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

# GCE AS

B400U10-1

Z22-B400U10-1

**FRIDAY, 20 MAY 2022 – AFTERNOON**

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

1 hour 30 minutes

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **12** | |
| **2.** | **18** | |
| **3.** | **13** | |
| **4.** | **12** | |
| **5.** | **11** | |
| **6.** | **9** | |
| **Total** | **75** | |

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**ADDITIONAL MATERIALS**

In addition to this paper you will 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 **6**.

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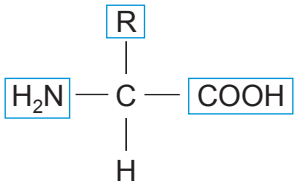
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Answer **all** questions.

**1.** Proteins are polymers of amino acids and are found in all living organisms. **Image 1.1** shows the general structural formula of an amino acid molecule.

**Image 1.1**




(a) **Complete the table** to name the groups shown in **Image 1.1**. [2]

| Group | Name |
|---|---|
| R | ..... |
| $NH_2$ | ..... |
| COOH | ..... |

(b) Apart from the elements shown in **Image 1.1**, state **one** other element which is found in some amino acids. [1]

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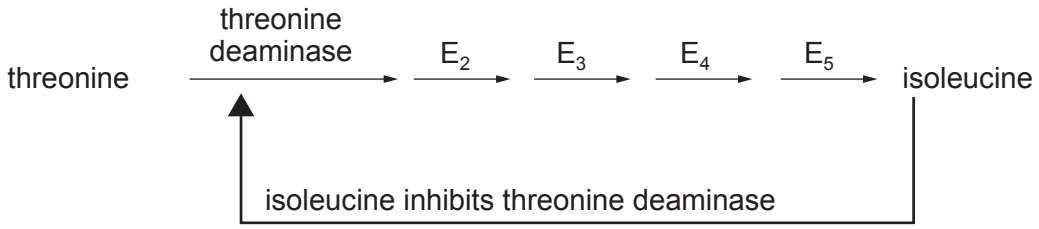


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(c) Plants can synthesise the amino acid isoleucine from a different amino acid, threonine, in a five-step metabolic pathway controlled by five different enzymes as shown in **Image 1.2**.

**Image 1.2**




Isoleucine acts as an inhibitor to the enzyme threonine deaminase. Predict and explain what would happen to the concentration of threonine as the concentration of isoleucine increases. [2]

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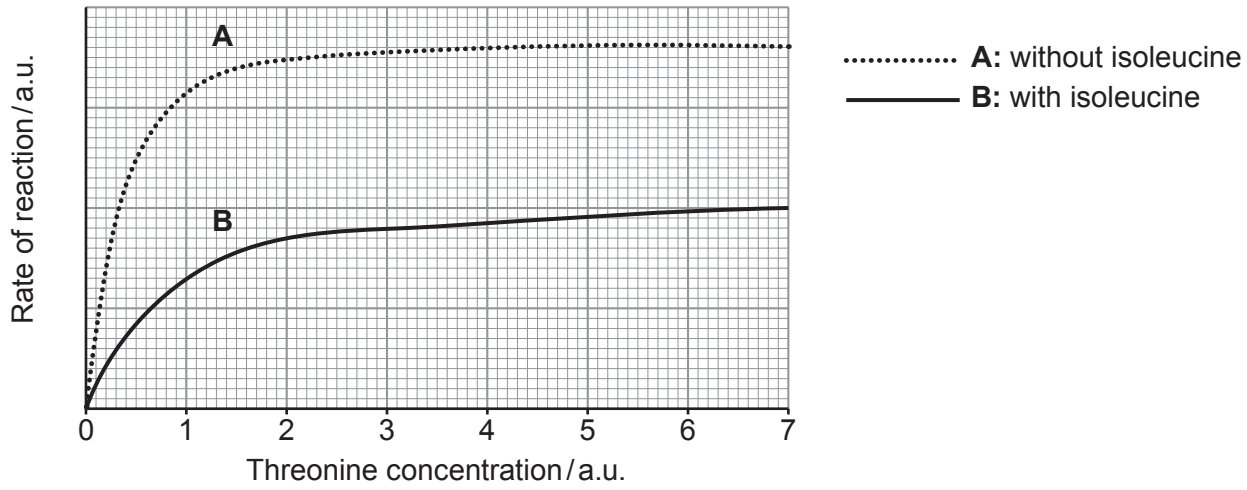


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(d) Threonine deaminase was extracted from a plant and isolated. The effect of isoleucine on the activity of the enzyme threonine deaminase was investigated. The rate of reaction was measured at increasing threonine concentrations both with and without isoleucine. The results of the investigation are shown in **Graph 1.3**.

**Graph 1.3**




(i) Describe and explain the results shown in curve **A**. [3]

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(ii) Explain the shape of curve **B**. [4]

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**2.** An investigation was carried out to determine the water potential of potato tissue using the following method.

1. Cut four cylinders of potato tissue, each approximately 50 mm long.
2. Place 30 $cm^3$ distilled water and three different concentrations of sodium chloride (NaCl) solution into four different boiling tubes.
3. Record the mass of each cylinder to the nearest 0.1 g.
4. Place one cylinder into each boiling tube.
5. Leave at room temperature for 45 minutes.
6. Gently blot and re-weigh the cylinders.

The results of the investigation are shown in **Table 2.1**.

**Table 2.1**

| Concentration of NaCl / mol $dm^{-3}$ | Initial mass of cylinder / g | Final mass of cylinder / g | Change in mass / g | Percentage change in mass |
|---|---|---|---|---|
| 0.0 | 4.2 | 4.5 | 0.3 | 7.14 |
| 0.2 | 4.1 | 4.2 | 0.1 | 2.44 |
| 0.6 | 4.4 | 3.9 | –0.5 | –11.36 |
| 0.8 | 4.2 | 3.5 | –0.7 | ..... |

(a) (i) Calculate the percentage change in mass of the potato cylinder in the 0.8 mol $dm^{-3}$ sodium chloride solution. **Write your answer in the table. Give your answer to two decimal places.** [2]

(ii) Explain why it is necessary to calculate the percentage change in mass. [1]

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(iii) **Use the results from Table 2.1 to plot a graph** showing how the percentage change in mass is affected by the concentration of sodium chloride solution. [4]



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(iv) With reference to the results of this investigation, describe **and** explain the relationship between the concentration of NaCl and the percentage change in mass of the potato cylinders. [4]

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(v) State what additional information would be required in order to determine the water potential of the potato tissue. [1]

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(vi) With reference to the method given, suggest and explain how confidence in the data collected could be improved. [2]

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(vii) Suggest **two** ways in which the accuracy of the investigation might be improved. [2]

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Due to rising sea levels, it is expected that some coastal regions of the UK will experience more frequent flooding by sea water. This will increase the salt concentration of the soil in the flooded regions. Increased salt concentrations in the soil may have an effect on the growth of potatoes in these areas.

Some varieties of potato may be more suitable than others for growing in soil with a high salt concentration due to differences in the water potential of the potato tubers.

An investigation was carried out to determine the water potential of three different varieties of potato. **Table 2.2** shows the water potential of the three varieties of potato.



**Table 2.2**

| Variety of potato | Water potential / kPa |
|---|---|
| A | –550 |
| B | –890 |
| C | –430 |

(b) Suggest which variety of potato might be best suited to planting in soil with a higher salt content. Explain your answer. [2]

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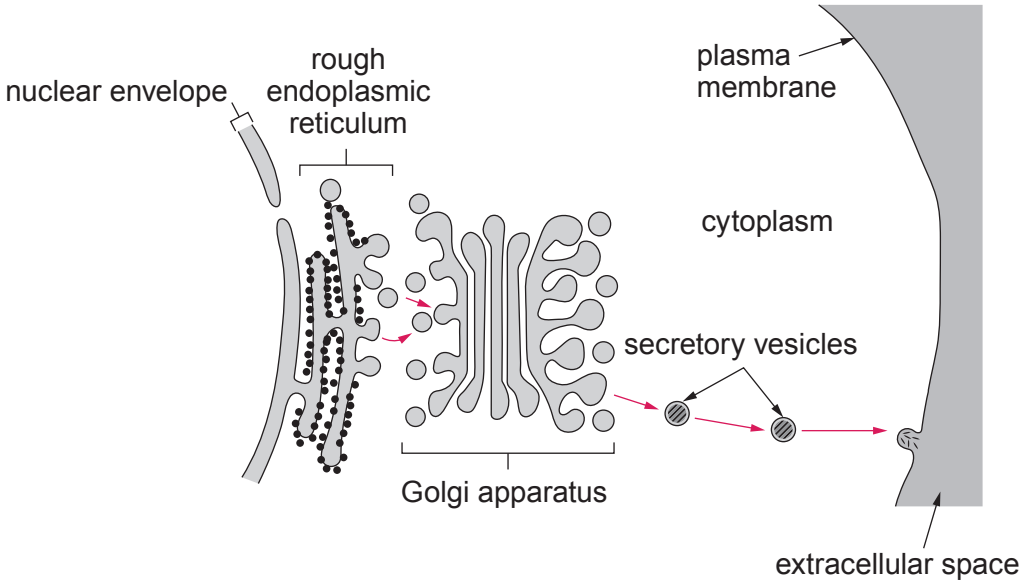


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**3.** A number of organelles are involved in the production and secretion of enzymes by cells. **Image 3.1** shows how different organelles are involved in this process in a eukaryotic cell.

**Image 3.1**




(a) Describe the sequence of events involved in the production and secretion of enzymes as shown in **Image 3.1**. [5]

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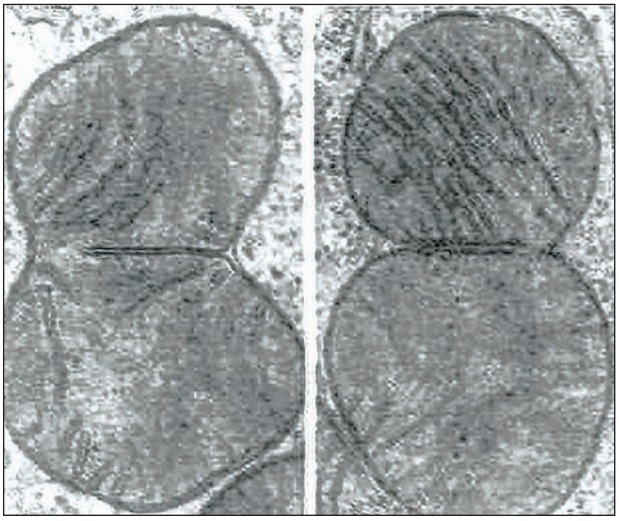


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**Image 3.2** shows another organelle which is also involved in the process of enzyme secretion.

**Image 3.2**




(b) (i) **Using the scale bar** provided, calculate the magnification of **Image 3.2**. [2]

Magnification = × .....

(ii) Name the organelle shown in **Image 3.2** and suggest its function in enzyme secretion. [3]

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(iii) The organelle shown in **Image 3.2** is in the process of self-replication. This is a similar process to that seen in bacteria.
Suggest and explain how this organelle is able to self-replicate. [3]

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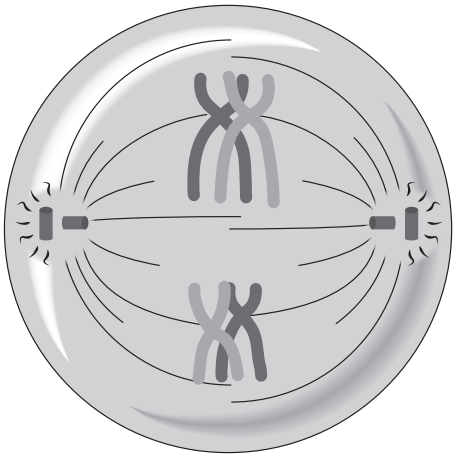


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**4.** Sexual reproduction in animals involves cell division by mitosis and meiosis. **Image 4.1** shows a cell undergoing meiosis.

**Image 4.1**



(a) (i) Name the stage of meiosis shown in **Image 4.1** and give **two** reasons for your choice. [3]

Stage: .....

Reasons: .....

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(ii) With reference to **Image 4.1**, explain **two** ways by which the process of meiosis contributes to genetic variation in an organism. [2]

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(iii) Name **one** structure in a flower where meiosis occurs. [1]

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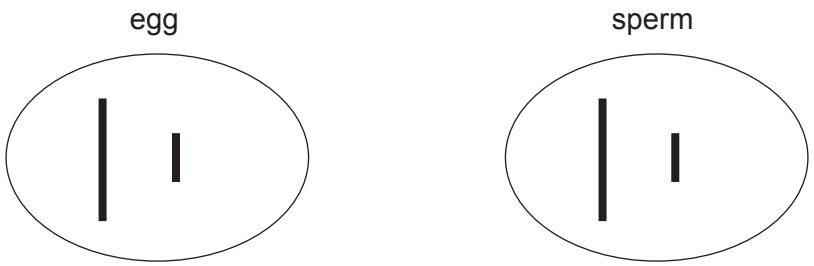
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(b) Honey bees have a complex social structure where only the queen bee produces eggs. If fertilised, these develop into female worker bees. If not fertilised they develop into males called drones, which produce sperm.

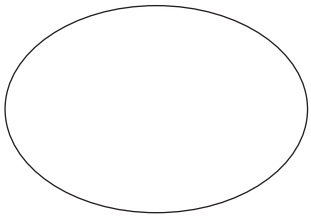
**Image 4.2** shows two chromosomes in the nuclei of bee gametes.

**Image 4.2**

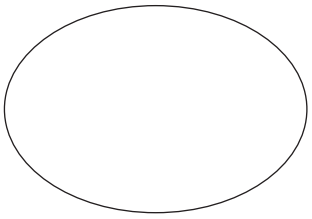



(i) In the nuclei below, draw the chromosomes as they would appear in the **body cells** of female and male bees. [2]

**female body** cell nucleus



**male body** cell nucleus



(ii) Explain why sperm cells in drones are produced by mitosis and not by meiosis. [2]

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(iii) Explain why male drones would not be clones. [2]

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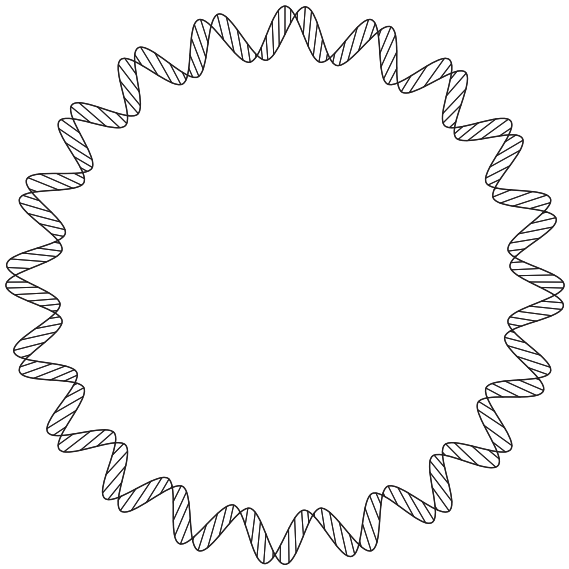
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**5.** The human papillomavirus (HPV) infects epithelial cells. The virus DNA molecule is 8 kb (kilobases) in length. The genome includes approximately 8 major genes.

**Image 5.1** shows the genetic material of the human papillomavirus.

**Image 5.1**



(a) (i) State **three** differences between the DNA of the human papillomavirus and the nuclear DNA of the host cell. [3]

| Human papillomavirus DNA | Host cell nuclear DNA |
|---|---|
| ..... ..... | ..... ..... |
| ..... ..... | ..... ..... |
| ..... ..... | ..... ..... |



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(ii) With reference to the structure of viruses, suggest a role for the viral genes. [1]

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Once inside the host cell, the virus capsid breaks down and the viral DNA enters the host cell nucleus. Inside the nucleus, the viral DNA is replicated, using the DNA apparatus of the host cell.

(b) (i) Suggest how the viral DNA enters the nucleus. [1]

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(ii) Using your knowledge of DNA replication, describe the process by which the viral DNA is replicated. [4]

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(iii) Explain why the viral DNA cannot be replicated outside the nucleus of the host cell. [1]

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(iv) The viral genome contains eight genes and therefore codes for a minimum of eight polypeptides.
State the name of the hypothesis represented by this statement. [1]

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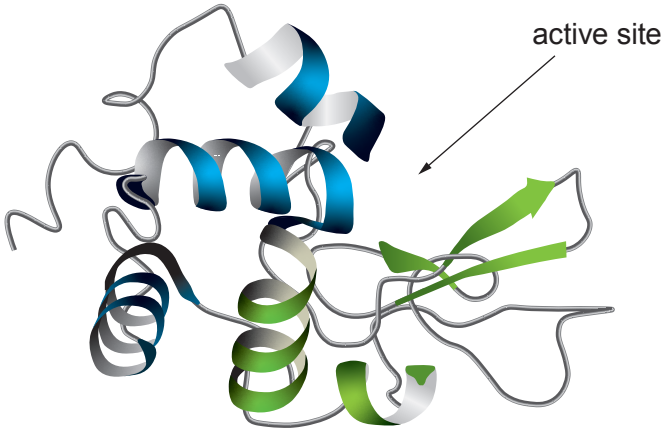


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**6.** Lysozyme is an enzyme which catalyses the breakdown of glycosidic bonds in polysaccharides in bacterial cell walls. It works using the induced fit model of enzyme action. **Image 6.1** shows a computer-generated model of lysozyme.

**Image 6.1**




Describe the three levels of protein structure present in the lysozyme molecule shown in **Image 6.1**.
Explain how the three levels of protein structure are maintained.
Describe and explain the induced fit model of enzyme action as shown by lysozyme. [9 QER]



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**END OF PAPER**



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