OCR
Oxford Cambridge and RSA

Friday 16 October 2020 – Morning

AS Level Biology A

H020/02 Depth in biology

Time allowed: 1 hour 30 minutes

You must have:
- the Insert (inside this document)

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

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 can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 **(a)** A student was observing onion epithelial cells using a light microscope. They photographed these cells and the image obtained is shown in Fig. 1.1. The student then made a drawing of a few cells from this image. The drawing is shown in Fig. 1.2.

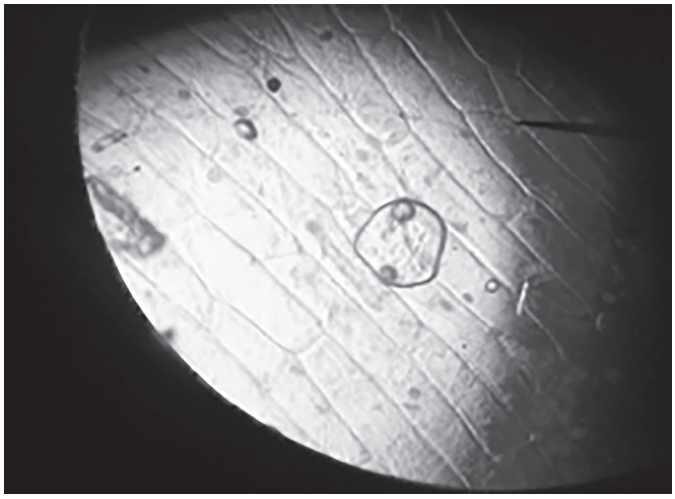

Fig. 1.1

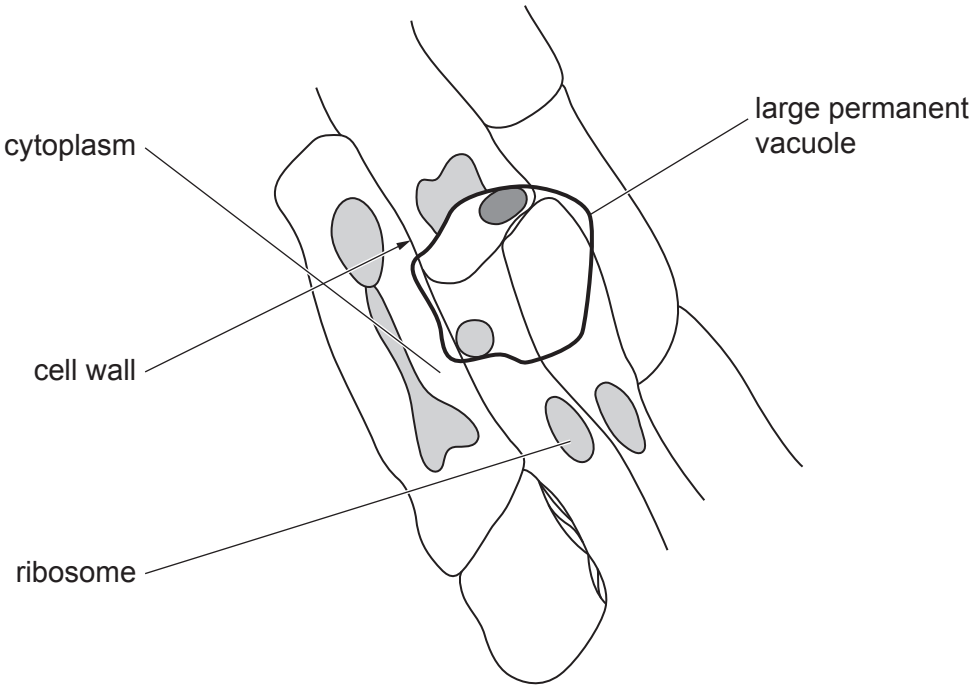

Fig. 1.2

The teacher stated that two of the labels on the drawing Fig. 1.2 were incorrect, and also that it was a poor quality biological drawing.

(i) Identify **one** incorrect label and explain your answer.

Incorrect label .....

Explanation .....

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[3]

(ii) State **three** changes, other than to the labels, to Fig. 1.2 that the student would need to make to improve the biological drawing.

1 .....

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2 .....

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3 .....

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[3]

(b) Both a transmission electron microscope (TEM) and a scanning electron microscope (SEM) can be used to view the same cell. However, the images formed will be different.

Compare the resolutions of these microscopes **and** the images formed by them.

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..... **[4]**

(c) (i) A student wrote the following passage about cells:

'Erythrocytes and neutrophils are formed in the spleen. One of the places ciliated epithelial cells are found is in blood vessels. Sperm cells are the male gametes and contain the haploid number of chromosomes. The cell wall of the guard cell is thicker on the side furthest away from the stoma, so the cell does not change shape symmetrically as its volume changes. Root hair cells increase the surface area for absorption of water and mineral ions from the soil.'

Identify **and** correct the errors in the passage.

Error 1 .....

Correction .....

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Error 2 .....

Correction .....

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Error 3 .....

Correction .....

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[3]

(ii) A man with a body mass of 73 kg was admitted to hospital with an infection. His neutrophil production was measured at approximately 3804 billion cells in a 24h period.

When healthy, the man was producing approximately 1.6 billion neutrophils $kg^{-1}\,h^{-1}$.

Calculate the percentage increase in neutrophil production due to the infection.

percentage increase = ... % **[2]**

(iii)* Erythrocytes and neutrophils are both examples of specialised blood cells.

Squamous and ciliated epithelial cells are also examples of specialised cells.

Describe how each of these **four** cells is specialised for its function.

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..... **[6]**

Additional answer space if required.

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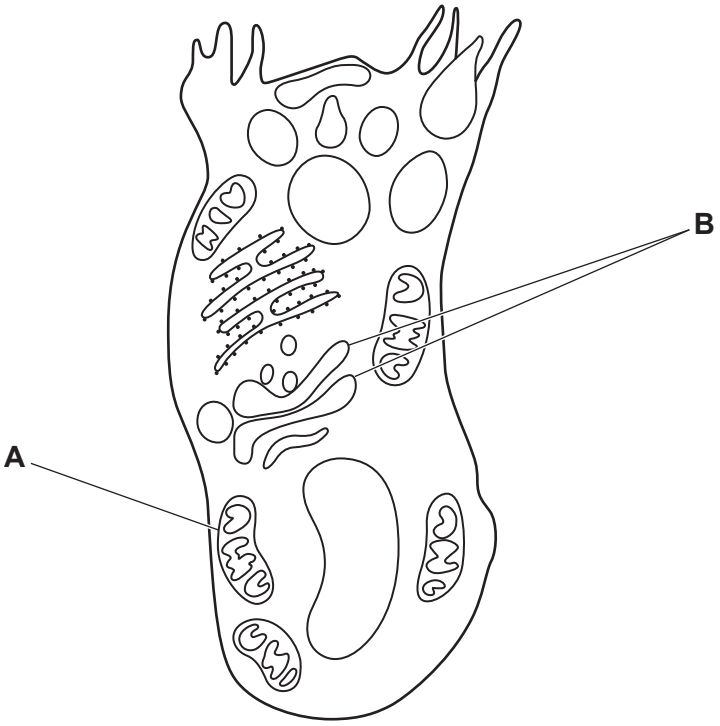
2 **(a)** Mucus is composed of water, carbohydrates, proteins and triglycerides.

Mucus is secreted by goblet cells.

Below is a diagram of a goblet cell as seen under an electron microscope.



(i) Suggest why goblet cells have large numbers of the cellular component labelled **A**.

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

(ii) Suggest how the role of the cellular component labelled **B** is relevant to the function of the goblet cell.

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..... **[2]**

(b) (i) Mucus is present in goblet cells as condensed granules.

Some studies reveal that when secreted, the mucus expands to 500 times its volume in 20 ms.

40 cm^3 of mucus is held in condensed granules.

Calculate the volume of mucus in these granules **one** second after secretion, assuming a constant rate of expansion.

volume of mucus = ... cm^3 **[2]**

(ii) Sjogren's syndrome is a rare condition that can reduce the production of mucus.

Suggest how the upper respiratory tract of a person with Sjogren's syndrome might be affected.

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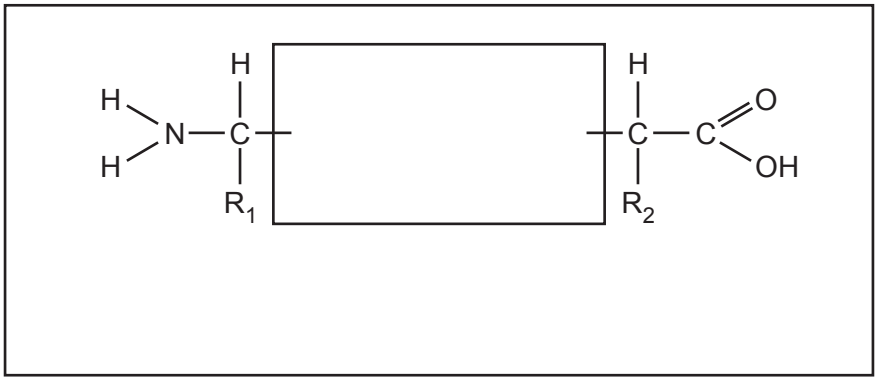
..... **[1]**

(c) (i) A protein is made up of amino acids which are joined by chemical bonds.

Below is an incomplete diagram of one of these bonds.

Complete the diagram of the molecular structure of these two amino acids to show how they are joined together **and** name the bond you have drawn.



Name of bond .....

[2]

(ii) The process of esterification leads to the formation of ester bonds during the production of triglycerides.

Describe what is meant by the term esterification.

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..... **[2]**

(d) Sjogren's syndrome is an autoimmune condition.

- Family members of Sjogren's syndrome sufferers can often have other autoimmune diseases such as Lupus
- Lupus affects approximately 1 in 1350 of the world's population
- In 2018 the world population was estimated at 7.7×10^9
- The world population is estimated to increase by 1.11% a year
- Around 60% of Lupus sufferers are photosensitive, meaning their symptoms can be triggered by going out in direct sunlight.

(i) Using the information provided, calculate how many of the world's Lupus sufferers by the end of 2019 would be photosensitive.

number of photosensitive Lupus sufferers = ... **[2]**

(ii) Lupus symptoms include pain in joints, inflammation, fatigue, fever and a skin rash.

Suggest what component of sunlight causes photosensitivity and which symptom is likely to be more common in photosensitive sufferers.

Component of sunlight .....

Symptom .....

[1]

(iii) Explain what is meant by an autoimmune disease **and** suggest why members of the same family can be sufferers of autoimmune diseases.

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..... **[2]**

3 **(a)** Different types of pathogen cause communicable diseases in plants and animals.

Complete the table by adding the correct type of pathogen for each communicable disease.

The first one has been done for you.

Type of Pathogen	Communicable Disease
bacterium	tuberculosis (TB)
.....	potato late blight
.....	malaria

[2]

(b) People with malarial pathogens generate distinct odours on their skin. Scientists in Gambia have carried out trials using dogs that have been trained to identify malarial infection in children. The dogs sniff clothing worn by the children. The dogs were trained to sniff each sample and to freeze if they detected malaria, or move on if they did not.

- In one trial the dogs sniffed the socks from 175 children
- 17% of these children had malaria
- The dogs correctly identified 70% of children with malarial infection by sniffing their socks.

(i) Calculate how many of the children who were suffering from malaria were correctly identified by the dogs.

number of children = ... **[2]**

(ii) Suggest **one** limitation of this trial.

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

(c) Some people are immune to malaria. They produce a specific type of antibody. One way in which antibodies defend the body is by acting as agglutinins.

Outline the action of agglutinins.

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..... **[2]**

Turn over for the next question

4 A program has been developed for vaccinations against the influenza virus and is updated yearly. It is recommended that the vaccination be given to adults aged 65 years and over and those under 65 years with 'at-risk' health conditions. However, not all the people in these groups take up the offer of the influenza vaccination.

The data in Fig. 4.1 show the number of influenza cases in four different environments within a single city during three consecutive winter periods from 2015–2018.

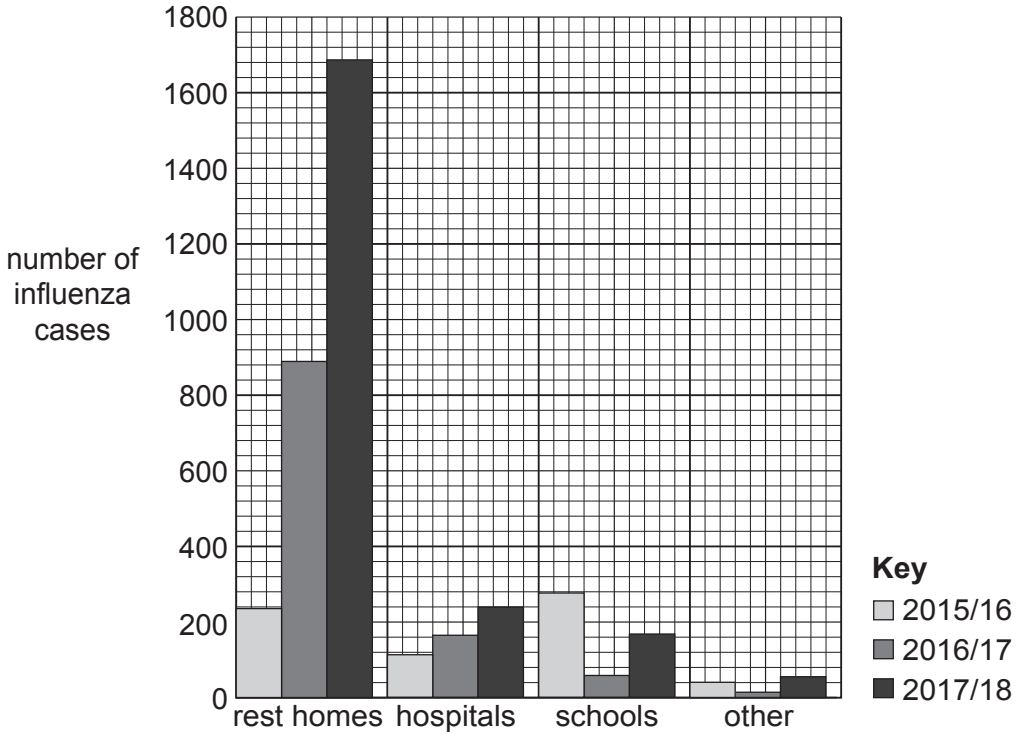

Fig. 4.1

The data in Fig. 4.2 show the percentage uptake of the influenza vaccine in four different environments in the same city during three consecutive winter periods from 2015–2018.

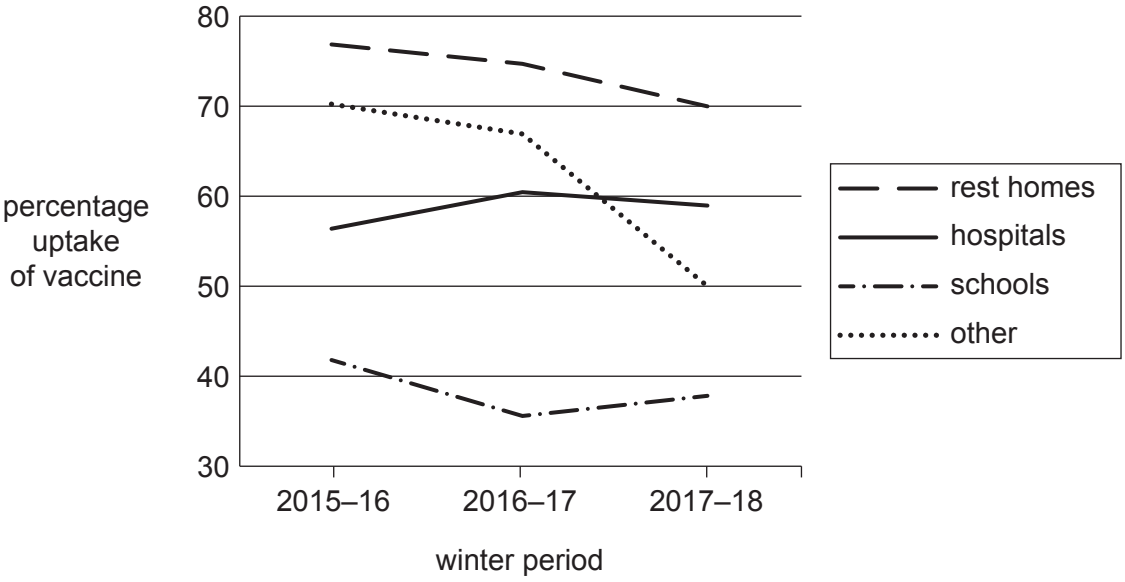

Fig. 4.2

(a) A student looking at the data in Fig. 4.1 and Fig. 4.2 made the following conclusion:

'The data shows that a vaccination program is a successful way of reducing influenza cases in this city, as there is a direct correlation between uptake of the influenza vaccine and the number of influenza cases.'

Evaluate the validity of this statement, based on the data in Fig. 4.1 and Fig. 4.2.

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..... **[4]**

(b) Complete the following sequence to outline how a vaccine gives an individual immunity. The first two steps have been completed for you.

Step 1: A vaccine is produced that is a safe form of an antigen.

Step 2: A small amount of vaccine is injected into blood of the individual to be vaccinated.

Step 3: .....

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Step 4: .....

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Step 5: .....

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[3]

(c) Measles is a highly contagious viral infection.

In October 2018, an outbreak of the disease on the island of Madagascar resulted in more than 50 000 cases of measles. Fewer than 50% of the population was vaccinated when the outbreak began. The government of Madagascar hoped to bring the epidemic under control by vaccinating 90% of the population.

Discuss why this response was likely to bring the measles outbreak on Madagascar under control.

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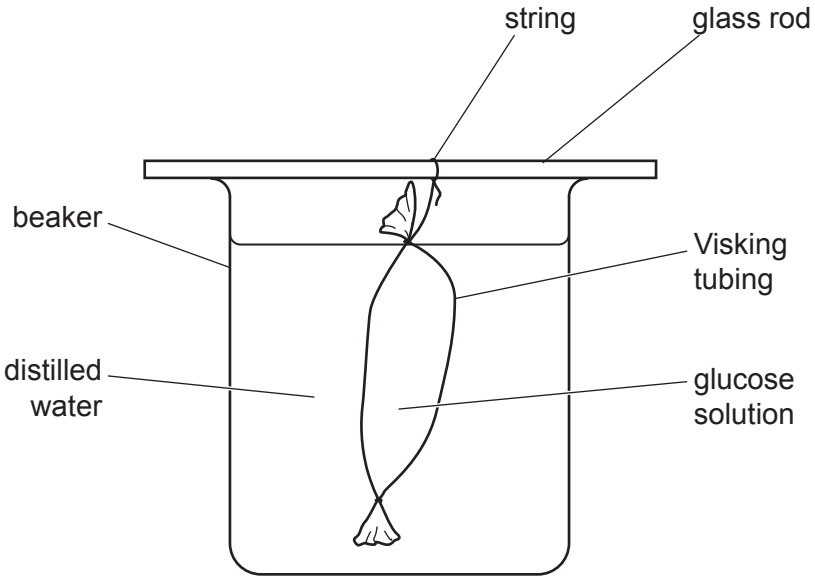
..... **[2]**

5 **(a)** A group of students set up the apparatus shown below to test the effect of temperature on the rate of diffusion of glucose molecules in model cells.

They determined the concentration of glucose in the distilled water by taking samples at 30s intervals. They carried out the Benedict's test on each sample and used a calibrated colorimeter to determine the absorbance of each sample. Previously they had produced a calibration curve of colorimeter readings against glucose concentration. They used the calibration curve to determine the glucose concentrations of their samples.

They carried out the investigation at three different temperatures.



A table of the results from the students' investigation is shown below.

	Concentration of glucose found in the distilled water samples taken at 30s intervals (mmol dm^{-3})				
Temperature of water bath (°C)	**0s**	**30s**	**60s**	**90s**	**120s**
10	0.00	0.33	0.65	0.98	1.30
20	0.00	0.80	3.21	2.40	3.20
30	0.00	1.23	2.45	3.68	4.90

(i) Suggest an improvement to the method that would allow the students to obtain more precise results.

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(ii) State **one** variable that should have been controlled during this experiment.

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

(b) (i) Before the students began their investigation they made a hypothesis.

State the hypothesis the students would have made **and** state the scientific process that supports your choice.

Hypothesis .....

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Scientific process .....

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[2]

(ii) Justify whether the results from the investigation support your hypothesis given in part **(b)(i)**.

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(c) Describe how you would use the same equipment to test if the thickness of the exchange surface affects the diffusion rate.

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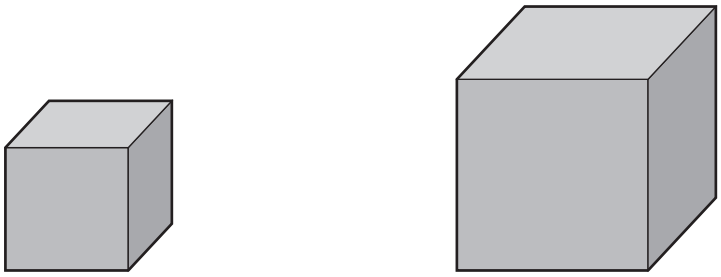
6 **(a)** The cubes shown in Fig. 6.1 represent two different sized animals.



Small multicellular animal
Volume = 8 cm^3
Surface area = 24 cm^2

Large multicellular animal
Volume = 64 cm^3
Surface area = 96 cm^2

Fig. 6.1

Explain how Fig. 6.1 demonstrates the need for larger multicellular animals to have specialised exchange surfaces.

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..... **[2]**

(b)* Fig. 6.2 and Fig. 6.3, **on the insert**, show images of exchange surfaces in a bony fish and an insect.

With reference to both Fig. 6.2 and Fig. 6.3 and your own knowledge, outline how the respiratory systems in a bony fish and in an insect are adapted to maximise ventilation and gaseous exchange.

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Additional answer space if required.

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(c) In mammals the lungs act as the gas exchange system. Various components of this system work together to ensure gas exchange is efficient. Two such components are cartilage and elastic fibres.

State the roles of these two components in mammalian gas exchange.

Cartilage .....

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Elastic fibres .....

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[2]

END OF QUESTION PAPER

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).