



B4F Bioenergetics: Foundation Tier Practice

AQA 8461 · Calculator allowed · about 75 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

1 Plants make food by photosynthesis.

(a) Define the term photosynthesis.

(1)

(Total for Question 1 is 1 mark)

2 Photosynthesis happens inside a special part of a plant cell.

(a) Name the organelle where most photosynthesis occurs.

(1)

(Total for Question 2 is 1 mark)

3 Raw materials for photosynthesis are taken from the air and the soil.

(a) State two raw materials (reactants) needed for photosynthesis.

(2)

(Total for Question 3 is 2 marks)

4 Photosynthesis makes substances that help plants grow.

(a) State two products of photosynthesis.

(2)

(Total for Question 4 is 2 marks)

5 Write a simple word equation for photosynthesis.

(a) Write the word equation for photosynthesis. (2)

(Total for Question 5 is 2 marks)

6 Chlorophyll is important for capturing light.

(a) State the role of chlorophyll in photosynthesis. (1)

(Total for Question 6 is 1 mark)

7 Light is one factor that affects the rate of photosynthesis.

(a) Explain why a plant's rate of photosynthesis falls if it is kept in the dark. (2)

(Total for Question 7 is 2 marks)

8 A student measured the increase in mass of a potted plant after two weeks under bright light. The mass increased by 8.0 g over 4 days when conditions were stable.

(a) Calculate the average increase in mass per day in grams per day. Show your working. (2)

(Total for Question 8 is 2 marks)

9 Carbon dioxide concentration usually affects photosynthesis.

(a) Predict what will happen to the rate of photosynthesis if the carbon dioxide concentration around a plant is increased (all other conditions unchanged). (1)

(Total for Question 9 is 1 mark)

10 Which factor would be limiting if a plant is grown in dim light but with plenty of water and carbon dioxide?

- (a) Name the limiting factor in this situation. (1)

(Total for Question 10 is 1 mark)

11 A required practical uses pondweed to measure oxygen production as a measure of photosynthesis. The apparatus includes a cut piece of pondweed, a water-filled tube to collect gas bubbles and a lamp at a fixed distance.

- (a) Give two variables that should be kept the same (controlled) during this investigation. (2)

(Total for Question 11 is 2 marks)

12 During the pondweed experiment, a student notices the number of bubbles varies a lot between repeats.

- (a) Suggest one improvement to reduce random variation in the number of bubbles counted. (1)

(Total for Question 12 is 1 mark)

13 Respiration also involves gases.

- (a) State which gas is used in aerobic respiration and which gas is produced. (1)

(Total for Question 13 is 1 mark)

14 A plant absorbs 30 J of light energy and stores 9 J as chemical energy in glucose during photosynthesis.

- (a) Calculate the efficiency of the plant at storing light energy as chemical energy. (2)
Show your working and give the answer as a percentage.

(Total for Question 14 is 2 marks)

- 15** A student recorded bubbles of oxygen produced by pondweed at different light intensities. The data are: light intensity 20 → 4 bubbles per minute; 40 → 8; 60 → 12; 80 → 16.
- (a)** Estimate the number of bubbles per minute at light intensity 50 by interpolation. (2)
Show a short calculation.

(Total for Question 15 is 2 marks)

- 16** Farmers use methods to increase photosynthesis in greenhouses to raise crop yield. Explain how a farmer could increase the rate of photosynthesis in a greenhouse to increase crop yield. In your answer include at least three different changes the farmer could make, how each change increases the rate of photosynthesis, and one reason why a farmer might not use a particular change.

(Total for Question 16 is 6 marks)

Mark scheme · B4F Bioenergetics: Foundation Tier Practice

Question 1

- (a) **B1** the process by which plants use light energy to make glucose from carbon dioxide and water, oe
- (a) **Answer: The process by which plants use light energy to make glucose from carbon dioxide and water.**

Question 2

- (a) **B1** chloroplast
- (a) **Answer: Chloroplast**

Question 3

- (a) **B1** carbon dioxide
- (a) **B1** water
- (a) **Answer: Carbon dioxide and water.**

Question 4

- (a) **B1** glucose
- (a) **B1** oxygen
- (a) **Answer: Glucose and oxygen.**

Question 5

- (a) **M1** gives reactants and products in the correct order with light energy present
- (a) **A1** carbon dioxide + water → glucose + oxygen
- (a) **Answer: carbon dioxide + water → glucose + oxygen**

Question 6

- (a) **B1** absorbs light energy (to drive photosynthesis)
- (a) **Answer: Absorbs light energy for photosynthesis.**

Question 7

- (a) **M1** states that less light means less energy available for the reactions
- (a) **A1** rate falls because the light-dependent stage cannot proceed as quickly, so less glucose and oxygen are produced, oe
- (a) **Answer: With less light there is less energy for the light-dependent reactions, so the rate of photosynthesis falls and less glucose and oxygen are produced.**

Question 8

- (a) **M1** substitutes: rate = 8.0 g / 4 days
- (a) **A1** 2.0 g per day
- (a) **Answer: 2.0 g per day**

Question 9

- (a) **B1** rate will increase (until another factor becomes limiting)
- (a) **Answer: The rate will increase, until another factor becomes limiting.**

Question 10

- (a) **B1** light (intensity)
- (a) **Answer: Light intensity**

Question 11

- (a) **B1** temperature, oe
- (a) **B1** distance between lamp and pondweed or light intensity (if lamp distance fixed then light intensity), oe
- (a) **Answer: Temperature and distance between lamp and pondweed (light intensity).**

Question 12

- (a) **B1** repeat the measurement more times and take an average, or
- (a) **Answer: Repeat the measurement several times and use the average.**

Question 13

- (a) **B1** oxygen used and carbon dioxide produced, or
- (a) **Answer: Oxygen is used and carbon dioxide is produced.**

Question 14

- (a) **M1** substitutes into efficiency = (useful energy out / total energy in) x 100, i.e. $(9 / 30) \times 100$
- (a) **A1** 30% cao
- (a) **Answer: 30 %**

Question 15

- (a) **M1** uses linear relation: between 40 and 60 intensity the bubbles go from 8 to 12 so slope = $(12-8)/(60-40) = 4/20 = 0.2$ bubbles per intensity unit
- (a) **A1** gives 10 bubbles per minute cao
- (a) **Answer: 10 bubbles per minute**

Question 16

- **Level 3** (5-6): Detailed explanation. Offers at least three valid methods, links each method to how it increases rate of photosynthesis, and gives a valid reason why a method might not be used; explanations are clear and linked to biology terms such as light intensity, carbon dioxide concentration, temperature and limiting factor.
- **Level 2** (3-4): Partial explanation. Describes two or three methods with correct but limited explanation of how they increase photosynthesis and may include one valid limitation or drawback.
- **Level 1** (1-2): Basic statements. Mentions one or two relevant methods with little or no explanation of how they increase photosynthesis and no real evaluation of drawbacks.
- **Indicative content:**
 - Increase light intensity using artificial lamps so more light energy is available to drive photosynthesis; increases rate when light is limiting.
 - Enrich carbon dioxide concentration in the greenhouse so more CO₂ is available as a raw material for photosynthesis; increases rate until another factor is limiting.
 - Raise temperature to the plant's optimum so enzymes involved in photosynthesis work faster; be careful as too high temperature denatures enzymes so there is a limit.
 - Ensure adequate water supply so stomata remain open and water is available as a raw material for photosynthesis; without water photosynthesis stops.
 - Use pest and disease control to keep leaves healthy so photosynthetic surface area is not reduced.
 - Possible drawbacks: cost of electric lighting or CO₂ enrichment; risk of increased disease at higher humidity or temperature; environmental or safety concerns with CO₂ use.