VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
2021
HIGHER 2

NAME: ……

CT CLASS: ……..……

BIOLOGY

9744 / 04

Paper 4 Practical

02/09/2021

2 hours 30 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name and CT in all the work handed in.

Give details of the practical shift and laboratory, where appropriate, in the boxes provided.

Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided on the Question Paper.

Shift
Laboratory

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in bracket [ ] at the end of each question or part question.

Question	**Marks**
1	
2	
Total	

Answer **all** questions.

1 You should read through the whole of this question carefully before you start your investigation.

Betalains are red pigments that are found in some fungi and flowering plants, including beetroot, *Beta vulgaris*.

Betalains are glycosides consisting of a glucose molecule bound to a pigment compound by a glycosidic bond.

Cells of *B. vulgaris* store molecules of betalain in their vacuoles. The membrane surrounding vacuoles in plant cells is the tonoplast, which has a similar structure to other cell membranes.

(a) (i) Suggest why betalain molecules cannot pass from vacuoles of plant cells into the cytoplasm.

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……..... [2]

Various factors influence the permeability of membranes.

You are required to investigate the effect of different concentrations of alcohol on the membrane permeability of root cells of *B. vulgaris*.

You are provided with:

- 3 cores of beetroot tissue in a beaker of distilled water
- 100% alcohol
- 10.0% betalain solution
- 1.0% betalain solution
- distilled water

Alcohol is highly flammable and harmful. You are recommended to wear eye protection. Ensure that there is no naked flame.

Proceed as follows.

1 Cut the cores of beetroot tissue into discs of approximately 4 mm thickness. You will need at least 12 discs for the experiment.

2 Wash these discs thoroughly in several changes of washing water. Leave the discs in distilled water while you prepare the solutions of alcohol.

(ii) Why were beetroot discs washed several times before they were used?

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……..... [1]

3 Use the 100% alcohol to make solutions of different concentrations of alcohol. You will need 5.0 cm^3 of each concentration to be placed into separate plastic vials for this investigation.

(iii) State the concentrations of alcohol that you will use in your investigation.

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…… [1]

(iv) Use the space provided below to show, in a suitable format, how you prepared the different concentrations of alcohol.

[4]

4 Place two washed discs of beetroot tissue into the plastic vials containing the different concentrations of alcohol and cap them. Leave them for at least **twenty minutes** before taking results. Meanwhile continue with step **5**.

(v) State and explain a step that you can take in the preparation of the discs to ensure that you obtained valid results in this investigation.

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…… [2]

5 Make up a series of standard solutions of betalain using the 10.0% betalain solution, the 1.0% betalain solution and distilled water, as shown in Table 1.1.

You will need to make 10.0 cm^3 of each standard solution in the test-tubes provided.

Table 1.1

concentration of standard solution of betalain/ %	volume of 10.0% betalain solution / cm^3	volume of 1.0% betalain solution / cm^3	volume of distilled water / cm^3
10.0	10.0	–	0.0
5.0	5.0	–	5.0
1.0	–	10.0	0.0
0.5	–	5.0	5.0
0.1	–	1.0	9.0
0.0	–	–	10.0

6 After twenty minutes, pour off the solution from each plastic vial (from step **4**) into an appropriately labelled test-tube. Compare the colour of these solutions with the standard solutions of betalain using the white card provided and estimate the concentration of betalain in each solution.

(vi) Use this space to record, in a suitable format, your results from step **6**.

[4]

(vii) Describe **and** explain your results.

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(viii) Based on the apparatus and materials provided, explain how you would increase the confidence in your estimation for 100% alcohol.

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(ix) Describe and explain a suitable control for this investigation.

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…… [2]

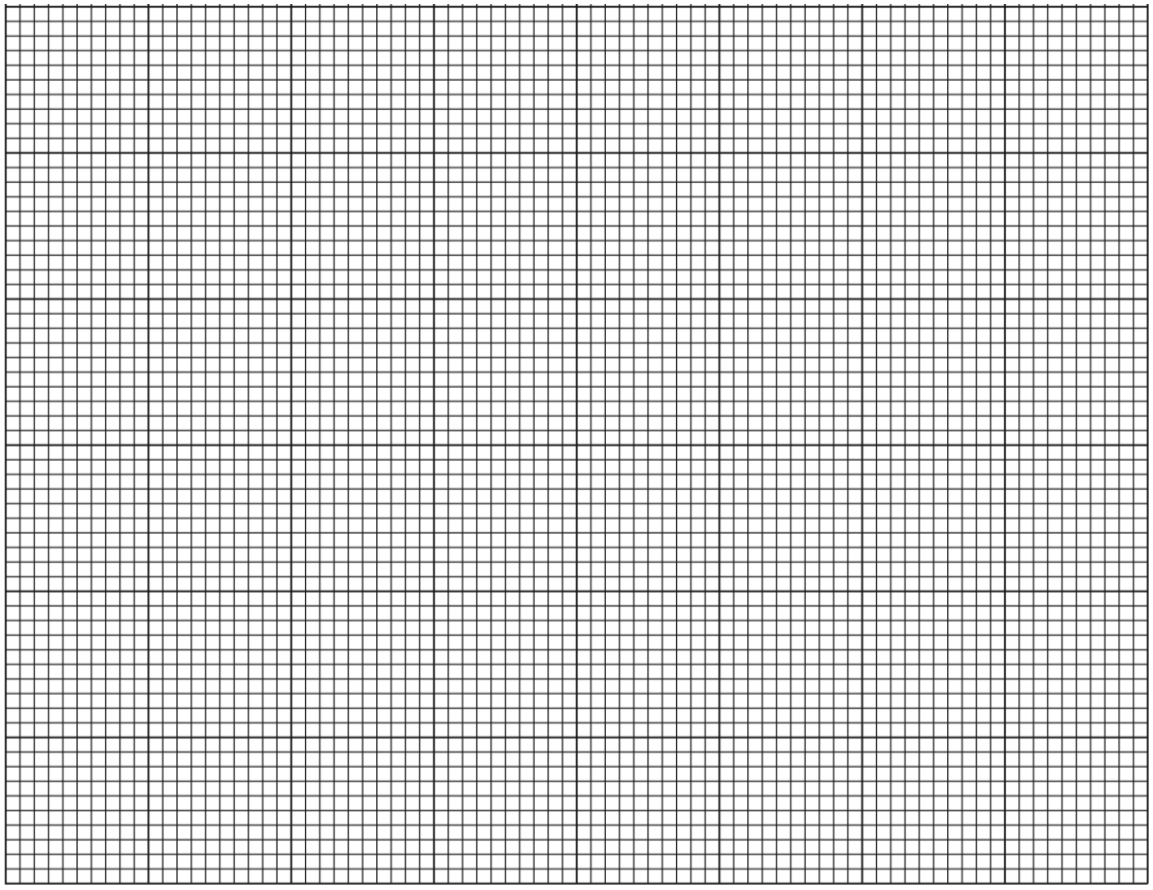
(b) This procedure can be modified to investigate other factors which influence the permeability of membranes.

A student measured permeability by using a colorimeter to measure the absorbance of green light by the solutions in which samples of beetroot had been immersed at various temperatures. The greater the absorbance, the more red pigment had leaked out of the beetroot cells. Fig. 1.1 shows the results of the investigation done by this student.

10°C 16a.u.	20°C 18a.u.	30°C 18a.u.	40°C 24a.u.
50°C 42a.u.	60°C 66a.u.	70°C 92a.u.	80°C 98a.u.

Fig. 1.1

(i) Use the grid to present your results in a suitable format.



[4]

(ii) With reference to the graph, explain the effect of temperature on the absorbance of light in the colorimeter.

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..... [3]

[Total: 28]

2 **TTI** is a slide of a stained transverse section of a plant stem.

You are not expected to be familiar with this specimen.

(a) (i) The stem shows regular patterns in the overall shape as well as distribution of vascular bundles.

Use Fig. 2.1 as a guide, draw a large, representative plan diagram of one third of the stem.

Use one ruled line and label to identify the xylem.

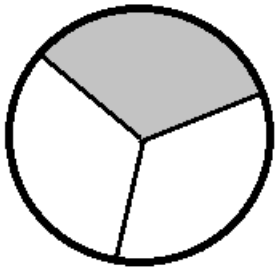

Fig. 2.1

[4]

(ii) You are provided with a plastic ruler and an eyepiece graticule that is attached to the microscope. Determine the length of the largest vascular bundle in the specimen on slide **TTI**.

Show your working clearly.

[3]

(iii) Use your answer in **(a) (ii)** to calculate the magnification of your drawing in **(a) (i)**.

Show your working clearly.

[2]

(iv) Explain why the use of the plastic ruler for calibration is less accurate compared to the use of a stage micrometer.

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…… [2]

(v) Observe the cells in the central region of the stem section on **TTI**.

Select one group of **four** adjacent cells that show some of the observable features of the central tissue.

Each cell must touch at least two of the other cells.

Make a large drawing of this group of **four** cells.

[3]

(vi) Complete the table below to describe two observable differences between the cells you have drawn and the xylem vessels in the slide.

Cells drawn in (v)	Xylem vessels

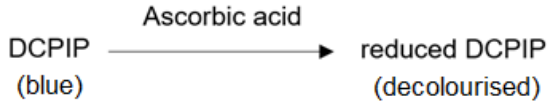
[2]

(b) Some plants contain both ascorbic acid and reducing sugars.

You have been provided with standard solutions containing respectively **0.5, 1.0, 2.0** and **4.0** mg cm^{-3} of ascorbic acid and a plant extract, labelled **C**.

You are required to determine the concentration of ascorbic acid (Vitamin C) in the plant extract **C**.

The concentration of ascorbic acid can be determined using the dye dichlorophenol indophenol (DCPIP). DCPIP can be decolourised (blue colour disappear) by ascorbic acid as shown in the equation below.



Proceed as follows.

1 Using a syringe, place 2 cm^3 of DCPIP solution in a test tube. Place the test tube in a rack.

2 You have been provided with standard solutions containing respectively **0.5, 1.0, 2.0** and **4.0** mg cm^{-3} of ascorbic acid.

Fill a 5 cm^3 syringe with **4.0** $mgcm^{-3}$ of ascorbic acid.

3 Add the solution, drop by drop, to the DCPIP solution. Stir gentle with a glass rod after each drop.

Determine the **number of drops** of **4.0** $mgcm^{-3}$ of ascorbic acid needed to decolourise the DCPIP solution.

4 Repeat this procedure, using fresh samples of DCPIP each time, with the other three solutions of ascorbic acid and, finally, with the plant extract **C** with which you have been provided. **Repeat the experiment again to get a second set of data**.

(i) Present your results in a suitable format in the space below.

[4]

(ii) Based on your results in step **4**, estimate the concentration of ascorbic acid in the plant extract **C**.

Concentration of ascorbic acid in **C**: …… [1]

(iii) Identify the most significant source of error in the experimental procedure and suggest an improvement.

Source of error	Improvement

[2]

(c) A student observed that the ascorbic acid found naturally in plants could also reduce the copper ions in Benedict's solution to produce a positive result.

You are now required to plan an investigation to estimate the quantity of reducing sugars present in the plant extract **C**.

Based on the information provided in **(b)**, describe a method that you can use to estimate, as accurately as possible, the concentration of reducing sugars **only** in the plant extract **C**. Do not plan for controls and repeats.

You are provided with the following reagents:

- Plant extract **C**
- Benedict's solution
- Distilled water
- 1M glucose solution
- DCPIP

Your planned method should:

- have a clear and helpful structure so that the method described could be repeated by anyone reading it
- include details to ensure that results are as accurate and repeatable as possible
- only make use of the reagents provided

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[Total: 27]