8.3 Photosynthesis

Question Paper

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

Time allowed: 60

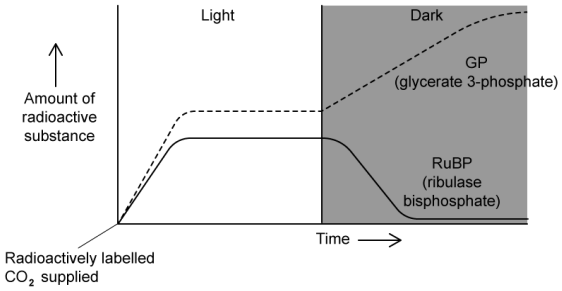
Score: /48

Percentage: /100

Question 1a

a)

An experiment using radioactive carbon was carried out by scientists to investigate the Calvin Cycle. The algae *Chlorella* was exposed to radioactive carbon for different amounts of time. The algae was then analysed for radioactive compounds. The graph below shows the results.



Explain the changes in the amount of radioactive substances in the dark.

[3 marks]

Question 1b

b)

Radioactive GP (glycerate 3–phosphate) was detected more rapidly than radioactive RuBP (ribulose bisphosphate).

Use your knowledge of the Calvin cycle to explain this finding.

[2 marks]

Question 1c

c)

Melvin Calvin carried out similar experiments in the 1950s. At the time his approaches were novel and only possible because of advances in apparatus and techniques.

Describe the techniques, and their purpose, used by Calvin that allowed him to identify the compounds involved in the Calvin cycle.

[3 marks]

Question 2a

a)
When plants are exposed to extremely high or low temperatures for a continued period of time, they are put under a lot of stress. This stress greatly impacts the rate of photosynthesis, in particular the light-dependent reaction of photosynthesis.

Explain why extreme cold leads to a decrease in the light-independent reaction.

[3 marks]

Question 2b

b)
State the precise location of light-independent reactions in photosynthetic plants.

[1 mark]

Question 2c

c)
Extreme cold can also cause a decrease in rubisco activity.

Explain why a decrease in the activity of the enzyme rubisco limits the rate of photosynthesis.

[2 marks]

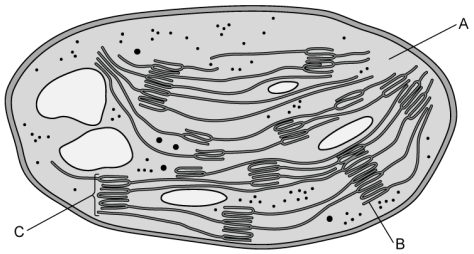
Question 2d

d)
Describe the exact role of ribulose bisphosphate (RuBP) in the Calvin cycle.

[2 marks]

Question 3a

a)
The diagram below shows a diagram of a chloroplast.



Identify the structures of a chloroplast labelled **A–C** in the diagram.

[3 marks]

Question 3b

b)
Describe the adaptations of structures **A** and **B** from the diagram in part a).

[2 marks]

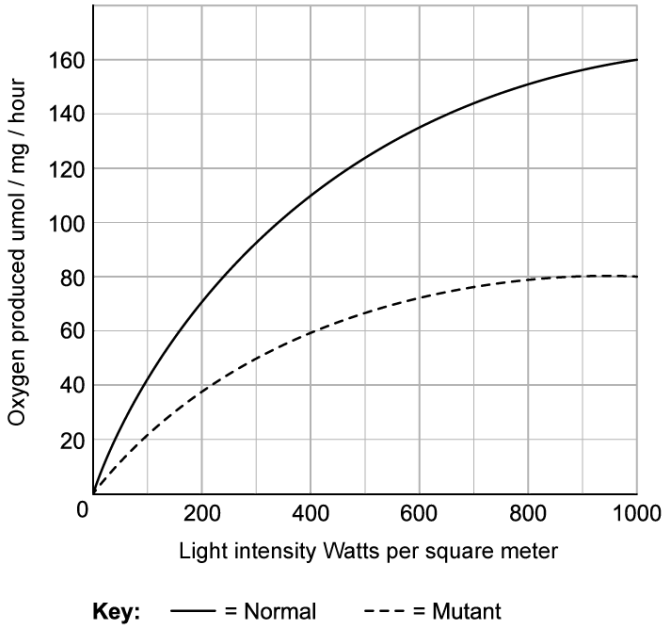
Question 3c

c)
Plants can contain more than one type of chlorophyll, a and b. Scientists grew plants that contained a mutant version of chlorophyll a. They investigated the effect of this mutation on the rate of photosynthesis.

The scientists

- Grew the mutant and normal plants in a range of light intensities
- Isolated the chloroplasts from both types of plants
- Measured the oxygen produced by the chloroplasts over a period of 20 minutes

Their results are shown in the graph below:



Explain why the scientists used the oxygen produced as a measure of the rate of photosynthesis.

[2 marks]

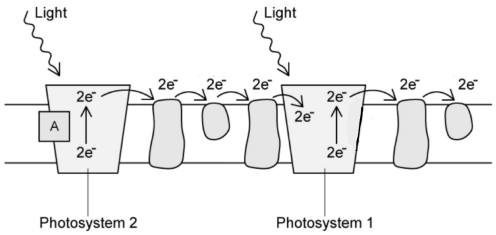
Question 3d

d)
Use the graph to calculate the difference in oxygen produced by the chloroplasts from normal plants compared to the mutant plants at a light intensity of 400 Watts/m².

[2 marks]

Question 4a

a)
The diagram below shows a representation of some of the reactions taking place during the light dependent reactions of photosynthesis.



Explain the process that occurs at label **A**.

[3 marks]

Question 4b

b)
Describe how the protein ferredoxin is involved in the reduction of NADP during the light dependent reaction.

[3 marks]

Question 4c

c)
The diagram from part a) shows the loss of electrons from photosystem 2, but does not show how these electrons are replaced.

State and explain the source of the electrons that replace those lost at stage **A**.

[2 marks]

Question 5a

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

a)
Crops absorb and use light energy for the production of photosynthetic products.

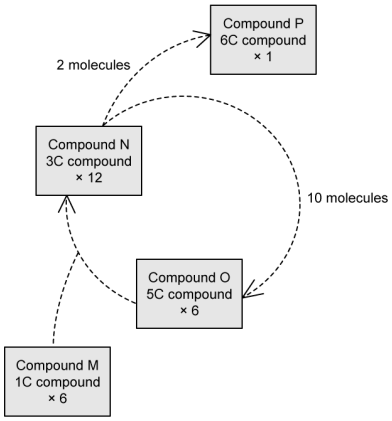
Describe how light energy is used by crop plants during the light-dependent reaction.

[5 marks]

Question 5b

b)

The diagram below depicts the light-independent reactions of photosynthesis.



Describe the mechanism of these reactions and explain how they allow for the continuous synthesis of 6-carbon sugars.

[7 marks]

Question 5c

c)

Explain the role of protons in the light dependent reaction of photosynthesis.

[3 marks]