

8.3 Photosynthesis

Question Paper

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|------------|--|
| Course | DP IB Biology |
| Section | 8. Metabolism, Cell Respiration & Photosynthesis (HL Only) |
| Topic | 8.3 Photosynthesis |
| Difficulty | Hard |

Time allowed: 70
Score: /58
Percentage: /100

Question 1a

a)

Explain why the light independent reactions of photosynthesis stop in the absence of light.

[2 marks]

[2 marks]

Question 1b

b)

Some species of bacteria that live on the ocean floor do not have access to light for photosynthesis. Instead, they use the process of chemosynthesis to make glucose using energy stored in substances such as methane, hydrogen sulfide (H₂S) and carbon dioxide. A simplified equation of one such reaction is shown below.



Use your knowledge of photosynthesis to suggest what hydrogen sulfide is used for in the process of chemosynthesis.

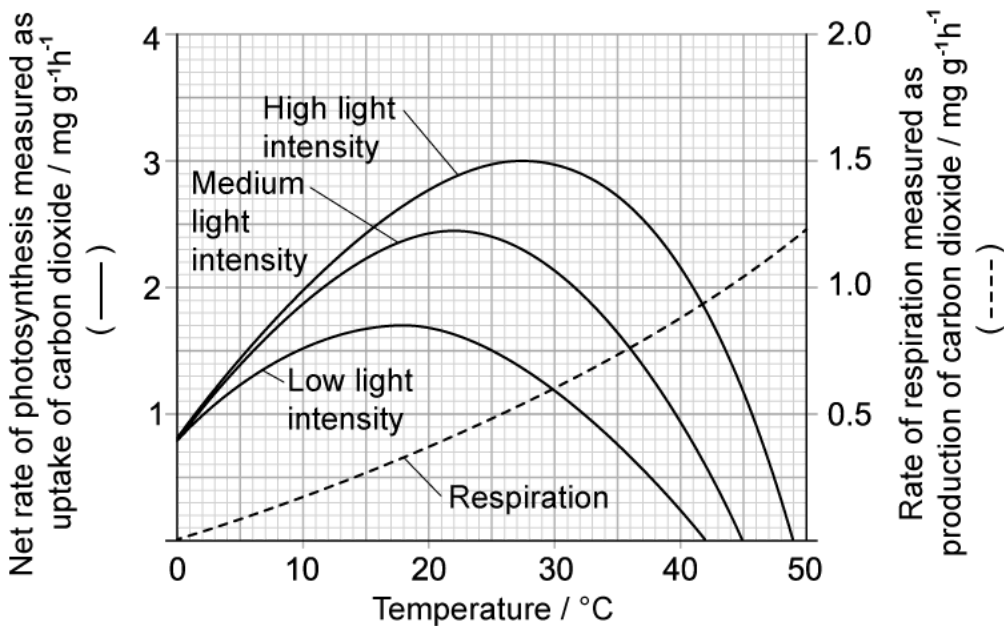
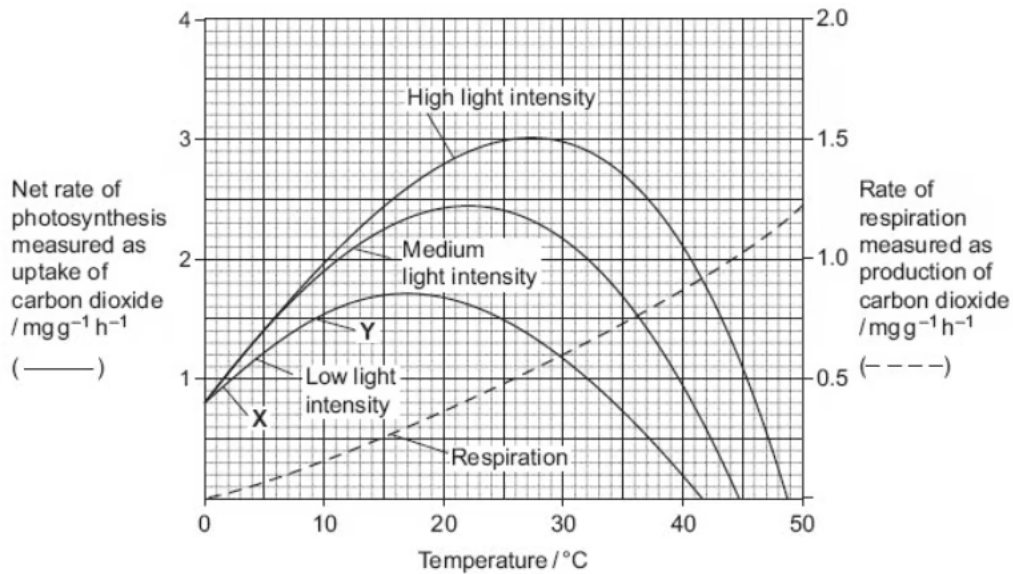
[3 marks]

[3 marks]

Question 1c

c)
 The rate of photosynthesis can be expressed as either gross or net rates. Gross photosynthesis is the total rate of carbon fixation (reduction of CO₂) without considering that some of the CO₂ is lost in respiration. Net photosynthesis is the carbon fixation rate minus the rate of CO₂ loss in respiration.

The graph below shows the effect of temperature on the net rate of photosynthesis at three different light intensities and the effect of temperature on the rate of respiration.



Note to illustrators: Please remove the letters X, Y and Z from the graph above.

Use the graph to calculate the gross rate of photosynthesis at 15°C and low light intensity.

[1 mark]

[1 mark]

Question 1d

d)

The average global temperature is 14°C . Scientists predict that over the course of the next 100 years, the average temperature could increase by up to 4°C . It is also predicted to become cloudier in many regions.

Use the graph to describe and explain how these changes are likely to affect the growth of plants.

[3 marks]

[3 marks]

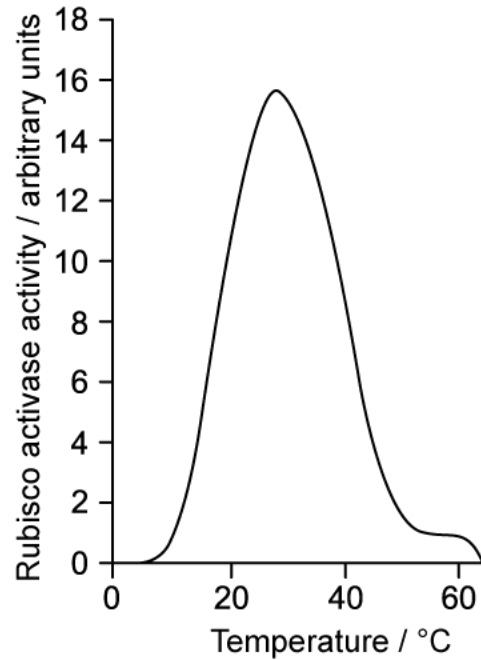
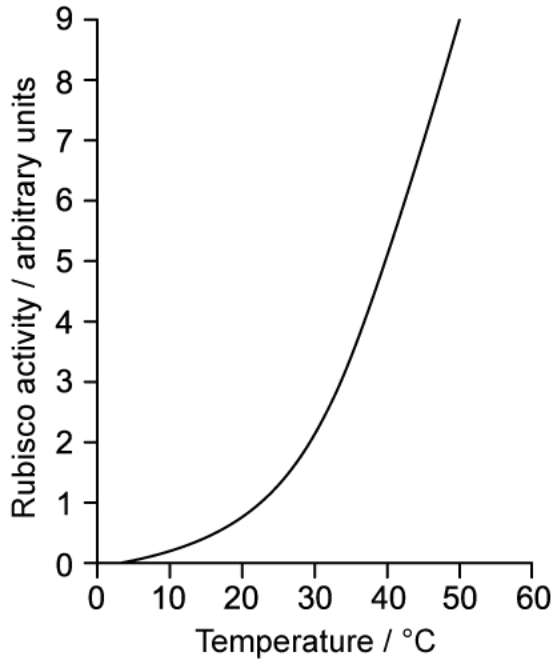
Question 2a

a)
 Researchers investigated the activity of two enzymes isolated from the leaf cells of lavender plants.

The two enzymes were:

- Rubisco
- Rubisco activase

The results of the investigation are shown in the graphs below.



The scientists concluded that heat stress reduces the activity of rubisco in plant leaves by affecting rubisco activase.

Use the data to evaluate their conclusion.

[4 marks]

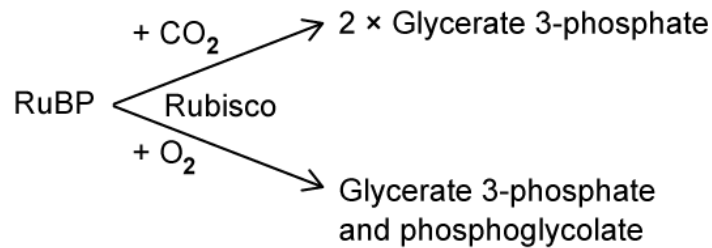
[4 marks]

Question 2b

b)

The enzyme rubisco catalyses the reaction between RuBP and carbon dioxide to form two molecules of glycerate-3-phosphate (GP). Rubisco can also catalyse a reaction between RuBP and oxygen to form one molecule of GP and one molecule of phosphoglycolate.

The reactions are shown in the diagram below.



Use the diagram to deduce the number of carbon atoms in one molecule of phosphoglycolate.

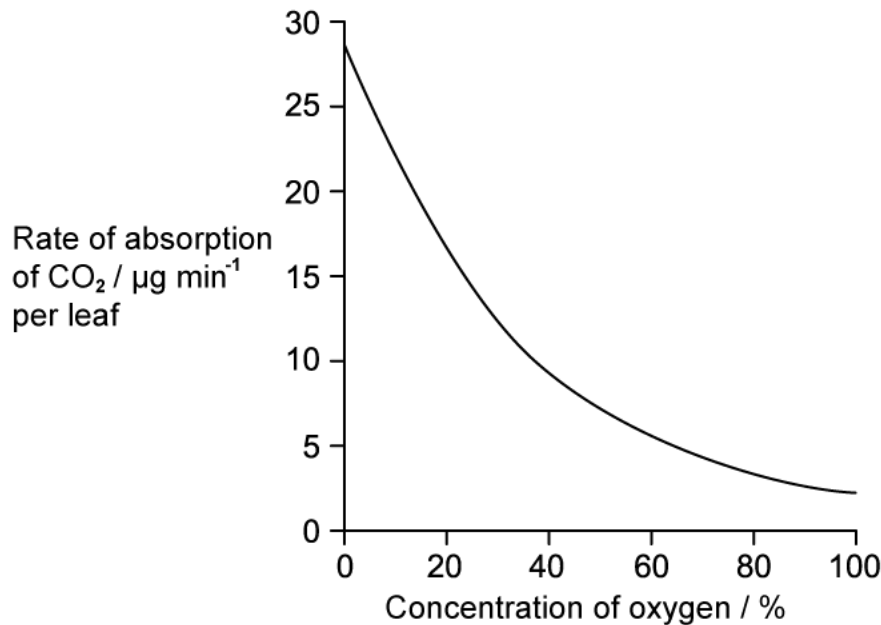
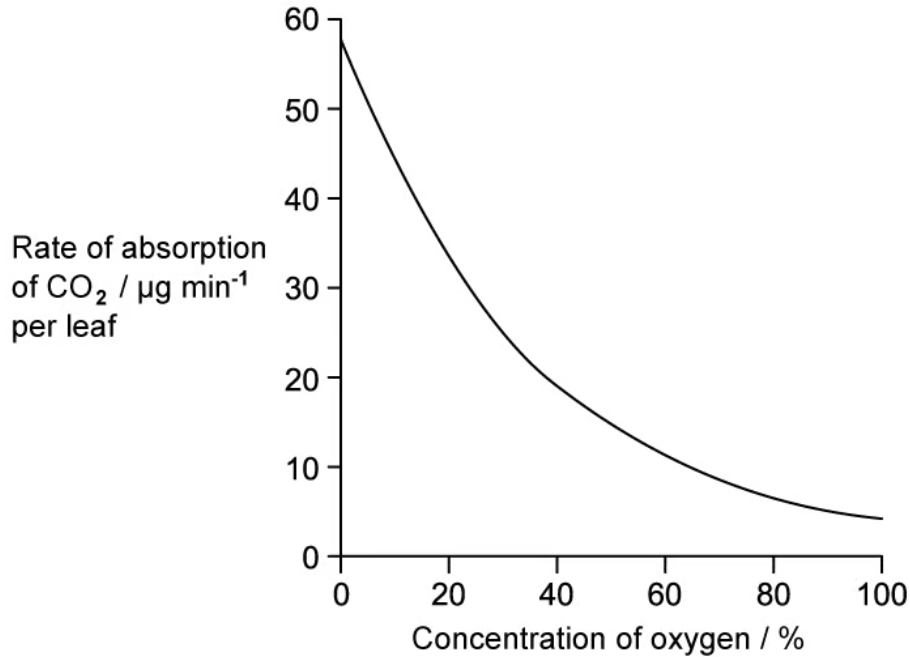
[1 mark]

[1 mark]

Question 2c

c)

The scientists investigated the effect oxygen concentration had on the absorption of carbon dioxide in leaves from tomato plants. The graph below shows their results.



Graphic designer: Please change the y axis numbers to increase in 5s not 10s and go up to 30 instead of 60.

Explain the results in the graph above using the diagram and information from part b) of the question.

[2 marks]

[2 marks]

Question 2d

d)

Use all the information provided and your knowledge of the light-independent reaction to explain why the yield from tomato plants decreases at higher concentrations of oxygen. Note: Phosphoglycolate is not used in the light-independent reaction.

[3 marks]

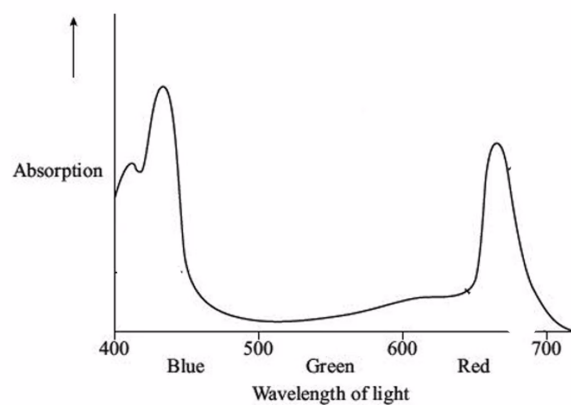
[3 marks]

Question 3a

a)

Some scientists were investigating photosynthesis in seaweed. During their investigation, they applied lights of different wavelengths to study the amount of light absorbed by the seaweed species.

Their results can be seen in the graph below.



State, with a reason, the types of pigments found in these species of seaweed.

[1 mark]

[1 mark]

Question 3b

b)

The scientists also measured the rate of the light dependent reactions in the seaweed at each of the different wavelengths.

| Species | Mean rate of photosynthesis / arbitrary units | |
|---------|---|---------------------|
| | Lamp X 400 – 700 nm | Lamp Y 430 nm |
| A | 1250.3 (\pm 115.6) | 920.2 (\pm 95.1) |
| B | 290.4 (\pm 55.6) | 276.6 (\pm 69.6) |

Suggest how the scientists measured the rate of the light dependent reactions.

[2 marks]

[2 marks]

Question 3c

c)

The scientists repeated the investigation twice more under the following conditions

1. They increased light intensity from lamps X and Y
2. They increased the temperature of the investigation from 15 °C to 20 °C.

Discuss how these changes may affect the amount of oxygen produced by the seaweed

[6 marks]

[6 marks]

Question 3d

d)

The scientists concluded that both species of seaweed showed increased rates of photosynthesis under lamp X compared to lamp Y.

Evaluate this conclusion.

[2 marks]

[2 marks]

Question 4a

a)

'Weed wonder'

is a weed killer designed to inhibit plastoquinone protein in chloroplasts of weeds.

Explain how this would affect the growth of weeds.

[5 marks]

[5 marks]

Question 4b

b)

Compare and contrast the processes that occur in the electron transport chain (ETC) of the light dependent reaction with the electron transport chain in respiration.

[6 marks]**[6 marks]**

Question 4c

c)

Oxidation and reduction are key to the metabolic pathways seen in photosynthesis.

Complete the table to indicate which substances are oxidised and which are reduced during the stages of photosynthesis.

| Stage | Substance | Oxidised / reduced |
|-------------------|----------------------------|--------------------|
| Light-dependent | NADP | |
| | PSII after photoexcitation | |
| Light-independent | GP | |
| | NADPH | |

[2 marks]

[2 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

a)

The concentrations of carbon dioxide in the air at different heights above ground in a forest changes over a period of 24 hours.

Use your knowledge of photosynthesis to describe and explain these changes. You can assume there is no air movement through wind throughout the 24 hour period.

[5 marks]

[5 marks]

Question 5b

b)

Certain types of ultraviolet radiation may induce the production of ATP in isolated plant cells by interacting with electrons found in photosystems.

Use your knowledge of phosphorylation to explain how.

[5 marks]**[5 marks]****Question 5c**

c)

Water absorbed by plants at the roots is carried to the leaves to be used in photosynthesis.

Explain the role of water in photosynthesis.

[5 marks]**[5 marks]**

