VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
2023
HIGHER 2

NAME : ……

CT CLASS : ……..……

BIOLOGY **9744**

Practical **30/08/2023**

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

1. Write your name, CT class shift number and laboratory in the spaces provided.

2. Answer **all** questions in the spaces provided on the Question Paper. The number of marks is given in brackets [ ] at the end of each question.

3. Write in dark blue or black pen. You may use an HB pencil for diagrams, tables and graphs.

4. You should spend the first **5 minutes** carefully reading the whole paper before starting to answer any question.

5. This paper consists of **3 questions**. **Students with the microscope and slide must begin with question 3**. You may continue with question 1 or 2 after you have completed question 3.

7. **1 hr 15 min** after the start of the exam, students with microscope will need to pass the instrument to their bench partners.

Shift
Laboratory

For examiner's use	
1	/20
2	/17
3	/18
Total	**/55**

Answer **all** questions.

1 Yeast cells contain enzymes that catalyse metabolic reactions. Some of these reactions release carbon dioxide.

You will investigate the release of carbon dioxide from a mixture of yeast and carbohydrate. The mixture is put into dialysis (Visking) tubing.

The dialysis tubing acts as a partially permeable membrane, allowing the carbon dioxide to diffuse out of the dialysis tubing.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	1g dried yeast	none	-
G	10.0% warm glucose solution	none	20
W	distilled water	none	50
B	bromothymol blue indicator solution	harmful	10
D	20 cm length of dialysis tubing in a beaker of distilled water	none	–

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

To test for the release of carbon dioxide, a sample of the water surrounding the dialysis tubing is added to drops of an indicator, **B**.

Fig. 1.1 shows the effect of increasing concentration of carbon dioxide on the colour of **B**. Yellow is the end-point.

Fig. 1.1

Carry out steps **1** to **21**.

1 Using **hot water** provided and **tap water**, adjust the water in the beaker labelled **water-bath** to 45 °C. You will **not** need to maintain this temperature.

2 Put 15 cm^3 of **G** into the boiling tube labelled **Y** which contains 1g dried yeast. Mix well.

Between step **3** and step **4**, you will be leaving the apparatus for 15 minutes. Use this time to continue with other parts of Question 1.

3 Put the boiling tube **Y** into the water-bath for 15 minutes.

4 After 15 minutes, remove the boiling tube **Y** from the water-bath.

5 Stir the mixture in the boiling tube **Y** and pour it into a beaker.

6 Label the spotting tile (dimple tile) with the sample times in minutes, as shown in Fig. 1.2.

7 Put 3 drops of **B** onto the spotting tile at each sample time, as shown in Fig. 1.2.

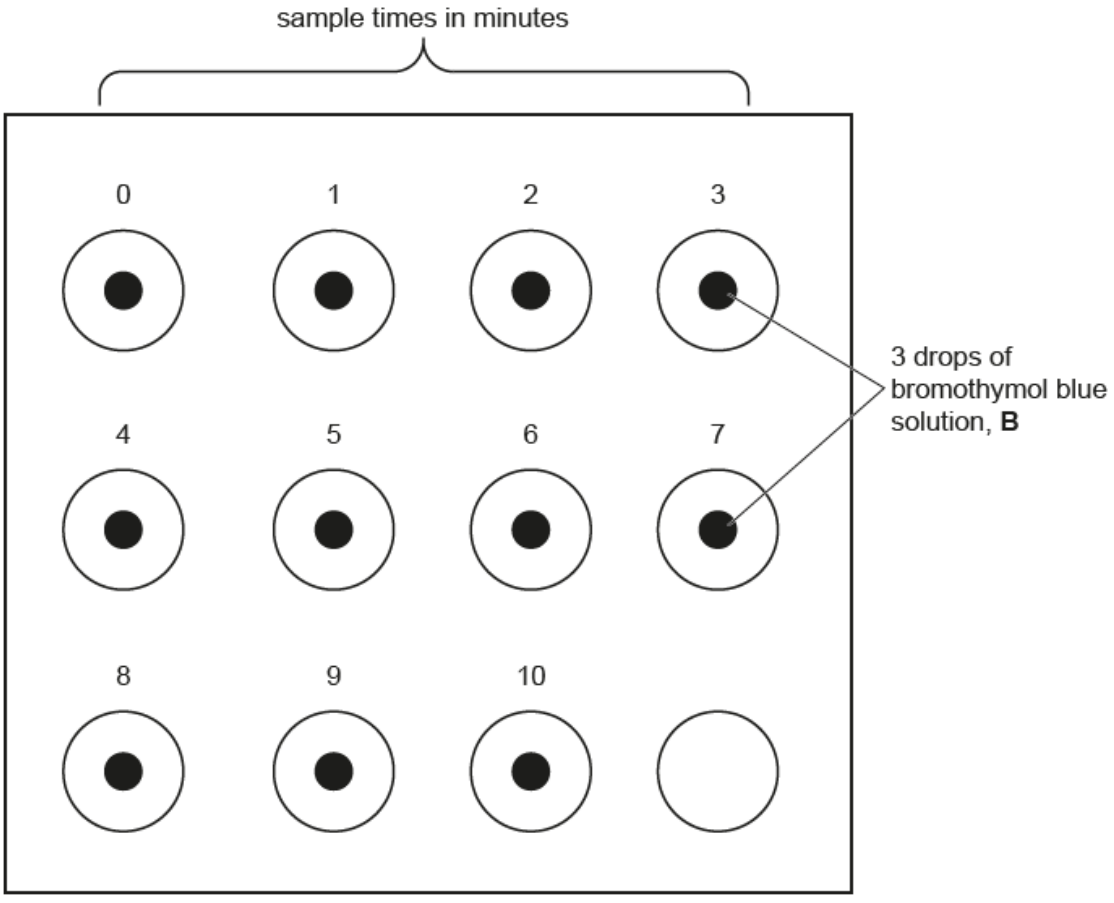

Fig. 1.2

Fig. 1.3 shows the apparatus you will set up for this investigation.

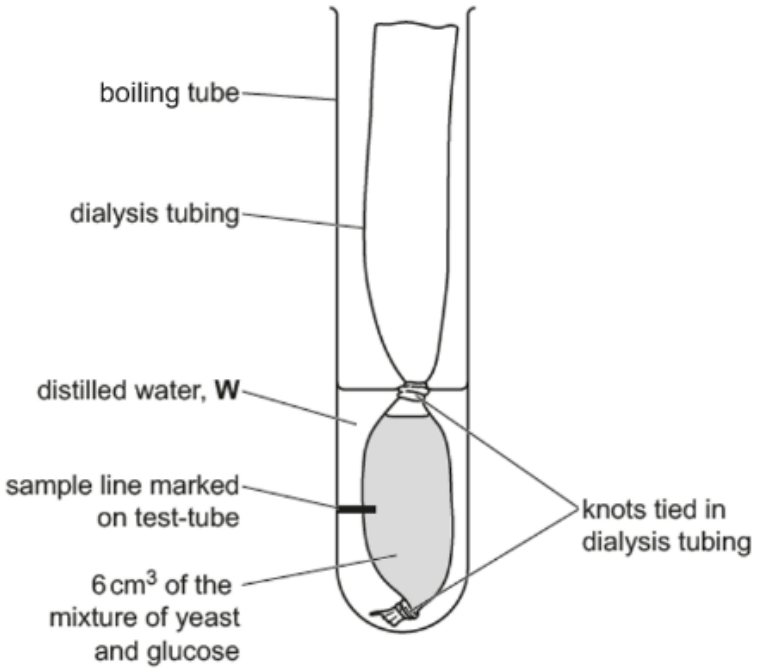

Fig. 1.3

8 Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

9 To open the other end, rub the tubing gently between your fingers and thumb.

10 Stir the mixture in the beaker from step 5 and put 6.0 cm^3 of this mixture into a syringe.

11 Wipe the outside of the syringe and put the mixture from the syringe into the dialysis tubing.

12 Rinse the outside of the dialysis tubing by dipping it into the water in the container labelled **D**.

Look carefully at Fig. 1.3 to help you with step **13** to step **15**.

13 Tie a knot just above the level of the mixture in the dialysis tubing, as shown in Fig. 1.3.

14 Put the dialysis tubing into a clean boiling tube so that it is resting on the bottom of the boiling tube, as shown in Fig. 1.3.

15 Draw a line on the boiling tube so that it is half-way between the two knots, as shown in Fig. 1.3. This is where you will take your samples from.

16 In this step, measure the volume of distilled water, **W**, needed to cover the section of dialysis tubing containing the mixture.

(a) (i) State the volume of **W** that you added to the test-tube in step **16**.

volume of **W** = ... cm^3 [1]

17 Take a sample of **W** from the boiling tube at the point you marked in step **15**, using a pipette.

18 Put 3 drops of **W** onto **B** at time 0 on the spotting tile. Put the remaining **W** in the pipette back into the boiling tube.

19 Start timing and put the boiling tube containing the dialysis tubing into the beaker labelled **water-bath**. Maintain the temperature at 40 – 45 °C.

20 Mix the sample of **W** and **B** on the spotting tile and immediately record the colour in **(a)(ii)**, using the colours stated in Fig. 1.1.

21 Repeat steps **17**, **18** and **20** for each of the sampling times until the end-point (yellow) is reached for **two** consecutive samples. If the end-point is not reached at 10 minutes, stop timing.

(ii) Record your results in an appropriate table.

[4]

(iii) This investigation used colour to indicate the concentration of carbon dioxide in the sample which is subjective.

Describe **two** improvements to this investigation that would increase the accuracy of the results other than the use of colorimeter/ colour chart.

1 .....

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2 .....

..... [2]

(iv) A student hypothesised that glucose diffuses into the surrounding of the dialysis tube.

You are provided a vial labelled **R** which contains the remaining contents of the boiling tube, collected after 20 minutes of the investigation.

Describe and carry out an appropriate test to determine whether the student's hypothesis can be accepted. Suggest how this would impact your results.

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..... [4]

(b) Another student measured the rate of carbon dioxide production when yeast was incubated with a substrate at different temperatures.

(i) State the independent variable in this investigation.

..... [1]

The results from the investigation at **35 °C** are shown in Table 1.2.

Table 1.2

time / min	carbon dioxide production / arbitrary unit
0	0
14	1.60
22	2.20
37	2.65
53	2.95
66	3.05

(ii) Plot a graph of the data shown in Table 1.2 on the grid in Fig. 1.4. Draw a line of best-fit.

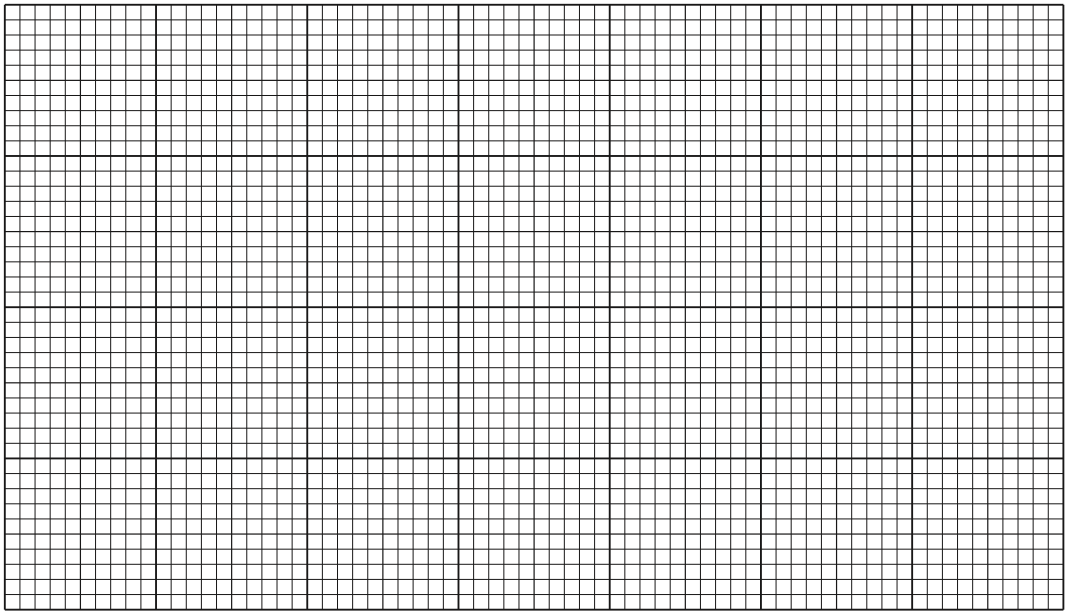

Fig. 1.4

[4]

(iii) Explain the trend shown by the graph in Fig. 1.4.

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..... [3]

(iv) Use the graph in Fig. 1.4 to find the initial rate of carbon dioxide production when the yeast was incubated at **35 °C**.

Initial rate of carbon dioxide production = ... [1]

[Total: 20]

2 The evolution of oxygen during the light-dependent steps in photosynthesis (Hill reaction) was proposed and proven by British biochemist Robin Hill. He demonstrated that isolated chloroplasts would make oxygen (O_2) but not fix carbon dioxide (CO_2) in 1937. This is evidence that the light dependent and light independent reactions of photosynthesis occur at different sites within the cell.

Hill also discovered Hill reagents, artificial electron acceptors that participate in the light reaction, such as dyes that change colour when reduced. These dyes permitted the finding of electron transport chains during photosynthesis.

In this investigation, an acidified indicator solution is used as the artificial electron acceptor that changes colour as it is reduced. The acidified indicator solution is purple-pink, and when reduced, becomes colourless.

You will investigate the effect of using chloroplast suspensions of different concentrations on the rate of photosynthesis.

In the investigation, you will mix chloroplast suspensions of different concentrations with the acidified indicator solution. The reduction is indicated by the change in colour of the solution, providing a measurable parameter to track the rate of photosynthesis.

You are provided with:

- test-tubes
- one specimen (flat-bottomed) tube
- a chloroplast suspension, **C**
- a dilute sucrose solution, **S**
- dilute sulfuric acid
- indicator solution
- a lamp

Proceed as follows:

1 Stir chloroplast suspension, **C** thoroughly.

2 Using the test tubes provided, dilute **C** with sucrose solution, **S,** to prepare four more concentrations of regular interval. Ensure that there is 10 cm^3 of solution for each concentration.

(a) (i) Describe how you will make up the various chloroplast concentrations using the chloroplast suspension **C** and the sucrose solution **S**.

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..... [2]

(ii) Suggest why a dilute sucrose solution is used instead of distilled water in the above preparation?

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..... [1]

3 Pour 10 cm^3 of a chloroplast suspension, **C** into the specimen tube provided. Place the specimen tube on a white tile and place the tube at a distance of 20 cm in front of the lamp.

4 Add 1 cm^3 of sulfuric acid to the specimen tube.

5 Add 1 cm^3 of indicator solution to the specimen tube. Stir the content.

6 Immediately turn on the lamp and start the stopwatch.

7 Record the time taken, in seconds, for the purple-pink indicator to become colourless. Stop the experiment if the indicator had not become colourless after five minutes.

8 Empty the contents of the specimen tube into the beaker labelled **waste.** Rinse and dry the tube with paper towel.

9 Repeat steps 3-8 with other concentrations.

(iii) Record your results in the space provided.

Process the data to obtain the rate of photosynthesis. Present your processed data with your results in the space provided.

[3]

(iv) With reference to your results, explain the effect of increasing chloroplast suspension concentration on the rate of photosynthesis.

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..... [3]

(b) Phytoplanktons are microscopic organisms living in aquatic environments that are capable of photosynthesising.

In the oceans, they are mainly found in the photic (sunlight) zone, where there is sufficient sunlight for them to undergo photosynthesis. However, recently, scientists discovered the presence of phytoplankton in disphotic (twilight) zone where the light intensity is even lower than that of the photic zone.

You are to plan an experiment to investigate the light compensation point of two species of phytoplankton **A** and **B** which are found in the photic and disphotic zone respectively.

You are provided with the following materials and apparatus.

- Alginate beads immobilised with species **A** and **B** separately.
- A range of specimen tubes (with cap) with different neutral density (ND) filter. The filters range from 0% (clear plastic) to 100% (aluminium foil) which can modify the intensity of light.
- Hydrogen carbonate indicator which is a type of pH indicator that is sensitive enough to show colour change as carbon dioxide concentration changes. The hydrogen carbonate indicator was maintained at atmospheric CO_2 concentration by aeration for 1 hour. The colour change of the indicator is shown in the table below:

Concentration of CO_2	**Indicator Colour**
Highest	Yellow
Higher	Orange
Atmospheric level	Red
Low	Magenta
Lowest	Purple

- Bench lamp
- Colorimeter and cuvettes
- Common laboratory apparatus (e.g., stopwatch, ruler, glass rod, beakers, test tubes, etc.)

(i) In the space below, sketch the graphs to show how the light compensation point of species **A** and **B** can be determined.

[2]

(ii) Describe the method you will carry out to determine the light compensation point of the two species of phytoplankton **A** and **B**. You do not have to plan for repeats.

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(iii) State one safety measure to minimise any risk associated with the proposed methodology.

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..... [1]

[Total: 17]

Question 3 starts on page 14

3 You are required to prepare a slide of the banana sample **B1** so that you can

- observe and record the effects of iodine on the cells,
- determine the average size of the inclusions inside the banana cells and
- compare the banana cells with the cells in slide **K1**.

You are provided with:

- a piece of banana, in a Petri dish labelled **B1**
- iodine solution, in a container labelled **iodine**

Iodine is a stain. If it comes into contact with your skin, wash it off with cold water.

Proceed as follows.

1 Use a toothpick to scrape a small amount of the banana **B1** from the surface of the fruit as shown in Fig. 3.1. You can choose to remove the banana skin before taking a sample of the banana cells.

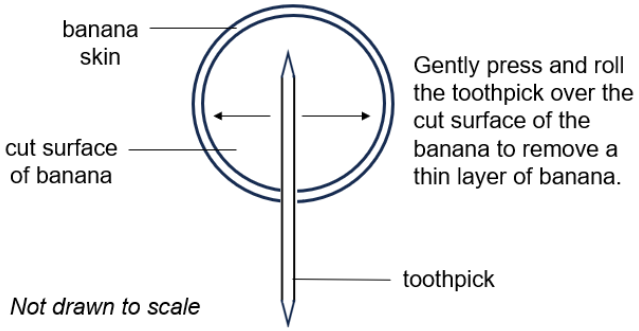

Fig. 3.1

2 Transfer the banana sample on the toothpick onto a clean microscope slide by rolling the toothpick on the slide. Remove any big pieces of banana tissue with the toothpick.

3 Add a drop of iodine solution to the smear. Put a coverslip over the smear. Wipe off any excess iodine on the slide with a paper towel

4 Using appropriate objective lens, look for two intact banana cells that have at least three large internal inclusions stained by iodine.

(a) (i) Draw, in the space provided, **two** whole cells. These cells need not be adjacent to each other. For each cell, you only need to draw the three largest inclusions.

Annotate clearly in your drawing, your observations of the colour and identity of the inclusions stained by iodine.

No other labels are required.

Do note that you would need to use this slide that you have prepared in ***(a)(iii) and (b).*** *Leave your slide on the stage but switch off the light source of your microscope after you have finished drawing so that the iodine does not dry out.*

Drawing of banana cells

[4]

(ii) You are now required to determine the average length of the three inclusions in one of the banana cells that you have drawn.

In order to do so, you will have to calibrate your eyepiece using the high-power objective.

Fig. 3.2 shows a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

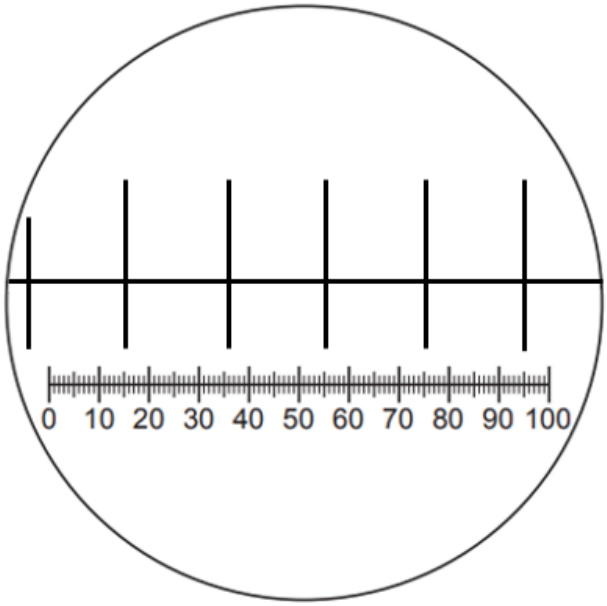

Fig 3.2

The length of one smallest division on the stage micrometer is 0.05 mm.

Use the stage micrometer to calibrate the eyepiece shown in Fig. 3.2.

Show your working clearly.

One eye-piece division is ……μm [2]

(iii) Assuming that the eyepiece shown in Fig 3.2 is the same as the one fitted onto your microscope, show how you can determine the average length of the three inclusions in one of the cells that you have drawn.

Show your working clearly.

Average length of the inclusions …… μm [3]

(b) You are now required to compare the banana cells with the cells found in slide **K1**.

Slide **K1** is a stained transverse section through a pine leaf.

You are not expected to be familiar with this specimen.

The central tissue of the pine leaf in slide **K1** is surrounded by a ring of cells. Locate the cells lying immediately above this layer.

Complete the table to show two observable differences, other than colour, between these cells and the banana cells that you have drawn in **(a)(i).**

Features	**Banana cells**	**Cells above the ring of cells in slide K1**

[2]

(c) Use the microscope to observe the distribution and proportion of the different tissues in the leaf on **K1**.

In the space below, draw a large plan drawing of **half** of the pine leaf. Your drawing must show the distribution and proportion of all tissues of the leaf.

Do not draw any cells.

Labels are not required.

[4]

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(d) Fig 3.1 is a photograph of a cross section of a stem. A grid has been placed over the photograph. Each square on the grid is 1 mm^2.

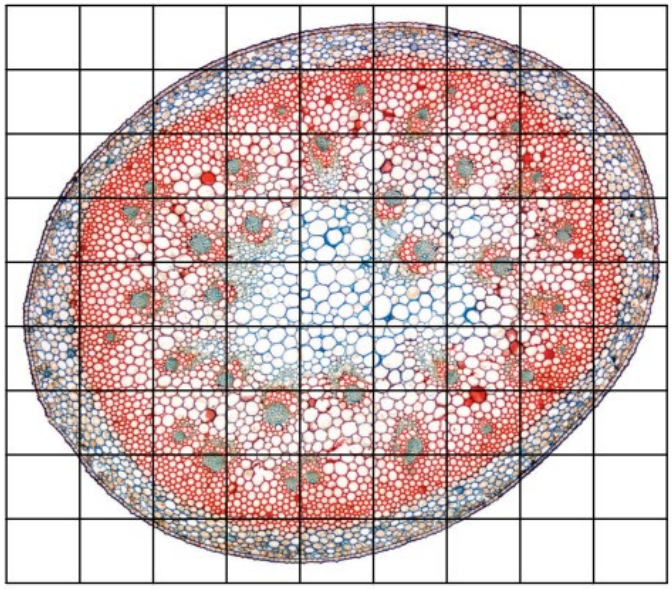

Fig 3.3

(i) Describe how you would use the grid to find the total area occupied by the stem. Your description should allow the collection of reliable results.

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..... [2]

(ii) Using the method that you have describe in **(i)**, determine the total area of the stem.

..... [1]

[Total: 18]

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