Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 2

General Certificate of Education
Advanced Level Examination
June 2013

Biology BIO6X/PM2

Unit 6X A2 Externally Marked Practical Assignment
Task Sheet 2

To be completed before the EMPA Written Test.

For submission by 15 May 2013

For this paper you must have
- a ruler with millimetre measurements
- a calculator.

Task 2

Introduction

If a piece is cut from an aquatic plant, placed in water and exposed to bright light, it will carry out photosynthesis. As a result, bubbles of gas are released from the cut end of the stem. The rate of bubbling can be used as a measure of the rate of photosynthesis.

During photosynthesis, plants use light of different wavelengths to different extents. Different wavelengths of light have different colours. In this part of the investigation, you will investigate the rate of photosynthesis in white light and green light. White light contains light of many wavelengths and colours. You will use a green solution to provide green light to the aquatic plant.

Materials

You are provided with

- aquatic plant
- 1 % sodium hydrogencarbonate solution
- green-coloured solution
- scissors
- glass rod
- forceps
- ruler
- boiling-tube rack
- 1 boiling tube
- large beaker
- lamp
- stopwatch or timer
- retort stand and clamp.

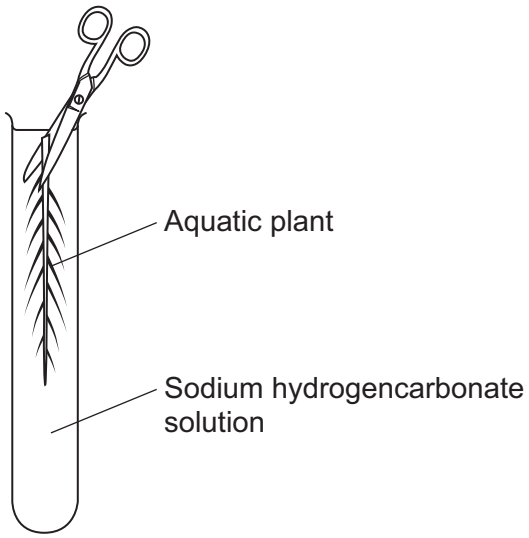
You may ask your teacher for any other apparatus you require.

Method

Read these instructions carefully before you start your investigation.

1. Fill the boiling tube to 2 cm below the top with 1 % sodium hydrogencarbonate solution.
2. Cut a piece from the aquatic plant, about 10 cm long, and push it into the tube until the cut end is just below the surface of the sodium hydrogencarbonate solution. Then use the scissors to cut the end of the stem at an angle, as shown in **Figure 3**. Use the glass rod to make sure the end of the stem stays below the surface of the sodium hydrogencarbonate solution. **Use the same piece of aquatic plant throughout your Task 2 investigation.**

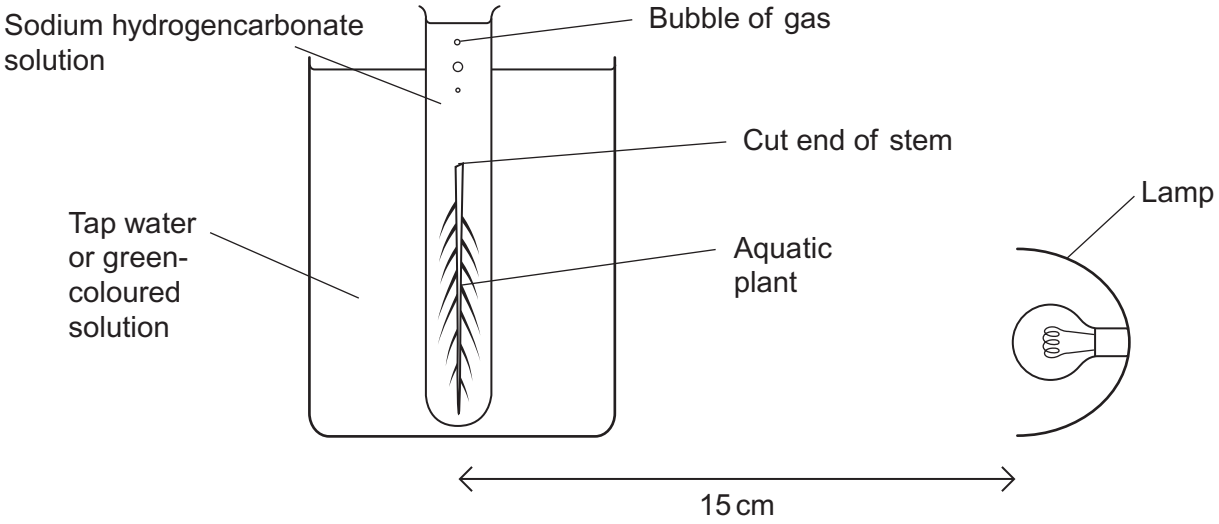
Figure 3



Turn over for steps 3 to 10

3. Fill the beaker with tap water to the 500 cm^3 mark. Use the retort stand and clamp to support the boiling tube in the centre of this beaker.
4. Position the lamp so that light shines onto the aquatic plant and the centre of the boiling tube in the beaker is 15 cm away from the bulb of the lamp, as shown in **Figure 4**.

Figure 4



5. If your plant releases a continuous stream of bubbles, you will be unable to count them accurately. Cut approximately 1 cm from the cut end of the stem and then reposition the plant in the boiling tube. Repeat this until the rate of bubbling can be counted.
6. Leave the plant for 10 minutes. During this time, prepare your results table.
7. After 10 minutes, count the number of bubbles rising from the cut end of the stem in a set time.
8. Repeat your counts as many times as necessary.
9. Carefully lift the boiling tube from the beaker. Keep the plant and sodium hydrogencarbonate solution in the tube. Replace the tap water in the beaker with the green-coloured solution and then reposition the boiling tube.
10. Repeat steps 4 to 8.

You must decide for yourself

- for how long to count bubbles in white light and in green light
- the number of repeat counts to make.

Recording your data

Record your raw data in an appropriate table in the space below.

Analysing your data

5 Use a statistical test to analyse your data and test your null hypothesis. You may use a calculator and the AQA Students' Statistics Sheet that has been provided.

You are provided with a sheet of graph paper. You may use this if you wish.

5 (a) State your null hypothesis.

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(1 mark)

5 (b) Give your choice of statistical test.

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(1 mark)

5 (c) Give the reason for your choice of statistical test.

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(1 mark)

5 (d) Calculate the test statistic. Show your working.

(1 mark)

5 (e) Interpret the test statistic in relation to your null hypothesis.
Use the words *probability* and *chance* in your answer.

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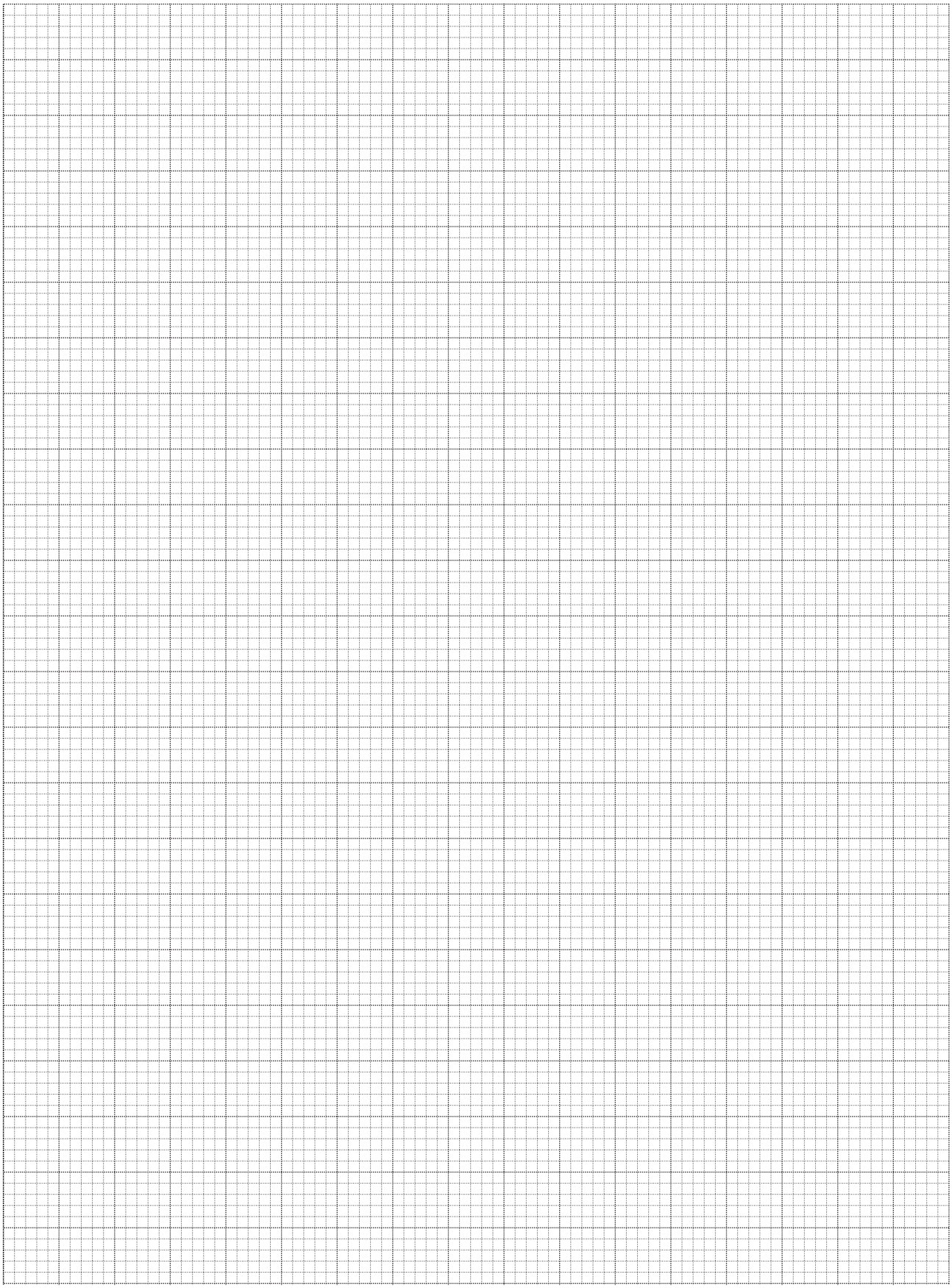
(2 marks)

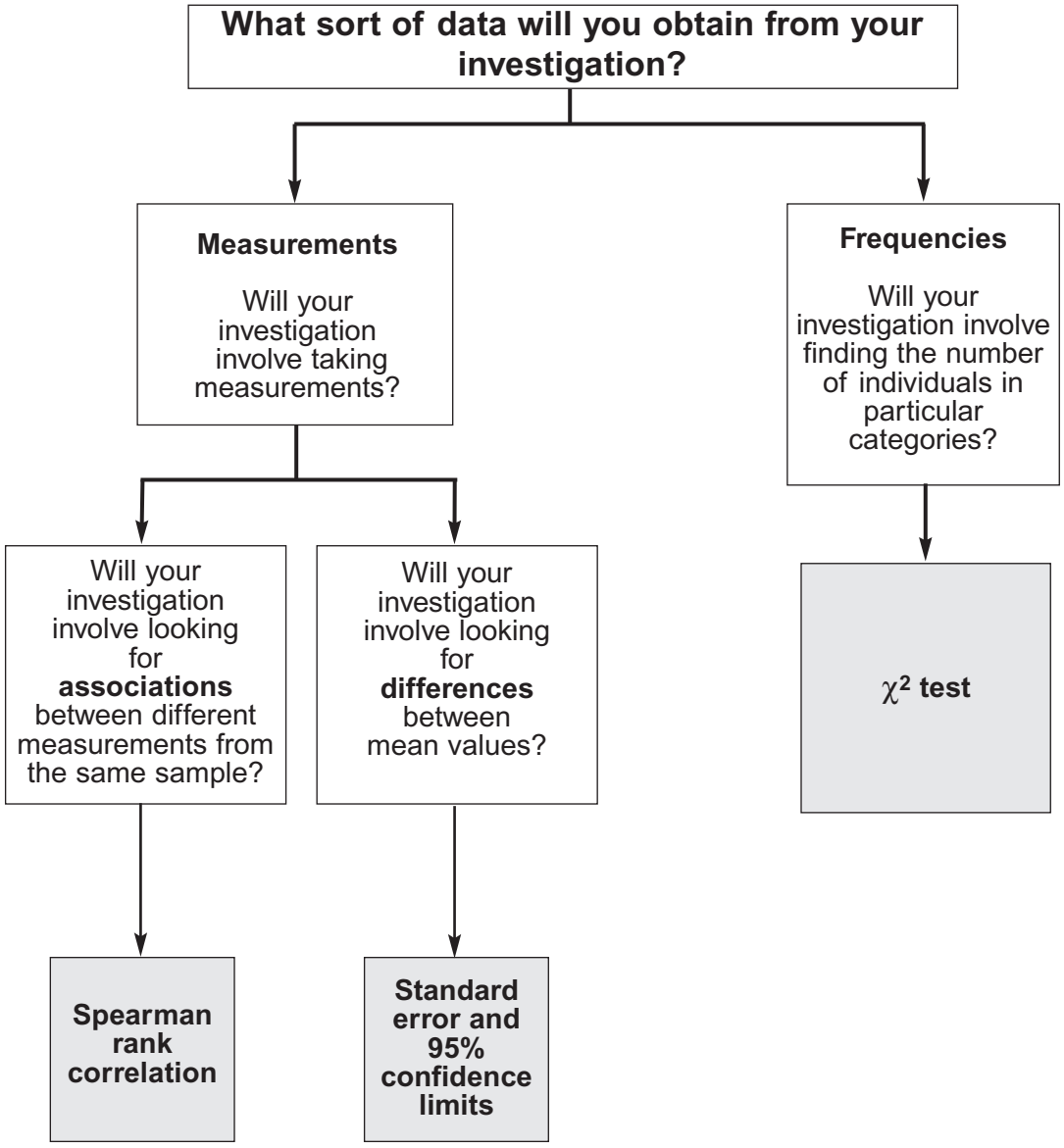
6

END OF TASK 2

You may use this graph paper if you wish



AQA Students' Statistics Sheet (version 3)



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

For use in the ISA and EMPA assessment

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

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

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

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