Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Examiner's Use Total EMPA mark	
Examiner's Initials	
Section	Mark
Task 1	
Task 2	
Section A	
Section B	
TOTAL EMPA MARK	

General Certificate of Education
Advanced Level Examination
June 2013

Biology BIO6X

Unit 6X A2 Externally Marked Practical Assignment
Written Test

For submission by 15 May 2013

For this paper you must have:	**Time allowed**
• the Task Sheet 2, including your results and statistical analysis • a ruler with millimetre measurements • a calculator.	• 1 hour 15 minutes
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked.	• The marks for questions are shown in brackets. • You are expected to use a calculator, where appropriate. • The maximum mark for this paper is 33. • You will be marked on your ability to: – organise information clearly – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:

I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

Practical Skills Verification	**Yes** ☐

Signature of teacher ..... Date .....

Section A

These questions are about your investigation into the effect of coloured light on the rate of photosynthesis.

Use your copy of Task Sheet 2, your results and your statistical analysis to answer the questions.

Answer **all** questions in the spaces provided.

6 In step 2, you were told to use the same piece of aquatic plant throughout your Task 2 investigation.
Explain why.

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(1 mark)

7 For how long did you decide to count bubbles?
Explain why you chose this length of time.

Time .....

Explanation .....

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(1 mark)

8 How many repeat counts did you take in each colour of light? Give **two** reasons why you did this number of repeat counts.

Number of repeat counts .....

Reason 1 .....

.....

Reason 2 .....

.....

(2 marks)

A student carried out a similar investigation to yours but also used blue and red solutions. His results are shown in **Figure 5**.

Figure 5

Colour of light	Mean number of bubbles produced by the aquatic plant in one minute (± standard deviation)
White	132 (±3)
Green	24 (±1)
Blue	43 (±2)
Red	73 (±2)

9 Calculate the percentage decrease in the number of bubbles produced in blue light compared with white light.

Answer .....

(2 marks)

The student kept fish and aquatic plants in an aquarium.

10 Suggest **two** reasons why it would be important to include aquatic plants when keeping fish in an aquarium.

1 .....

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2 .....

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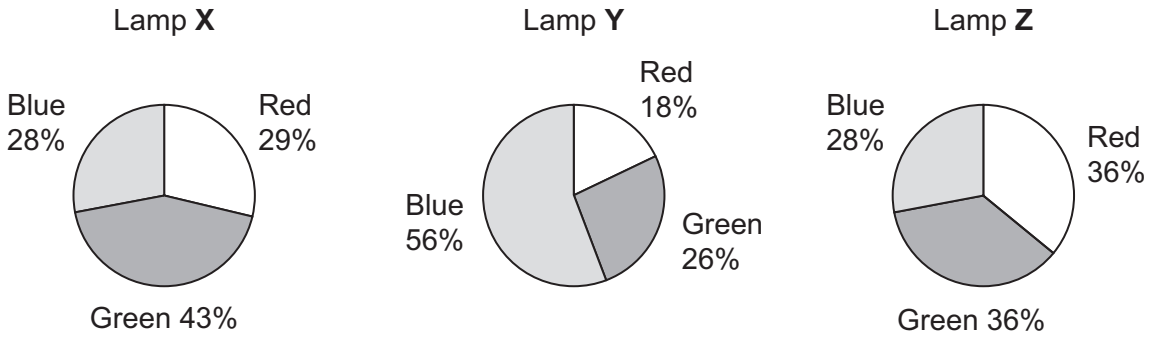
(2 marks)

Turn over ▶

The student wanted to buy new lamps for his aquarium to make sure the aquatic plants would carry out photosynthesis rapidly. He found information about the proportions of different colours of light produced by three types of lamp, **X**, **Y** and **Z**. This information is shown in **Figure 6**.

Figure 6



11 (a) The student used this information and his results from **Figure 5** to choose the lamp to light his aquarium. He chose lamp **Z**.

Suggest why he chose lamp **Z**.

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(1 mark)

11 (b) Other than the proportion of light of different colours, give **one** feature of a lamp that could affect the rate of photosynthesis of the aquatic plants.

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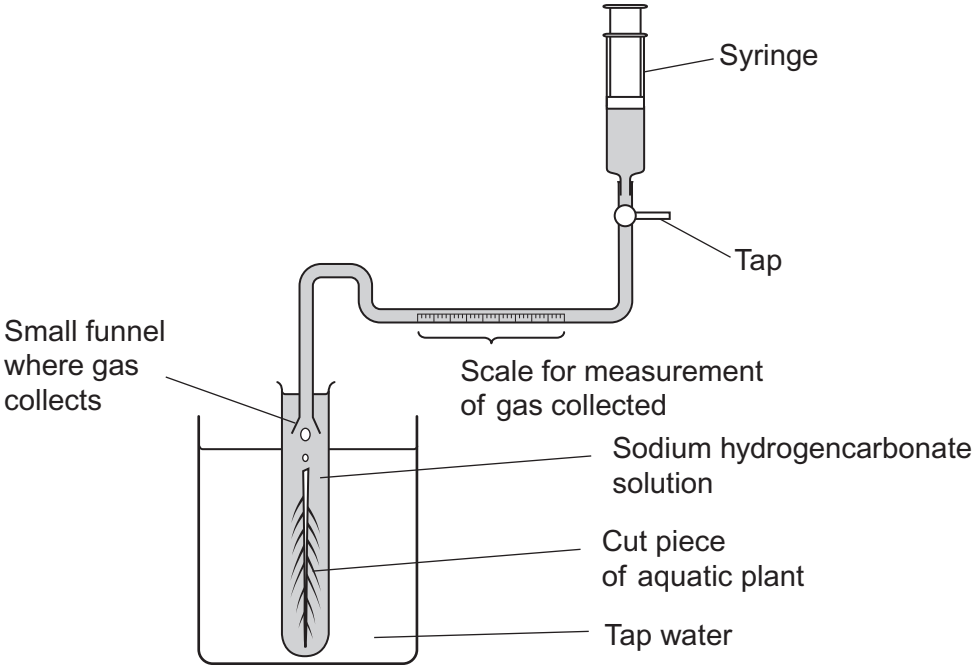
(1 mark)

Another student carried out a similar investigation to yours but she used the apparatus shown in **Figure 7** to measure the gas produced by the aquatic plant.

Figure 7



12 What is the syringe used for?

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(1 mark)

13 Using this apparatus, the student obtained a more accurate measurement of the volume of gas produced than by counting bubbles.
Explain why.

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(2 marks)

13

Resource Sheet

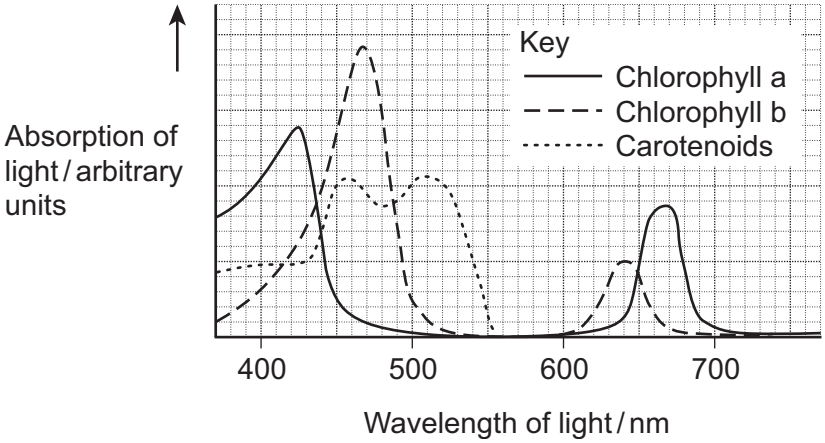
Introduction

Plants have pigments that absorb light energy for photosynthesis. These pigments include two types of chlorophyll and a group of pigments known as carotenoids. Different species of plant contain different amounts of these pigments. The pigments that each plant species has are adaptations to where and how they live; their ecological niche.

Resource A

Figure 8 shows the absorption of light of different wavelengths by chlorophyll a, chlorophyll b and carotenoids.

Figure 8

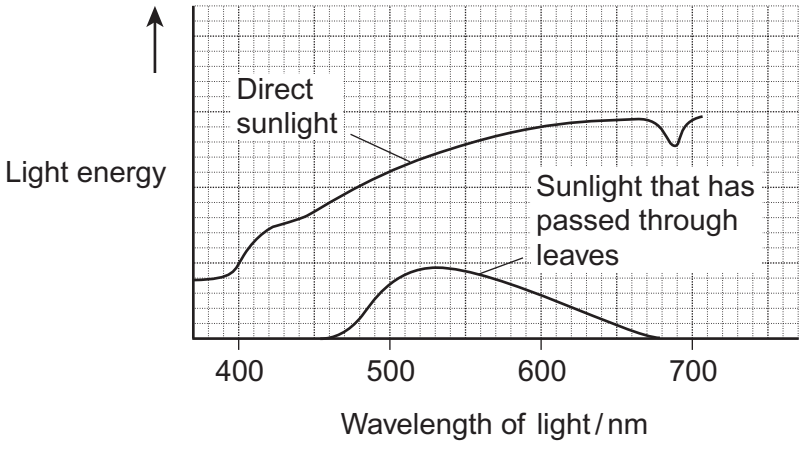


A scientist investigated the energy in light of different wavelengths reaching the ground in a forest. She measured the energy in

- direct sunlight
- sunlight that had passed through the leaves of trees.

Figure 9 shows her results.

Figure 9



Resource B

Beech trees have two types of leaves called sun leaves and shade leaves. Sun leaves grow on branches exposed to direct sunlight, shade leaves grow on branches exposed to light that has passed through leaves. An ecologist collected sun leaves and shade leaves from beech trees and determined the mean mass of each photosynthetic pigment in both types of leaf. His results are shown in **Figure 10**.

Figure 10

Photosynthetic pigment	Mean mass of each pigment per m^2 of leaf area / µg (± standard deviation)	
	Sun leaves	Shade leaves
Chlorophyll a	299.3 (± 2.1)	288.9 (± 0.1)
Chlorophyll b	90.7 (± 2.1)	111.1 (± 0.1)
Carotenoids	0.10 (± 0.01)	0.07 (± 0.01)

Turn over for the next question

Section B

Use the information in the **Resource Sheet** and your own knowledge to answer the questions.

Answer **all** questions in the spaces provided.

Use **Resource A** to answer **Questions 14** to **16**.

14 Use **Figure 8** to describe the absorption of light of different wavelengths by chlorophyll a.

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(2 marks)

15 Few species of plant can live below large trees in a forest.
Use the information in **Figure 8** and **Figure 9** to suggest why.

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(3 marks)

(Extra space) .....

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16 In leaves at the top of trees in a forest, carbon dioxide is often the limiting factor for photosynthesis.
Use your knowledge of photosynthesis to suggest and explain **one** reason why.

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(2 marks)

Use **Resource B** to answer **Questions 17** to **20**.

17 Describe how you would present the data in **Figure 10** as a graph.

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(2 marks)

18 The ecologist collected shade leaves at random from a branch.
Suggest a method he could have used to collect shade leaves at random from a branch.

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(2 marks)

Turn over ▶

19 The ecologist concluded that there is a significant difference between the amounts of chlorophyll b in sun leaves and shade leaves of beech trees.

Do you agree with this conclusion?

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(2 marks)

20 Each type of chlorophyll is produced by a specific enzyme-controlled pathway. Use this information to suggest how the same beech tree can produce more chlorophyll b in some leaf cells than others.

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(2 marks)

Use both **Resource A** and **Resource B** to answer **Questions 21** and **22**.

21 It is an advantage to beech trees to produce more chlorophyll b in the shade leaves.

Suggest and explain why.

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(2 marks)

22 There are two hypotheses about the advantage to plants of producing carotenoids.

Hypothesis 1

Carotenoids help shade leaves to absorb more light of wavelengths 480 nm to 520 nm for photosynthesis.

Hypothesis 2

Carotenoids prevent damage to chlorophyll from very bright light.

22 (a) Which hypothesis do the data provided on the resource sheet support?

Explain your answer.

Hypothesis .....

Explanation .....

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(2 marks)

Question 22 continues on the next page

22 (b) Suggest **one** other piece of experimental evidence you would need in order to be more confident about drawing your conclusion in Question **22(a)**.

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(1 mark)

20

END OF QUESTIONS