



General Certificate of Education
Advanced Level Examination
June 2010

Biology

BIO6T/P10/task

Unit 6T A2 Investigative Skills Assignment Task Sheet

The effect of light intensity on the rate of photosynthesis

Introduction

When placed in water and exposed to light of an appropriate intensity, an aquatic plant produces bubbles of gas. The rate of bubbling can be used as a measure of the rate of photosynthesis.

You will investigate photosynthesis of an aquatic plant and find out if light intensity and rate of photosynthesis are correlated. Light intensity decreases as the distance between the lamp and plant increases.

Materials

You are provided with

- aquatic plant
- 1 % sodium hydrogencarbonate solution
- test tube
- test tube rack
- ruler
- lamp
- stopwatch or timer
- scissors
- glass rod
- forceps
- AQA Students' Statistics Sheet (version 2) provided at the back of this Task Sheet.

You may ask your teacher for any other apparatus you require.

Outline method

Read these instructions carefully before you start your investigation.

1. Fill the test tube to the top with 1 % sodium hydrogencarbonate solution.
2. Take a piece of the aquatic plant about 5 cm long and push it into the tube until the cut end is just below the surface of the sodium hydrogencarbonate solution. Use the scissors to cut the stem at an angle. Make sure that the stem stays below the surface of the sodium hydrogencarbonate solution. (See **Figure 1**)

Figure 1

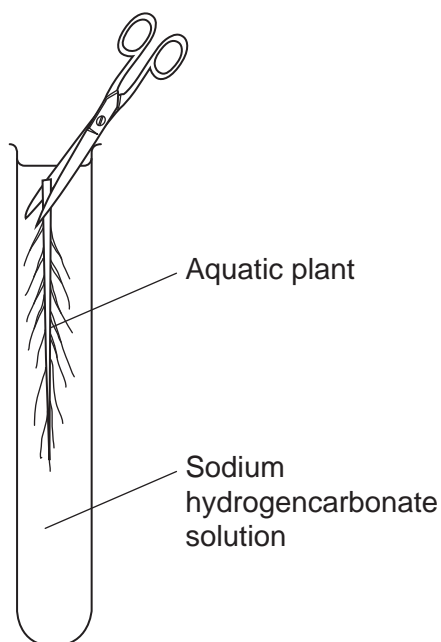
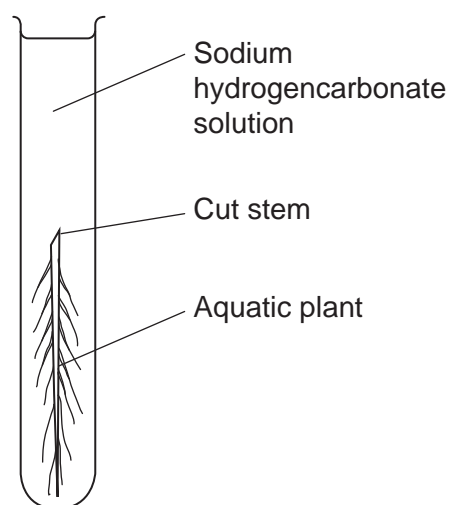


Figure 2



4. Use the glass rod to push the plant gently into the tube. The cut end of the stem should be at the top and about half way down the tube as shown in **Figure 2**.
5. Place the tube in the test tube rack 10 cm away from the bulb of the lamp.
6. Leave the plant for 5 minutes and then count the number of bubbles rising from the cut end of the stem in 1 minute.
7. Repeat your counts as many times as necessary.
8. Take additional readings at appropriate distances from the lamp to find out if there is a correlation between light intensity and the rate of photosynthesis. The distance of the plant from the bulb of the lamp should be within the range 5 to 30 cm.

You must decide for yourself

- the number of repeat measurements to take at each light intensity
- the number of different light intensities to investigate.

ISA BIO6T/P10 Candidate Results Sheet: Stage 1

The effect of light intensity on the rate of photosynthesis

Centre Number

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Candidate number

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Candidate Name

Record your data in a table in space below.

Hand in this sheet at the end of each practical session.

There are no marks awarded for the table at A2.

Turn over ►

ISA BIO6T/P10 Candidate Results Sheet: Stage 2

The effect of light intensity on the rate of photosynthesis

Centre Number

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Candidate number

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Candidate Name

The distances from the lamp can be converted into a measure of light intensity by calculating $\frac{1}{d^2}$ where d = distance from the plant to the lamp.

- 1 Calculate $\frac{1}{d^2}$ for each value of d, and complete the table below.

d / cm	$\frac{1}{d^2}$

(1 mark)

Analyse your data with a suitable statistical test. You may use a calculator and the Students' Statistics Sheet that has been provided at the back of this Task Sheet to perform this test.

- 2 State your null hypothesis.

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(1 mark)

- 3 (a) Give your choice of statistical test

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(1 mark)

3 (b) Give reasons for your choice of statistical test.

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(1 mark)

4 Calculate the test statistic.

(1 mark)

Turn over ►

5 Interpret the test statistic in relation to the null hypothesis being tested.

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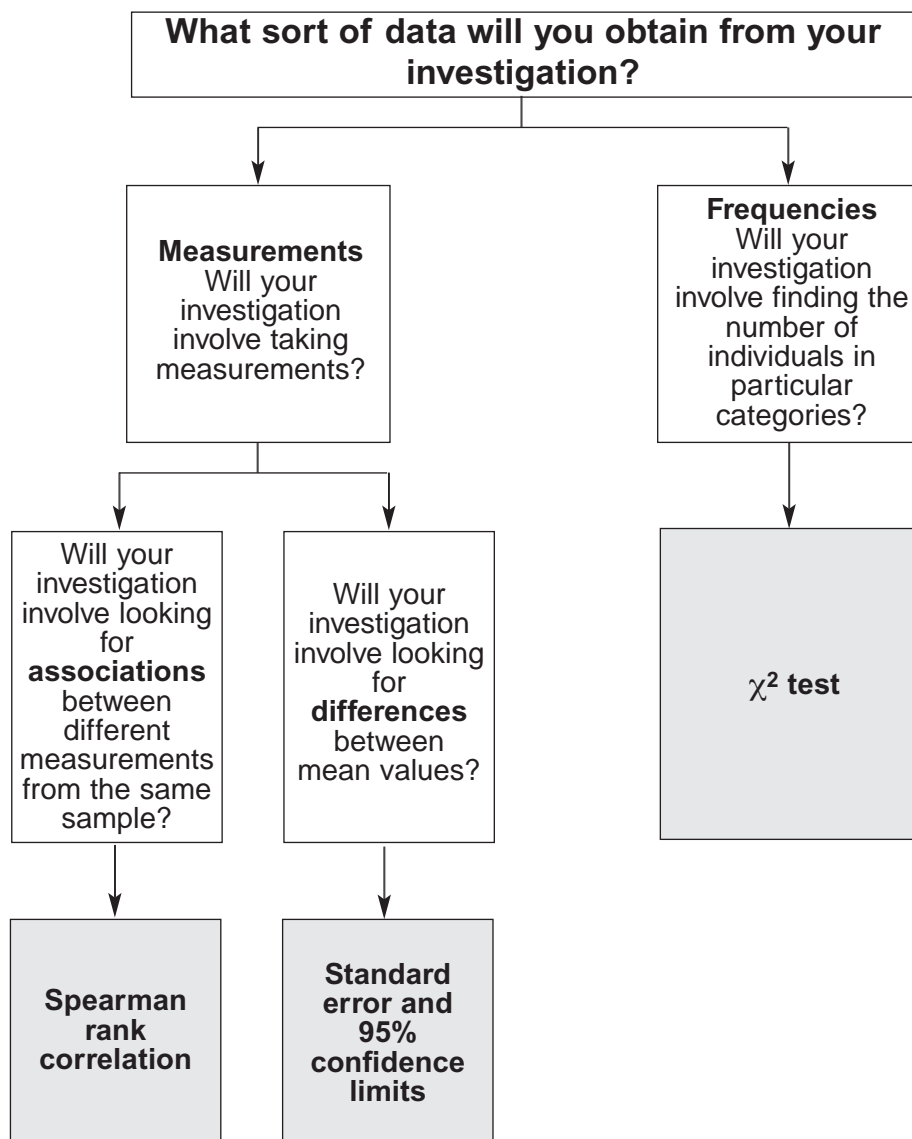
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(2 marks)

END OF QUESTIONS

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AQA Students' Statistics Sheet (version 2)



Standard error and 95% confidence limits

Calculate the standard error of the mean, SE , for each sample from the following formula

$$SE = \frac{SD}{\sqrt{n}}$$

where SD = the standard deviation
and n = sample size

95% confidence limits = $2 \times SE$ above and below the mean

The χ^2 test

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O represents the results you observe in the investigation and E represents the results you expect.

Table showing the critical values of χ^2 at P = 0.05 for different degrees of freedom

Degrees of Freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

Spearman rank correlation test

Calculate the value of the Spearman rank correlation, r_s , from the equation

$$r_s = 1 - \left[\frac{6 \times \sum D^2}{n^3 - n} \right]$$

where n is the number of pairs of items in the sample and D is the difference between each pair of measurements.

Table showing the critical values of r_s at P = 0.05 for different numbers of paired values

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

For use in the ISA and EMPA assessment