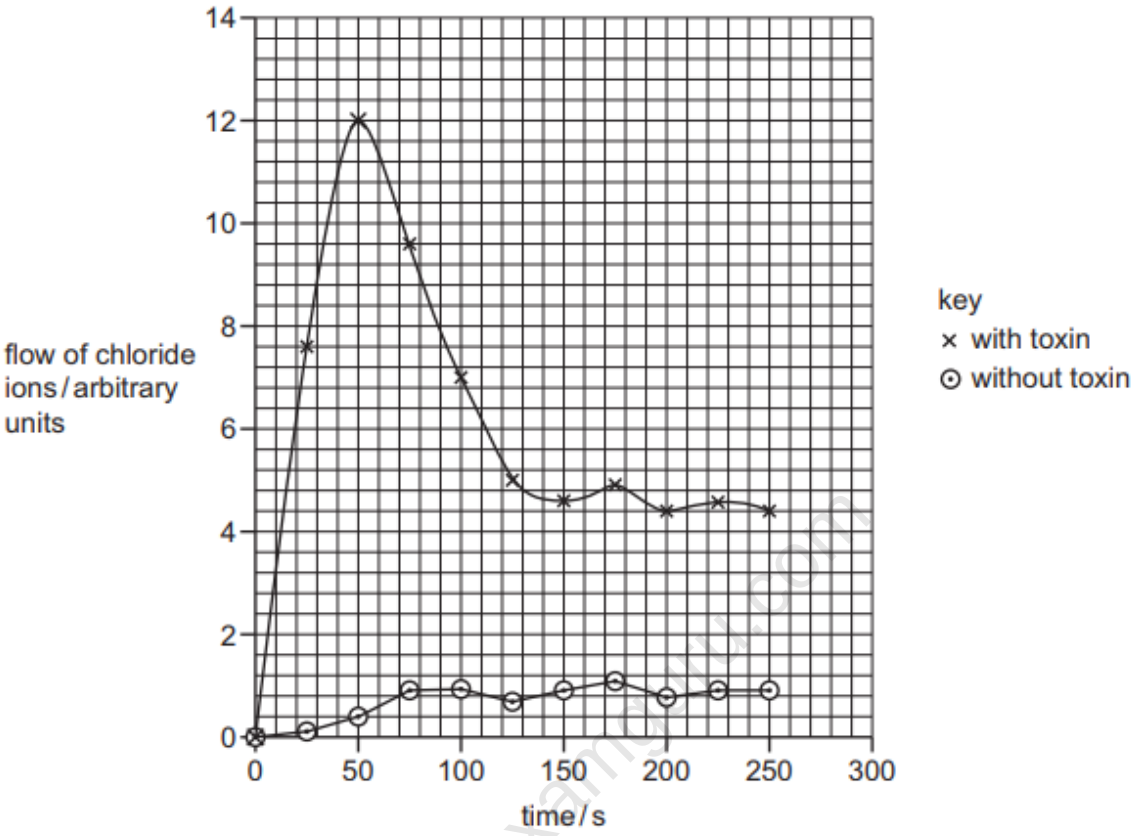


Fig. 2.2

(i) Calculate the difference in flow of chloride ions between the cells with the toxin and the cells without the toxin at 50 seconds.

Show your working and state the units in your answer.

..... [2]

(ii) Use the data in Fig. 2.2 to describe the effect of the toxin on the flow of chloride ions out of the cells.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Chloride ions cannot move out of cells by simple diffusion.

Suggest **and** describe how chloride ions could move out of cells.

.....

.....

.....

.....

.....

.....

..... [3]

(d) The loss of chloride ions from cells causes diarrhoea and dehydration in patients with cholera.

(i) State which organ in the alimentary canal is affected by the cholera toxin.

..... [1]

(ii) Describe the treatment for cholera.

.....

.....

.....

.....

..... [2]

[Total: 18]

Chapter 11: Gas Exchange in Humans

1 The ribcage and diaphragm are involved in the breathing mechanism to ventilate the lungs.

Fig. 3.1 is a flow chart that shows the changes that take place when breathing in.

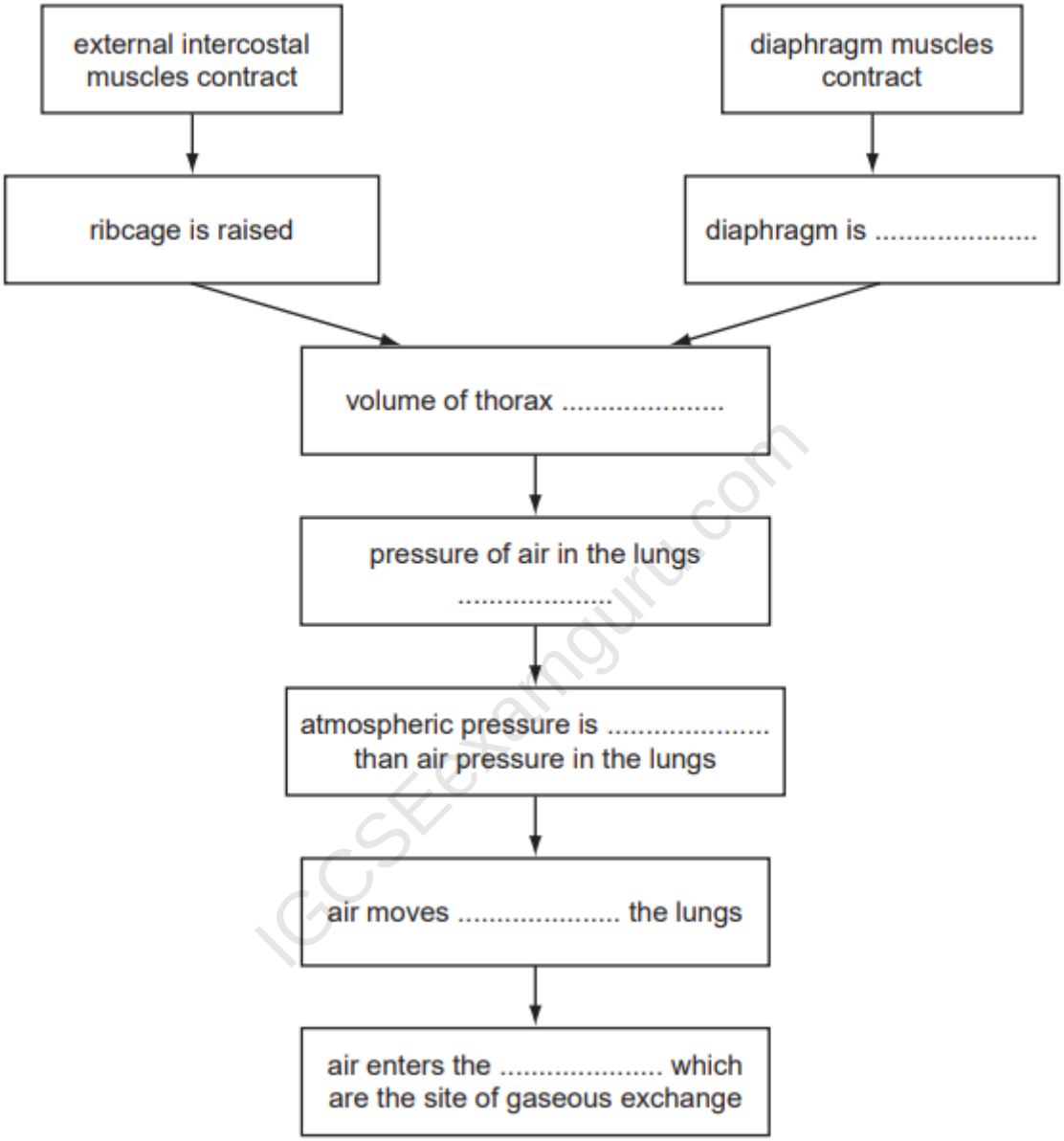


Fig. 3.1

(a) Complete Fig. 3.1 by writing appropriate words in the spaces provided. [6]

(b) Fig. 3.2 shows part of the epithelium that lines the trachea.

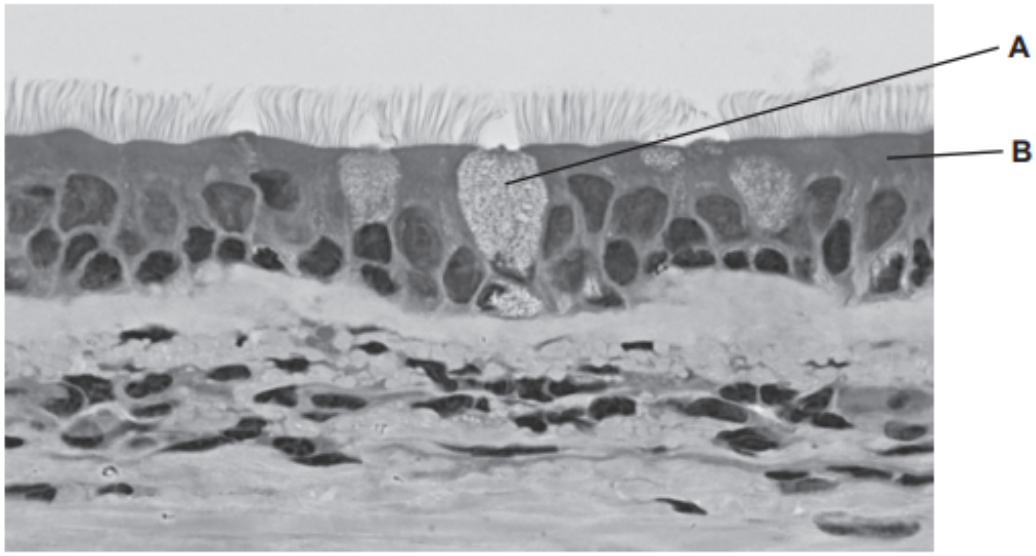


Fig. 3.2

Explain how the cells labelled **A** and **B** in Fig. 3.2 protect the gas exchange system.

A .....

.....

.....

.....

B .....

.....

.....

..... [4]

[Total: 10]

2 **(a)** Fig. 1.1 shows the human head, neck and thorax.

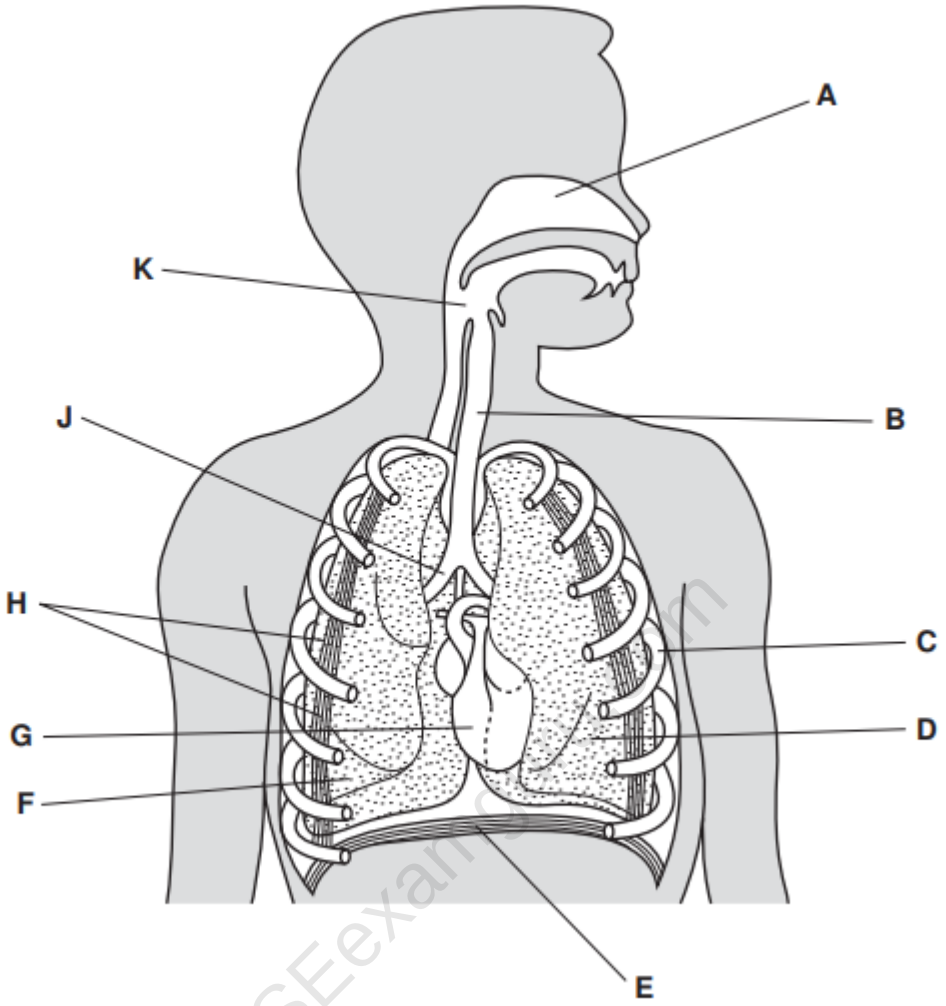


Fig. 1.1

Complete Table 1.1 by writing **one** letter from Fig. 1.1 to identify the named structures.

The first one has been done for you.

Table 1.1

structure	letter from Fig. 1.1
left lung	**D**
bronchus	
diaphragm	
intercostal muscle	
rib	
trachea	

[5]

(b) In an investigation, a student breathed in and out of the apparatus shown in Fig. 1.2.

Valve **X** opens to allow atmospheric air in while valve **Y** is closed.

When the student breathes out, valve **X** is closed and valve **Y** opens to allow breathed out air into the bag.

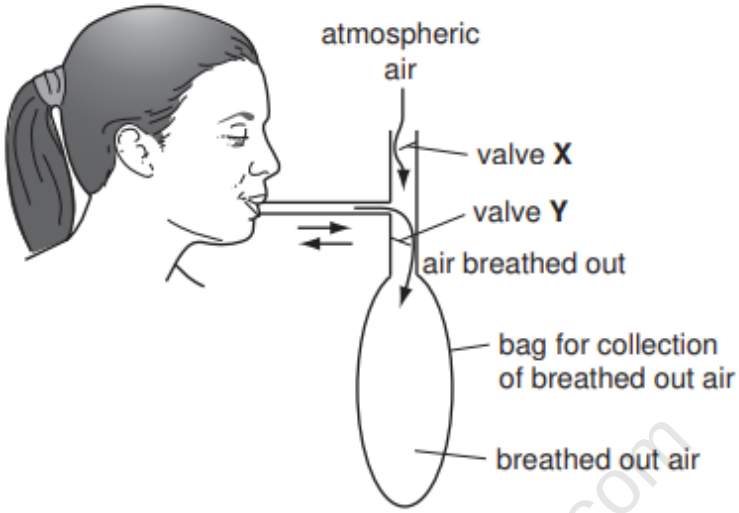


Fig. 1.2

The student breathed in and out **four times**. The bag was sealed and the volume of air inside the bag was measured.

A sample of air from the bag was analysed for the percentage composition of oxygen, carbon dioxide and nitrogen.

The student then did some vigorous exercise for five minutes. After the exercise, the student repeated the procedure.

The results of the investigation are shown in Table 1.2.

Table 1.2

	sample of breathed out air	
	before exercise	after exercise
total volume of air collected in bag / cm^3	2000	15000
mean volume of air per breath / cm^3	500	
percentage of oxygen / %	17.2	15.3
percentage of carbon dioxide / %	3.6	5.5
percentage of nitrogen / %	74.9	74.7

(i) Calculate the mean volume of air per breath after exercise.

Write your answer in Table 1.2.

Show your working.

[1]

(ii) Suggest **one** way, **not shown** in **Table 1.2**, in which the student's breathing changed after exercise.

.....

..... [1]

(iii) The figures in Table 1.2 for the percentage composition of air in each sample do not add up to 100 %.

Name **one** other gas that would be present in **both** samples of air.

..... [1]

(iv) The results for oxygen and carbon dioxide in the samples of breathed out air taken before and after exercise are different.

Describe **and** explain these differences.

.....

.....

.....

.....

.....

..... [3]

[Total: 11]

3 Fig. 1.1 shows some cells from the lining of the trachea.

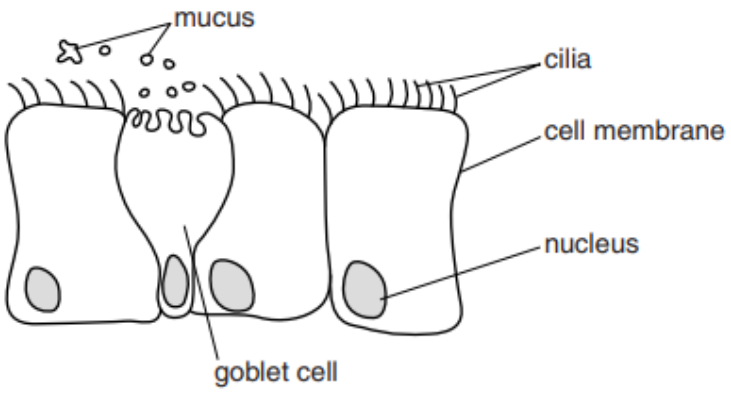


Fig. 1.1

(a) Describe the functions of the nucleus and cell membrane.

nucleus .....

.....

cell membrane .....

.....

.....

.....

[4]

(b) The cells in Fig. 1.1 form a tissue.

Define the term *tissue*.

.....

..... [1]

(c) The goblet cell secretes mucus.

Describe the role of mucus and cilia in the trachea.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

4 Fig. 6.1 shows the movement of the ribs and the diaphragm during breathing in.

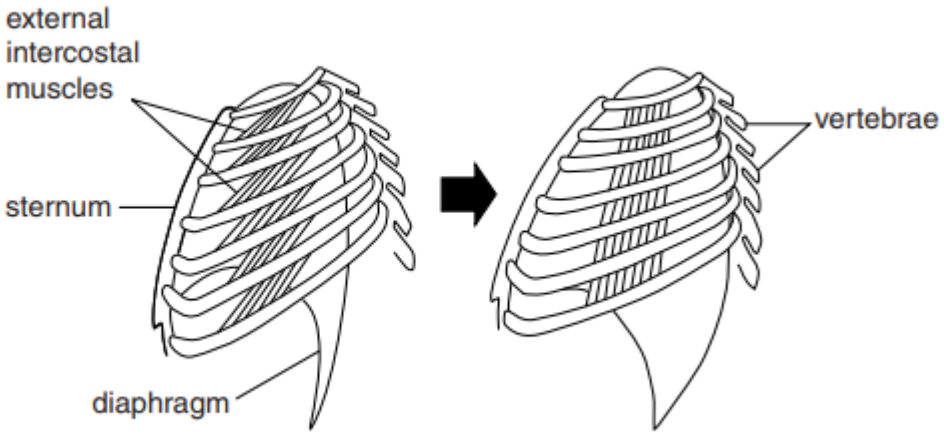


Fig. 6.1

(a) State what happens to the following structures during breathing in.

diaphragm.....

.....

.....

ribcage.....

.....

.....

external intercostal muscles .....

.....

.....[3]

(b) Explain the effect of strenuous physical activity on the pH of the blood.

.....

.....

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.....

.....

.....

.....

.....[3]

[Total: 6]

5 Fig. 4.1 shows part of the human gas exchange system.

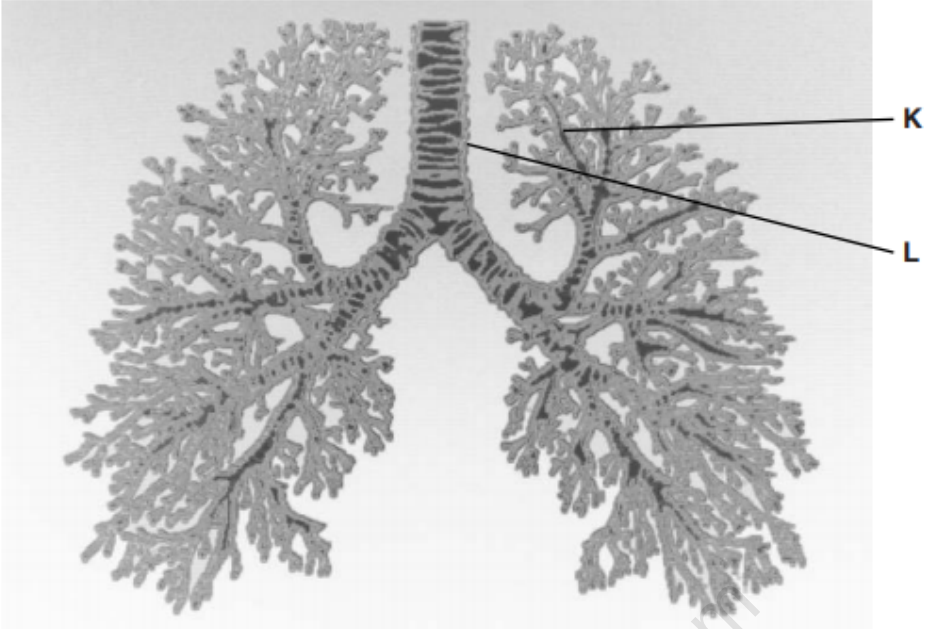

Fig. 4.1

(a) (i) Name structure **K**.

..... [1]

(ii) Ciliated cells and goblet cells line structure **L**.

Explain the function of these cells in structure **L**.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Gas exchange occurs at the alveoli.

(i) Describe how oxygen molecules move from the alveoli into the blood.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) During inspiration, air moves from the atmosphere into the lungs.

Describe the mechanism of inspiration.

.....

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.....

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.....

..... [4]

(iii) Name **one** gas that is found in a higher concentration in expired air than in inspired air.

..... [1]

(c) Tobacco smoke affects the gas exchange system.

Name **two** components of tobacco smoke and describe their effect on the gas exchange system.

component 1 .....

effect .....

.....

.....

component 2 .....

effect .....

.....

.....

[4]

[Total: 16]

6 The pressure in the lungs of a student before and during the start of a volleyball match was recorded.

The results are shown in Fig. 2.1.

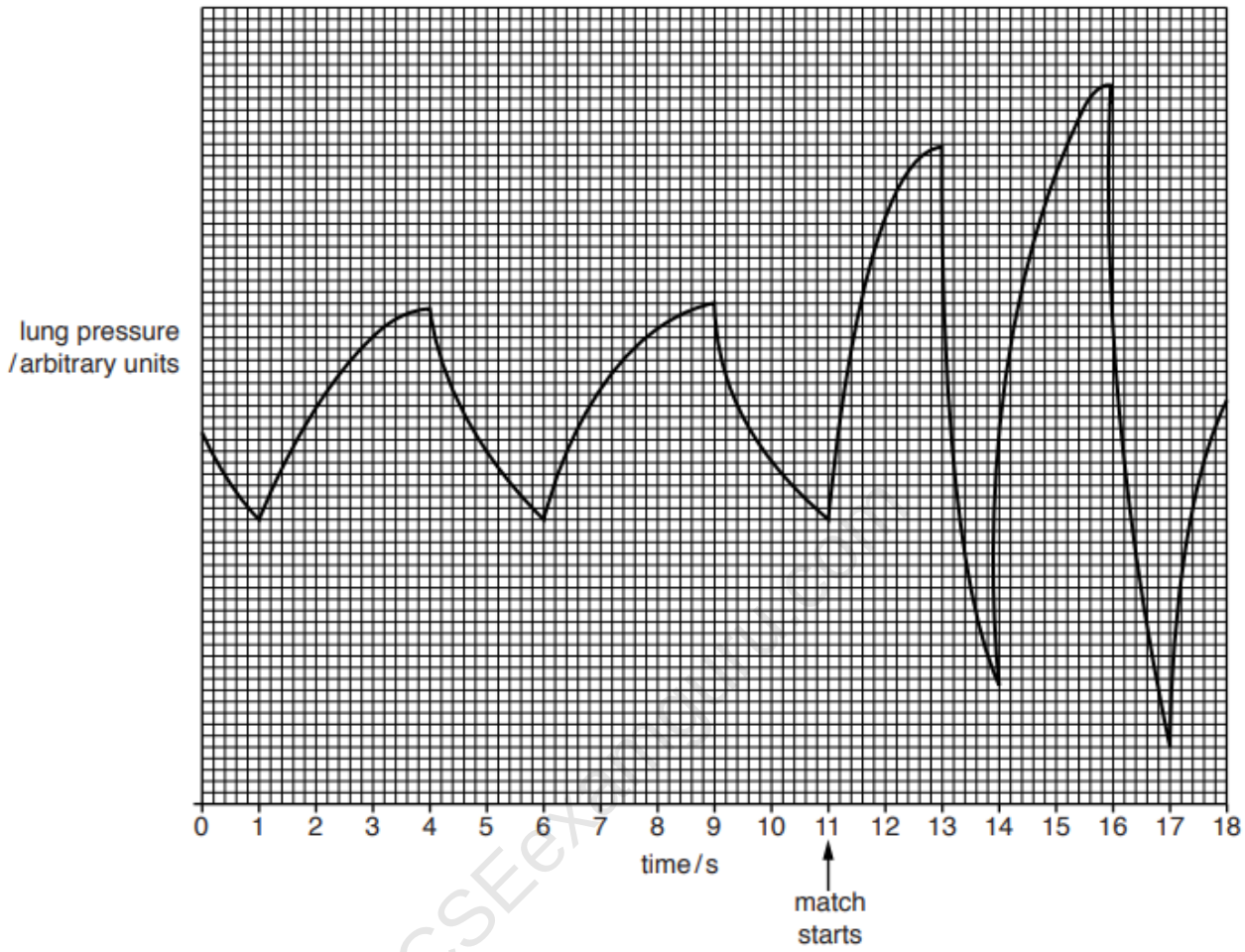

Fig. 2.1

(a) (i) Use the results in Fig. 2.1 to calculate the breathing rate before the start of the match. Express your answer to the nearest whole number.

Show your working.

.....breaths per minute
[2]

(ii) Use the results in Fig. 2.1 to describe how the pattern of breathing during the match is different from the pattern of breathing before the match starts.

.....

.....

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.....

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.....[3]

(b) Describe the process of inhalation.

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.....[4]

(c) Carbon dioxide is excreted from the body through the lungs.

(i) Explain why this process is termed *excretion*.

.....

.....

.....[1]

(ii) Name the part of the blood in which most carbon dioxide is transported.

.....[1]

(iii) Describe the effect of increased carbon dioxide concentration on blood pH.

.....[1]

(d) Carbon dioxide moves from the blood capillaries into the alveoli by diffusion.

Explain why the rate of diffusion of carbon dioxide increases during exercise.

.....

.....

.....

.....

.....[2]

[Total: 14]

7 Sports physiologists study ways in which athletes can improve their performance by recording factors such as oxygen uptake and the concentration of lactic acid in the blood. They can also monitor how these two factors change during training.

Fig. 2.1 shows an athlete running on a treadmill in a physiology laboratory while aspects of his breathing are measured.

Fig. 2.1

The athlete ran on a treadmill at a slow speed for 11 minutes.

His oxygen uptake was measured before, during and after the exercise.

The results are shown in Fig. 2.2.

The arrows indicate the start and end of the period of exercise.

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Fig. 2.2

(a) (i) State the oxygen uptake at rest, before the athlete started running.

.....$cm^3 kg^{-1} min^{-1}$ [1]

(ii) Use Fig. 2.2 to describe the changes in oxygen uptake during and after running on the treadmill (from 2 to 25 minutes).

.....

.....

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.....

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.....

.....[4]

(iii) Explain the change in oxygen uptake during the run (between 2 and 13 minutes).

.....

.....

.....

.....

.....

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.....

.....[4]

(b) The lactic acid concentration in the blood of the athlete was measured at intervals.
At the end of the slow run the lactic acid concentration had increased by 30%.

After a rest, the athlete ran at a much faster speed on the treadmill. At the beginning of this exercise the lactic acid concentration in his blood was 100 mg dm^{-3}. After 11 minutes running at the faster speed, his lactic acid concentration was 270 mg dm^{-3}.

(i) Calculate the percentage increase in lactic acid concentration at the end of the faster run.

Show your working.

answer ..... %
[2]

(ii) Explain why the percentage increase in lactic acid is much greater when running at the faster speed.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 14]

1 Niusila Opeloge from Samoa holds a Commonwealth Games record for weightlifting. He can lift 338 kg. Weightlifting is an example of an anaerobic sport as muscles act over a short period of time.

(a) Write a balanced chemical equation for anaerobic respiration in muscle.

..... → ..... [2]

Weightlifting involves contraction of the muscles of the arms.

Fig. 4.1 shows the muscles that move the forearm.

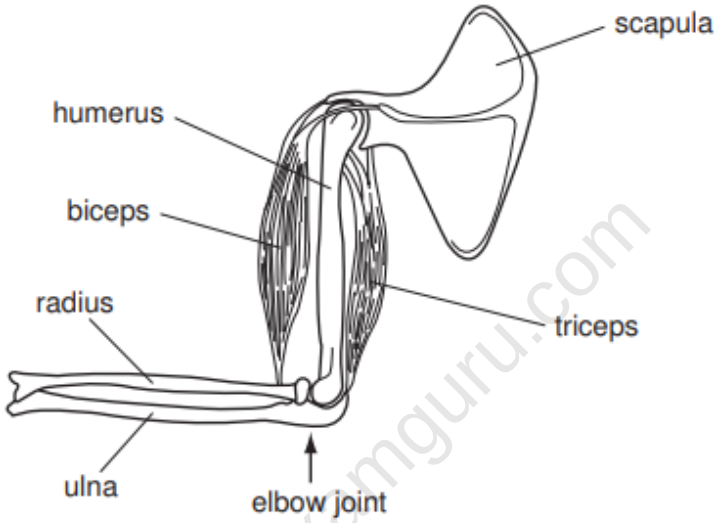

Fig. 4.1

(b) Describe how the muscles identified in Fig. 4.1 work to move the forearm up.

.....

.....

.....

..... [2]

Exercise that occurs over a longer period of time than weightlifting often involves aerobic respiration as well as anaerobic respiration.

Fig. 4.2 shows the oxygen consumed by an athlete during and after a 5000 metre race.

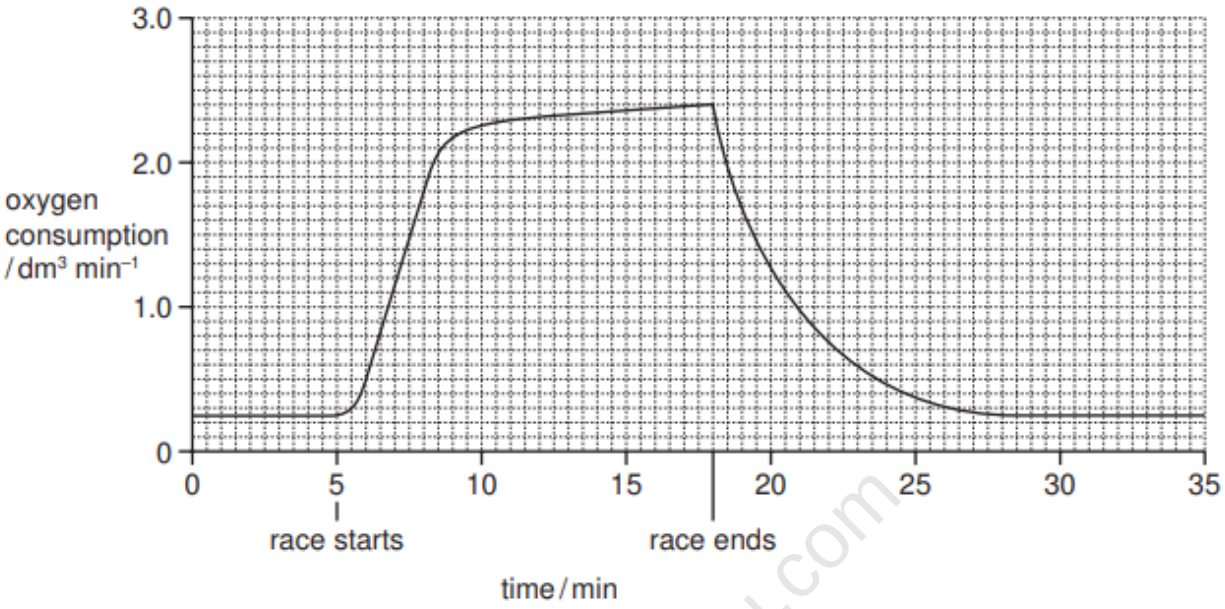

Fig. 4.2

(c) Describe the athlete's oxygen consumption during **and** after the race as shown in Fig. 4.2.

You will gain credit for using the figures in the graph to support your answer.

during .....

.....

.....

.....

.....

after .....

.....

.....

.....

..... [4]

(d) Explain why the oxygen consumption does not return immediately to the resting level after the exercise is finished.

.....

.....

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.....

.....

.....

.....

.....

.....

[5]

[Total: 13]

2 **(a)** Yeast cells and human muscle cells can carry out both aerobic and anaerobic respiration.

Complete Table 4.1 by writing the end products of aerobic and anaerobic respiration in these two types of cell.

Table 4.1

cell	end products of respiration	
	aerobic	anaerobic
yeast	..... + ...	..... + ...
human muscle cell	..... + ...	.....

[4]

(b) During exercise there are changes to:

- breathing rate;
- ventilation rate;
- oxygen absorption;
- heart rate;
- blood pressure.

The effect of strenuous exercise is shown in Table 4.2.

Table 4.2

	before exercise	immediately after exercise
breathing rate / breaths per minute	11	22
ventilation rate (volume of air taken into the lungs per minute) / dm^3 per minute	6	90
oxygen absorption / cm^3 per minute	250	2500
heart rate / beats per minute	65	170
blood pressure / kPa	15	25

Explain why the changes shown in Table 4.2 occur during exercise.

.....

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.....

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..... [5]

[Total: 9]

3 **(a)** Define the term *respiration*.

.....

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.....

.....

.....[2]

(b) A rowing machine is a piece of apparatus that is used in many fitness centres.

Fig. 4.1 shows a man training on a rowing machine. The man in the photograph has his arms extended during the rowing stroke as shown in Fig. 4.2.

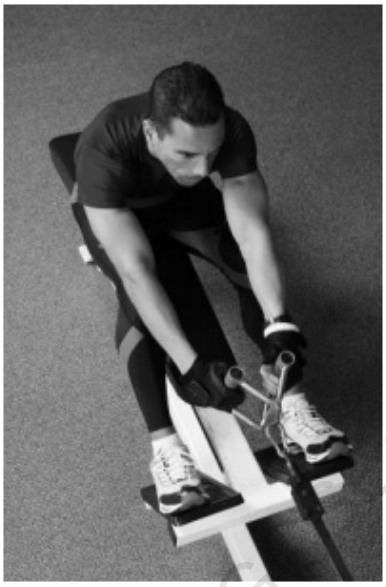

Fig. 4.1

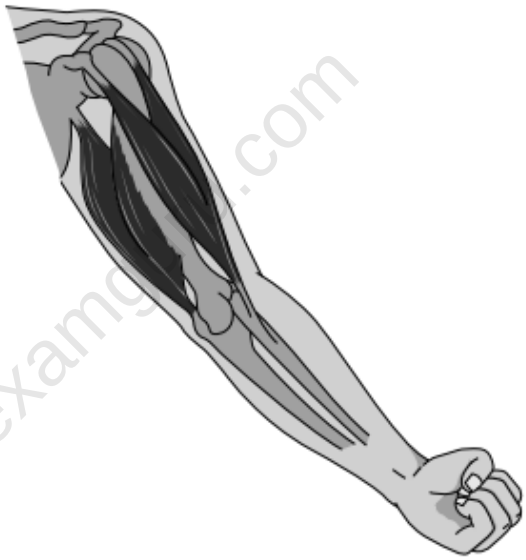

Fig. 4.2

Use Fig. 4.2 to describe how the hand is moved closer to the chest during the rowing stroke.

.....

.....

.....

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.....

.....

.....[3]

(c) The man has an intense workout on the rowing machine.

Fig. 4.3 shows his oxygen uptake before and during the exercise.

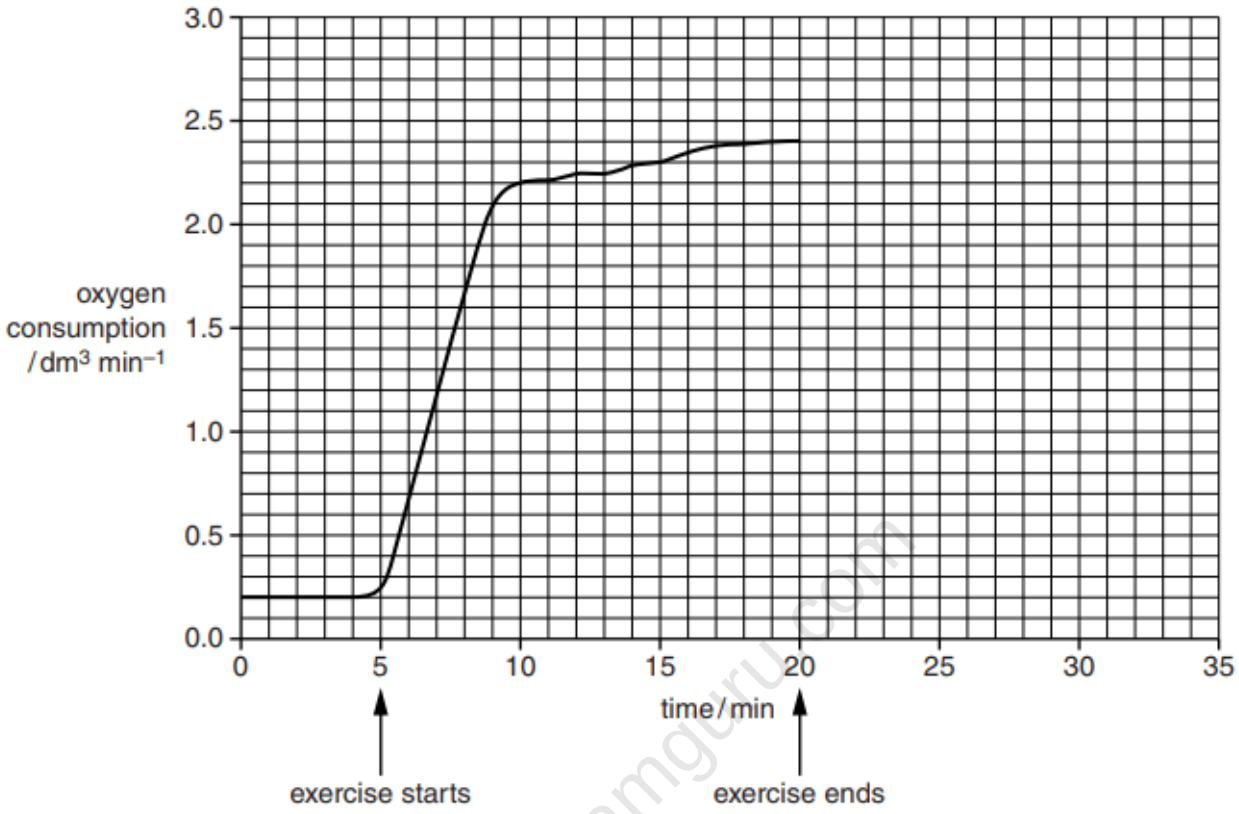

Fig. 4.3

(i) Explain why there is a steep increase in the man's oxygen consumption at the start of the exercise.

.....

.....

.....

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.....

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.....[4]

(ii) It took 10 minutes after the man had stopped rowing for his oxygen consumption to decrease to its resting value.

On Fig. 4.3 draw a line between 20 minutes and 35 minutes to show the change in oxygen consumption after exercise has stopped. [2]

(iii) Explain why the man's oxygen consumption did not return to the resting value **immediately** after exercise.

.....

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.....

.....

.....

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.....[4]

[Total: 15]

4 Researchers designed an investigation to find the effect of increasing levels of exercise on two groups of people.

The first group of people were trained cyclists and the second group were untrained cyclists.

The researchers asked all the people to cycle at four levels of effort: 30%, 45%, 60% and 75% of their maximum cycle speed.

They cycled for eight minutes at each level of effort.

(a) The researchers predicted that the pulse rate of all the cyclists would increase during exercise.

Explain this prediction.

.....

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.....

.....

.....[2]

Fig. 3.1 shows the average concentration of lactic acid in the blood of the trained cyclists and untrained cyclists in the investigation.

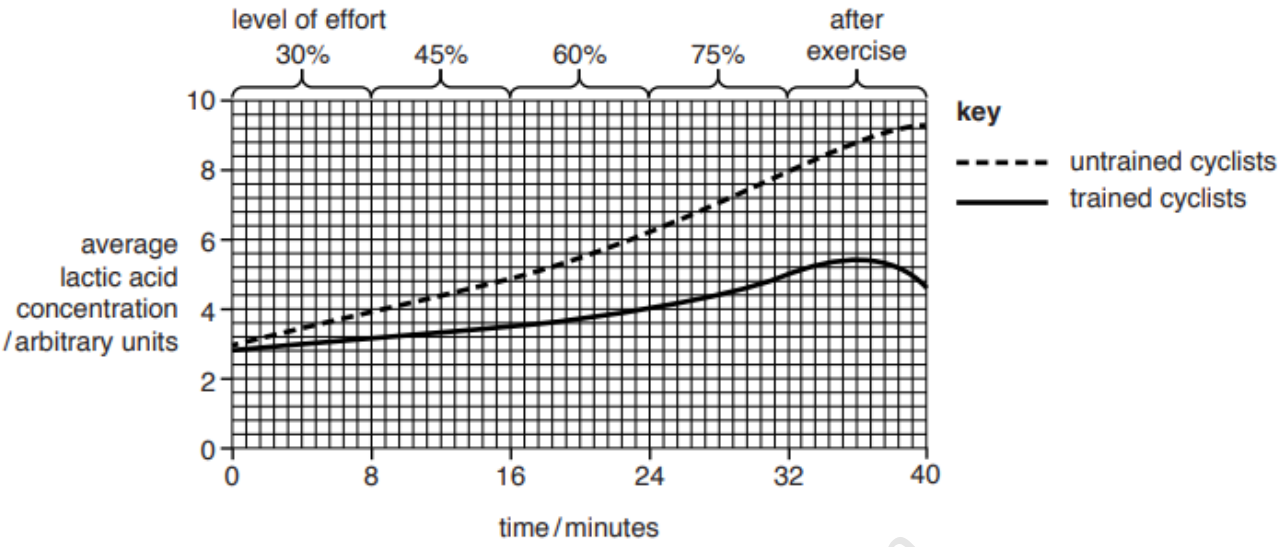

Fig. 3.1

(b) Describe the effect of the increasing levels of effort on the average lactic acid concentration in the blood of the **untrained** cyclists.

You should use data from Fig. 3.1 in your answer.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Lactic acid is produced in the muscles during anaerobic respiration.

(i) Define the term *anaerobic respiration*.

.....

.....

.....

.....

.....[2]

(ii) Describe how the lactic acid produced in muscle cells enters the blood.

.....

.....

.....[1]

(iii) Name the component of the blood that transports lactic acid.

.....[1]

(d) Explain why the lactic acid concentration in the blood in trained cyclists is different from the untrained cyclists eight minutes **after** the exercise.

You should use data from Fig. 3.1 in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 13]