1.19 Photosynthesis: Test Pack

AQA 8464 · Calculator allowed · about 50 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Plants convert light energy into chemical energy by photosynthesis.

(a) Name the gas produced by photosynthesis that is released to the atmosphere. **(1)**

(Total for Question 1 is 1 mark)

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2 Complete the word equation for photosynthesis.

(a) Fill in the missing words: carbon dioxide + water -> + oxygen **(2)**

(Total for Question 2 is 2 marks)

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3 A leaf disc method measures rate qualitatively by observing how long it takes discs to float due to oxygen production. Which variable does the 'time for discs to float' best represent and why?

(a) Name the variable represented and give a brief explanation. **(2)**

(Total for Question 3 is 2 marks)

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4 In the same Elodea experiment, the student kept the lamp brightness the same but changed distance. State one control variable they should have kept the same and suggest how to control it.

(a) Give one control variable, explain how to keep it constant and explain why it must be kept constant. **(3)**

(Total for Question 4 is 3 marks)

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5 A different grower currently produces 45 tonnes of tomatoes per year without carbon dioxide enrichment, selling them at £850 per tonne. Installing a carbon dioxide enrichment system is predicted to increase the yield to 54 tonnes per year. The system would cost £2400 per year to run (this does not include the cost of installing the equipment).

(a) Calculate the percentage increase in yield predicted for the carbon dioxide enrichment system. **(2)**

(b) Calculate the extra revenue (income) per year predicted from the increased yield. **(2)**

(c) Calculate the net financial benefit per year (the extra revenue minus the running cost) of installing the system. **(2)**

(d) The carbon dioxide enrichment system itself costs £15000 to install. Calculate how many years it would take for the net financial benefit to pay back this installation cost. Give your answer to 1 decimal place. **(3)**

(Total for Question 5 is 9 marks)

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6 Photosynthesis and respiration are both described in terms of energy transfer.

(a) State whether photosynthesis is an exothermic or an endothermic reaction. **(1)**

(b) Explain what is meant by describing photosynthesis as an 'endothermic' reaction. **(2)**

(Total for Question 6 is 3 marks)

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7 Plants use the glucose produced by photosynthesis for much more than just releasing energy.

(a) Name the process, other than converting glucose into a storage product, that plant cells mainly use glucose for, to release energy. **(1)**

(b) Much of a plant's glucose is converted into starch for storage. Give one reason why starch is better suited than glucose for storage in plant cells. **(2)**

(c) Name the insoluble carbohydrate, made from glucose, that is used to strengthen plant cell walls. **(1)**

(d) Explain how glucose is used, together with nitrate ions absorbed from the soil, to produce amino acids and then proteins in a plant. **(2)**

(e) Name one other substance, used for storage in some seeds, that glucose can be converted into. **(1)**

(Total for Question 7 is 7 marks)

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8 A group investigated the effect of light intensity on the rate of photosynthesis in an aquatic plant, keeping carbon dioxide concentration and temperature constant. Their results are shown in the table below.

Light intensity (arbitrary units): 0, 20, 40, 60, 80, 100
Rate of photosynthesis (arbitrary units): 0, 8, 15, 20, 20, 20

Light intensity (arbitrary units)	Rate of photosynthesis (arbitrary units)
0	0
20	8
40	15
60	20
80	20
100	20

(a) Describe the relationship between light intensity and rate of photosynthesis shown by the data. **(2)**

(b) Explain why the rate of photosynthesis stops increasing once light intensity rises above 60 units, even though light intensity continues to increase. **(2)**

(c) Suggest one change to the experimental conditions that could increase the rate of photosynthesis beyond 20 units, at a light intensity of 100. **(2)**

(Total for Question 8 is 6 marks)

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9 A farmer wants to increase crop yield in a greenhouse. Which two environmental factors could be controlled to increase the rate of photosynthesis? Give one practical method for controlling each factor.

(a) Give two factors and one method for each to control them in a greenhouse. **(3)**

(Total for Question 9 is 3 marks)

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Mark scheme · 1.19 Photosynthesis: Test Pack

Question 1

(a) oxygen cao **B1**

(a) Answer: Oxygen

Question 2

(a) glucose or sugar **B1**

(a) oxygen cao **B1**

(a) Answer: Glucose and oxygen

Question 3

(a) identifies that time to float is inversely related to rate of photosynthesis (i.e. a shorter time means a higher rate) **M1**

(a) explains that oxygen produced fills the discs and makes them buoyant, so faster oxygen production gives shorter float time, oe **A1**

(a) Answer: Time to float, which is inversely related to rate of photosynthesis: a shorter time means a higher rate because more oxygen is produced faster, making discs buoyant.

Question 4

(a) identifies a valid control variable such as temperature, carbon dioxide concentration, or volume of water **M1**

(a) gives a method to keep it constant, e.g. use water at the same temperature or place beaker in a water bath set to a fixed temperature, or add a measured volume of sodium hydrogen carbonate to supply constant CO_2, oe **A1**

(a) makes the link that keeping this variable constant reduces its effect on the rate so results isolate the effect of light distance, oe **B1**

(a) Answer: Example: control temperature by placing the beaker in a water bath at a constant temperature; this keeps temperature constant so rate changes are due to light distance only.

Question 5

(a) (54 - 45) / 45 x 100, oe **M1**

(a) 20% cao **A1**

(a) Answer: 20%

(b) 9 (tonnes) x £850, oe **M1**

(b) £7650 cao **A1**

(b) Answer: £7650

(c) 7650 - 2400 (ft from (b)), oe **M1**

(c) £5250 cao (ft from (b)) **A1**

(c) Answer: £5250

(d) 15000 / their (c), oe **M1**

(d) 15000 / 5250, method correctly shown **M1**

(d) 2.9 years (awrt), cao (ft from (c)) **A1**

(d) Answer: 2.9 years

Question 6

(a) endothermic cao **B1**

(a) Answer: Endothermic.

(b) energy is transferred (taken in) from the environment to the chloroplast/plant, oe **B1**

(b) this light energy is transferred to (stored in) the chemical bonds of the glucose that is produced, oe **B1**

(b) Answer: Energy (light energy) is taken in from the environment, and is transferred to (stored in) the chemical bonds of the glucose produced.

Question 7

(a) (aerobic) respiration cao **B1**

(a) Answer: (Aerobic) respiration.

(b) starch is insoluble, oe **B1**

(b) so it does not dissolve and draw water into the cell by osmosis (does not affect the cell's water potential), or: it is a large, compact molecule that is well suited to storage, oe **B1**

(b) Answer: Starch is insoluble, so (unlike glucose) it does not dissolve and affect the movement of water into the cell by osmosis.

(c) cellulose cao **B1**

(c) Answer: Cellulose.

(d) glucose is combined (reacts) with nitrate ions to produce amino acids, oe **B1**

(d) these amino acids are then used to build proteins, oe **B1**

(d) Answer: Glucose is combined with nitrate ions (absorbed from the soil) to produce amino acids, which are then used to build proteins.

(e) lipids (fats/oils) cao **B1**

(e) Answer: Lipids (fats or oils).

Question 8

(a) as light intensity increases from 0 to 60 units, the rate of photosynthesis increases, oe **B1**

(a) above a light intensity of 60 units, the rate stays constant (levels off / reaches a plateau), oe **B1**

(a) Answer: The rate of photosynthesis increases as light intensity increases from 0 to 60 units, then stays constant (levels off) above 60 units.

(b) above this point, light intensity is no longer the limiting factor, oe **B1**

(b) another factor (e.g. carbon dioxide concentration or temperature) has become the limiting factor instead, oe **B1**

(b) Answer: Above 60 units, light intensity is no longer limiting the rate; another factor (such as carbon dioxide concentration or temperature) has become the limiting factor instead.

(c) increase the carbon dioxide concentration, or increase the temperature (up to the optimum), oe **B1**

(c) because this factor was now limiting the rate, so increasing it would allow the rate of photosynthesis to rise again, oe **B1**

(c) Answer: Increase the carbon dioxide concentration (or increase the temperature, up to the optimum), because one of these factors is now limiting the rate, and increasing it would allow the rate to rise further.

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Question 9

(a) factor: light; method: use artificial lamps or extend lighting hours **B1**

(a) factor: carbon dioxide; method: release measured CO_2 gas or burn hydrocarbon heaters with controlled vents **B1**

(a) factor: temperature; method: use heaters and thermostats to maintain an optimum temperature (accept any two factors with methods, award appropriately) **B1**

(a) Answer: Examples: light - use artificial lamps to increase light intensity; carbon dioxide - add controlled CO_2 enrichment; temperature - use heaters with thermostat to keep optimum temperature.

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