1. A student wanted to investigate **photosynthesis**. They used the following method.

Step 1 Cut a 10 cm piece of pondweed.

Step 2 Place the piece of pondweed into a beaker of water, covered with an inverted filter funnel. Make sure the cut end of the pondweed is at the top.

Step 3 Fill a measuring cylinder with water and carefully invert it over the top of the filter funnel.

Step 4 Position a lamp exactly 100 cm from the pondweed. Switch the lamp on and leave it for 2 minutes to allow the pondweed to acclimatise.

Step 5 Start a stopclock and record the number of bubbles produced in 3 minutes.

Step 6 After 3 minutes, record the volume of gas that has been collected in the measuring cylinder.

Step 7 Refill the measuring cylinder with water and repeat steps 4–6 for distances of 80 cm, 60 cm, 40 cm, and 20 cm.

a. Suggest what question the students were trying to answer with this method.

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b. Give a list of apparatus needed for this investigation.

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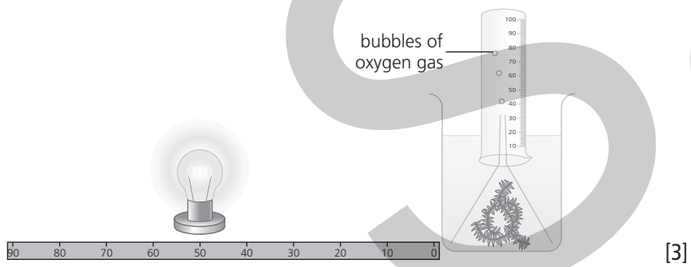
c. Add seven labels to the following diagram to fully label it.



[3]

Exam tip

This is a science exam, not an English exam. Your answer for this should be no more than five words long. Do not answer this in a full sentence and do not repeat the question.

d. State the dependent variable in this investigation.

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e. Light intensity is an important requirement for this investigation. Two groups of students carried out this investigation. One group used the light sources provided by the teacher and another group decided to use the light from their mobile phones as a light source. The two groups had very different results. Use the information in the question and your knowledge of photosynthesis to suggest why they had different results.

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Exam tip

When 'compare' is the exam command word, you need to mention the similarities and the differences in your answer.

f. Two groups of students carried out the investigation in exactly the same way. Their results are shown in the tables.

Group 1

	Distance of light source / cm	
	10	20
Number of gas bubbles	120	74
Volume of gas / cm³	19	13

Group 2

	Distance of light source / cm	
	10	20
Number of gas bubbles	40	27
Volume of gas / cm³	18	12

Compare and explain the two sets of results.

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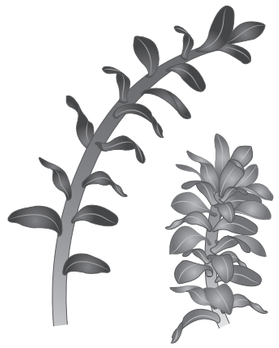
g. Two samples of pondweed are shown below.



Comment on whether it would be a fair test to compare these two samples of pondweed. Explain your answer.

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Exam tip

Whenever you see a table of results, you should look for any **anomalous results**. There is often one hiding in there. Do not include this result when working out the average.

h. The following set of results was obtained after repeating the experiment.

		Distance of light source / cm			
		10	**20**	**30**	**40**
Number of gas bubbles released in 1 minute	**Test 1**	40	27	15	11
	Test 2	42	68	17	12
	Test 3	38	25	19	9
	Mean average				

Calculate the average (mean) of the three tests for each distance. Write your answers in the table. [4]

i. A student wanted to repeat their investigation later in the day. The sample of pondweed was first tested at the start of the day, left in water in the sun for the duration of the day, and then retested at the end of the day. The volumes of gas collected at the end of the day were much lower than the volumes of gas collected at the start of the day. Suggest why.

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j. Suggest an alternative piece of apparatus to the measuring cylinder that could be used to collect an accurate volume of gas.

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k. Describe the possible sources of error in this experiment and how they can be controlled.

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