InkBiology

ANSWER BOOK

Chloroplasts: catching light and turning it into ATP

Photosynthesis and primary productivity · Unit B13

AQA 3.5.1 · OCR A 5.2.1 · Edexcel A Topic 5.4 · CAIE 13.1

6 questions · 20 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **B1** an absorption spectrum shows how much light a pigment absorbs at each wavelength. **B1** an action spectrum shows the rate of photosynthesis at each wavelength. [2]

SECTION B · Standard, 3 to 5 marks

B1 **B1** a photon is absorbed by the pigments of photosystem II and the energy is funnelled to the chlorophyll a at the reaction centre, from which an electron is raised to a higher energy level and lost altogether, leaving the molecule positively charged. **B1** the lost electron is replaced by the photolysis of water on the inner face of the thylakoid membrane, which gives protons, electrons and oxygen. **B1** the excited electron is passed from carrier to carrier along the thylakoid membrane, losing energy at each transfer. **B1** that energy drives protons from the stroma into the thylakoid space, so a steep proton gradient builds across the membrane. **B1** protons flow back into the stroma through ATP synthase, driving photophosphorylation, while the electron reaches photosystem I, is re-energised by light and is passed with a proton to NADP, giving reduced NADP. [5]

B2 **B1** non-cyclic uses photosystem II and photosystem I, whereas cyclic uses photosystem I alone. **B1** in non-cyclic the electron ends up on NADP and never returns, whereas in cyclic it is passed to a carrier and returned to the same photosystem. **B1** non-cyclic needs photolysis of water to replace the electrons photosystem II loses, so it releases oxygen, whereas cyclic splits no water and releases none. **B1** non-cyclic produces both ATP and reduced NADP, whereas cyclic produces ATP only, which suits a job such as pumping potassium ions into a guard cell. [4]

B3 **B1** chlorophyll absorbs strongly in the blue region and in the red region of the spectrum. **B1** its absorption falls to a small fraction of that peak in the green band around 550 nm, so green light is barely absorbed. **B1** the green light is reflected and transmitted instead, so it is the light that reaches the eye, and a leaf lit only by green light photosynthesises slowly. [3]

B4 **M1** Rf = distance moved by the spot ÷ distance moved by the solvent, with both distances measured from the pencil line and the spot measured to its centre. **M1** 79 ÷ 84. **A1** Rf = 0.94, a ratio with no units, which can never exceed 1. [3]

B5 **B1** the oxygen-18 appears in the oxygen gas the plant releases. **B1** the oxygen given off in photosynthesis comes from the photolysis of water at the thylakoid membrane, not from carbon dioxide. **B1** water is split into protons, electrons and oxygen, so any label carried by the water leaves in the gas; had the oxygen come from carbon dioxide, unlabelled gas would have been released instead. [3]