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

# GCE A LEVEL

S23-1400U50-1E

1400U50-1E

**FRIDAY, 28 APRIL 2023 – MORNING**

## BIOLOGY – A2 unit 5
### Practical Examination
## Practical Analysis Task

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **20** | |
| **2.** | **10** | |
| **Total** | **30** | |

1400U501E 01

**ADDITIONAL MATERIALS**

In addition to this examination paper, you will need a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
Pencil may be used to draw tables and graphs.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.
The maximum mark for this paper is 30.

**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

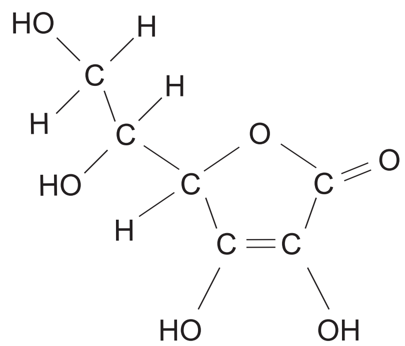
Examiner only

Answer **all** questions.

**1.** Many mammals can synthesise vitamin C from their food. Humans cannot and so our diet must contain plant foods to provide the vitamin C that we need. Vitamin C has essential roles in both plant and animal metabolism.

(a) **Image 1.1** shows the structure of a vitamin C molecule.

**Image 1.1**




Write the chemical formula of this molecule, showing the number of each type of atom. [1]

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

1400U501E
03







**Turn over.**

Examiner only

(b) Methylene blue is blue when oxidised and colourless when reduced. Vitamin C is a reducing agent which can reduce methylene blue and decolourise it. The more vitamin C that is present, the greater the volume of methylene blue that can be decolourised. If you know the concentration and volume of methylene blue that is decolourised by a vegetable extract solution, you can find the concentration of vitamin C that the extract contains.

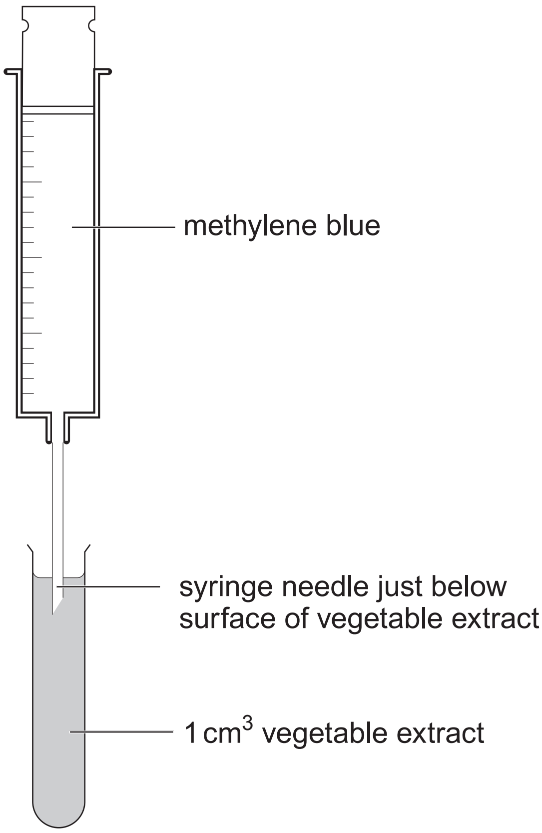
Steps **1–3** and **Image 1.2** outline the technique:

1. Place 1 $cm^3$ of a vegetable extract containing vitamin C in a small container.

2. Fill a syringe fitted with a needle with 0.1 mg 100 $cm^{-3}$ methylene blue. Slowly inject the methylene blue just below the surface of the vegetable extract. Take great care not to disturb the liquid surface, to avoid introducing air into the solution.

3. Continue to add methylene blue until it is no longer reduced i.e. it remains blue when injected. Read the volume of methylene blue that has been injected.

**Image 1.2**





Examiner only

(i) **Box 1.3** shows an extract from the entry on a Student Safety Sheet for using methylene blue:

**Box 1.3**

| |
|---|
| WARNING<br>may cause allergic reaction on contact with skin;<br>causes skin/serious eye irritation; |

Use the information given in **Box 1.3** to complete **Table 1.4**, which is a risk assessment for methylene blue. [1]

**Table 1.4**

| Hazard | Risk | Control measure |
|---|---|---|
| ........................ | ........................ | ........................ |
| ........................ | ........................ | ........................ |

(ii) Identify **one** other hazard in this experiment **and** state the risk associated with it. [1]

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

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

(iii) If the liquid surface is disturbed while the methylene blue is being injected, air enters the vegetable extract being tested. Suggest what effect this might have on the volume of methylene blue that would need to be added. Explain your answer. [2]

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

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

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

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

1400U501E 05

Examiner only

(c) **Table 1.5** shows the results of 15 trials of an experiment to measure the vitamin C content of peas and of green cabbage.

**Table 1.5**

| Vitamin C content / mg 100 g$^{-1}$ | |
|---|---|
| Peas | Green cabbage |
| 35 | 40 |
| 36 | 35 |
| 43 | 34 |
| 47 | 29 |
| 40 | 36 |
| 32 | 36 |
| 38 | 37 |
| 46 | 28 |
| 46 | 41 |
| 41 | 42 |
| 39 | 34 |
| 31 | 34 |
| 45 | 36 |
| 44 | 38 |
| 37 | 37 |
| Mean = 40.0 | Mean = ………………… |

Calculate the mean concentration of vitamin C in green cabbage. **Write your answer in Table 1.5.** [1]

Space for working

Examiner only

(d) A statistical table showed that the critical value of t at $p = 0.05$ and 28 degrees of freedom is 2.048.

(i) Explain the meaning of '$p = 0.05$' in this experiment. [1]

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

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

(ii) Show how, in this analysis, the number of degrees of freedom is calculated to be 28. [1]

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

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

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

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

(e) (i) The Student's t-test was used to compare the concentrations of vitamin C in peas and green cabbage. A student constructed a null hypothesis for this test, stating:

'There is no difference between the vitamin C concentrations of peas and green cabbage.'

Rewrite the null hypothesis, showing **two** ways in which the student's null hypothesis could be improved. [2]

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

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

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

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

(ii) Using the data in **Table 1.5**, the calculated value of t was 2.527. In relation to the null hypothesis and the critical value, explain why it would be better to eat 100 g of peas than 100 g of green cabbage. [3]

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

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

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

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

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

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

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

Examiner only

(f) In a second experiment, the iron concentration in four samples of peas and green cabbage was measured. **Table 1.6** shows the readings obtained.

**Table 1.6**

| Iron content / mg 100 g$^{-1}$ | |
|---|---|
| Peas | Green cabbage |
| 0.45 | 0.39 |
| 0.46 | 0.36 |
| 0.52 | 0.41 |
| 0.49 | 0.45 |
| Median = ..................... | Median = 0.40 |

(i) The t-test was not considered to be the most suitable statistical test for comparing these iron concentrations. Instead, a test comparing the median values was used. Find the median value of the concentration of iron in peas. **Write your answer in the table.** [2]

Space for working

(ii) Describe **one** way this second experiment could be altered so that a t-test could be used to compare the concentrations of iron in peas and green cabbage. [1]

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

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

Examiner only

(g) Changes in land use and altered farming practices have reduced the amount of nitrate and ammonium ions in many soils. Farmers, therefore, often use a high concentration of chemical fertiliser. Use your knowledge of the nitrogen cycle to explain why a farmer may use less fertiliser if legumes, such as peas, are grown rather than green cabbage. [4]

..........

..........

..........

..........

..........

..........

..........

..........

..........

..........

20





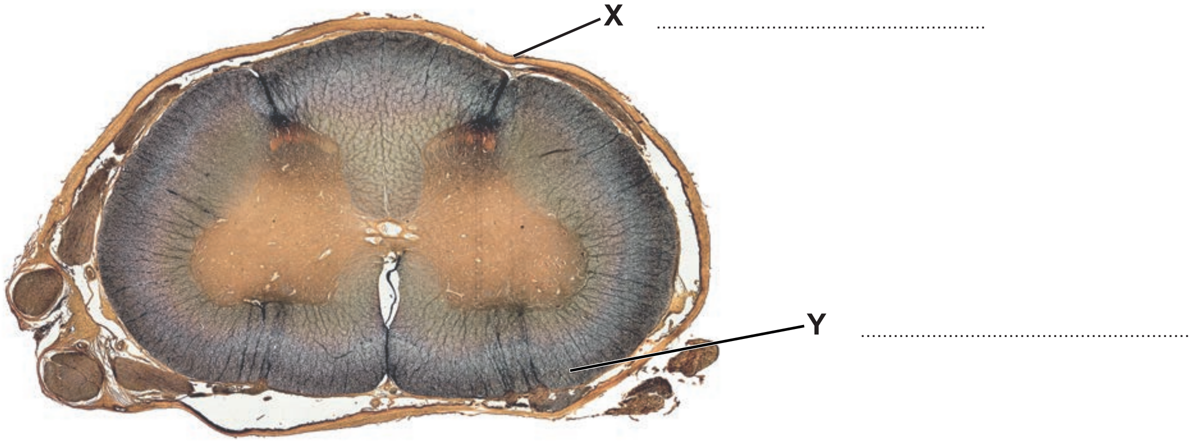


Turn over.

Examiner only

**2.** **Image 2.1** is a transverse section through a human spinal cord.

**Image 2.1**




(a) On **Image 2.1**

(i) **Use a labelled line** to identify the central canal. [1]

(ii) Identify the areas labelled **X** and **Y**. [2]

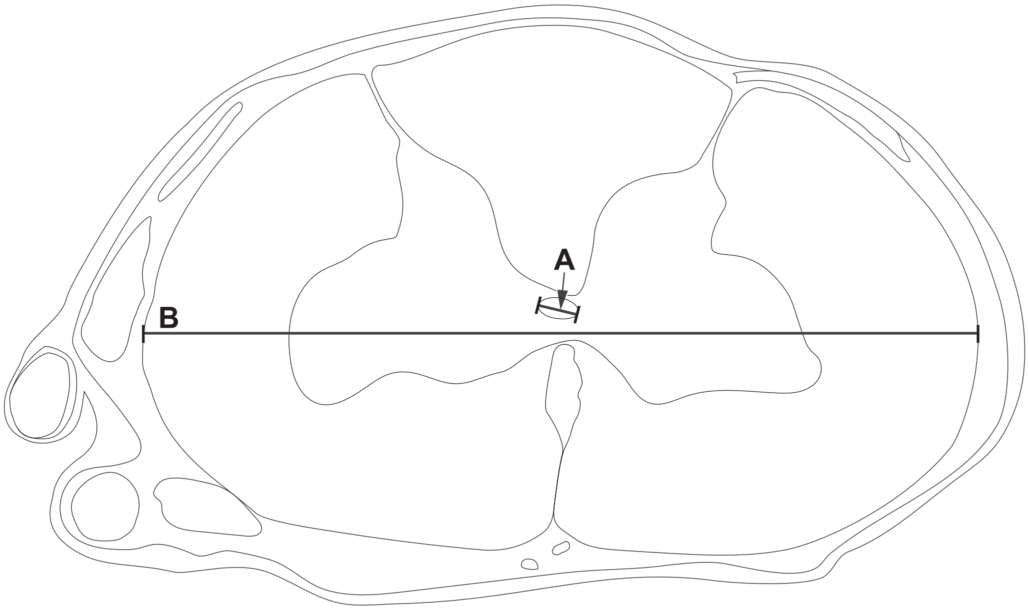


 (1400U50-1E)

Examiner only

(b) **Image 2.2** is a low power plan of the transverse section of the spinal cord shown in **Image 2.1**. Lines **A** and **B** show two lengths that have been measured using a microscope.

**Image 2.2**




(i) In order to measure the lengths of **A** and **B**, the microscope must be calibrated. Apart from a microscope, name **two** other pieces of microscopy equipment that are required to carry out the calibration. [2]

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

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

(ii) The ratios of the lengths of **A** and **B** in the low power plan must be the same as in the specimen. This can be expressed as:

$$\frac{\text{actual length of } \mathbf{A}}{\text{actual length of } \mathbf{B}} = \frac{\text{length of } \mathbf{A} \text{ in low power plan}}{\text{length of } \mathbf{B} \text{ in low power plan}}$$

The actual length of **A** is 0.5 mm and the actual length of **B** is 12.4 mm.
Use the equation to calculate the length the line **B** should be drawn at in a low power plan, if line **A** is drawn at 8.0 mm. [2]

Length of line **B** = ...................................... mm

Examiner only

(c) (i) **Image 2.3** shows a different section through a spinal cord. Some structures are labelled.
On **Image 2.3**, **draw one reflex arc** to show **three** neurones, including their cell bodies and showing where neurones enter and leave the spinal cord.
Label the **three** neurones. [2]

**Image 2.3**


(ii) Explain why the width of a synapse between two neurones could not be measured using a light microscope. [1]

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

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

10

**END OF PAPER**

