# 1.3 Respiration and Photosynthesis: 1-hour Pack

Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** Explain why plants need to respire even though they can also photosynthesise.

(3)

**2** A student tests a leaf for starch to show photosynthesis has happened. She boils the leaf in water, then in ethanol to remove chlorophyll, and finally adds iodine solution which turns blue-black where starch is present.

**(a)** Why is the leaf boiled in water at the start? **(1)**

**(b)** Why is ethanol used after boiling in water? **(1)**

**3** Write down the word equation for photosynthesis, including the products.

(3)

**4** Name the small openings on the underside of a leaf that allow carbon dioxide in and oxygen out.

(1)


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**5** Which of these is a product of anaerobic respiration in human muscle cells during vigorous exercise?

- [ ] A) Carbon dioxide and water
- [ ] B) Lactic acid
- [ ] C) Ethanol and carbon dioxide
- [ ] D) Oxygen

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**6** Write down the word equation for photosynthesis.

**(1)**

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

**(2)**

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

**(4)**

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**9** State the part of a plant cell where photosynthesis happens.

**(1)**


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**10** Describe the role of chlorophyll in photosynthesis. Give two points.

(2)

**11** 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)

**12** 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)

**13** Photosynthesis is the process plants use to make food. Complete the word equation for photosynthesis:
carbon dioxide + water --(a)--> glucose + (b)

**(a)** Name the type of energy that should be written above the arrow. **(1)**

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

**(c)** State the green substance found in chloroplasts that absorbs light energy for photosynthesis. **(1)**


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**14** Choose the correct letter for each question about cells and gas exchange.

**(a)** Which organelle is the main site of photosynthesis? **(1)**

- ☐ A) Nucleus
- ☐ B) Mitochondrion
- ☐ C) Chloroplast
- ☐ D) Ribosome

**(b)** Which organelle is the main site of aerobic respiration? **(1)**

- ☐ A) Chloroplast
- ☐ B) Mitochondrion
- ☐ C) Vacuole
- ☐ D) Cell wall

**(c)** Which gas is taken in by a leaf mainly to be used for photosynthesis during daylight? **(1)**

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

**(d)** Which structures on the underside of a leaf allow gases to enter and leave? **(1)**

- ☐ A) Stomata
- ☐ B) Xylem
- ☐ C) Phloem
- ☐ D) Root hairs

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**15** Distinguish between breathing and respiration.

**(2)**


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**16** Balanced symbol equations show the same number of atoms of each element on both sides.

**(a)** Complete the balanced symbol equation for aerobic respiration by writing in the missing number: **(1)**

$C_6H_{12}O_6 + 6O_2$ -> ___CO2 + $6H_2O$

**(b)** Complete the balanced symbol equation for photosynthesis by writing in the two missing numbers: **(2)**

___CO2 + ___H2O -> $C_6H_{12}O_6 + 6O_2$

**(c)** State why these equations are described as balanced. **(1)**

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**17** A market gardener grows cucumbers in a glasshouse. She burns a paraffin heater, which releases carbon dioxide, and uses artificial lighting on dull days.
Explain how increasing carbon dioxide concentration and increasing light intensity can each affect the rate of photosynthesis in the cucumber plants, and why increasing carbon dioxide concentration will not always increase the rate of photosynthesis.

**(6)**


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**18** Practical investigation: A group of students investigates how the distance of a lamp from pondweed affects the rate of photosynthesis, by counting bubbles of oxygen produced per minute.

Distance from lamp (cm): 10, 20, 40

Rate of bubble production (bubbles/min): 32, 8, 2

**(a)** Identify two variables, other than distance, that should be controlled in this investigation. **(2)**

**(b)** State the independent variable and the dependent variable in this investigation. **(2)**

**(c)** Describe the relationship between distance from the lamp and rate of photosynthesis shown above. **(1)**

**(d)** Show that the rate of photosynthesis is inversely proportional to the square of the distance for the data given. **(3)**


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# Mark scheme · 1.3 Respiration and Photosynthesis: 1-hour Pack

## Question 1

plants need energy for life processes such as growth and active transport at all times, oe — **M1**

photosynthesis can only happen when light is available, whereas respiration happens continuously in all living cells, oe — **M1**

conclusion linking the two points: respiration is needed constantly to supply energy, day and night, oe — **A1**

Answer: **Plants need energy for life processes such as growth and active transport at all times. Photosynthesis only happens when light is available, but respiration happens continuously in every living cell, so plants must respire constantly to supply this energy, day and night.**

## Question 2

(a) to stop enzyme activity and break down cell membranes so iodine can reach starch (oe) — **B1**

(a) Answer: **To stop enzyme activity and break down cell membranes so the iodine can reach any starch**

(b) to remove chlorophyll so colour change from iodine can be seen clearly — **B1**

(b) Answer: **To remove chlorophyll so the iodine colour change can be seen clearly**

## Question 3

reactants correct: carbon dioxide + water cao — **M1**

arrow labelled to show light (energy) is needed, oe — **A1**

products correct: glucose + oxygen cao — **A1**

Answer: **Carbon dioxide + water --(light energy)--> glucose + oxygen**

## Question 4

stomata cao — **B1**

Answer: **Stomata**

## Question 5

lactic acid cao (B) — **B1**

Answer: **Lactic acid**

## Question 6

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

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

## Question 7

high temperature can damage or denature enzymes involved in photosynthesis — **M1**

so enzymes work less well and the rate of photosynthesis decreases (linked consequence) — **A1**

Answer: **Very high temperatures can denature the enzymes used in photosynthesis, so the enzymes work less well and the rate falls.**

## Question 8

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 $CO_2$ concentration and temperature can become limiting — **M1**

against: at very high light or high temperature enzymes may be damaged so rate falls — **M1**

conclusion that increasing light does not always increase rate; it depends on other limiting factors and optimum conditions — **A1**

Answer: **Increasing light can increase the rate if light is limiting, but only up to a point; if $CO_2$ 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 9

chloroplast(s) cao — **B1**

Answer: **Chloroplast**

## Question 10

captures light energy from the Sun (or absorbs light) — **M1**

uses light energy to convert carbon dioxide and water into glucose (production of food) or phrase linking light energy to making glucose — **A1**

Answer: **Chlorophyll absorbs light energy; it uses that energy to help make glucose from carbon dioxide and water.**

## Question 11

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 — **M1**

two control variables stated (any two of: temperature, carbon dioxide concentration, type/size of pondweed, volume of water, light colour) both needed — **A1**

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 12

method: 150 - 40 — **M1**

110 units cao — **A1**

Answer: **110 units of sugar available for growth and storage (units)**

## Question 13

(a) light (energy) — **B1**

(a) Answer: **light energy**

(b) oxygen — **B1**

(b) Answer: **oxygen**

(c) chlorophyll — **B1**

(c) Answer: **chlorophyll**


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## Question 14

(a) C (Chloroplast) **B1**

(a) Answer: **C**

(b) B (Mitochondrion) **B1**

(b) Answer: **B**

(c) C (Carbon dioxide) **B1**

(c) Answer: **C**

(d) A (Stomata) **B1**

(d) Answer: **A**

## Question 15

breathing (ventilation) is the physical movement of air/gases into and out of the lungs **B1**

respiration is the chemical reaction inside cells that releases energy from glucose **B1**

Answer: **Breathing is the physical movement of air in and out of the lungs; respiration is the chemical process in cells that releases energy from glucose.**

## Question 16

(a) 6 (cao) **B1**

(a) Answer: **6**

(b) $6CO_2$ (cao) **B1**

(b) $6H_2O$ (cao) **B1**

(b) Answer: **$6CO_2$ and $6H_2O$**

(c) the same number of atoms of each element appears on both sides (reactants and products) **B1**

(c) Answer: **Same number of atoms of each element on both sides.**

## Question 17

**Level 1** Basic, isolated statements about factors needed for photosynthesis (e.g. light or carbon dioxide is needed), with little or no reference to the idea of a limiting factor. Limited use of scientific vocabulary. **1-2**

**Level 2** A clear explanation of how increasing light intensity or carbon dioxide concentration increases the rate of photosynthesis while that factor is limiting, with some reference to another factor eventually becoming limiting. **3-4**

**Level 3** A full, logically linked explanation covering both light intensity and carbon dioxide concentration, correctly applying the concept of limiting factors, and clearly explaining why the rate levels off once a different factor becomes limiting, related to the glasshouse context. **5-6**

**Indicative content:**

- Photosynthesis requires light energy, carbon dioxide, water and chlorophyll, and produces glucose and oxygen
- Increasing light intensity increases the rate of photosynthesis because more light energy is available to drive the reaction, as long as light intensity is the limiting factor
- Increasing carbon dioxide concentration increases the rate of photosynthesis because carbon dioxide is a raw material, as long as carbon dioxide is the limiting factor
- Whichever factor is in shortest supply relative to what is needed limits the overall rate (the limiting factor)
- Beyond a certain point, carbon dioxide (or light) is no longer limiting, so a different factor, such as temperature or the other resource, becomes limiting and the rate levels off
- A paraffin heater releases both carbon dioxide and heat, so it can raise temperature as well as carbon dioxide concentration, which may allow the rate to increase further if temperature was previously limiting
- Very high temperatures can denature the enzymes controlling photosynthesis reactions, reducing the rate, so there is an optimum temperature
- The market gardener aims to keep all factors (light, carbon dioxide, temperature) close to optimum together, rather than increasing only one, in order to maximise yield


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## Question 18

(a) temperature of the water **B1**

(a) concentration/volume of dissolved carbon dioxide (e.g. sodium hydrogencarbonate solution), or species/length of pondweed, or time allowed for counting **B1**

(a) Answer: **e.g. temperature of the water and concentration of dissolved carbon dioxide**

(b) independent variable: distance of the lamp from the pondweed **B1**

(b) dependent variable: rate of bubble production (rate of photosynthesis) **B1**

(b) Answer: **Independent: distance from lamp. Dependent: rate of bubble production.**

(c) as distance increases, rate of photosynthesis decreases (the relationship is not linear/proportional) **B1**

(c) Answer: **As distance increases, the rate of photosynthesis decreases.**

(d) calculates distance squared for each distance: 100, 400, 1600 **M1**

(d) calculates rate x distance$^2$ for each row: 32x100=3200, 8x400=3200, 2x1600=3200 **M1**

(d) cso: all three values equal 3200, showing rate x d$^2$ is constant, so rate is inversely proportional to d$^2$ **A1**

(d) Answer: **Rate x distance$^2$ = 3200 in every case, so rate is inversely proportional to d$^2$.**


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