OCR
Oxford Cambridge and RSA

H

Tuesday 14 May 2019 – Afternoon

GCSE (9–1) Combined Science B
(Twenty First Century Science)

J260/05 Biology (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
• a ruler (cm/mm)

You may use:
• a scientific or graphical calculator
• an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

First name(s) _____

Last name _____

INSTRUCTIONS
• Use black ink. You may use an HB pencil for graphs and diagrams.
• Answer **all** the questions.
• Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
• Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
• The total mark for this paper is **95**.
• The marks for each question are shown in brackets **[ ]**.
• Quality of extended response will be assessed in the question marked with an asterisk (*).
• This document consists of **28** pages.

OCR is an exempt Charity

Turn over

2

Answer **all** the questions.

1 Cellular respiration takes place in living cells.

(a) In which parts of a cell do the reactions of cellular respiration take place?

Tick (✓) **two** boxes.

Cell wall ☐

Chloroplasts ☐

Cytoplasm ☐

Mitochondria ☐

Nucleus ☐

Plasmids ☐

[2]

(b) Which processes need energy from cellular respiration?

Tick (✓) **two** boxes.

Active transport ☐

Diffusion ☐

Gaseous exchange ☐

Muscle contraction ☐

Osmosis ☐

Transpiration ☐

[2]

All living cells produce hydrogen peroxide (H_2O_2) as a waste product.

The cells in potatoes contain an enzyme called catalase. It breaks down H_2O_2 to water and oxygen, this is the equation for the reaction that takes place.

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$
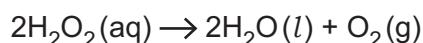
Mia investigates the effect of H_2O_2 concentration on the rate of this reaction.

She writes out her method.

1. Put a peeled potato in a liquidiser with some water to make potato extract.
2. Dip a paper disc in the potato extract. The potato extract is a source of catalase.
3. Drop the paper disc into a test tube containing H_2O_2 solution.
4. Wait until the disc has sunk to the bottom.
5. Time how long it takes for the disc to rise to the surface of the H_2O_2.

This is a diagram of her apparatus.
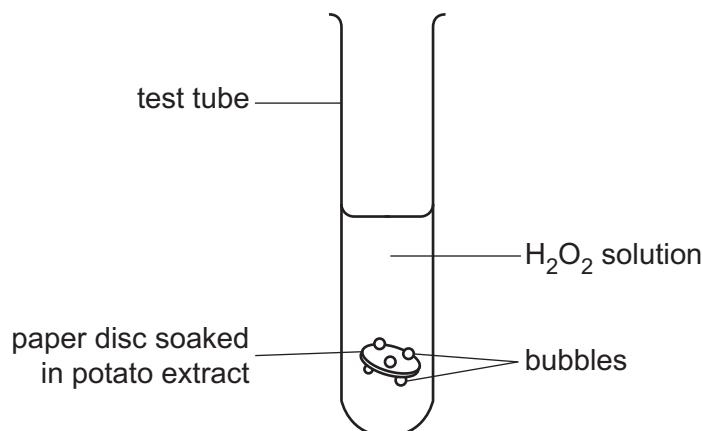
(c) Mia's method lacks the detail needed for another scientist to reproduce her findings.

Suggest additional detail which would allow another student to follow the method exactly.

....

....

....

....

....

.... **[3]**

4

(d) Bubbles form on the paper disc when it is in the H_2O_2 solution. This causes the disc to rise to the surface of the solution.

Mia thinks that if a disc rises more quickly, this means that the rate of reaction is faster.

Explain why she is correct.

....

....

....

.... **[2]**

(e) The table shows Mia's results.

Concentration of H_2O_2 solution (%)	Time taken for paper disc to reach the surface (s)
0.75	19.69
1.50	15.13
3.00	12.90
4.50	10.00
6.00	7.66

(i) Calculate the rate of reaction for 6.00% H_2O_2 solution.

Give your answer to **3** significant figures.

Rate = ... s^{-1} **[3]**

5

(ii) Which conclusions are supported by the data in the table?

Tick (✓) **two** boxes.

Between 0.75% and 6.00% H_2O_2 the reaction rate increases by approximately 2.5 times. ☐

Doubling the concentration of H_2O_2 halves the time taken for the disc to reach the surface. ☐

Increasing the concentration of H_2O_2 decreases the rate of reaction. ☐

Increasing the concentration of H_2O_2 increases the time taken for the disc to reach the surface. ☐

The biggest difference in time taken for the paper disc to reach the surface is between 0.75 and 1.50% H_2O_2. ☐

[2]

(f) Describe what Mia could do to increase confidence in her data.

....

.... **[1]**

(g) Use the lock and key model to explain why the enzyme catalase can **only** break down H_2O_2.

....

....

....

....

....

....

.... **[4]**

6

2   Herring are a type of fish. They live in the North Sea.

   (a) Fig. 2.1 shows the food web for a community living in the North Sea.
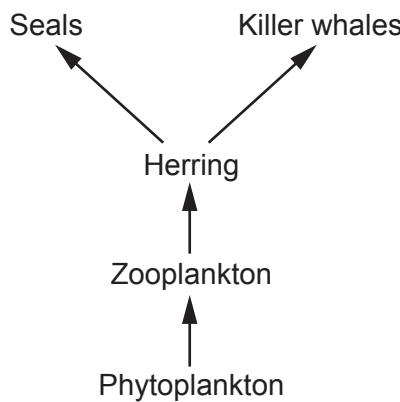
Fig. 2.1

   (i) Humans catch and eat herring.

   Add **humans** to the food web in **Fig. 2.1**.   **[1]**

   (ii) Explain why seals and killer whales are described as competitors.

   ....

   ....

   ....

   .... **[2]**

   (iii) What is the correct name for the process that produces food and biomass in food chains?

   Put a (ring) around the correct answer.

   Diffusion   Osmosis   Photosynthesis   Respiration   Transpiration
   [1]

   (iv) What is the name of the biomass producer in the North Sea food web in **Fig. 2.1**?

   .... **[1]**

(v) Some students are studying the North Sea food web.

They discuss how fishing may affect the biodiversity of the North Sea.

Amir
Fishing will increase the biodiversity as there will be more zooplankton.

Ben
Fishing will decrease the biodiversity as there could be local extinctions of killer whales and seals.

Jane
Fishing will not change the biodiversity. There will just be smaller populations of all the species.

Sarah
Fishing will increase the biodiversity as the populations of all the species will increase.

Which student is correct?

Tick (✓) **one** box.

Amir ☐

Ben ☐

Jane ☐

Sarah ☐

Explain your answer.

....

....

.... **[2]**

(b) The bar chart in **Fig. 2.2** shows how many herring were caught from the North Sea each year from 1960 to 2000.
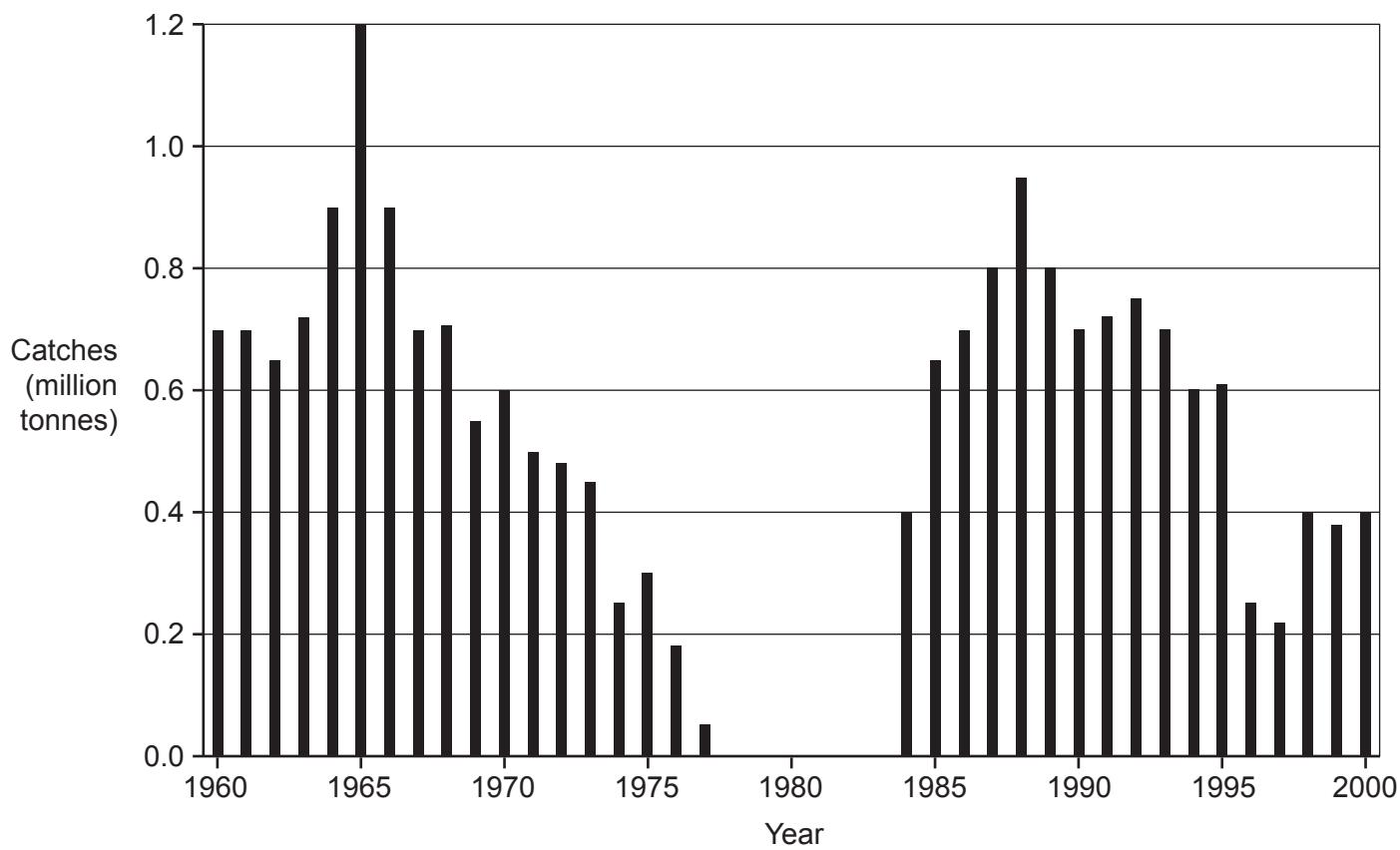
Fig. 2.2

(i) In which year was the catch greatest **and** how big was it?

Year ....

Catch .... **[1]**

(ii) By 1977 the herring population in the North Sea was so low that fishing for herring was banned.

Fishing restarted in 1984. A limit was put on the number of tonnes of herring that could be caught each year.

The limit was changed in 1996.

What evidence from the bar chart in **Fig. 2.2** indicates that the limit was changed?

....

.... **[1]**

(iii) Calculate the rate of increase in the herring catch from 1984 to 1988.

Rate = ... million tonnes / year **[3]**

(c) Since 1998 North Sea herring fishing has been described as sustainable.

Explain what sustainable means in this context.

....

....

....

....

.... **[2]**

Turn over

10

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

3 Influenza (flu) is a common human infection.

(a) Infections are caused by pathogens. Pathogens can be spread in different ways.

(i) Draw lines to connect each **pathogen** to **how it is spread**.

Pathogen		**How it is spread**

		By contact with contaminated surfaces
Athlete's foot fungus		By contaminated food or water
Malaria protist		By mosquitoes
Salmonella bacterium		By sexual intercourse

[1]

Turn over

(ii) Coughing and sneezing can spread the virus that causes flu.

Look at the poster in **Fig. 3.1**.

Fig. 3.1

Explain how following the advice in the poster (**Fig. 3.1**) could prevent the spread of flu.

....

....

....

....

.... **[3]**

(b) In 2017 there was a flu epidemic in Australia. 170 000 people in Australia were infected. 72 of these people died. The population of Australia in 2017 was 25 000 000.

(i) Calculate the probability of an individual person in Australia being infected in 2017.

Probability = ... **[2]**

(ii) The same flu virus could affect the UK. The population of the UK is approximately 66 000 000.

Assume that the death rate in the UK would be the same as in Australia.

Estimate how many people would die of this flu virus in the UK.

Estimated number of deaths = ... **[3]**

(c) The diagram in **Fig. 3.2** shows a flu virus.

The virus is made from four different proteins.


M-protein

N-protein

R-protein

H-protein
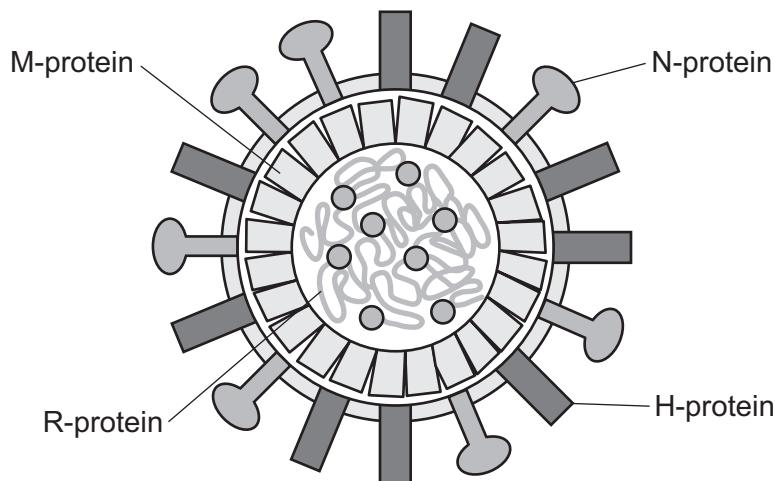
Fig. 3.2

The virus is approximately 0.1 μm in diameter.

Which device must scientists have used to look at the virus so that they could draw such a detailed diagram?

Tick (✓) **one** box.

Electric microscope ☐

Electron microscope ☐

Light microscope ☐

Magnifying glass ☐

[1]

Turn over

(d) (i) Infants under the age of 6 months are too young to be vaccinated against flu.

Doctors recommend that older children and adults are vaccinated. Explain how this helps protect **infants** from flu.

....

....

....

.... **[2]**

(ii)* Read the article about flu viruses and vaccination.

> Flu virus proteins change rapidly due to a high mutation rate.
>
> Each year doctors develop a vaccine for the flu virus they expect to be the most common that year.
>
> It takes several months to make a flu vaccine.
>
> In most years a vaccinated person is 40 to 60% **less** likely to develop flu.

Use the information in the article to explain:

• how vaccination and the immune system protect against flu
• why the vaccine is never 100% effective.

....

....

....

....

....

....

....

....

....

....

....

.... **[6]**

(e) Flu can increase the risk of other diseases such as pneumonia.

Pneumonia is a disease of the lungs, caused by an infection.

(i) Suggest why having flu increases the risk of catching pneumonia.

....

.... **[1]**

(ii) An adult man has a lung volume of 5 litres and a lung surface area of $70\,m^2$.

Write down the simplest surface area to volume ratio for this man's lungs.

Surface area : volume = ... **[1]**

(iii) Pneumonia causes fluid to collect in the alveoli of the lungs.

The diagram in **Fig. 3.3** shows this happening in one alveolus.
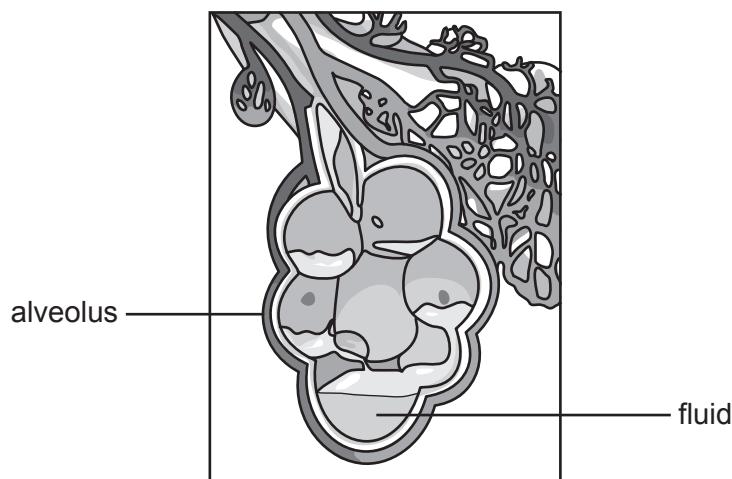
alveolus ——

—— fluid

Fig. 3.3

Suggest how the fluid collecting in the alveoli will affect gas exchange **and** explain why the symptoms of pneumonia, include feeling tired and weak.

....

....

....

....

....

....

.... **[4]**

Turn over

4   Huntington's disease is caused by a faulty allele of a single gene.

   (a) (i)   A person will have Huntington's disease if they inherit a faulty allele from one parent **or** from both parents.

             Complete the Punnett square to show how Huntington's disease may be inherited if only **one** of the parents has the disease.

             Use:
             • **H** to represent a Huntington's disease allele
             • **h** to represent a normal allele.

[3]

      (ii)   Write down the expected percentage of Huntington's disease phenotypes.

             Percentage = ... % **[1]**

   (b) Huntington's disease is caused by the production of a damaged protein.

      (i)   Proteins are polymers.

            Which molecules are joined together to make a protein?

            Tick (✓) **one** box.

            Amino acids   ☐

            Fatty acids   ☐

            Glycerol   ☐

            Sugars   ☐

[1]

17

(ii) DNA is also a polymer.

Describe the structure of DNA.

....

....

....

....

....

.... **[3]**

(iii) Explain how changes to the DNA polymer can cause changes to the protein polymer.

....

....

....

.... **[2]**

Turn over

5 Sickle cell disease (SCD) is an inherited condition.

People with SCD have faulty red blood cells.

The drawing shows red blood cells in the same volume of blood taken from two different people. The cells were viewed using a light microscope.

Red blood cells from a person **without** SCD

Red blood cells from a person with SCD

normal red blood cell

red blood cell with sickle shape

nucleus
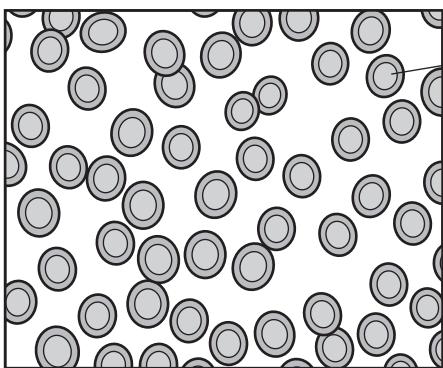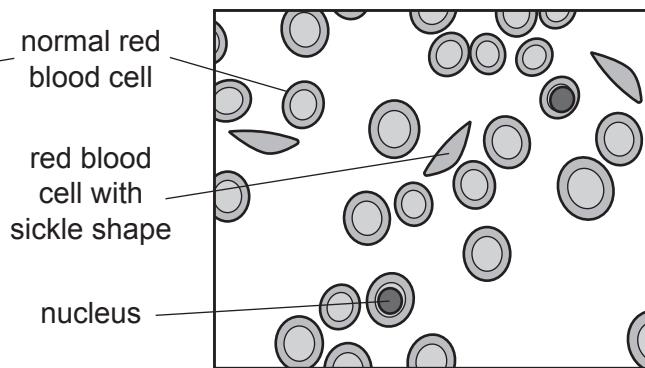
(a) (i) The structure of red blood cells is adapted to carry oxygen.

Changes to the red blood cells in people with SCD mean they carry less oxygen. Explain why.

....

....

....

....

....

....

....

.... **[4]**

(ii) What must be added to cells so that the nuclei can be seen using a light microscope?

.... **[1]**

(b) Only red blood cells can contain the protein haemoglobin.

Explain why other specialised cells **cannot** produce haemoglobin.

....

....

....

.... **[2]**

(c) A team of scientists claimed to have cured SCD in a man in 2017.

They added an extra gene to some of his stem cells. These stem cells specialise to become red blood cells.

All the blood tests they performed showed that the man had been cured of SCD.

They published their results in a scientific journal so that other scientists could read about the cure.

(i) Evaluate the scientists' claim to have cured SCD.

....

....

....

.... **[2]**

(ii) The scientists used adult stem cells from the man for the procedure.

Why does the use of adult stem cells cause fewer ethical issues than the use of embryonic stem cells?

....

....

....

.... **[2]**

Turn over

(d) The diagrams show two stages of the heartbeat. The shading shows which chambers and arteries contain blood at the end of each stage. The arrows show the direction in which the blood moved.

Put ticks (✓) in the boxes that correctly describe each stage.
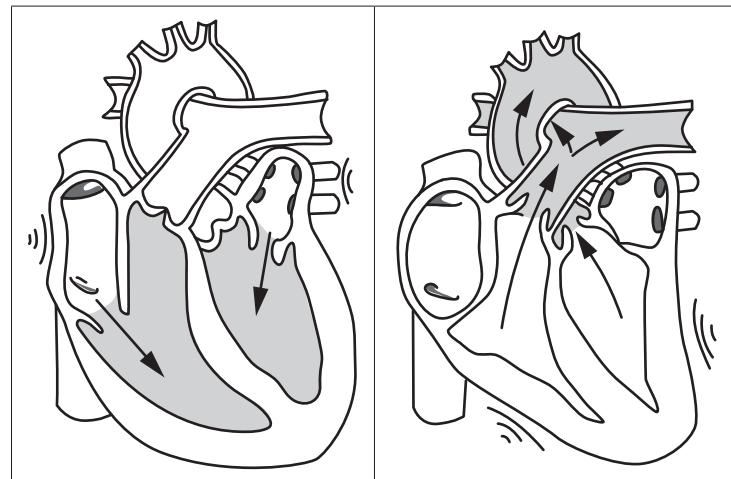
Atria contracting		
Ventricles contracting		
Valves between atria and ventricles shut		

[2]

21

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

6 A scientist investigated how maggots respond to light.

She set up a card circle with a light source on one side. Four areas were marked on the card circle. Maggots were placed on the centre of the circle as shown in **Fig. 6.1**.
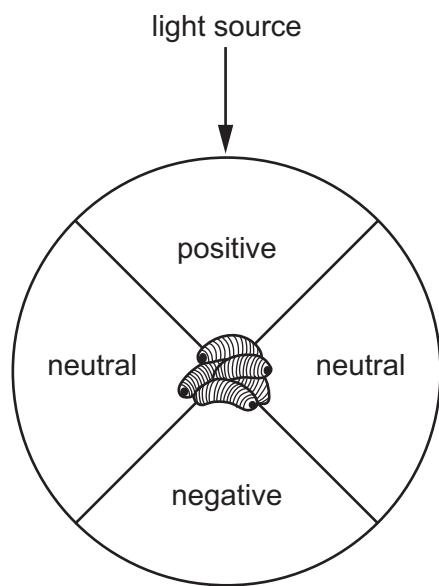
Fig. 6.1

The light was switched on and the maggots moved on the card circle. The number of maggots in the positive, negative and neutral areas was recorded after three minutes.

The experiment was repeated using four different light intensities.

The scientist put her results in a table.

Light intensity (arbitrary units)	Percentage of maggots recorded in each area (%)		
	Positive	**Negative**	**Neutral**
1	30	35	36
2	27	56	17
3	18	78	4
4	0	92	8

(a) (i) Use the data in the table to suggest the **lowest** light intensity that can be detected by the maggots.

Explain your answer.

Light intensity .... arbitrary units

Explanation ....

....

.... **[2]**

(ii) Suggest how the scientist could develop the investigation to find out whether maggots can detect different colours of light.

....

....

....

.... **[2]**

(b) Maggots can respond to stimuli such as light because they have a nervous system. Neurons in the nervous system connect to each other at synapses.

Fig. 6.2 shows a synapse.
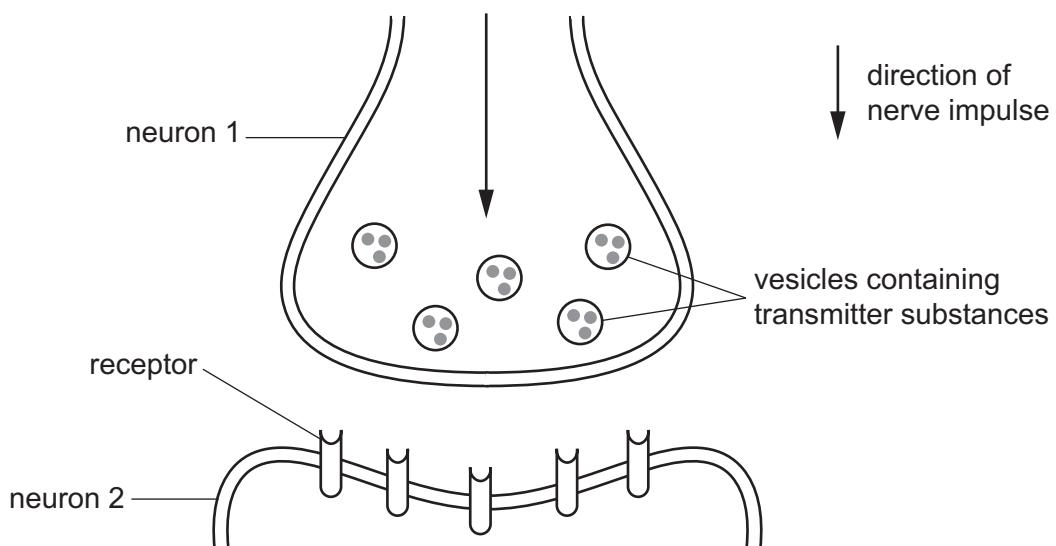
Fig. 6.2

Use **Fig. 6.2** to explain the role of transmitter substances in transmitting impulses between neurons.

....

....

....

....

....

....

....

.... **[4]**

7 Plants transport sucrose (sugar) in their phloem vessels by translocation.

Fig. 7.1 shows a model of translocation.
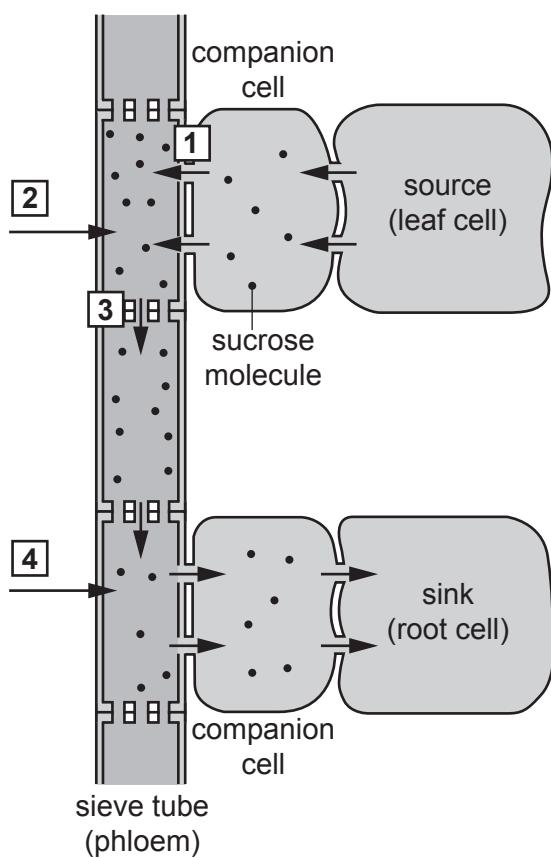

Fig. 7.1

(a) (i) Which numbered arrow in **Fig. 7.1** shows active transport?

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

[1]

25

(ii) Which numbered arrows in **Fig. 7.1** show osmosis?

Tick (✓) **two** boxes.

1 ☐

2 ☐

3 ☐

4 ☐

[1]

(iii) Explain why active transport can take place in phloem but **not** in xylem.

....

....

....

.... **[2]**

(iv) Companion cells contain soluble proteins.

Explain why these proteins cannot diffuse across the cell membrane into the phloem.

....

.... **[1]**

(b) **Fig. 7.2** shows a cross section through a leaf, as seen with a light microscope.
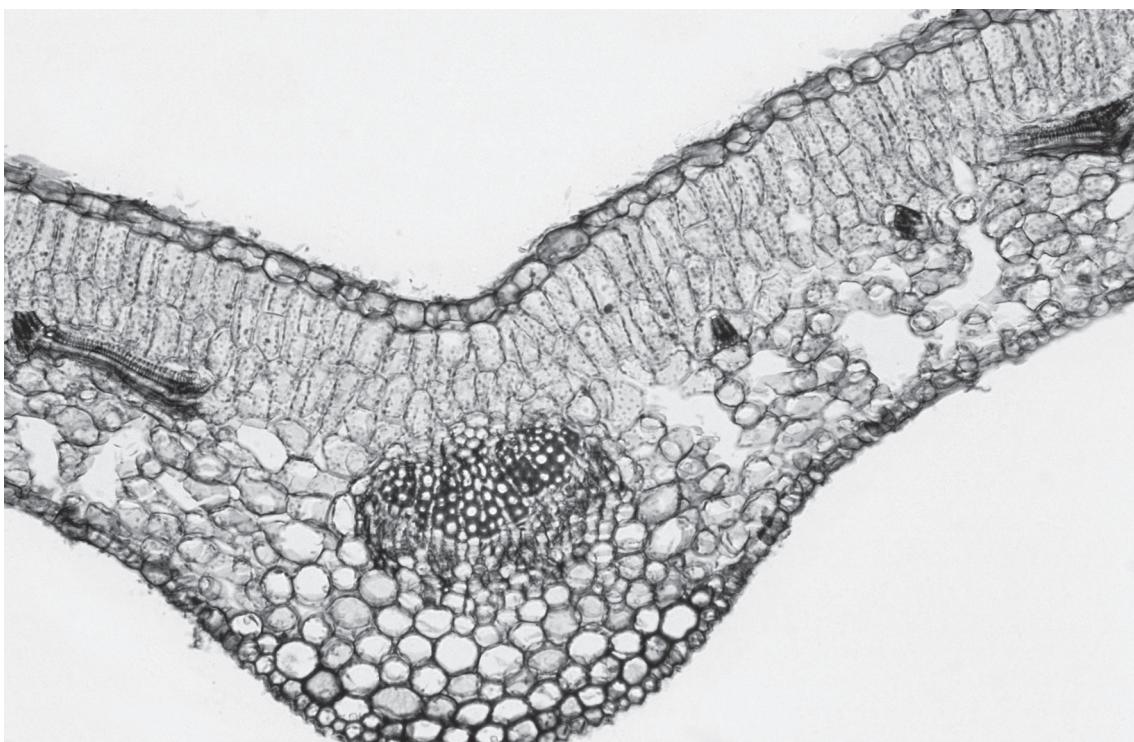
Fig. 7.2

Describe how you could make a temporary slide of a cross section through a leaf.

....

....

....

.... **[2]**

END OF QUESTION PAPER

27

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

OCR

Oxford Cambridge and RSA