| Surname | Centre Number | Candidate Number |
|---|---|---|
| First name(s) | | 2 |

# GCE AS

B400U10-1

S23-B400U10-1

**MONDAY, 15 MAY 2023 – MORNING**

## BIOLOGY – AS component 1
### Basic Biochemistry and Cell Organisation

1 hour 30 minutes

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **18** | |
| **2.** | **17** | |
| **3.** | **23** | |
| **4.** | **8** | |
| **5.** | **9** | |
| **Total** | **75** | |

B400U101
01

**ADDITIONAL MATERIALS**

In addition to this paper you may require a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

The assessment of quality of extended response (QER) will take place in question **5**.

The quality of written communication will affect the awarding of marks.

JUN23B400U10101

© WJEC CBAC Ltd.

Examiner only

Answer **all** questions.

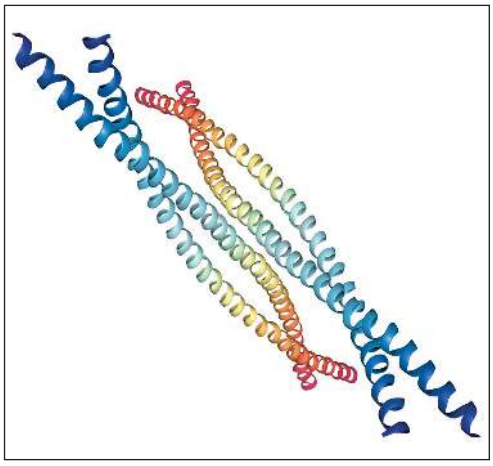
**1.** (a) Inorganic ions are found in many of the main biological molecules in living organisms. **Complete Table 1.1** to state **one** role of each of the inorganic ions shown. [2]

**Table 1.1**

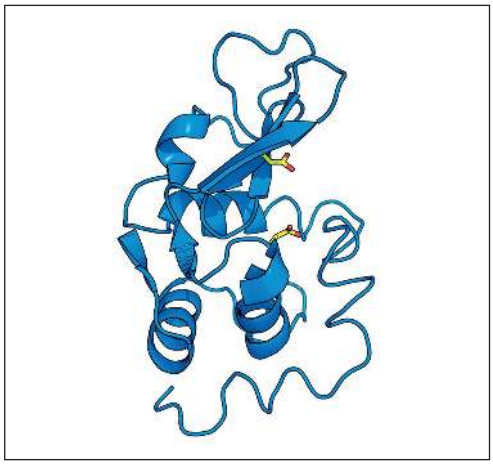
| Inorganic ion | Role in living organisms |
|---|---|
| $Mg^{2+}$ | ..... |
| $Fe^{2+}$ | ..... |
| $Ca^{2+}$ | ..... |
| $PO_4^{3-}$ | ..... |

(b) Proteins are major biological molecules. The structures of keratin and lysozyme are shown in **Image 1.2**.

**Image 1.2**



Keratin



Lysozyme

(i) State **two** structural differences between the two types of proteins shown in **Image 1.2**. [2]

.....

.....

.....

.....



© WJEC CBAC Ltd.

Examiner only

(ii) Polypeptides are polymers of amino acids joined by peptide bonds. Name the type of reaction which takes place to form these bonds. [1]

.....

(iii) Lysozyme is an enzyme which functions in a way that supports the theory of the induced fit hypothesis. Describe the induced fit hypothesis. [4]

.....

.....

.....

.....

.....

.....

.....

.....

(iv) Describe how the lock and key hypothesis is different from the induced fit hypothesis. [2]

.....

.....

.....

.....





© WJEC CBAC Ltd.

Examiner only

(c) Acid phosphatase (ACP) is an enzyme that catalyses the removal of an inorganic phosphate ion from a substrate by the induced fit model of enzyme action.

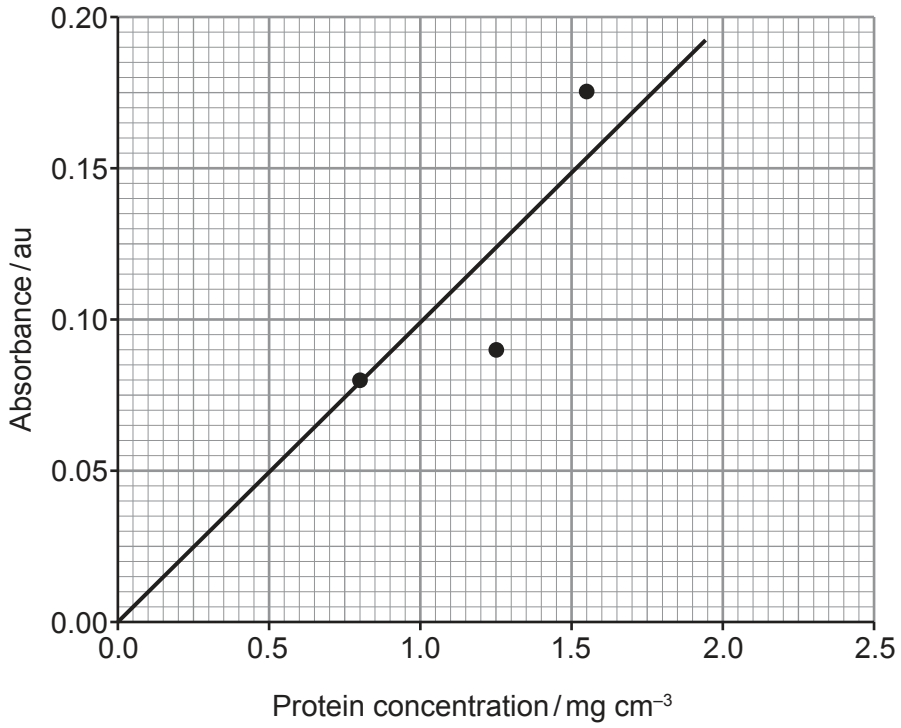
(i) The enzyme acid phosphatase is a protein. Name the reagent that would be used to test for protein **and** the colour produced by a positive result. [2]

.....

.....

The concentration of ACP in mung bean leaves of different ages was investigated. A standard curve was produced using three known concentrations of protein. The samples of protein were mixed with a reagent and the absorbance of light of the protein and reagent measured using a colorimeter. The standard curve is shown in **Graph 1.3**.

**Graph 1.3**






© WJEC CBAC Ltd.

Examiner only

Leaves of different ages were collected. Protein was extracted from the leaves and the sample placed with the reagent in a colorimeter. **Table 1.4** shows the concentration of protein found in the different leaf extracts.

**Table 1.4**

| Age of leaf / days | Protein concentration / mg $cm^{-3}$ |
|---|---|
| 1 | 2.1 |
| 2 | 1.9 |
| 3 | 1.7 |
| 4 | 1.0 |
| 5 | ..... |
| 6 | 0.2 |

(ii) The extract from the day 5 leaf was tested and the absorbance was found to be 0.04 au. **Use the standard curve in Graph 1.3** to determine the protein concentration of the extract. **Write your answer in Table 1.4**. [1]

(iii) Explain why chlorophyll would need to be removed from the extract before the absorbance is measured. [1]

.....

.....

(iv) Explain why this method would not allow the determination of the actual **acid phosphatase (ACP)** concentration. [1]

.....

.....

(v) Use evidence from **Graph 1.3** to explain **one** possible source of error with the method used to produce the standard curve. [2]

.....

.....

.....

.....

B400U1010 5

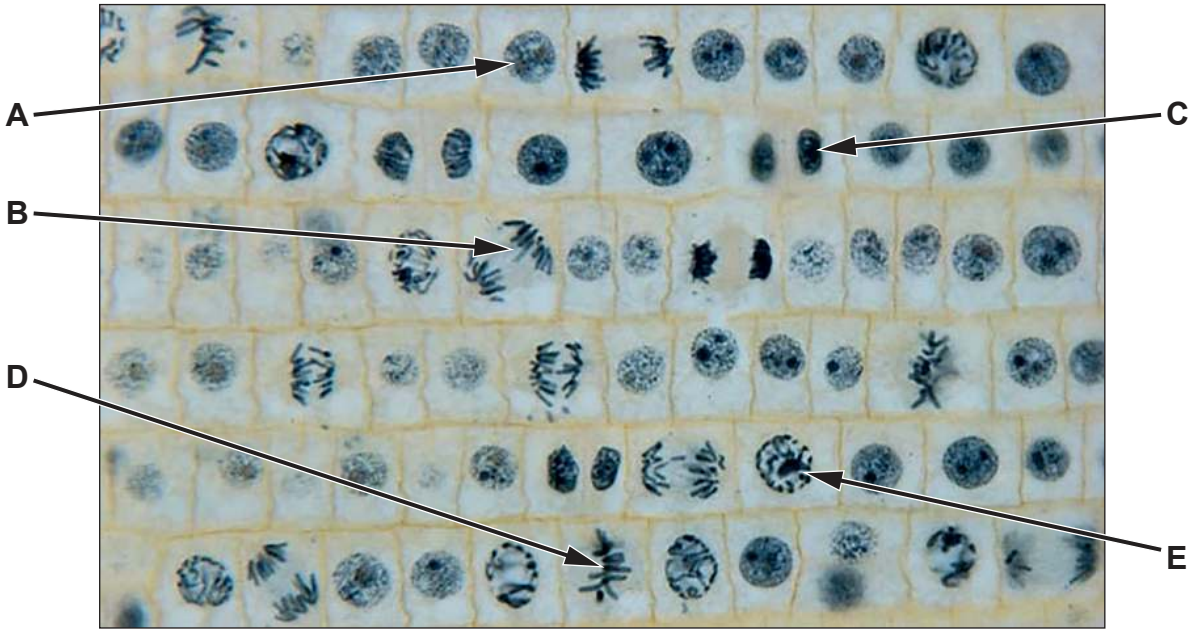


© WJEC CBAC Ltd.

Examiner only

**2.** Cell division was observed in the root tips of onions. The root tips were removed and prepared for viewing with the light microscope. The photomicrograph in **Image 2.1** shows cells in the root tip at ×400 magnification.

**Image 2.1**




(a) (i) State what was added to the tissue during preparation and explain why this was necessary. [2]

.....

.....

.....

.....



© WJEC CBAC Ltd.

Examiner only

(ii) Give **three** reasons why chromosomes cannot be seen in all cells in **Image 2.1**. [3]

.....

.....

.....

.....

.....

.....

(iii) Using letters **(A–E)** from **Image 2.1**, identify cells that match the descriptions of the stages in **Table 2.2**. [3]

**Table 2.2**

| Description of the stage | Letter |
|---|---|
| The chromosomes condense | ..... |
| Pairs of chromatids are on the equator | ..... |
| The nuclear envelopes are being reformed | ..... |
| Replication of DNA is taking place | ..... |
| Chromatids being pulled to the poles | ..... |

(iv) Identify the longest stage of the cell cycle. Use evidence from **Image 2.1** and your own knowledge to explain your answer. [2]

.....

.....

.....

.....



© WJEC CBAC Ltd.

Examiner only

(b) The mitotic index can be calculated to show the number of cells undergoing mitosis. This can give an estimate of the growth rate at the root tip. The number of cells undergoing mitosis were counted at different distances from the root tip. The results are shown in **Table 2.3**.

**Table 2.3**

| Distance from the root tip / μm | Total number of cells in field of view | Total number of cells in mitosis | Mitotic index / % |
|---|---|---|---|
| 200 | 57 | 7 | 12.3 |
| 500 | 49 | 4 | ..... |
| 1500 | 53 | 1 | 1.9 |
| 2000 | 54 | 0 | 0 |

(i) Calculate the mitotic index for 500 μm from the root tip. **Write your answer in Table 2.3**. [2]

Space for working

(ii) Suggest how you could increase the reliability of the method for calculating the mitotic index of this root tip. [2]

.....

.....

.....

.....

(iii) Explain the significance of mitotic cell division to living organisms. [3]

.....

.....

.....

.....

.....

.....

17



© WJEC CBAC Ltd.

# BLANK PAGE

# PLEASE DO NOT WRITE ON THIS PAGE



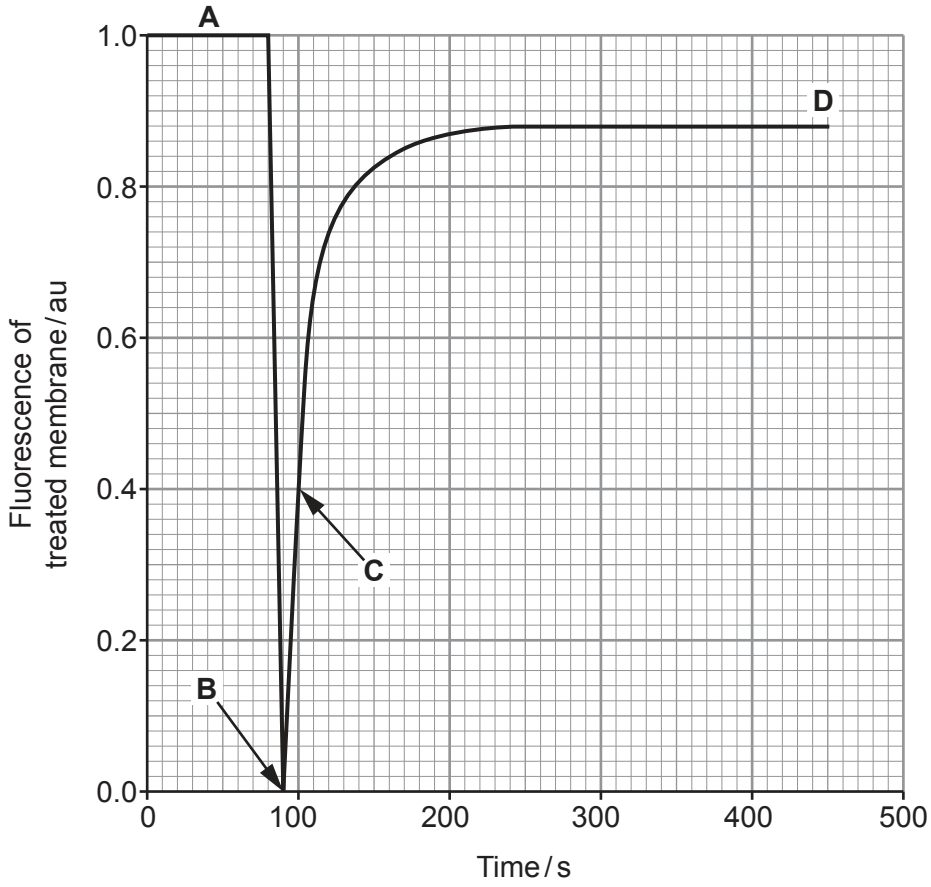


© WJEC CBAC Ltd.

Examiner only

**3.** (a) Cell membranes are composed of a double layer of phospholipids.
An experiment was carried out to investigate the positioning of phospholipids in the membrane of a living cell. All phospholipids in the membrane were labelled with a fluorescent marker dye. When the marker dye absorbed light, it stopped fluorescing. The membrane in the area exposed to light then appeared as a dark spot. The level of fluorescence of the membrane over a period of time is shown in **Graph 3.1**.

**Graph 3.1**




(i) Use **one** of the letters **(A–D)** shown on **Graph 3.1** to suggest when the cell membrane was exposed to the light and explain your answer. [1]

.....

.....

.....

.....

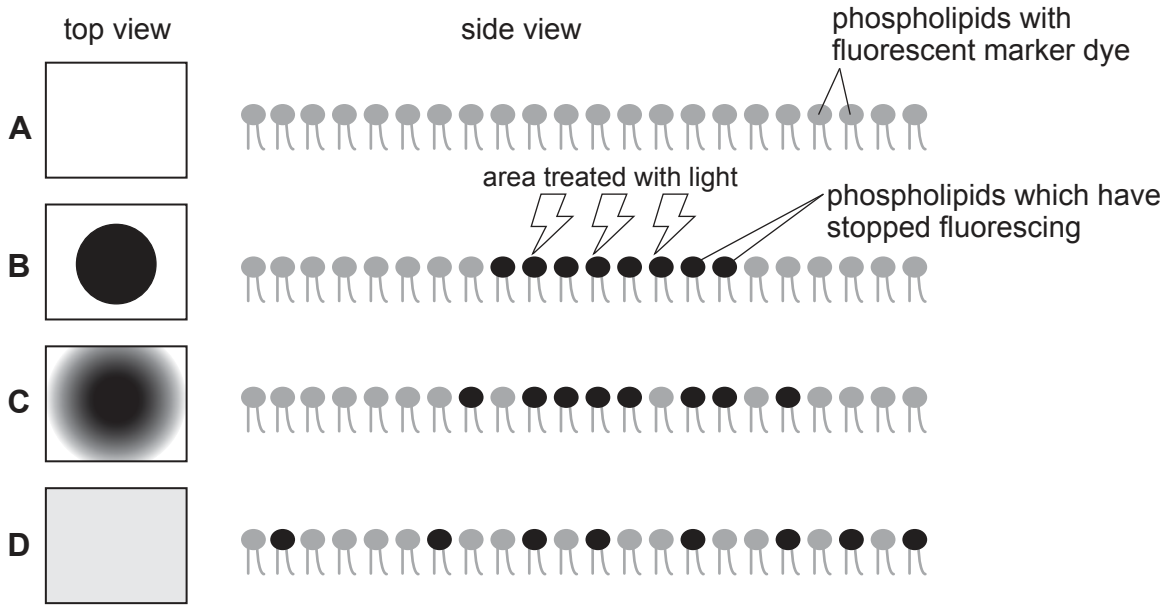


© WJEC CBAC Ltd.

Examiner only

**Image 3.2** shows the top and side view of an area of the membrane before, during and after exposure to a light source.

**Image 3.2**




(ii) Use the results shown in **Graph 3.1 and Image 3.2** and your knowledge of membrane structure to explain the recovery of the fluorescence. [3]

.....

.....

.....

.....

.....

.....

B400U101
11

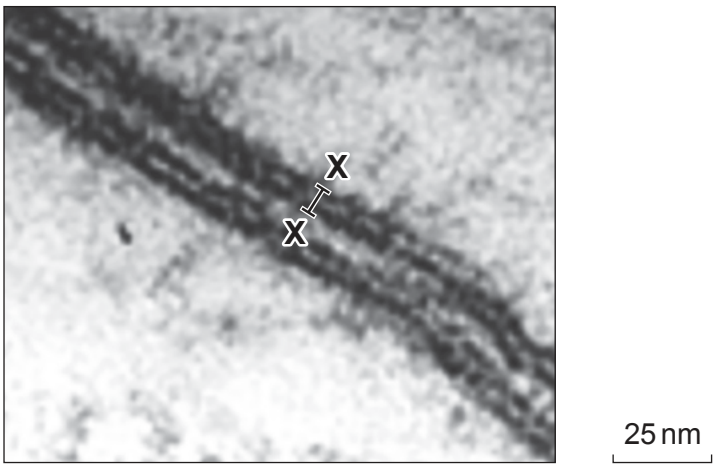


© WJEC CBAC Ltd.

Examiner only

(b) **Image 3.3** shows an electron micrograph of the plasma membranes of two adjacent cells.

**Image 3.3**




(i) Use only the **scale bar** to calculate the magnification of **Image 3.3**. [2]

Magnification = × .....

(ii) Use your answer from (i) to calculate the actual width of the plasma membrane shown by **X–X**. **Express your answer to two significant figures**. [2]

Actual width = ..... nm

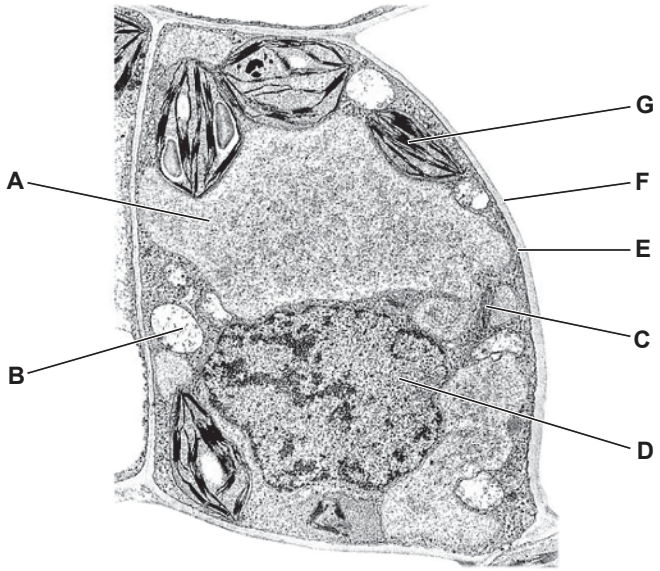


© WJEC CBAC Ltd.

Examiner only

(c) **Image 3.4** is an electron micrograph of a plant cell showing some organelles.

**Image 3.4**




Using letters **(A–G)** from **Image 3.4**, identify the organelles in **Table 3.5**. [2]

**Table 3.5**

| Organelle | Letter |
|---|---|
| Chloroplast | ..... |
| Nucleus | ..... |
| Vacuole | ..... |

(d) The effect of sodium chloride concentration on membrane structure was studied using beetroot cells. Beetroot cells contain a red pigment called betalain which is released when the membrane structure is disrupted. A temperature of 30 °C disrupts the membrane structure and allows the pigment to escape from the cell.

The method used to study the membrane structure is shown below:

Method

- Samples of beetroot were added to test tubes containing a range of sodium chloride solutions.
- They were left for five minutes at 30 °C.
- A sample of the liquid was then placed in a cuvette.
- The absorbance of light was recorded using a colorimeter.

(i) Suggest why the temperature would need to be controlled in this experiment. [2]

.....

.....

.....

.....



© WJEC CBAC Ltd.

Examiner only

The results of the investigation are shown in **Table 3.6**.

**Table 3.6**

| NaCl concentration / % | Absorbance of betalain solution / au | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.1 | 0.49 | 0.52 | 0.48 | 0.50 |
| 0.2 | 0.26 | 0.26 | 0.27 | 0.26 |
| 0.3 | 0.14 | 0.20 | 0.15 | ..... |
| 0.4 | 0.09 | 0.10 | 0.08 | 0.09 |
| 0.5 | 0.03 | 0.01 | 0.03 | 0.02 |

(ii) Calculate the mean absorbance for 0.3% NaCl solution. **Write your answer in Table 3.6**. [1]

(iii) Use the data in **Table 3.6** to describe and explain the effect of increasing the concentration of the NaCl solution on the permeability of the beetroot membrane. [4]

.....

.....

.....

.....

.....

.....

.....

.....

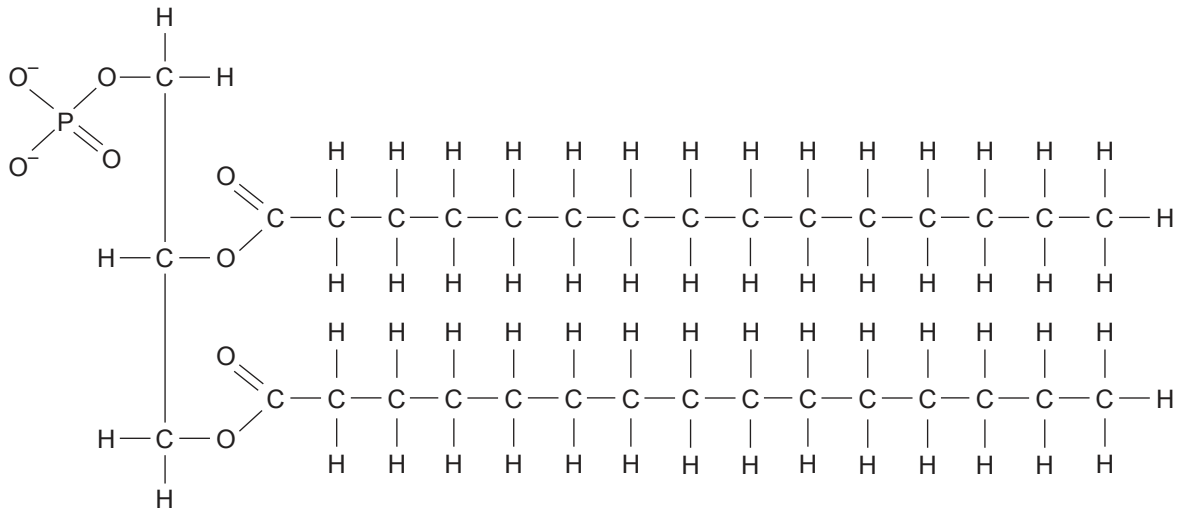


© WJEC CBAC Ltd.

Examiner only

**Image 3.7** shows the structure of a phospholipid.

**Image 3.7**



(iv) When dissolved in water, NaCl dissociates to form $Na^+$ and $Cl^-$ ions. Use the structure shown in **Image 3.7** and the data in **Table 3.6** to suggest how the interaction between the $Na^+$ ions and the phospholipid affects the fluidity of the membrane. [4]

(v) Suggest how the method could be modified to investigate the effect of temperature on membrane stability. [2]

23



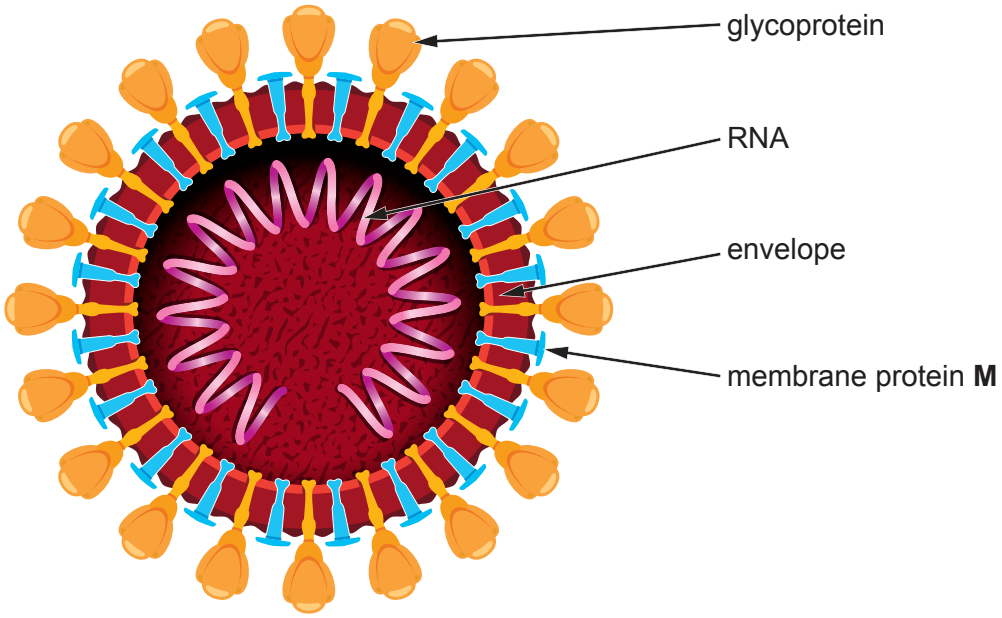
© WJEC CBAC Ltd.

Examiner only

**4.** SARS is a type of virus which causes a respiratory disease. **Image 4** shows the structure of the virus. All viruses contain a nucleic acid within their core and are surrounded by a protein coat called a capsid.

The SARS virus infects human cells and takes over the cells' metabolism. It is replicated by the human cells, which make the viral proteins using the same organelles as they would for normal protein synthesis within a cell.

**Image 4**




(a) The genetic material within the SARS virus is RNA. State **two** ways in which the structure of RNA differs from DNA. [2]

.....

.....

.....

.....

(b) Membrane protein **M** is coded for by a section of the viral RNA. This section of the viral RNA is used to form a complementary mRNA molecule in the cytoplasm of the host cell. This mRNA is then processed in a similar way to host cell mRNA.

(i) Part of the viral RNA is shown below. **Write the sequence of bases** for the complementary mRNA molecule formed from the viral RNA. [1]

Viral RNA A U G G C C A G U U A A

Complementary mRNA .....



© WJEC CBAC Ltd.

Examiner only

(ii) Using your own knowledge of protein synthesis suggest how the host cell uses the mRNA to produce viral membrane protein **M**. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

8



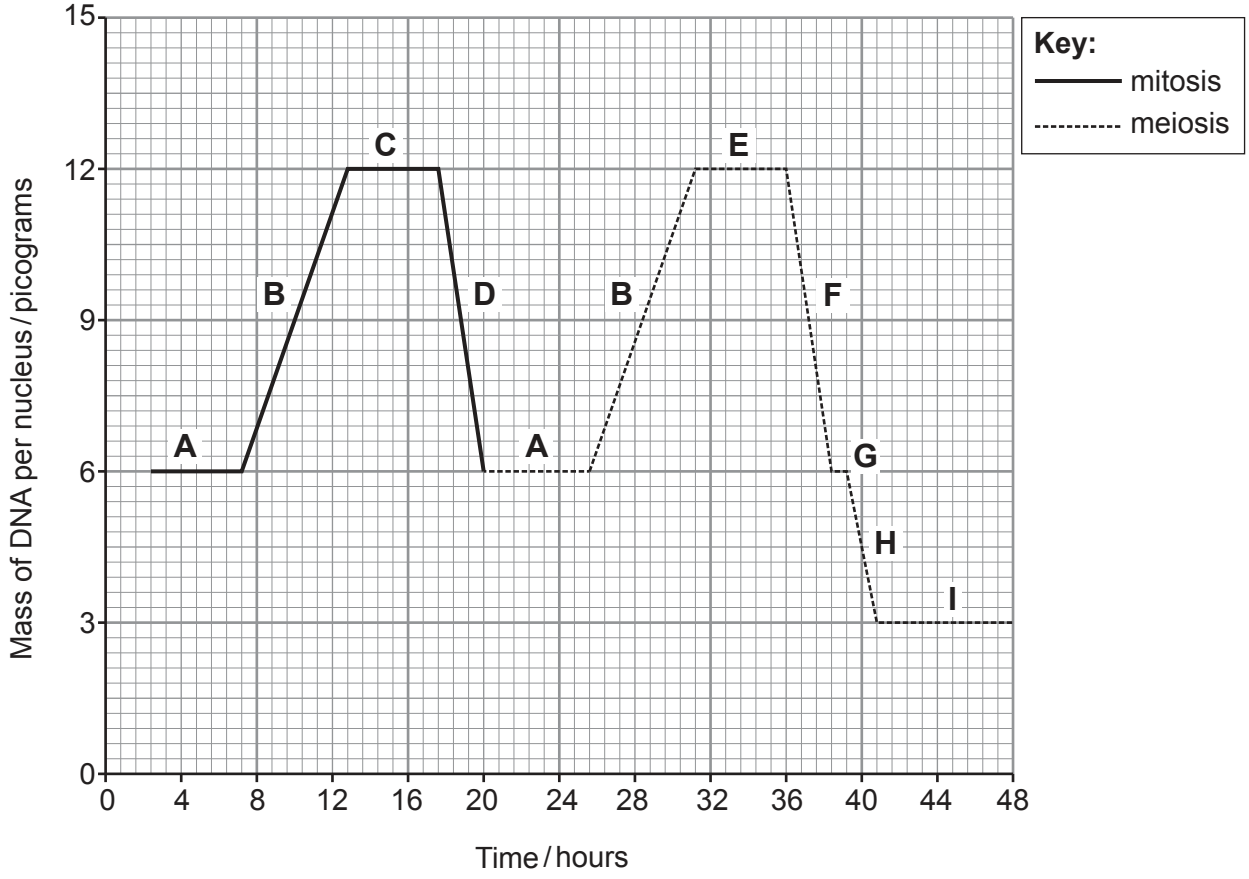
© WJEC CBAC Ltd.

Examiner only

**5.** Cells within the human male testes produce sperm through the processes of mitosis and meiosis.

**Graph 5** shows the mass of DNA found in the nucleus of one of these cells as it undergoes mitosis and then meiosis to form a single sperm cell. The letters (**A–I**) indicate stages before and during cell division by mitosis and meiosis.

**Graph 5**




Use the information in **Graph 5** and your knowledge of cell division to explain the changes in the DNA mass of the nucleus for both mitosis and meiosis. Explain how meiosis increases the genetic variation of offspring. [9 QER]

.....

.....

.....

.....

.....

.....



© WJEC CBAC Ltd.

Examiner only



© WJEC CBAC Ltd.

Examiner only



© WJEC CBAC Ltd.

Examiner only

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

9

**END OF PAPER**



© WJEC CBAC Ltd.

| Question number | Additional page, if required. Write the question number(s) in the left-hand margin. |
|---|---|
| | |

Examiner only



© WJEC CBAC Ltd.

| Question number | Additional page, if required.<br>Write the question number(s) in the left-hand margin. |
|---|---|
| | |

Examiner only



© WJEC CBAC Ltd.

# BLANK PAGE

# PLEASE DO NOT WRITE ON THIS PAGE



© WJEC CBAC Ltd.