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**	

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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.

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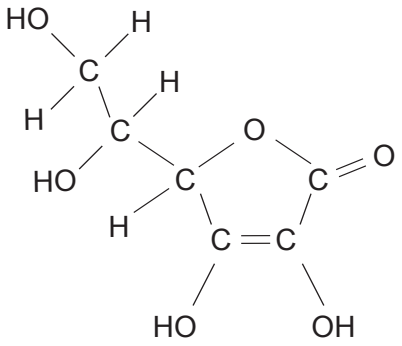
Answer **all** questions.

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]

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(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.

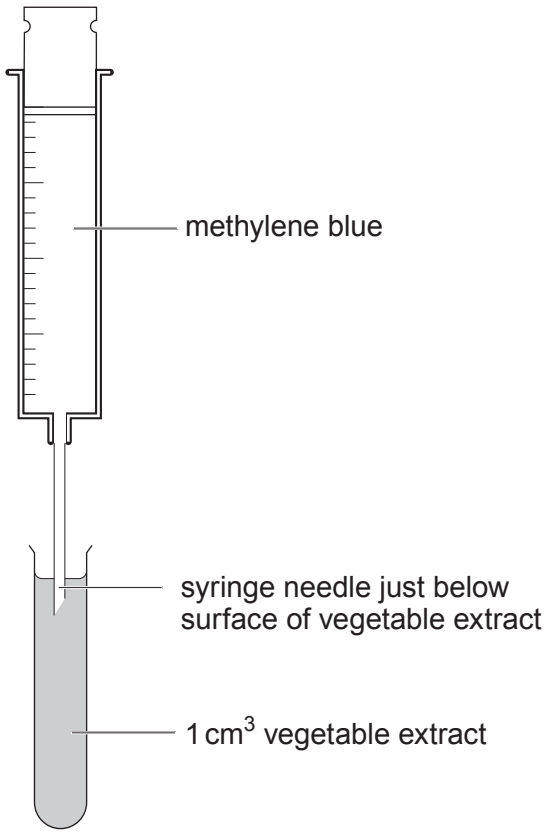
Steps **1**–**3** and **Image 1.2** outline the technique:

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



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

Box 1.3

WARNING
may cause allergic reaction on contact with skin; 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
.....	.....	.....
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(ii) Identify **one** other hazard in this experiment **and** state the risk associated with it. [1]

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(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]

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(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

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(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]

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

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(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]

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(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]

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(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]

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(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]

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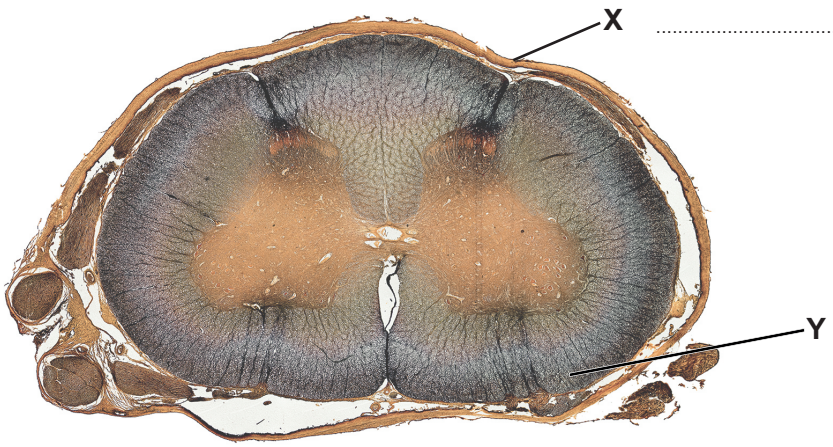
2. **Image 2.1** is a transverse section through a human spinal cord.

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]

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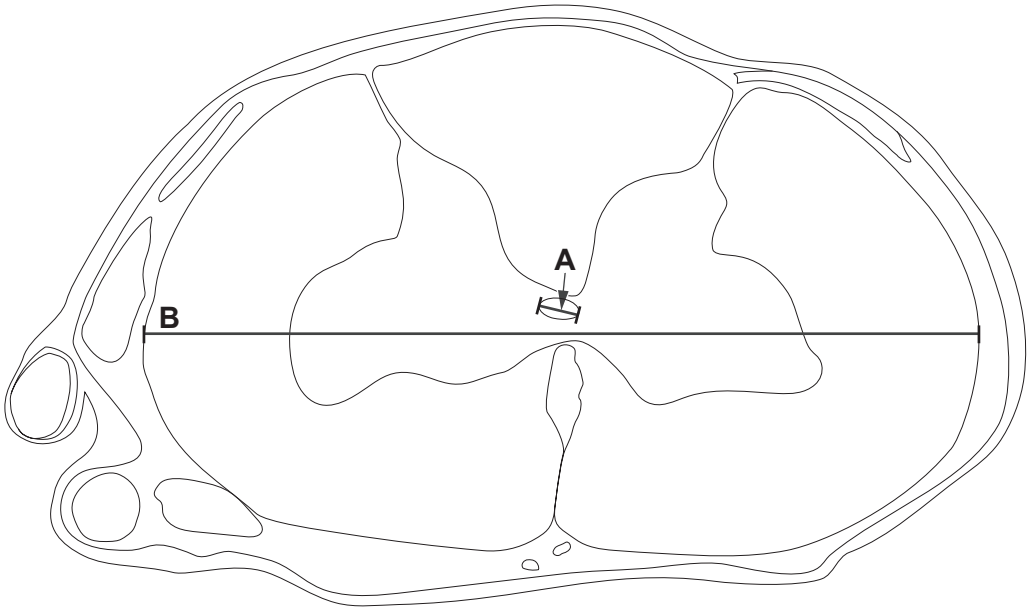
(b) **Image 2.2** is a low power plan of the transverse section of the spinal cord shown in **Image 2.1**. Lines **A** and **B** show two lengths that have been measured using a microscope.

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]

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(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

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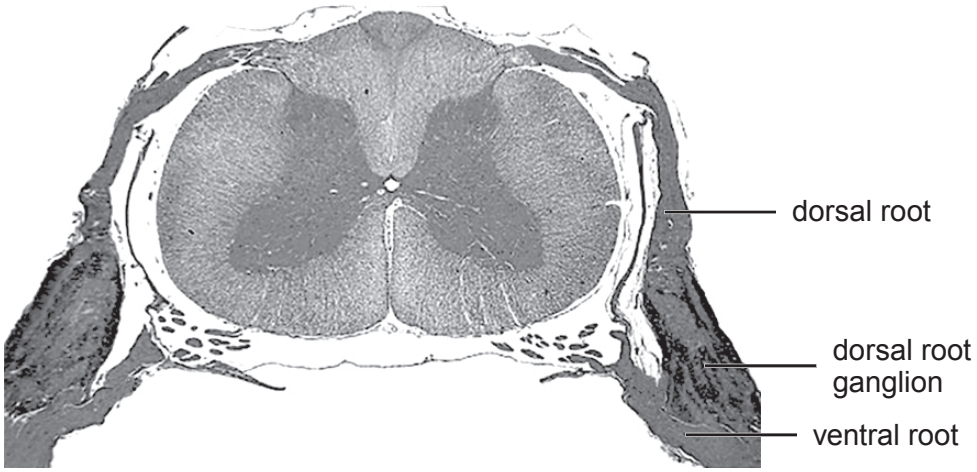
(c) (i) **Image 2.3** shows a different section through a spinal cord. Some structures are labelled.
On **Image 2.3**, **draw one reflex arc** to show **three** neurones, including their cell bodies and showing where neurones enter and leave the spinal cord.
Label the **three** neurones. [2]

Image 2.3



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

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END OF PAPER