## The Challenges of Size (F)

**1.** Marram grass grows on sand dunes with very little water available. It has a leaf that is curled in on itself so that the stomata are hidden on the inside, as shown in the diagram.



Why does this adaptation help the plant to survive on sand dunes?

- A Increases gas exchange from the stomata.
- **B** Reduces air movement around the stomata.
- **C** Increases photosynthesis by the leaf.
- D Increases water uptake by the leaf.

Your answer

[1]

- 2. Which process moves food around in plants?
- A Osmosis
- **B** Respiration
- C Translocation
- **D** Transpiration



[1]

3. Some plants can wilt if they lose more water than they take up.

Which conditions make a plant most likely to wilt?

- A Higher wind speed and lower temperature
- **B** Lower wind speed and lower temperature
- **C** Lower wind speed and higher temperature
- D Higher wind speed and higher temperature

Your answer

[1]

4. The graph shows total water loss from a plant.



Calculate the water lost between 5 and 15 minutes using the line of best fit.

Α	2.	2 r	nl	per	1	0	0	g

- **B** 2.4 ml per 100 g
- C 2.6 ml per 100 g
- **D** 2.8 ml per 100 g

Your answer



5. Which substances are absorbed from the soil by the root hair cell?



- A Carbohydrates and proteins
- **B** Carbon dioxide and nitrogen
- **C** Proteins and vitamins
- D Water and mineral ions

Your answer

[1]

6. A cube of potato is used to investigate the effect of surface area on osmosis.

The cube is  $3 \times 3 \times 3$  cm.

What is the surface area to volume ratio of the cube?

Α	1:2
в	2:1
С	6:1
D	1:6

Your answer

[1]

7. Transpiration has a cooling effect on the leaves of plants.

Which statement best describes how this happens?

- A Evaporation of water from the leaf removes heat energy.
- **B** Water entering the stomata takes heat energy from the leaf surface.
- **C** Water dripping off the leaf causes heat energy to be lost.
- **D** Water falling on the leaf removes heat energy.

Your answer

Ľ	1	]
-		-

8. Which type of human cell is shown in this diagram?



**9.** Hypercholesterolemia (HC) is caused by a dominant allele on chromosome 19. This allele has mutations which cause a change in the order of DNA nucleotides.

\* People with HC are more likely to get heart disease. The diagram shows the heart of a person who has heart disease.



The graph shows the results of a study of men aged 30 to 49. The study measured the cholesterol levels in the blood of the men. It also recorded if the men developed signs of heart disease.



Explain the possible link between cholesterol and heart disease and if this link is supported by the graph. Use evidence from the diagram and the graph in your answer.

 [6]

**10 (a).** Some students investigate the effect of the surface area : volume ratio on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes that have been stained blue using a pH indicator solution. The indicator will turn red in acidic conditions.

They put different sized cubes into 3 different test tubes of hydrochloric acid and time how long it takes for the cubes to completely change to red.

Fig. 21.1 shows the apparatus they use.



The table shows the students' results.

Length of each side of the cube (mm)	surface area : volume ratio	Time to completely change colour (seconds)
2		32
4	3:2	61
6	1:1	170

i. Calculate the surface area : volume ratio for the cube with sides of 2 mm.

ii. What conclusion can be made about the effect of surface area : volume ratio on the rate of diffusion?

[1]

iii. Emphysema causes some of the walls of alveoli in the lungs to break down. This produces a smaller number of larger air sacs.

Use the results to explain the effect of emphysema on oxygen diffusing into the blood.

(b). In a condition called sickle cell anaemia, the red blood cells can change shape. This reduces the amount of oxygen getting to cells in the body.

Fig. 21.2 shows a red blood cell and a sickled red blood cell.





Red blood cell

Sickled red blood cell

Fig. 21.2

Explain why sickle cell anaemia reduces the amount of oxygen getting to cells in the body.

[2]

11 (a). Rats are a major pest in many areas of the world. They can reduce food security and spread diseases.



Warfarin is a chemical that is used as a rat poison. It stops platelets working in the blood.

Describe the function of platelets in the blood.

(b). Some rats are resistant to warfarin. When fed with large amounts of warfarin the rats do not die.

Scientists found that the resistance is due to the dominant allele R.

Two resistant rats (Rr) mate.

Complete this genetic diagram to find the ratio of resistant rats to non-resistant rats that would be expected to be produced.



Ratio = .....[3]

(c). After several years, the percentage of resistant rats in the population had increased.

Use Darwin's theory of natural selection to explain this observation.

[3]

(d). Scientists are now trying to find another poison to use on rats.

They have introduced a chemical called phosphine. This blocks the action of mitochondria in rat cells.

Explain why this might kill rats.





Describe how the diagram shows that humans have a double circulatory system.

[2]

(b). Look at the diagrams of the circulation systems in an amphibian, bird and fish.

[3]



Which of these has a circulatory system most similar to humans?

Tick ( $\checkmark$ ) **one** box.

Amphibian	
Bird	
Fish	

Explain your choice.

(c). Scientists investigate how exercise affects blood flow to different organs in the body.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
- Measure the blood flow to different organs in the person's body
- Repeat this with the person exercising at a constant speed on a treadmill in the same room.

The table shows the scientists' results.

Organ	Rate of blood flow (ml per minute)		
Organ	Sitting	Doing exercise	
Brain	750	750	
Heart muscle	250	1000	
Muscles	1200	22 000	
Skin	500	600	
Other organs	3100	650	
Total	5800	25 000	

i. By how many times has the **total** blood flow increased by doing exercise?

Give your answer to the **nearest whole number**.

ii. The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

[2]

**13.** Fifty years ago scientists experimenting on plants had to inject dyes to measure water flow.

Now they can use modern methods such as MRI and X-ray imaging.

Scientists are now developing new ideas on how water flows through a plant that are different from theories developed fifty years ago.

Explain why.

**14 (a).** The diagram shows cells that are important in the process of **transpiration** in plants.



What is the name of plant cell X?

Tick ( $\checkmark$ ) **one** box.

Phloem cell	
Root hair cell	
Xylem cell	

[1]

(b). State two ways that cell  ${\bf X}$  is adapted to its function in a plant.

1

2

**15.** The diagram shows a cross-section of a plant stem.

A greenfly feeds on the plant by piercing through to the tissue shown in the cross-section of a plant stem.



i. What is the name of the tissue in the stem that the greenfly is trying to reach with its mouthpart? Tick ( $\checkmark$ ) **one** box.

Phloem	
Root hair	
Xylem	

[1]

ii. Explain why plants infested with greenfly have very poor growth.

16 (a). There are several treatments for coronary heart disease (CHD).

One of these is an operation.

In this operation, doctors insert a metal grid called a stent into the artery.



i. Look at the diagram.

Why does using a stent help treat CHD?

[2]

ii. Taking a drug called statins is a treatment for CHD.

The drug is taken every day and lowers the level of cholesterol in a person's blood.

Suggest one advantage and one disadvantage of taking statins.

Advantage

Disadvantage

(b). Angina is caused by a problem in the arteries that supply the heart muscle.

Fatty material (cholesterol) builds up in these arteries.



In angina the heart muscle starts to carry out anaerobic respiration.

Explain why this happens.

Use the information in the diagram and your biological knowledge.

[3]

17 (a). Look at the diagram of the human circulatory system.



How is the thickness of the heart wall on the left side different to the right side?

Write down two reasons for the difference.

(b). Look at the diagram.

It shows a section of an artery and a vein.



i. Describe two differences in structure between the artery and the vein shown in the diagram.



ii. Write down **one** difference between arteries and veins that is **not** shown in the diagram.

[1]

18. Stomata are found on the surface of leaves.

The diagram shows some of the surface cells of a leaf.



i. Write down the name of the cell labelled X.

[1]

ii. Describe **two** functions of stomata.

19 (a). Look at the diagram of the human circulatory system.



i.

Write the letter **X** on the diagram to show the position of the left ventricle. [1]

ii. Complete the sequence to show the flow of blood through the circulatory system.



[2]

(b). The blood travels through the heart twice on one complete circuit of the body.

a. What is the name of this type of circulation?

[1]

b. Suggest two advantages of blood travelling through the heart twice in each complete circuit of the body.

 $\ensuremath{\textbf{20}}$  . Lichens are sensitive to pollution because they take up chemicals from the air.

The diagram shows a 'bushy' species of lichen and a 'crusty' species of lichen.



Bushy lichens are usually more sensitive to pollution than crusty lichens.

Use the diagrams to suggest why.

[1]

21. Strokes are a type of cardiovascular disease.

One cause of a stroke is an artery in the brain bursting.



Blood bursts through wall

i. When a person has a stroke, why are arteries more at risk of bursting than veins?

[1]

ii. How are arteries adapted to try and prevent them bursting and causing a stroke?

[1]

**22 (a).** Some students investigate the effect of the ratio of surface area:volume on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes stained blue with pH indicator.

They put different sized cubes into a beaker of hydrochloric acid and time how long it takes for the cubes to completely change colour.



The table shows their results.

length of 1 side of cube (cm)	surface area:volume ratio (cm <sup>-1</sup> )	time to completely change colour in seconds
1		132
2	3	328
3	2	673

i. Calculate the surface area:volume ratio for the cube with sides of 1 cm.

answer = ...... cm<sup>-1</sup>

[1]

[1]

ii. Calculate the rate of colour change for each of the three cubes.

Write your answers in the table below.

length of 1 side of cube (cm)	rate of colour change (s <sup>-1</sup> )
1	
2	
3	

iii.

Show your answers in standard form.

iv. Use the results and your calculations in parts (i) and (ii)

Explain why most large multi cellular organisms need transport systems, such as the blood system, but most single celled organisms do **not**.

v. Explain why using gelatine spheres instead of cubes might be more biologically accurate but suggest why the students used cubes instead.

[2]

[2]

(b). Oxygen enters red blood cells by diffusion.

Describe and explain how red blood cells are adapted for the efficient uptake and transport of oxygen.

23 (a). Emma wants to investigate the effect of air movement on transpiration.

The diagram shows how she sets up her experiment.



Emma measures the rate of transpiration by measuring the loss in mass over 3 hours.

She does this first with the fan switched off.

She then repeats this but with the fan switched on.

She keeps all other environmental conditions the same.

These are her results.

	Fan switched off	Fan switched on
Mass loss in 3 hour in g	37	144

Explain the difference in her results.

[2]

(b). Emma kept environmental conditions like light intensity and temperature the same.

i. Why was it important to keep the light intensity the same?

ii. Why was it important to keep the temperature the same?

24. Rheumatic fever is a rare disease in the UK.

Look at this information.

## Rheumatic fever information leaflet

Bacteria can enter the mouth and cause sore throats.

This may develop into rheumatic fever.

Rheumatic fever is much more likely if a person does not get enough food or lives in overcrowded conditions.

White blood cells in the body make protein molecules to kill these bacteria.

However, sometimes these molecules attack heart valves making them leaky.

i. Put ticks ( $\checkmark$ ) in the **two** boxes that best describe rheumatic fever.

a communicable disease	
a disease that is caused by defective alleles	
a non-communicable disease	
a disease that is affected by lifestyle	

[1]

ii. White blood cells make protein molecules to kill the bacteria.

What is the name of these protein molecules?

[1]

iii. The diagram shows one of the valves that can be made leaky by rheumatic fever.



People who have this leaky valve often have these symptoms:

- they get out of breath easily
- they do not seem to have much energy and feel tired.

Write about the job of this valve and how damage to it may cause these symptoms.

[4]

**25 (a).** Some students investigate the effect of the ratio of surface area:volume on the rate of diffusion in animal cells.

They use hydrochloric acid and gelatine cubes stained blue with pH indicator.

They put different sized cubes into a beaker of hydrochloric acid and time how long it takes for the cubes to completely change colour.



The	table	shows	their	results.
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length of 1 side of cube (cm)	surface area:volume ratio (cm <sup>-1</sup> )	time to completely change colour in seconds
1		132
2	3	328
3	2	673

i. Calculate the surface area:volume ratio for the cube with sides of 1 cm.

answer = ..... cm<sup>-1</sup>

ii. Calculate the rate of colour change for each of the three cubes.

Write your answers in the table below.

Show your answers in standard form.

[1]

length of 1 side of cube (cm)	rate of colour change (s⁻¹)
1	
2	
3	

iii. Use the results and your calculations in parts (i) and (ii)

Explain why most single celled organisms do **not** need a transport system (e.g. the circulatory system of multi cellular organisms).

[2]

[2]

(b). Oxygen enters red blood cells by diffusion.

Describe and explain how red blood cells are adapted for the efficient uptake and transport of oxygen.

26 (a). Emma wants to compare the transpiration rates of two types of plant.

The plants have different sized leaves.

The diagram shows how she sets up her experiment.



Suggest why Emma put a layer of oil on top of the water.

(b).

She makes sure that each plant has the same number of leaves.

Which other experimental conditions should she keep the same?

[3]

(c). \* The table shows Emma's results.

	Plant species A (bigger leaves)	Plant species B (smaller leaves)
mass at start (g)	261	273
mass after 24 hours (g)	228	231

Write a conclusion with an explanation about this experiment.

Use data / calculations in your answer.

27. What is the process when water goes out of plant leaves into the air?

- A. osmosis
- B. photosynthesis
- C. translocation
- D. transpiration

Your answer

[1]

28. Through which type of cell do plants take in water?

- A. guard cell
- B. phloem cell
- C. root hair cell
- D. xylem cell

Your answer

[1]

29. The pictures show four foxes from different parts of the world.

Which fox has the largest surface area:volume ratio?

[6]

[1]



END OF QUESTION PAPER