



Oxford Cambridge and RSA

# A Level Biology A

H420/03 Unified biology

## Practice paper – Set 2

Time allowed: 1 hour 30 minutes



**You may use:**

- a scientific or graphical calculator
- a ruler (cm/mm)

First name										
Last name										
Centre number						Candidate number				

### INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- 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.
- Do **not** write in the barcodes.

### INFORMATION

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

Answer **all** the questions.

1 Phagocytes are white blood cells that are involved in non-specific immune responses against pathogens.

(a) The following passage describes the mode of action of a phagocyte.

Complete the passage using the most appropriate words or phrases.

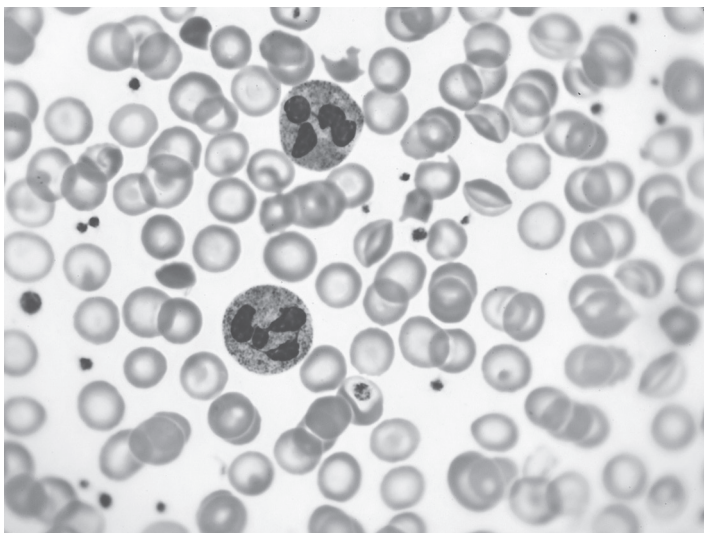
Receptors on the cell membrane of a phagocyte recognise antibody molecules known as ....., which are bound to pathogens and enhance phagocytosis.

Once engulfed by a phagocyte, a pathogen is contained in a vacuole called a .....

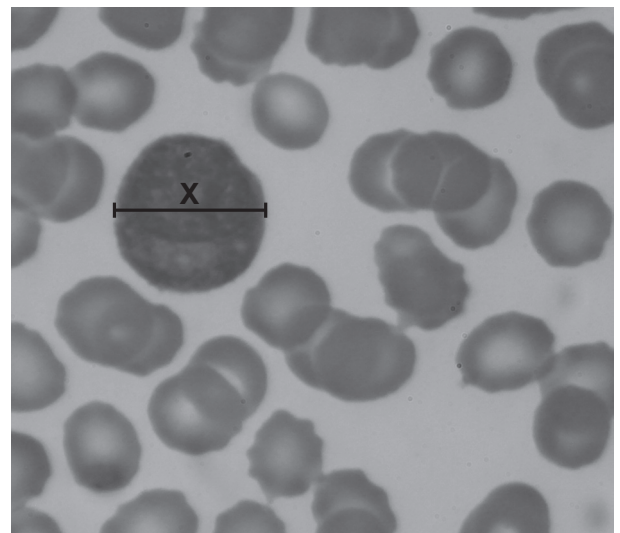
..... . Organelles called ..... produce enzymes that digest the pathogen.

[3]

(b) Fig. 1 shows two blood smears, **A** and **B**.



**A**



**B**

**Fig. 1**

(i) Which of the two images, **A** or **B**, shows a non-specific immune response?

Explain your answer.

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

3

(ii) The actual width of **X** in Fig. 1 image **B** is  $15\mu\text{m}$ .

Calculate the magnification used to produce image **B** in Fig. 1.

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

Answer = ..... [2]

**Turn over for the next question**

2 Squid are an order of aquatic animals. Many species of squid show a reflex response to changes in their body position.

- A sensory receptor called a statocyst detects changes in the body position of the squid in their aquatic environment.
- The reflex response corrects the squid's body position.

(a) (i) Describe the components and events involved in a reflex arc.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

..... [3]

(ii) Suggest one benefit to the squid of the reflex response described above.

.....  
.....

..... [1]

(iii) A statocyst sensory receptor is shown in Fig. 2.1.

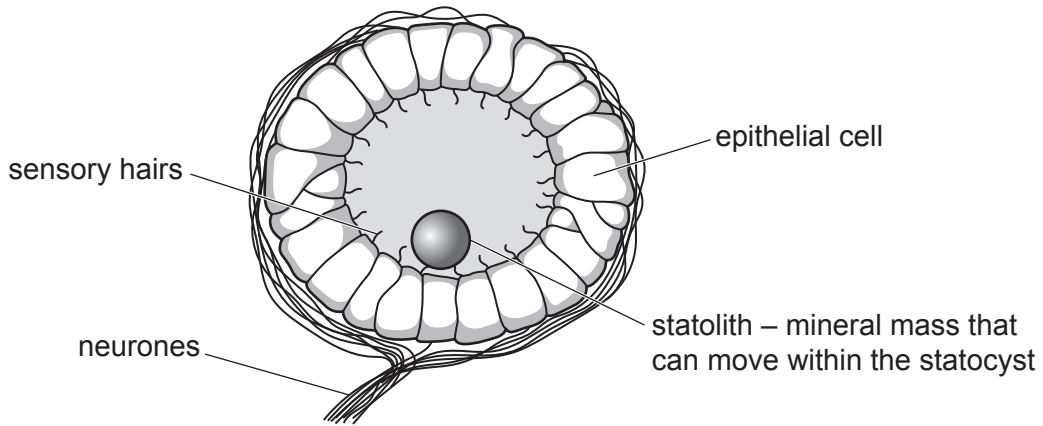


Fig. 2.1

What can you conclude from Fig. 2.1 about the mechanism by which a statocyst acts as a transducer?

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) Lobsters and sea cucumbers also have statocysts. From this information, the student concluded:

*'I think this means squids, lobsters and sea cucumbers evolved from a recent common ancestor and are probably classified in the same phylum.'*

Evaluate the extent to which the information about lobsters and sea cucumbers supports the student's conclusion.

.....

.....

.....

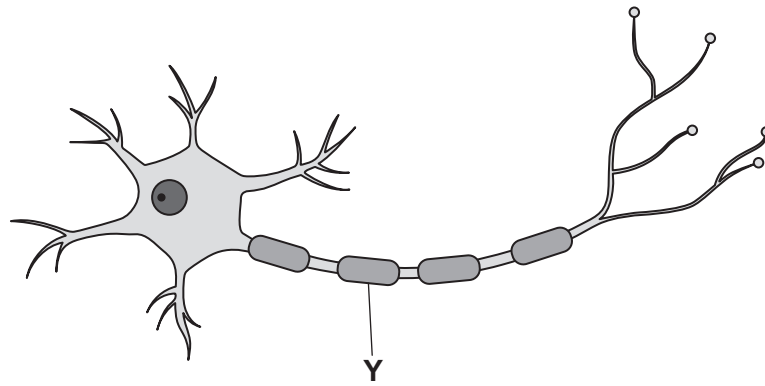
.....

.....

.....

..... [2]

(c) Fig. 2.2 shows a representation of a human neurone.



**Fig. 2.2**

(i) Name the type of neurone shown in Fig. 2.2.

..... [1]

(ii) State the function of Y in Fig. 2.2.

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



- 3 Fig. 3.1 shows a bubble alga, *Valonia ventricosa*, which is one of the largest unicellular organisms in the world.

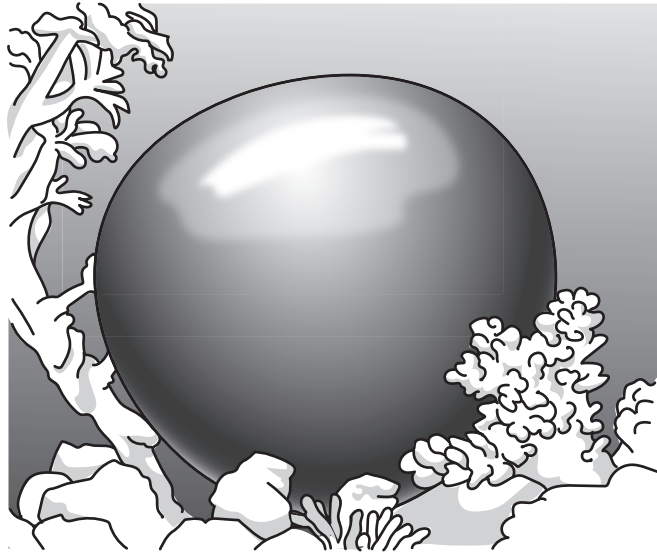


Fig. 3.1

- (a) Calculate the surface area to volume ratio of a bubble alga that has a diameter of 2.5 cm. Assume the bubble alga is spherical. Show your working.

Answer = ..... [3]

- (b) Multicellular organisms, such as plants, have evolved internal transport systems.  
(i) Explain the benefit to plants of internal transport systems.

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



- (ii) The transport systems of plants contain cells that are specialised to perform a particular function.

The table below shows information about three types of specialised plant cell. Three boxes have been completed already.

Complete the rest of the table by placing the correct responses in the empty boxes.

Cell	Location	Example of a substance transported	Contains chloroplasts? (✓ or X)
Guard cell		carbon dioxide	
Companion cell			X
Root hair cell	roots		

[3]

Question 3(c) begins on page 10





4 Stem cell therapy is a potential future treatment for diabetes mellitus.

(a) Stem cells were extracted from the bone marrow of 131 patients with diabetes mellitus. Each patient received an implantation of their own stem cells.

Following the stem cell treatment:

- 53 patients showed no change
- 78 patients showed an improvement in their condition.

Suggest three additional pieces of information that would be needed to assess the effectiveness of the stem cell therapy.

1.....  
.....  
2.....  
.....  
3.....  
.....

[3]

(b) In the future, it might be possible to differentiate stem cells in a laboratory (*in vitro*) before they are implanted into the pancreas of a patient with diabetes.

(i) Name the type of differentiated cell that scientists would produce from stem cells in order to treat diabetes mellitus.

..... [1]

(ii) Which type of diabetes mellitus is most likely to be improved by stem cell therapy?

Explain your answer.

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

- (c) The blood glucose concentration of a diabetes patient was measured on five separate occasions.

The five measured values (in  $\text{mmol dm}^{-3}$ ) were 8.7, 8.7, 9.0, 9.0 and 10.9.

- (i) Using the formula below, calculate the standard deviation of the patient's blood glucose concentration.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

$n$  = number of samples

$x$  = each value in the data set

$\bar{x}$  = mean

Answer ..... [3]

- (ii) Explain why standard deviation is better than range for measuring the dispersion of these data.

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

(iii) Scientists compared the blood glucose concentrations of two diabetes patients:

- a patient who had received stem cell therapy
- a patient who had received no stem cell therapy.

Describe **two** aspects of the experimental design that the scientists would need to consider in order to produce a valid comparison of the two patients.

.....

.....

.....

..... [2]

5 (a) Cells can be counted and analysed using a technique called flow cytometry. DNA in the cells is stained with a fluorescent dye before analysis. The degree of fluorescence is dependent on the amount of DNA present.

(i) Use your knowledge of the cell cycle to name the stages of interphase that match the following descriptions.

*The stage in which a cell produces the least fluorescence*

.....

*The stage in which a cell produces the most fluorescence*

.....

*The stage in which the highest number of cells is recorded*

.....

[3]

(ii) Scientists analysed a sample of liver cells. Of these cells, 27.2% were found to be undergoing cell division or nuclear division. An adult human's liver contains approximately 180 billion cells.

Estimate the number of cells in interphase in an adult human's liver.

Write your answer in standard form to **two** significant figures.

Answer = ..... [1]

(iii) Suggest why the use of fluorescent dyes in flow cytometry is inappropriate when analysing red blood cells.

.....

..... [1]

(b) Red blood cells contain high concentrations of the enzyme carbonic anhydrase.

(i) A scientist planned to investigate the effect of pH on the activity of carbonic anhydrase.

State **two** factors that the scientist would need to control during this investigation.

- 1 .....
- .....
- 2 .....
- .....

[2]

(ii) Human blood is maintained at a pH of 7.4 by reactions that occur in red blood cells.

Use your knowledge of these reactions to explain how a pH of 7.4 is maintained.

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

[3]





(b) Potatoes often suffer bruising, which reduces their value as a food crop.

A variety of crop potato that does not bruise has been developed using a technique called gene silencing.

Scientists carry out gene silencing by inserting small sequences of RNA into potato cells. These RNA sequences are complementary to mRNA from genes responsible for bruising.

Use this information to suggest why the technique is called 'gene silencing'.

.....

.....

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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).

A large area of lined paper for writing answers. It features a vertical margin line on the left side and horizontal dotted lines for writing. The lines are evenly spaced and extend across the width of the page.

A large area of the page is filled with horizontal dotted lines, providing a space for writing answers. A solid vertical line runs down the left side of this area, creating a margin.



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