Analysis of Data and Conclusions

Question Paper 3

Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	Analysis of Data and Conclusions
Booklet	Question Paper 3

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**

1 You should read through the whole of this question carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

(a) Fig. 1.1 is an electronmicrograph of a chloroplast.

Label three parts of the chloroplast on Fig. 1.1.

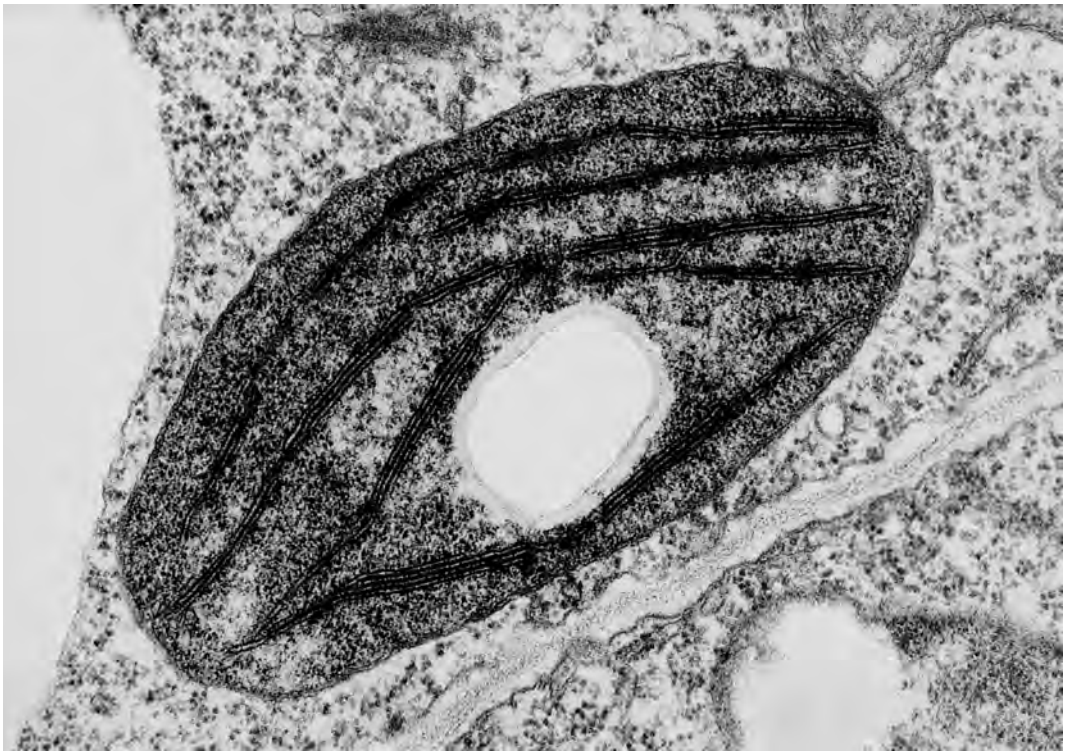

Fig. 1.1

[3]

(b) For this investigation you are supplied with a suspension of chloroplasts. The suspension was prepared in the following way.

1 Some leaves were cut into small pieces and placed in a blender.

2 The pieces were homogenised in an ice-cold sucrose solution buffered at pH 7.0.

3 The homogenised leaf tissue was filtered to remove cell debris.

Explain why chloroplasts are suspended in a medium which:

- is ice-cold
- is buffered
- contains sucrose.

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During the light-dependent stage of photosynthesis, hydrogen ions and electrons are transferred to hydrogen acceptor molecules, including NADP.

Dichlorophenolindophenol (DCPIP) is used in investigations to monitor the light-dependent stage of photosynthesis. DCPIP is a blue dye which acts as a hydrogen and electron acceptor. As DCPIP is reduced, its blue colour disappears.

electrons and hydrogen ions from water + DCPIP (blue) $\longrightarrow$ reduced DCPIP (colourless)

You are required to determine the rate of the light-dependent stage of photosynthesis at different light intensities.

In this investigation, you will mix samples of the chloroplast suspension with a DCPIP solution. You will then use filters to expose the samples to six different light intensities and record the time it takes for the mixture to change colour from blue-green to the green colour of the chloroplast suspension.

Table 1.1 shows the percentage light transmission of the six filters.

Table 1.1

filter	percentage light transmission
1	100.0
2	71.0
3	50.0
4	25.0
5	12.5
6	6.3

Read through the instructions carefully and decide on the controls that you will use [see (c) on page 6] before starting the procedure.

Space is provided in **(d)** on page 6 to present your results.

1 Stir the chloroplast suspension using the glass rod and remove a sample of the extract by inserting a capillary tube into it. Remove the capillary tube, wipe it to remove any external material and place it on the white tile. This tube will act as a **colour standard** to show the **green** colour you will see when DCPIP is reduced in the other capillary tubes.

The colour standard should be left on the white tile throughout the investigation.

2 Use the dropping pipette to add just enough of the **DCPIP solution** to the chloroplast suspension in the beaker to make it turn **blue-green**. Shake the beaker gently as you add the DCPIP solution. At this stage, the chloroplast suspension should be noticeably blue-green. If the chloroplast suspension appears green with **no blue colour**, add more drops of DCPIP solution until the colour is blue-green. Immediately wrap the beaker with foil, as shown in Fig. 1.2. Add the foil cap, which needs to be easy to remove when necessary, so that the mixture in the beaker is kept in the dark.

Put the foil-covered beaker back into ice-cold water.

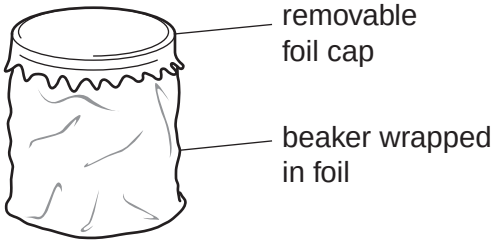

Fig. 1.2

3 Set up a bench lamp approximately 150 mm from the white tile. Do **not** switch the lamp on yet.

*The following procedures will need to be carried out rapidly, so **read steps 4 to 7, and question (c) before starting step 4**.*

4 Remove the foil cap from the beaker and take a sample of the mixture by inserting another capillary tube. This will be the **reaction tube**. Replace the foil cap immediately. Wipe the reaction tube to remove any external material and place it on the white tile next to the **colour standard**.

5 Cover **both** tubes (the colour standard and the reaction tube) with one of the folded filters as soon as the reaction tube is placed on the tile, as shown in Fig. 1.3.

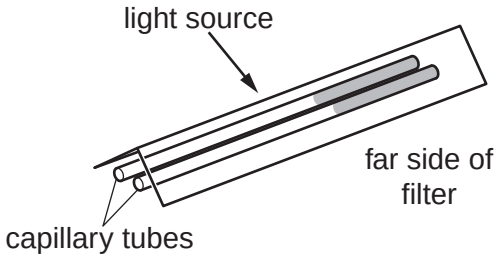

Fig. 1.3

6 Switch on the bench lamp and immediately start a stopwatch or stop clock. Record the time, in seconds, for the colour in the reaction tube to match that of the colour standard. Switch off the bench lamp.

*It may be necessary to lift the far side of the filter **briefly** in order to see when the colour in the reaction tube has matched that of the colour standard.*

7 Repeat steps **4** to **6** using each of the five remaining filters. If there is no change in colour in a **reaction tube** after ten minutes, record 'infinity' and the rate of change as 0.

You have been supplied with spare capillary tubes for replicates and controls.

8 Calculate the rate of the reduction of the DCPIP for each reaction tube and record appropriately in the space provided to present your results, in **(d)** below.

(c) State any controls that you chose to use **and** explain why you considered them necessary in this investigation.

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(d) Use the space below to present all of your results.

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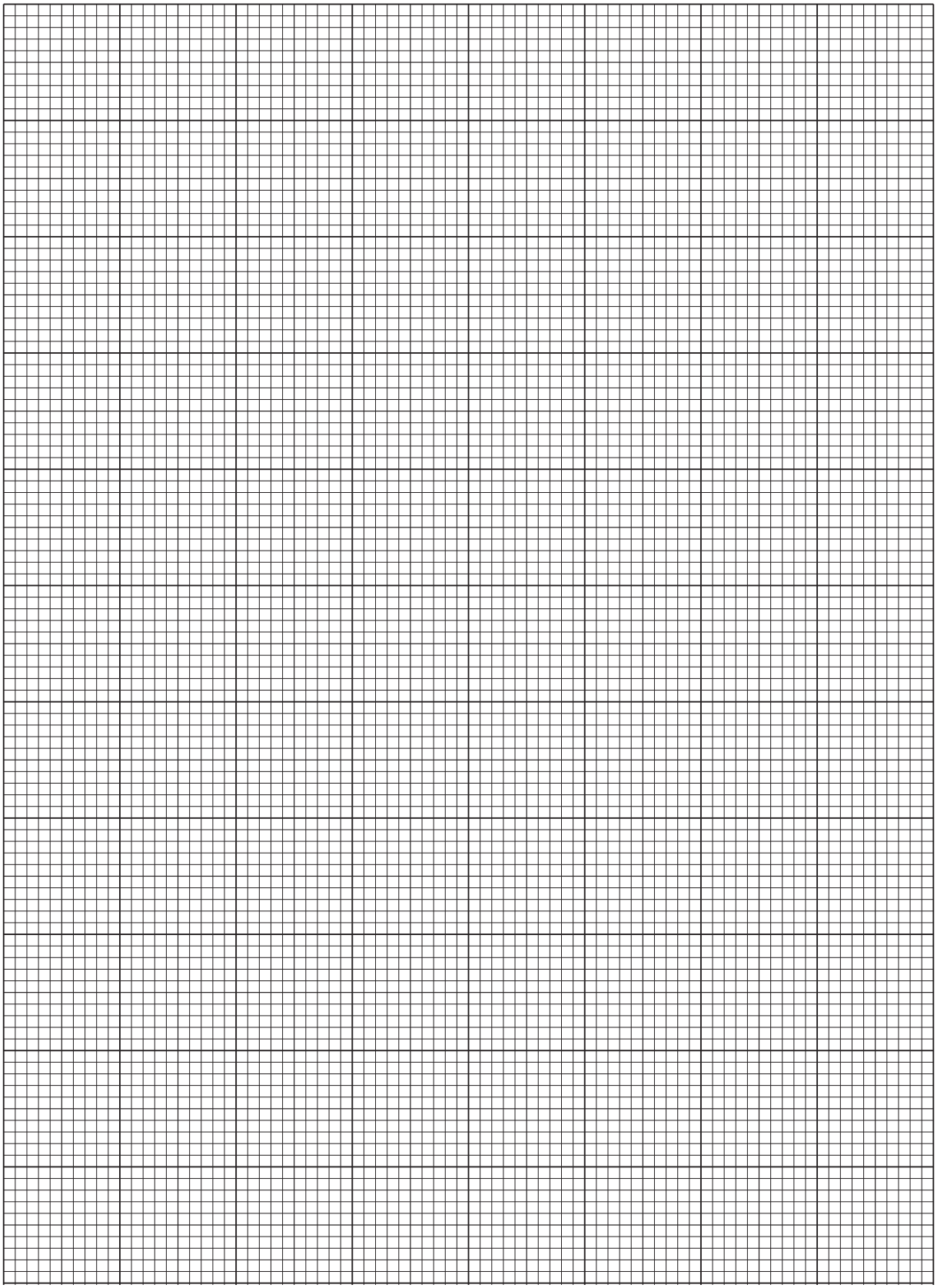
(e) Draw a graph of your results on the grid below to show the effect of light intensity on the rate of the light-dependent stage of photosynthesis.



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(f) Describe **and** explain the pattern of results shown by your graph.

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(g) DCPIP easily crosses chloroplast membranes. Some other electron acceptors used in investigations of the light-dependent stage of photosynthesis do not.

Suggest how a chloroplast suspension would be treated in order to be used with one of these other electron acceptors.

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(h) DCPIP accepts electrons from the electron transport chain between photosystem II (PSII) and photosystem I (PSI).

Explain how this allows the light-dependent stage of photosynthesis to be studied without any influence from the action of the light-independent stage (Calvin cycle).

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(i) Identify the limitations and sources of error in the investigation that may have affected the quality of the results.

Explain how you would improve the method to overcome the limitations that you have identified.

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