K3E Respiration and Photosynthesis: Depth and Practice

AQA AQA KS3 Biology · Calculator allowed · about 75 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Write down the word equation for photosynthesis.

(1)

2 State the part of a plant cell where photosynthesis happens.

(1)

3 Name the gas produced by plants during photosynthesis that is released into the air.

(1)

4 Describe the role of chlorophyll in photosynthesis. Give two points.

(2)

5 Explain why most leaves are broad and thin. Give two linked reasons relating to photosynthesis.

(2)

6 Write down the word equation for aerobic respiration.

(1)

---

7 A student plans an experiment using a piece of pondweed to investigate how light intensity affects rate of photosynthesis. Identify the independent variable, one suitable dependent variable, and two control variables the student should keep the same.

(3)

---

8 A plant produces 150 units of sugar during a day. It uses 40 units of that sugar for respiration. Calculate how many units of sugar are available for growth and storage.

(2)

---

9 The table shows results from a simple light experiment. Light intensity (arbitrary units): 10, 20, 40, 80. Rate of photosynthesis (bubbles per minute): 2, 4, 8, 10. a) At which intensity does the rate stop doubling each time? b) Calculate the percentage increase in rate from intensity 10 to 20.

(3)

---

10 Explain why very high temperatures can decrease the rate of photosynthesis. Give two linked points.

(2)

11 Suggest two practical ways a gardener could increase the rate of photosynthesis for plants in a greenhouse.

(2)

---

12 State one difference between aerobic and anaerobic respiration in terms of oxygen use and one in terms of products.

(2)

---

13 Name the process by which yeast make alcohol and carbon dioxide when they have no oxygen.

(1)

---

14 A student records oxygen produced by a water plant. The volume of oxygen collected rises from 0.0 ml to 2.4 ml in 6 minutes. Calculate the average rate of oxygen production in ml per minute.

(1)

---

15 In the pondweed bubble experiment, explain two steps the student should take to make the test fair (one sentence each).

(2)

16 Describe how stomata and guard cells help with gas exchange in leaves. Include how they open and close.

(3)

---

17 Design an experiment to compare the effect of different colours of light (red, green, blue, white) on the rate of photosynthesis using common water plants. Your answer should include the key steps you would do, the measurements you would take, the variables you would control and how you would compare results.

(6)

---

18 Evaluate the statement: 'Increasing the light intensity will always increase the rate of photosynthesis.' Give reasons for and against and a concluding sentence.

(4)

---

19 Using the data from question 9 (rates 2 bubbles/min at intensity 10 and 4 bubbles/min at intensity 20), calculate the percentage increase in rate from intensity 10 to 20. Show your working.

(2)

20 Describe three leaf adaptations that help increase the efficiency of photosynthesis. One adaptation per line.

(3)

Mark scheme · K3E Respiration and Photosynthesis: Depth and Practice

Question 1

- **B1** carbon dioxide + water -> glucose + oxygen cao
- Answer: **carbon dioxide + water -> glucose + oxygen**

Question 2

- **B1** chloroplast(s) cao
- Answer: **Chloroplast**

Question 3

- **B1** oxygen cao
- Answer: **Oxygen**

Question 4

- **M1** captures light energy from the Sun (or absorbs light)
- **A1** uses light energy to convert carbon dioxide and water into glucose (production of food) or phrase linking light energy to making glucose
- Answer: **Chlorophyll absorbs light energy; it uses that energy to help make glucose from carbon dioxide and water.**

Question 5

- **M1** large surface area so more light can be absorbed
- **A1** thin so gases (carbon dioxide and oxygen) can diffuse quickly to and from cells (linked reason stated)
- Answer: **Leaves are broad to give a large surface area for absorbing more light and thin so carbon dioxide can diffuse quickly to the photosynthetic cells.**

Question 6

- **B1** glucose + oxygen -> carbon dioxide + water + energy cao
- Answer: **glucose + oxygen -> carbon dioxide + water + energy**

Question 7

- **M1** independent variable = light intensity (or distance of lamp) cao
- **M1** dependent variable = rate of photosynthesis measured by bubbles per minute or volume of oxygen per minute
- **A1** two control variables stated (any two of: temperature, carbon dioxide concentration, type/size of pondweed, volume of water, light colour) both needed
- Answer: **Independent variable: light intensity. Dependent variable: rate of photosynthesis (bubbles per minute or oxygen volume per minute). Controls: keep temperature and carbon dioxide concentration the same (also keep same pondweed piece and water volume).**

Question 8

- **M1** method: 150 - 40
- **A1** 110 units cao
- Answer: **110 units of sugar available for growth and storage (units)**

Question 9

- **M1** a) identify intensity 80 or state between 40 and 80 where doubling stops
- **M1** method for percentage: (4 - 2) / 2 x 100
- **A1** 100% cao
- Answer: **a) At intensity 80 the rate stops doubling. b) 100% increase**

Question 10

- **M1** high temperature can damage or denature enzymes involved in photosynthesis
- **A1** so enzymes work less well and the rate of photosynthesis decreases (linked consequence)
- Answer: **Very high temperatures can denature the enzymes used in photosynthesis, so the enzymes work less well and the rate falls.**

Question 11

- **M1** increase light intensity e.g. use grow lamps or place plants nearer light
- **A1** increase CO2 concentration (e.g. CO2 generator) or keep temperature optimal; either acceptable
- Answer: **Use additional grow lamps or move plants nearer the light; increase carbon dioxide in the greenhouse or keep temperature at an optimum for photosynthesis.**

Question 12

- **M1** aerobic uses oxygen, anaerobic does not
- **A1** aerobic produces carbon dioxide and water and more energy; anaerobic in animals produces lactic acid and in yeast produces alcohol and carbon dioxide
- Answer: **Aerobic respiration uses oxygen while anaerobic does not; aerobic produces carbon dioxide and water and more energy, anaerobic can produce lactic acid (animals) or alcohol and carbon dioxide (yeast).**

Question 13

- **B1** fermentation (or anaerobic respiration) cao
- Answer: **Fermentation (anaerobic respiration)**

Question 14

- **B1** 0.4 ml per minute cao
- Answer: **0.4 ml/minute**

Question 15

- **M1** control temperature by keeping lamp at same distance and using same room or water bath
- **A1** use same length and species of pondweed and same volume of water so biological and volume factors are controlled
- Answer: **Keep the temperature the same (for example keep the lamp at the same distance and do all tests in the same room) and use the same length and species of pondweed in the same volume of water.**

Question 16

- **M1** stomata are small pores on the underside of leaves for gas exchange (CO2 in, O2 out)
- **M1** guard cells surround stomata and change shape to open or close the pore
- **A1** opening happens when guard cells take up water and become turgid, closing when they lose water and become flaccid, controlling gas exchange and water loss
- Answer: **Stomata are pores that let CO2 in and O2 out. Guard cells around each stoma change shape to open or close it. Guard cells open when they take up water and become turgid and close when they lose water, controlling gas exchange and water loss.**

Question 17

- **Level 3** (5-6): Detailed method with repeated fair tests, clear measurements and valid comparison.
- **Level 2** (3-4): Basic method with some control of variables and a suggested way to measure rate, but lacking repeat measures or clear comparison.
- **Level 1** (0-2): Limited ideas, vague method or missing controls and measurements.
- **Indicative content:**
  - use identical lengths of the same water plant (e.g. Elodea) in separate beakers of the same water
  - use coloured filters or LED lamps set to red, green, blue and white; keep light intensity equal by adjusting distance or using a light meter
  - measure rate by counting oxygen bubbles per minute or collect oxygen over time using a syringe or gas syringe to measure volume
  - control variables such as temperature, carbon dioxide concentration, water volume and plant size
  - repeat each colour several times and calculate mean rates; compare means and include simple analysis of which colour gives highest rate and why
  - include safety notes about electrical equipment and avoiding overheating lamps

Question 18

- **M1** for: increasing light increases rate when light is the limiting factor (more energy for photosynthesis)
- **M1** against: only true up to a point because other factors like CO2 concentration and temperature can become limiting
- **M1** against: at very high light or high temperature enzymes may be damaged so rate falls
- **A1** conclusion that increasing light does not always increase rate; it depends on other limiting factors and optimum conditions
- Answer: **Increasing light can increase the rate if light is limiting, but only up to a point; if CO2 or temperature are limiting or if enzymes are damaged by high temperature, the rate will not increase, so the statement is not always true.**

Question 19

- **M1** method (4-2)/2 x 100 or equivalent
- **A1** 100% cao
- Answer: **100% increase**

Question 20

- **B1** broad flat shape to increase surface area
- **B1** thin for short diffusion distance for gases
- **B1** many chloroplasts in palisade cells to absorb more light
- Answer: **Broad flat shape for large surface area; thin so gases diffuse a short distance; many chloroplasts in palisade cells to absorb more light.**