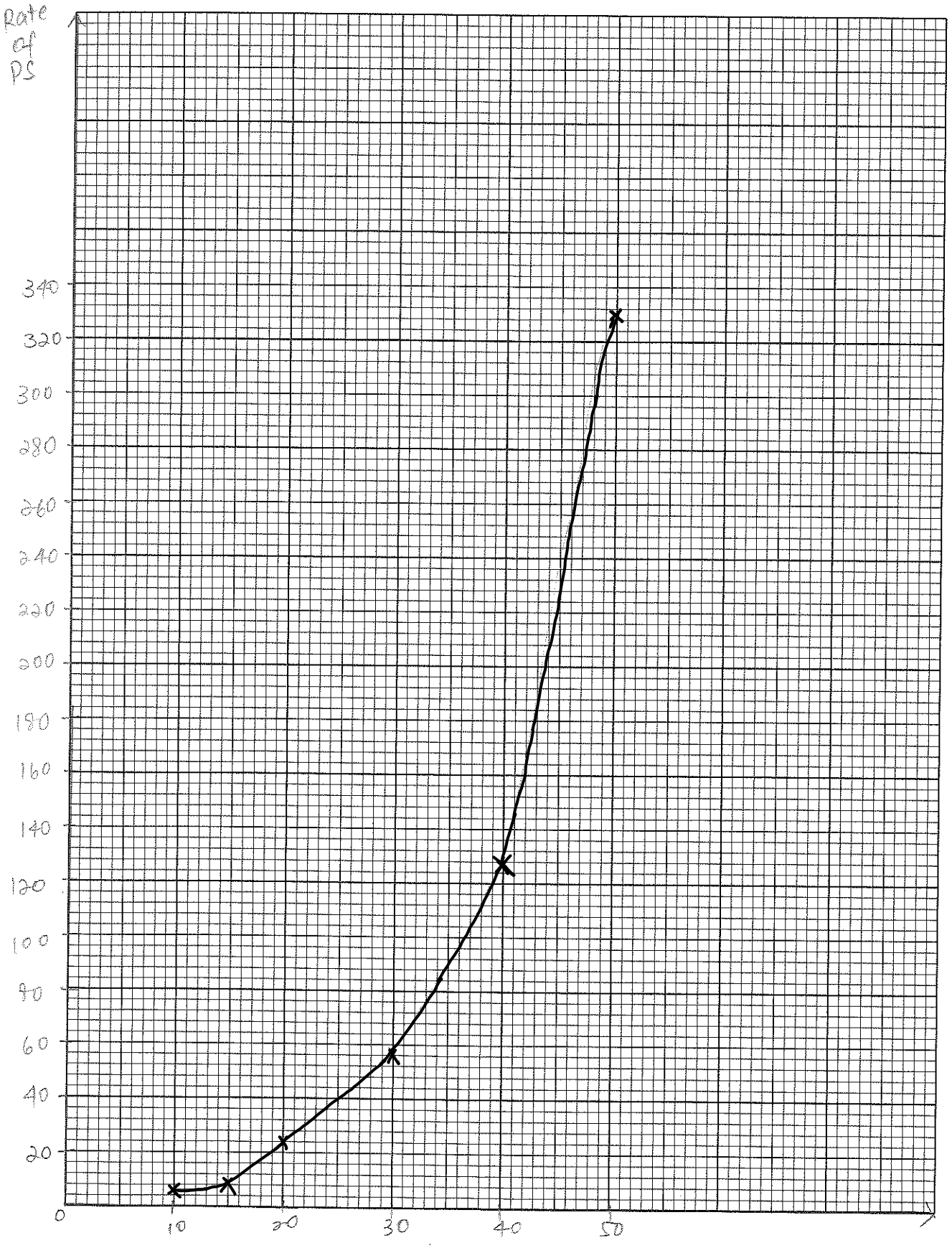
(a) Record your results in a table.

Test tube	Time taken for indicator to turn c/s	Rate of photosynthesis
A	3	333 ~~00~~
B	8	125 ~~00~~
C	17	~~58 80~~ 59
D	38	~~26 30~~
E	108	9 ~~26~~
F	158	6 ~~33~~

Heading [1]
Table - 3 columns. 7 rows [1]
Trend - Time taken ↑, ROP ↓ [1]
Rate - calculated correctly [1]
Whole no [1]

[5]

(b) Draw a graph of your results to show the effect of changing the chloroplast suspension concentration on the rate of photosynthesis.



[5]

(c) (i) State the independent and dependent variables in your investigation.

independent variable Different concentrations of chloroplast suspension. (x volume)

dependent variable Time taken for indicator to become colourless.

[2]

(ii) Describe the results of your investigation as shown in your graph.

As percentage of chloroplast suspension from 10% to 50%, the rate of photosynthesis increases from to . [1]
As percentage of chloroplast suspension increases from 10% to 20% the increase in the rate of photosynthesis is less steep. [1] As the % of chloroplast suspension increases from 20% to 50%, the increase in the rate of photosynthesis is greater. [1]

[3]

↑ROP

(iii) Explain why increasing the concentration of the chloroplast suspension has the effect you described in **1(c)(ii)**.

Increasing the concentration of chloroplast suspension will increase the amount of chlorophyll present in the suspension. [1]
Thus more light can be absorbed by chlorophyll thus increasing the rate of photosynthesis. [1]

[2]

(d) Describe **two** ways in which your method of using the syringes ensured that the dilutions in step 2 were made accurately.

1 Ensured that tip of the syringe is submerged in solution to prevent drawing in air which will result in less volume being drawn.

2 Reading the scale at eye level. to ensure an accurate volume of solution is measured for the dilution.

↳ errors in procedure / use of equipment [2]

(e) (i) Suggest **two** sources of error, **other than measuring volumes**, that apply to this investigation and in each case explain their effect on the quality of the results.

source of error Perception of colour change.

explanation The time recorded for colour change may be longer or shorter than the actual depending on one's perception of the colour change.

source of error The approximate distance of specimen tube from the lamp.

explanation The distance of specimen tube from lamp will affect the light intensity. This will in turn affect the time taken and therefore the rate of photosynthesis.
i.e. longer distance results in greater time taken and lower rate of photosynthesis. [2]

(ii) Suggest an improvement to the method, that will reduce the effect of the error, for **one** of the errors you have identified in **1(e)(i)**.

Insert a diagram that clearly indicates the start point of 20 cm from the lamp to the end point at the specimen tube. [1]

(f) Light intensity is one factor that affects the rate of photosynthesis.

Outline how you would investigate the effect of light intensity on the rate of photosynthesis of a chloroplast suspension.

Independent variable : Distance of chloroplast suspension away from lamp. (10cm, 20cm, 30cm, 40cm and 50cm).

Dependent variable : Time taken for indicator to turn colourless.

Constant variable : % of chloroplast suspension, ~~power of lamp~~

~~Procedure : Prepare 20% chloroplast suspension in 5 specimen tubes.~~

[1/2]

[5]

1. Place 10cm³ of 20% chloroplast suspension into a specimen tube.
2. Place it on a white tile and ensure that the specimen tube is 20cm in front of the lamp.
3. Add 1cm³ of sulfuric acid and 1cm³ of indicator sol^n into the specimen tube. Mix the contents of the tube.
4. Turn on the lamp & immediately start ē stop watch.
5. Record the time taken for ē purple-pink indicator to become colourless. [1/2]
7. Repeat steps 1 to 5 another 4 times with the distance between the lamp and ST at 40cm, 60cm, 80cm and 100cm. [1/2]
6. Calculate the rate of PS using $ROP = \frac{1000}{t \text{ (in s)}}$. [1/2]
8. As distance betw lamp & ST ↑, light intensity ↓ and therefore rate of photosynthesis ↓. [1].

[Total: 27]

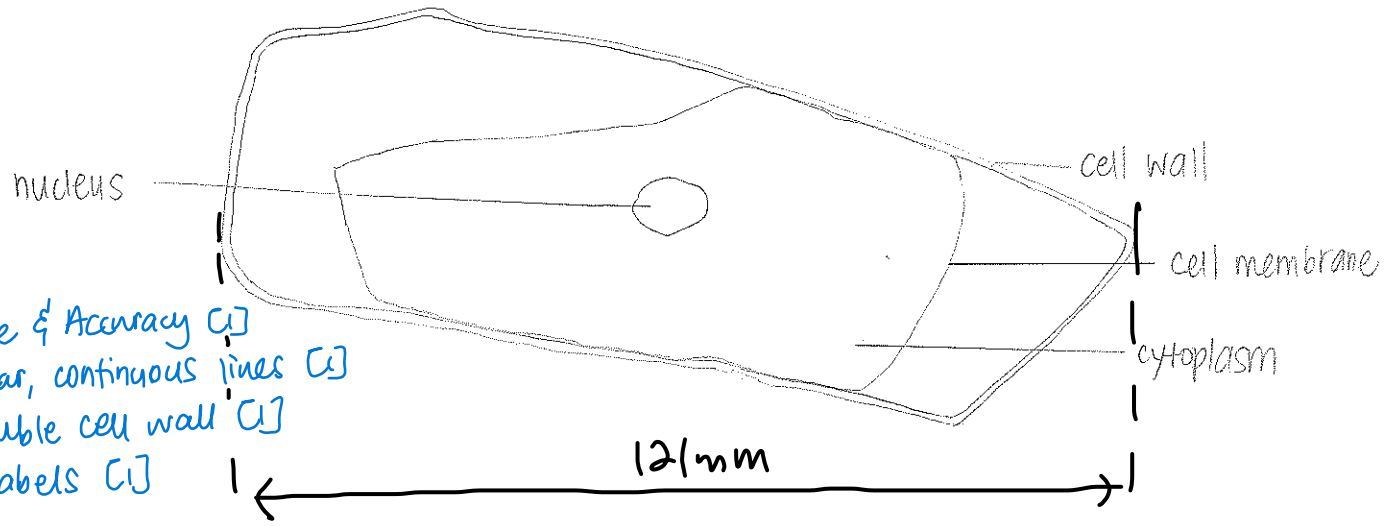
(a) Explain why the students put the onion epidermal peel in a dilute iodine solution.

To stain the cell for viewing under light microscope.
(colour / stain cell to achieve clarity when using light microscope)

[1]

(b) **(i)** Make a large, labelled drawing of the cell indicated by **X** in Fig. 2.2.

Drawing of cell X



Size & Accuracy [1]
clear, continuous lines [1]
double cell wall [1]
labels [1]

[4]

(ii) The students measured the maximum length of cell **X** as 0.20 mm.

Calculate the magnification of your drawing of cell **X**. Show your working.

magnification = $\frac{121}{0.20}$ [1] indicated on drawing

= 605

magnification = 605 x [1] ..... [2]

(c) Explain why the cells became plasmolysed when the salt solution was added.

The salt solution has a lower water potential than the cell sap of the onion cells. (1)

Water moves out of the cell into the solution by osmosis (1)

As a result, cell membrane begins to shrink away from the cell wall, causing the cells to be plasmolysed. (1)

[3]

(d) The students investigated the extent of plasmolysis in the onion cells.

The students measured six cells. They made two measurements on each cell. One measurement was of the maximum cell length (**A**) and the second measurement was the length of the cell contents (**B**).

The positions of measurement **A** and measurement **B** are demonstrated in Fig. 2.3, which is not drawn to scale.

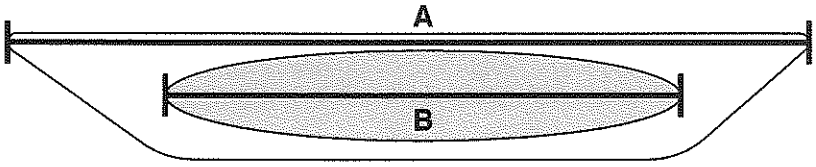


Fig. 2.3

The students' results are shown in Table 2.1.

Table 2.1

cell	maximum cell length (**A**) / mm	length of cell contents (**B**) / mm	length of cell contents as a percentage of maximum cell length
1	0.25	0.18	72.00
2	0.20	0.14	70.00
3	0.28	0.22	78.57
4	0.17	0.11	64.71
5	0.23	0.15	65.22
6	0.34	0.25	73.53
		mean percentage	70.67

} must be to 2dp

(i) Complete Table 2.1 by calculating:

- the length of the cell contents (**B**) of cell 6 as a percentage of the maximum cell length (**A**)
- the mean percentage.

[2]

(ii) Explain why it is important that the students calculated the length of the cell contents as a percentage of the maximum cell length for each cell.

The maximum cell length for each cell varies therefore calculating the percentage would give a clearer comparison between the cells.

.....[1]

[Total: 13]