Q1. Scientists studied the rate of carbon dioxide uptake by grape plant leaves. Grape leaves have stomata on the lower surface but no stomata on the upper surface.

The scientists recorded the carbon dioxide uptake by grape leaves with three different treatments:

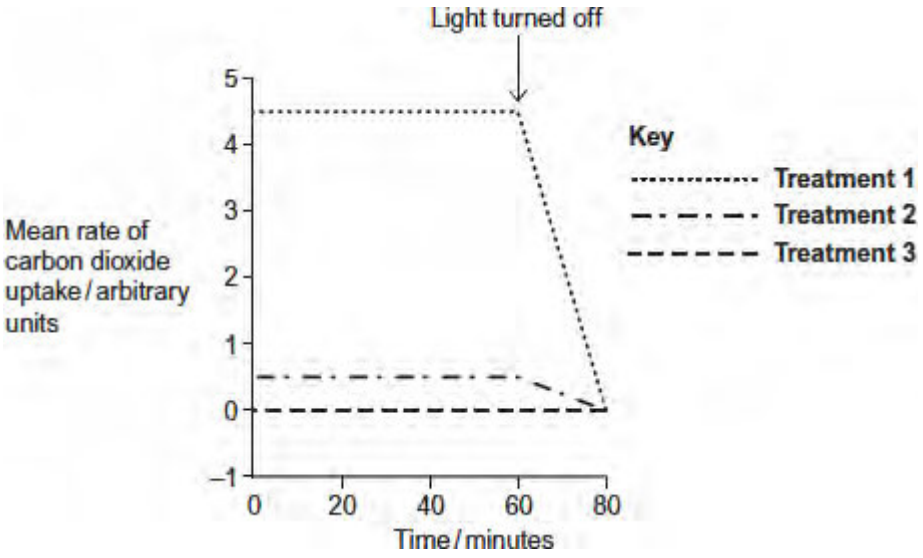
Treatment 1 − No air-sealing grease was applied to either surface of the leaf.

Treatment 2 − The lower surface of the leaf was covered in air-sealing grease that prevents gas exchange.

Treatment 3 − Both the lower surface and the upper surface of the leaf were covered in air–sealing grease that prevents gas exchange.

The scientists measured the rate of carbon dioxide uptake by each leaf for 60 minutes in light and then for 20 minutes in the dark.

The scientists' results are shown in the diagram below.



(a) Suggest the purpose of each of the three leaf treatments.

Treatment 1 .....

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Treatment 2 .....

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Treatment 3 .....

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(3)

(b) (i) Describe the results shown for **Treatment 1**.

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(2)

(ii) The stomata close when the light is turned off.

Explain the advantage of this to the plant.

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(2)

(c) (i) **Treatment 2** shows that even when the lower surface of the leaf is sealed there is still some uptake of carbon dioxide.

Suggest how this uptake of carbon dioxide continues.

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(1)

(ii) In both **Treatment 1** and **Treatment 2**, the uptake of carbon dioxide falls to zero when the light is turned off.

Explain why.

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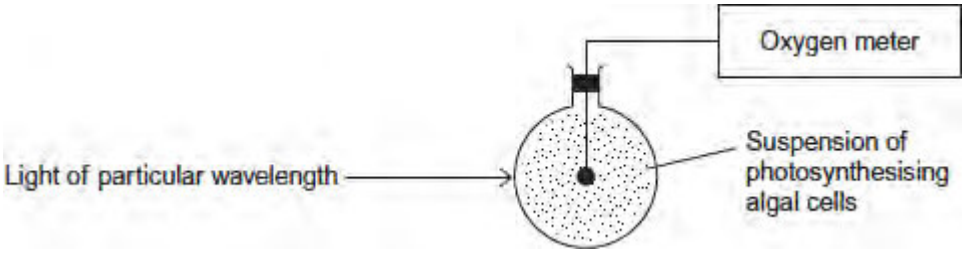
(2)

(Total 10 marks)

Q2. A student investigated the effect of different wavelengths of light on the rate of photosynthesis. She used the apparatus shown in **Figure 1**.

Figure 1



(a) What measurements should the student have taken to determine the rate of photosynthesis?

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(1)

(b) Other than temperature and pH, give **two** factors which should be kept constant during this investigation.

1 .....

2 .....

(2)

(c) The student did **not** use a buffer to maintain the pH of the solution.
Explain what would happen to the pH of the solution during this investigation.

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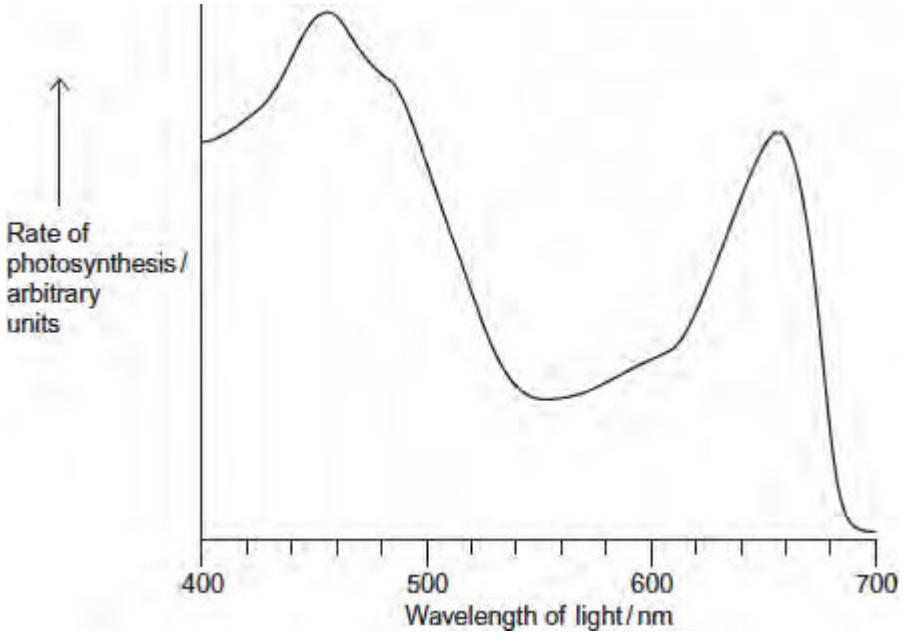
(2)

(d) **Figure 2** shows the student's results.

Figure 2



Suggest and explain why the rate of photosynthesis was low between 525 nm and 575 nm wavelengths of light.

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[Extra space] .....

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(2)
(Total 7 marks)

Q3.(a) On islands in the Caribbean, there are almost 150 species of lizards belonging to the genus *Anolis*. Scientists believe that these species evolved from two species found on mainland USA. Explain how the Caribbean species could have evolved.

(6)

(b) *Anolis sagrei* is a species of lizard that is found on some of the smallest Caribbean islands. Describe how you could use the mark-release-recapture method to estimate the number of *Anolis sagrei* on one of these islands.

(4)

(c) Large areas of tropical forest are still found on some Caribbean islands. The concentration of carbon dioxide in the air of these forests changes over a period of 24 hours and at different heights above ground.

Use your knowledge of photosynthesis and respiration to describe and explain how the concentration of carbon dioxide in the air changes:

- over a period of 24 hours
- at different heights above ground.

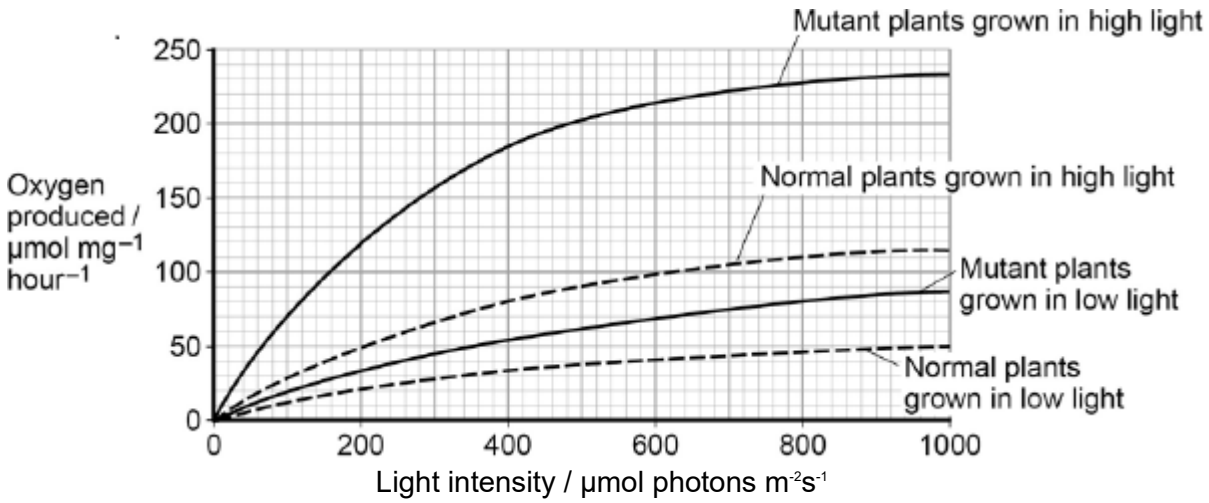
(5)
(Total 15 marks)

Q4. Chloroplasts contain chlorophyll a and chlorophyll b. Scientists found tobacco plants with a mutation that caused them to make more chlorophyll b than normal tobacco plants. They investigated the effect of this mutation on the rate of photosynthesis.

The scientists carried out the following investigation.

- They grew normal and mutant tobacco plants. They grew some of each in low light intensity and grew others in high light intensity.
- They isolated samples of chloroplasts from mature plants of both types.
- Finally, they measured oxygen production by the chloroplasts they had isolated from the plants.

The figure below shows the scientists' results.



(a) Explain why the scientists measured the rate of production of oxygen in this investigation.

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(2)

In each trial, the scientists collected oxygen for 15 minutes.

(b) Calculate the difference in the oxygen produced by the chloroplasts from mutant plants grown in low and high light intensities at a light intensity of 500 µmol photons m^{-2} s^{-1}.

Show your working.

Difference ..... μmol O_2 mg^{-1} $hour^{-1}$

(2)

(c) The scientists suggested that mutant plants producing more chlorophyll b would grow faster than normal plants in all light intensities.

Explain how these data support this suggestion.

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(Extra space) .....

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(4)
(Total 8 marks)

Q5. Farmland previously used for growing crops was left for 30 years and developed into woodland. During this period, ecologists recorded an increase in the diversity of birds in the area.

(a) Name the process that resulted in the development of woodland from farmland.

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(1)

(b) Explain the increase in the diversity of birds as the woodland developed.

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(Extra space) .....

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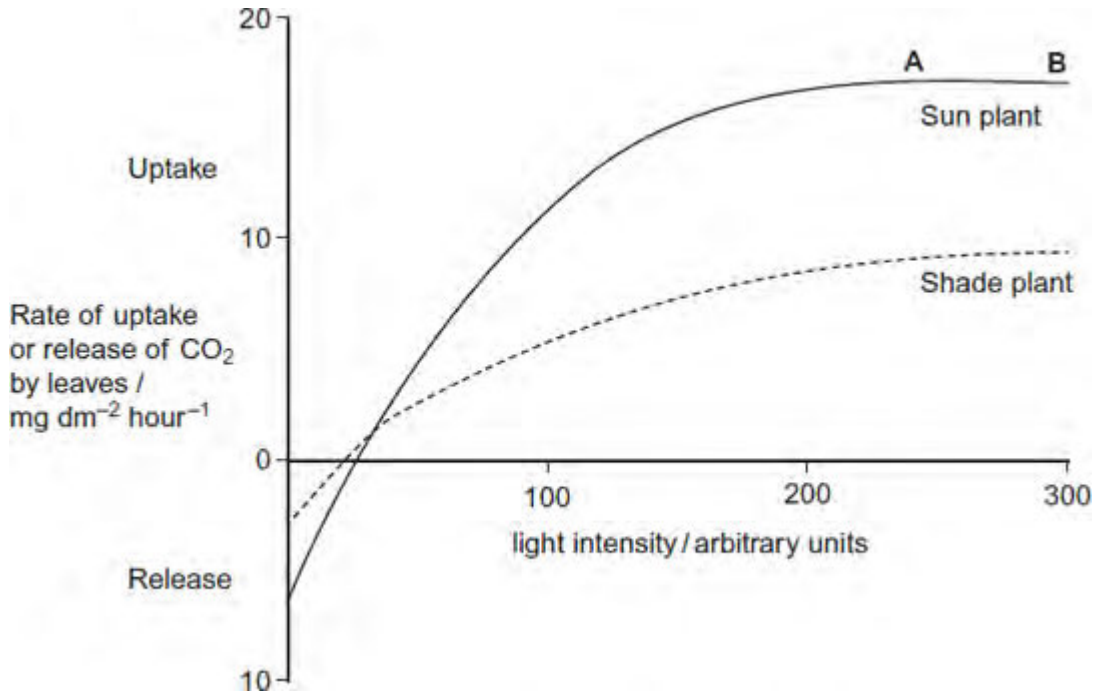
(3)

(c) The ecologists also investigated photosynthesis in two species of plant found in the woodland. One of the species was adapted to growing in bright sunlight (sun plant) and the other was adapted to growing in the shade (shade plant). The ecologists' results are shown in the figure below.



(i) Give **two** factors which could be limiting the rate of photosynthesis in the sun plant between points **A** and **B** on the figure.

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2.....

(1)

(ii) Explain why CO_2 uptake is a measure of net productivity.

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(Extra space) .....

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(1)

(iii) Use the information in the figure to explain how the shade plant is better adapted than the sun plant to growing at low light intensities.

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(Extra space) .....

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(2)

(Total 8 marks)