

Photosynthesis: practice questions

8 questions • 27 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 27

1 PAPER 1A STYLE [1 mark]

What is the source of the oxygen released in photosynthesis by plants, algae and cyanobacteria?

- A. ☐ Carbon dioxide
- B. ☐ Glucose
- C. ☐ Water
- D. ☐ Chlorophyll

2 PAPER 1A STYLE [1 mark]

Which statement explains why the action spectrum of photosynthesis is not zero in the green part of the spectrum?

- A. ☐ Chlorophyll absorbs green light more strongly than red light.
- B. ☐ Accessory pigments absorb some light in this region.
- C. ☐ Green light has the highest energy per photon.
- D. ☐ Green light is reflected and then used by the stroma.

3 PAPER 1A STYLE [1 mark]**HL only**

In the Calvin cycle, how many molecules of triose phosphate are converted into three molecules of RuBP?

- A. ☐ Two
- B. ☐ Three
- C. ☐ Five
- D. ☐ Six

Pigments from a spinach leaf were separated by paper chromatography. The solvent front moved 9.0 cm from the origin. Reference Rf values for this method are: carotene 0.93, xanthophyll 0.70, chlorophyll a 0.50, chlorophyll b 0.40. The data are for practice. (a) Calculate the Rf value of spot 2. [1] (b) Using colour and Rf values, identify spots 1 and 3. [2] (c) Suggest why the pigments separate. [1]

Distances moved by pigment spots		
Spot	Colour	Distance from origin / cm
1	Orange-yellow	8.4
2	Yellow	6.3
3	Blue-green	4.5
4	Yellow-green	3.6

Answer =

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5 PAPER 1B STYLE

[5 marks]

An aquatic plant was placed 10 cm from a lamp behind filters that let through light of one colour. The volume of oxygen released in 10 minutes was measured. The data are for practice. (a) Calculate the rate of oxygen production in blue light, in $\text{cm}^3 \text{ min}^{-1}$. [1] (b) Compare the rates in the different colours of light. [2] (c) State two variables that should be controlled. [2]

Volume of oxygen released in 10 minutes		
Colour of light	Approximate wavelength / nm	Volume of oxygen / cm^3
Blue	450	1.8
Green	550	0.4
Red	680	1.5

Answer =

6 PAPER 2A STYLE

[3 marks]

Compare enclosed greenhouse experiments with free-air carbon dioxide enrichment (FACE) experiments as ways of predicting future rates of photosynthesis and plant growth.

7 PAPER 2A STYLE

[4 marks]

HL only

(a) Explain why plants need high concentrations of Rubisco in the stroma. [2] (b) Predict, with a reason, what happens to the concentration of glycerate 3-phosphate when a plant is moved into darkness. [2]

8 PAPER 2B STYLE

[8 marks]

HL only

Explain how the light-dependent reactions in the thylakoids produce ATP and reduced NADP.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C [1]

2. [1]

B B [1]

3. [1] **HL only**

C C [1]

4. [4]

- (a) $6.3 \div 9.0 = 0.70$ [1]
- (b) spot 1: R_f 0.93 / $8.4 \div 9.0$, orange-yellow, so carotene [1]
- (b) spot 3: R_f 0.50 / $4.5 \div 9.0$, blue-green, so chlorophyll a [1]
- (c) pigments differ in solubility in the solvent / attraction to the stationary phase, so travel different distances OWTTE [1]

5. [5]

- (a) $1.8 \div 10 = 0.18 \text{ cm}^3 \text{ min}^{-1}$ [1]
- (b) highest rate in blue light, then red [1]
- (b) lowest rate in green light, but not zero [1]
- (b) blue rate is 4.5 times green / use of values from the table [1]
- (b) [max 2]
- (c) light intensity / distance from lamp [1]
- (c) temperature [1]
- (c) CO_2 concentration / concentration of hydrogencarbonate [1]
- (c) same plant / mass of plant / time allowed to adjust [1]
- (c) [max 2]

6. [3]

- both: grow plants at raised CO_2 concentration to predict effects of future CO_2 levels [1]
- greenhouse: variables (temperature, water, light) easier to control [1]
- FACE: plants in field / natural ecosystem conditions so results more realistic [1]
- FACE: other variables (weather, soil, pests) harder to control / vary [1]
- [max 3]

7. [4] **HL only**

- (a) Rubisco works relatively slowly [1]
- (a) Rubisco is not effective at low CO_2 concentrations [1]
- (b) glycerate 3-phosphate concentration rises [1]
- (b) no ATP / reduced NADP from light-dependent reactions, so GP not converted to triose phosphate [1]
- (b) Rubisco still fixes CO_2 with the remaining RuBP, forming GP (until RuBP runs out) [1]
- (b) [max 2]

8. [8] HL only

- photosystems are arrays of chlorophyll and accessory pigments in the thylakoid membrane [1]
- light absorbed and energy passed to the reaction centre (special chlorophyll) [1]
- excited electrons emitted from photosystem II [1]
- photolysis of water in PSII replaces electrons, releasing protons (into lumen) and oxygen [1]
- electrons pass along a chain of carriers [1]
- energy used to pump protons from stroma into thylakoid lumen [1]
- proton gradient across the thylakoid membrane [1]
- protons diffuse through ATP synthase into the stroma: chemiosmosis [1]
- ATP synthase phosphorylates ADP to ATP [1]
- electrons reach photosystem I, are re-excited by light [1]
- NADP accepts two electrons from PSI and a hydrogen ion from the stroma, forming reduced NADP [1]
- cyclic photophosphorylation: electrons from PSI return to carriers to make ATP only [1]
- [max 8]