GCSE and IGCSE Biology: Photosynthesis Worksheet - Mark Scheme

Year 10-11 · GCSE (AQA 4.4.1) and Cambridge IGCSE 0610 topic 6 · Exam-style questions

Section A: Photosynthesis and the uses of glucose [18 marks]

1	The process by which plants (producers) make glucose / carbohydrates (1) from carbon dioxide and water using light energy absorbed by chlorophyll (1).	**2**
2(a)	carbon dioxide + water ⟶ glucose + oxygen (1); light and chlorophyll shown above the arrow (1)	**2**
2(b)	$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$ Guidance: 1 mark for correct formulas, 1 mark for balancing.	**2**
2(c)	Energy is transferred from the surroundings (light) to the chloroplasts / energy is taken in.	**1**
2(d)	Chloroplast (1); chlorophyll (1)	**2**
3	Respiration: releases energy for the cell. Starch: insoluble store of energy that does not affect water movement. Cellulose: builds cell walls for strength and support. Amino acids: to make proteins for growth and enzymes. Fats and oils: energy store (e.g. in seeds). Guidance: 1 mark each.	**5**
4	Magnesium is needed to make chlorophyll (1); without chlorophyll the leaves look yellow (chlorosis) and photosynthesis is reduced (1). Nitrate is needed to make amino acids (1) which are used to make proteins for growth (1).	**4**

Section B: Leaf structure and gas exchange [12 marks]

5	Waxy cuticle: waterproof, reduces water loss. Upper epidermis: thin and transparent so light passes through. Palisade mesophyll: many chloroplasts, close to the top to absorb light. Spongy mesophyll: air spaces allow gases to diffuse. Stomata and guard cells: allow CO_2 in and O_2 out; guard cells open and close them. Xylem: carries water and minerals to the leaf. Phloem: carries sucrose away from the leaf. Guidance: 1 mark each.	**7**
6	Diffuses into the leaf through the stomata (1); through the air spaces in the spongy mesophyll (1); down a concentration gradient, because CO_2 is used up in photosynthesis, then into the cell (1).	**3**
7	Large surface area absorbs more light (1). Thin so gases have a short diffusion distance / light reaches all cells (1).	**2**

Section C: Limiting factors [11 marks]

8	A factor that is in short supply and stops the rate of photosynthesis increasing (1). Any two of: light intensity, carbon dioxide concentration, temperature, chlorophyll amount (2).	**3**
9(a)	Light intensity	**1**
9(b)	Light is no longer limiting (1) because carbon dioxide concentration is limiting / in short supply (1).	**2**
9(c)	Temperature (or chlorophyll amount).	**1**
9(d)	Distance is 3 times larger; intensity is $1 \div 3^2$ (1) = 9 times smaller (1).	**2**
9(e)	Benefit: higher rate of photosynthesis so higher crop yield (1). Cost: heating and CO_2 are expensive; costs must be less than extra profit (1).	**2**

Section D: Practical skills [16 marks]

10(a)	20; 11; 6; 3 bubbles per minute	**3**
10(b)	As the lamp distance increases, light intensity decreases (1) and the rate of photosynthesis decreases (1).	**2**
10(c)	Independent: distance of lamp (1). Dependent: number of bubbles per minute (1). Control (any two): temperature, same pondweed, CO_2 concentration, time, same lamp (2).	**4**
10(d)	It absorbs heat so temperature stays constant.	**1**
10(e)	Collect and measure the volume of gas / repeat and calculate a mean / use a gas syringe.	**1**
11	Boil leaf in water to kill and stop reactions (1); heat in ethanol in a hot water bath to remove chlorophyll (1); rinse in water (1); add iodine solution (1); blue-black shows starch (1). Safety: turn off flames as ethanol is flammable / wear eye protection (do not give mark). Guidance: 5 marks maximum.	**5**

Total: 57 marks. Accept any scientifically correct alternative wording.