1.3 Respiration and Photosynthesis: 30-minute Pack

Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A greenhouse gardener increases the carbon dioxide concentration in a greenhouse from 0.04% to 0.1% while keeping light intensity and temperature constant. The rate of photosynthesis of the plants increases.

(a) Explain why increasing the carbon dioxide concentration increased the rate of photosynthesis. **(2)**

(b) Suggest what would happen to the rate of photosynthesis if the carbon dioxide concentration were increased further and further, and explain why. **(2)**

2 A student investigates the effect of light intensity on the rate of photosynthesis of pondweed by counting bubbles of oxygen released per minute at different distances from a lamp.

(a) Identify one variable the student should keep the same. **(1)**

(b) Explain why this variable must be controlled. **(2)**

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3 Which of these is NOT usually a limiting factor for the rate of photosynthesis?

- ☐ A) Light intensity
- ☐ B) Carbon dioxide concentration
- ☐ C) Temperature
- ☐ D) Oxygen concentration

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4 Write down the word equation for aerobic respiration in humans.

(3)

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5 Name the organelle in plant cells where photosynthesis happens.

(1)

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6 This question has two parts.

(a) Write the word equation for anaerobic respiration in yeast cells (fermentation). **(2)**

(b) Explain one everyday use of this process. **(1)**

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

(2)

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8 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)

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9 A student puts a piece of pondweed in a test tube of water and moves a lamp to different distances from it. At each distance they count the bubbles of gas the pondweed gives off in one minute. Explain two steps the student should take to make the test fair (one sentence each).

(2)

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

(3)

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11 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)

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Mark scheme · 1.3 Respiration and Photosynthesis: 30-minute Pack

Question 1

(a) carbon dioxide was the limiting factor (in short supply, restricting the rate) **M1**

(a) more CO_2 available means more can be used as a raw material for photosynthesis, so the rate increases, oe **A1**

(a) Answer: **Carbon dioxide was limiting the rate of photosynthesis; increasing its concentration provided more of this raw material, so more photosynthesis could occur**

(b) the rate would eventually level off (stop increasing) **M1**

(b) because another factor, such as light intensity or temperature, would then become limiting, oe **A1**

(b) Answer: **The rate would level off, because another factor such as light intensity or temperature would then become the limiting factor**

Question 2

(a) e.g. water temperature, CO_2 concentration (amount of sodium hydrogencarbonate), length/mass of pondweed **B1**

(a) Answer: **The temperature of the water**

(b) this variable also affects the rate of photosynthesis **M1**

(b) so it must be kept constant so that any change in bubble rate is caused only by light intensity, oe **A1**

(b) Answer: **Temperature also affects the rate of photosynthesis, so it must be kept the same so that any change in the rate of bubbling is caused only by the change in light intensity**

Question 3

oxygen concentration cao (D) **B1**

Answer: **Oxygen concentration**

Question 4

glucose + oxygen -> carbon dioxide + water + energy (all components present) cao **M1**

energy included as a product or implied in words (cao) ft **A1**

order of reactants and products acceptable if components are present (cao) **A1**

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

Question 5

chloroplasts cao **B1**

Answer: **Chloroplasts**

Question 6

(a) glucose -> ethanol + carbon dioxide cao **M1**

(a) + energy included, oe **A1**

(a) Answer: **Glucose -> ethanol + carbon dioxide + energy**

(b) brewing/making alcoholic drinks or bread-making (carbon dioxide makes dough rise), oe **B1**

(b) Answer: **Bread-making - the carbon dioxide produced makes the dough rise**

Question 7

aerobic uses oxygen, anaerobic does not **M1**

aerobic produces carbon dioxide and water and more energy; anaerobic in animals produces lactic acid and in yeast produces alcohol and carbon dioxide **A1**

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 8

0.4 ml per minute cao **B1**

Answer: **0.4 ml/minute**

Question 9

one valid control with a reason, e.g. keep the temperature the same (water bath, heat shield or same room), because temperature also affects the rate **B1**

a second, different valid control, e.g. same piece, length or species of pondweed; same volume of water or amount of carbon dioxide (sodium hydrogencarbonate); count for the same time; let the pondweed settle at each distance before counting. Do not credit keeping the lamp at the same distance (that is the variable being changed) **B1**

Answer: **Any two valid controls, e.g. keep the temperature the same (use a water bath) and use the same piece of pondweed in the same volume of water, counting bubbles for the same time at each distance.**

Question 10

stomata are small pores on the underside of leaves for gas exchange (CO_2 in, O_2 out) **M1**

guard cells surround stomata and change shape to open or close the pore **M1**

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 **A1**

Answer: **Stomata are pores that let CO_2 in and O_2 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.**

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Question 11

Level 3 Detailed method with repeated fair tests, clear measurements and valid comparison.	**5-6**
Level 2 Basic method with some control of variables and a suggested way to measure rate, but lacking repeat measures or clear comparison.	**3-4**
Level 1 Limited ideas, vague method or missing controls and measurements.	**0-2**

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

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