1.3 Respiration and Photosynthesis: Test Pack

Calculator allowed · about 45 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Which two raw materials does a green leaf need for photosynthesis? Choose two.

- ☐ A) Carbon dioxide
- ☐ B) Nitrogen gas
- ☐ C) Water
- ☐ D) Oxygen

2 A pondweed produces 45 cm^3 of oxygen gas in 15 minutes during photosynthesis. Calculate the mean rate of oxygen production in cm^3 per minute.

(2)

3 Give one reason why counting bubbles is not always a reliable way to measure the rate of photosynthesis, and suggest a better method.

(2)

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4 A gardener measures the number of bubbles of oxygen produced by an aquatic plant in different light intensities over 5 minutes. Data: Light intensity 10 units -> 8 bubbles; 20 units -> 16 bubbles; 40 units -> 30 bubbles; 80 units -> 34 bubbles.

(a) Calculate the rate of oxygen production (bubbles per minute) at light intensity 40 units. **(2)**

.....

(b) Describe what happens to the rate of oxygen production between light intensity 40 and 80 units and give a simple biological reason. **(2)**

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

(2)

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

(3)

7 Write down the word equation for aerobic respiration.

(1)

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8 Complete the word equation for aerobic respiration:
glucose + (a) -> carbon dioxide + (b) (+ energy released)

(a) Name the missing reactant. **(1)**

(b) Name the missing product. **(1)**

(c) State one place in a cell where most of the reactions of aerobic respiration take place. **(1)**

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9 A gardener grows tomato plants in a heated, well-lit glasshouse in winter. The rate of photosynthesis is measured at three carbon dioxide concentrations, with light intensity and temperature kept constant at fixed levels that may limit photosynthesis.
CO_2 concentration (ppm): 400, 800, 1200
Rate of photosynthesis (arbitrary units): 10, 18, 19

(a) Describe how the rate of photosynthesis changes as CO_2 concentration increases from 400 ppm to 1200 ppm. **(2)**

(b) Explain, in terms of limiting factors, why the rate of photosynthesis does not keep increasing between 800 ppm and 1200 ppm. **(2)**

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10 A gas syringe collected 45 cm^3 of carbon dioxide from a fermenting yeast culture in 9 minutes.
Show that the mean rate of gas production was 5 cm^3 per minute.

(3)

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11 Practical investigation: A student tests a geranium leaf to find out whether it contains starch, using iodine solution.

(a) State why the plant should be left in the dark for 24 to 48 hours before the test (destarching). **(1)**

(b) Put these four steps of the starch test in the correct order by writing 1 to 4: **(2)**
Rinse the leaf in cold water
Boil the leaf in ethanol using a water bath
Add iodine solution to the leaf
Boil the leaf in water

(c) Explain why the leaf is boiled in ethanol using a water bath rather than directly over a Bunsen flame. **(2)**

(d) State the colour change that shows starch is present when iodine solution is added. **(1)**

(e) A destarched leaf kept in bright light for several hours is compared with a destarched leaf kept in the dark for the same time. Predict and explain the difference in the iodine test result between the two leaves. **(2)**

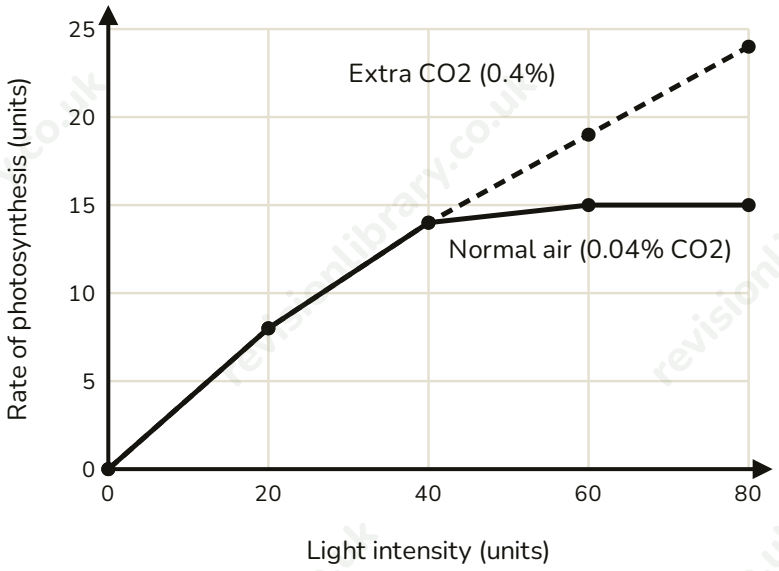
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12 The rate of photosynthesis of a plant was measured at increasing light intensities, once in normal air (0.04% CO_2) and once in air enriched with extra carbon dioxide (0.4% CO_2). Temperature was kept constant and optimal throughout.

Light intensity (units): 0, 20, 40, 60, 80

Rate with normal CO_2 (units): 0, 8, 14, 15, 15

Rate with extra CO_2 (units): 0, 8, 14, 19, 24



(a) Compare the two sets of results at a light intensity of 40 units, and explain what this shows about the limiting factor at this point. **(2)**

(b) Compare the two sets of results at a light intensity of 80 units, and explain what this shows about the limiting factor for the plant in normal air. **(2)**

(c) Predict what would happen to the rate of photosynthesis in the extra CO_2 condition if the light intensity were increased further beyond 80 units, assuming CO_2 remained unlimited. **(1)**

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Mark scheme · 1.3 Respiration and Photosynthesis: Test Pack

Question 1

carbon dioxide and water cao (A and C) **B1**

Answer: **Carbon dioxide and water**

Question 2

45 / 15 **M1**

3 cm³ per minute cao **A1**

Answer: **3 cm^3 per minute**

Question 3

bubbles vary in size, so counting them does not accurately measure the volume of gas produced, oe **M1**

better method: collect the gas in a syringe/inverted measuring cylinder and measure its volume directly **A1**

Answer: **Bubbles can vary in size, so counting them is not an accurate measure of the volume of oxygen produced. A more reliable method is to collect the gas in a gas syringe or inverted measuring cylinder and measure its volume directly.**

Question 4

(a) calculate 30 bubbles / 5 minutes **M1**

(a) 6 bubbles per minute cao **A1**

(a) Answer: **6 bubbles per minute**

(b) states rate increases only slightly from 6 to 6.8 bubbles per minute (34/5 = 6.8) or says it levels off **M1**

(b) gives reason such as another factor becoming limiting, e.g. CO_2 or temperature, so photosynthesis levels off **A1**

(b) Answer: **Rate increases only slightly from 6 to 6.8 bubbles per minute; photosynthesis is levelling off because another factor such as CO_2 or temperature is limiting**

Question 5

increase light intensity e.g. use grow lamps or place plants nearer light **M1**

increase CO_2 concentration (e.g. CO_2 generator) or keep temperature optimal; either acceptable **A1**

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 6

any one valid adaptation with its benefit, e.g. broad flat shape for a large surface area to absorb light; thin, so gases diffuse a short distance; many chloroplasts in palisade cells to absorb more light; palisade cells near the upper surface; stomata to let carbon dioxide in; air spaces in the spongy layer for gas diffusion; veins (xylem) to bring water; transparent upper epidermis to let light through **B1**

a second, different valid adaptation from the same list **B1**

a third, different valid adaptation from the same list **B1**

Answer: **Any three, e.g. broad flat shape for large surface area; thin so gases diffuse a short distance; many chloroplasts in palisade cells to absorb more light.**

Question 7

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

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

Question 8

(a) oxygen **B1**

(a) Answer: **oxygen**

(b) water **B1**

(b) Answer: **water**

(c) mitochondria (mitochondrion) **B1**

(c) Answer: **mitochondria**

Question 9

(a) rate increases quickly from 400 ppm to 800 ppm **B1**

(a) rate then levels off (little further increase) between 800 ppm and 1200 ppm **B1**

(a) Answer: **Rate rises from 400 to 800 ppm, then levels off from 800 to 1200 ppm.**

(b) carbon dioxide is no longer the limiting factor at this point **B1**

(b) a different factor (e.g. light intensity or temperature) is now limiting the rate of photosynthesis **B1**

(b) Answer: **CO_2 is no longer limiting between 800 ppm and 1200 ppm. Light intensity or temperature, kept at a fixed level that may limit photosynthesis, now limits the rate.**

Question 10

rate = volume / time **M1**

45 / 9 **M1**

cso: = 5 cm³/min, matching the value given **A1**

Answer: **5 cm³ per minute**

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Question 11

(a) to remove/use up any starch already stored in the leaf, so any starch found later must have been made during the test **B1**

(a) Answer: **To remove existing starch so results show only new starch made in the experiment.**

(b) Boil in water (1) and Boil in ethanol (2) correctly placed **B1**

(b) Rinse in cold water (3) and Add iodine (4) correctly placed **B1**

(b) Answer: **1) Boil in water 2) Boil in ethanol (water bath) 3) Rinse in cold water 4) Add iodine solution**

(c) ethanol is flammable **B1**

(c) a water bath heats the ethanol gently without a naked flame nearby, reducing the risk of the ethanol vapour catching fire **B1**

(c) Answer: **Ethanol is flammable, so a water bath heats it safely without a naked flame that could ignite the vapour.**

(d) orange/brown changes to blue-black **B1**

(d) Answer: **orange/brown to blue-black**

(e) the leaf kept in the light turns blue-black because it has photosynthesised and made starch **B1**

(e) the leaf kept in the dark stays orange/brown because no photosynthesis occurred without light, so no starch was made **B1**

(e) Answer: **Light leaf: blue-black (starch made). Dark leaf: orange/brown (no starch made, no photosynthesis).**

Question 12

(a) the rate is the same (14 units) in both normal and extra CO_2 conditions **B1**

(a) this shows that light intensity, not CO_2 concentration, is the limiting factor at this point, since extra CO_2 makes no difference **B1**

(a) Answer: **Rates are identical (14 units), showing light intensity is limiting, not CO_2, at this point.**

(b) in normal air the rate has levelled off at 15, while with extra CO_2 the rate is higher and still rising, at 24 **B1**

(b) this shows that CO_2 concentration is now the limiting factor for the plant in normal air, since adding more CO_2 allows a higher rate at the same light intensity **B1**

(b) Answer: **Normal air plateaus at 15, extra CO_2 reaches 24, showing CO_2 is now limiting in normal air.**

(c) the rate would eventually level off (plateau) as some other factor, such as the amount of chlorophyll or enzyme availability, becomes limiting **B1**

(c) Answer: **The rate would eventually plateau as another factor, such as the amount of chlorophyll, becomes limiting.**

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