



11: Plant physiology and biochemistry – Topic questions

The questions in this document have been compiled from past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2017	May/June	41
2	2017	May/June	42
9	2017	May/June	42

The mark scheme for each question is provided at the end of the document.

- 2 Corals grow in shallow seawater. Corals consist of colonies of small animals called polyps. These polyps have photosynthetic protocists called algae inside their cells, which is advantageous both to the coral polyps and to the algae.

The algae that live within the cells of the polyps can also live independently as free-living algae.

- (a) The rate of photosynthesis of algae that live within the cells of coral polyps is higher than that of free-living algae.

Suggest **and** explain how living inside the cells of coral polyps increases the rate of photosynthesis in these algae compared to free-living algae.

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- (b) The relative abundance of five different chloroplast pigments in the algae of corals was determined. The results are shown in Table 2.1.

Table 2.1

chloroplast pigment	percentage of total
chlorophyll a	39
peridinin	39
chlorophyll c2	13
dinoxanthin	7
β-carotene	2

Outline the method you would use to separate and identify the pigments present in an extract of these algae.

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- (c) Table 2.2 shows the light wavelengths at which each algal chloroplast pigment shows its two largest peaks of light absorption.

Table 2.2

chloroplast pigment	peak 1 wavelength /nm	peak 2 wavelength /nm
chlorophyll a	430	662
peridinin	456	485
chlorophyll c2	450	396
dinoxanthin	442	471
β-carotene	454	480

Corals kept in tanks are often illuminated by lamps radiating mostly violet and blue light with wavelengths in the range of 400–490 nm.

With reference to Table 2.1 and Table 2.2, suggest why lamps radiating mostly violet and blue light are expected to increase coral growth.

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[Total: 9]

2 Chloroplasts belong to a group of organelles called plastids. Although different types of plastid have different structures and functions, one type of plastid can change into another type of plastid in response to environmental or developmental signals.

- Example 1: plants grown in the dark have plastids called etioplasts which lack chlorophyll. If these plants are exposed to light, the etioplasts quickly change into chloroplasts.
- Example 2: chloroplasts in surface tissues of tomato fruits change into plastids called chromoplasts as the fruits ripen. Thylakoid membranes break down and chlorophyll synthesis stops. Chromoplasts synthesise and accumulate red lycopene and orange β -carotene pigments.

(a) For each of these examples, explain the effect on the rate of photosynthesis of one type of plastid changing into another type of plastid.

Example 1

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Example 2

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(b) Outline the method you would use to separate and identify the pigments in an extract of tomato chromoplasts.

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- (c) Cyanobacteria are prokaryotic organisms. Plastids are thought to have evolved from cyanobacteria that became incorporated into larger cells. Experiments show that free-living cyanobacteria can adapt to environmental signals in the same way as plastids.

Fig. 2.1 shows the absorption spectra of cyanobacteria grown under two different lighting conditions. One group was grown under fluorescent light and the other group was grown under red light.

The range of light wavelengths absorbed by each group of cyanobacteria was then measured under identical lighting conditions.

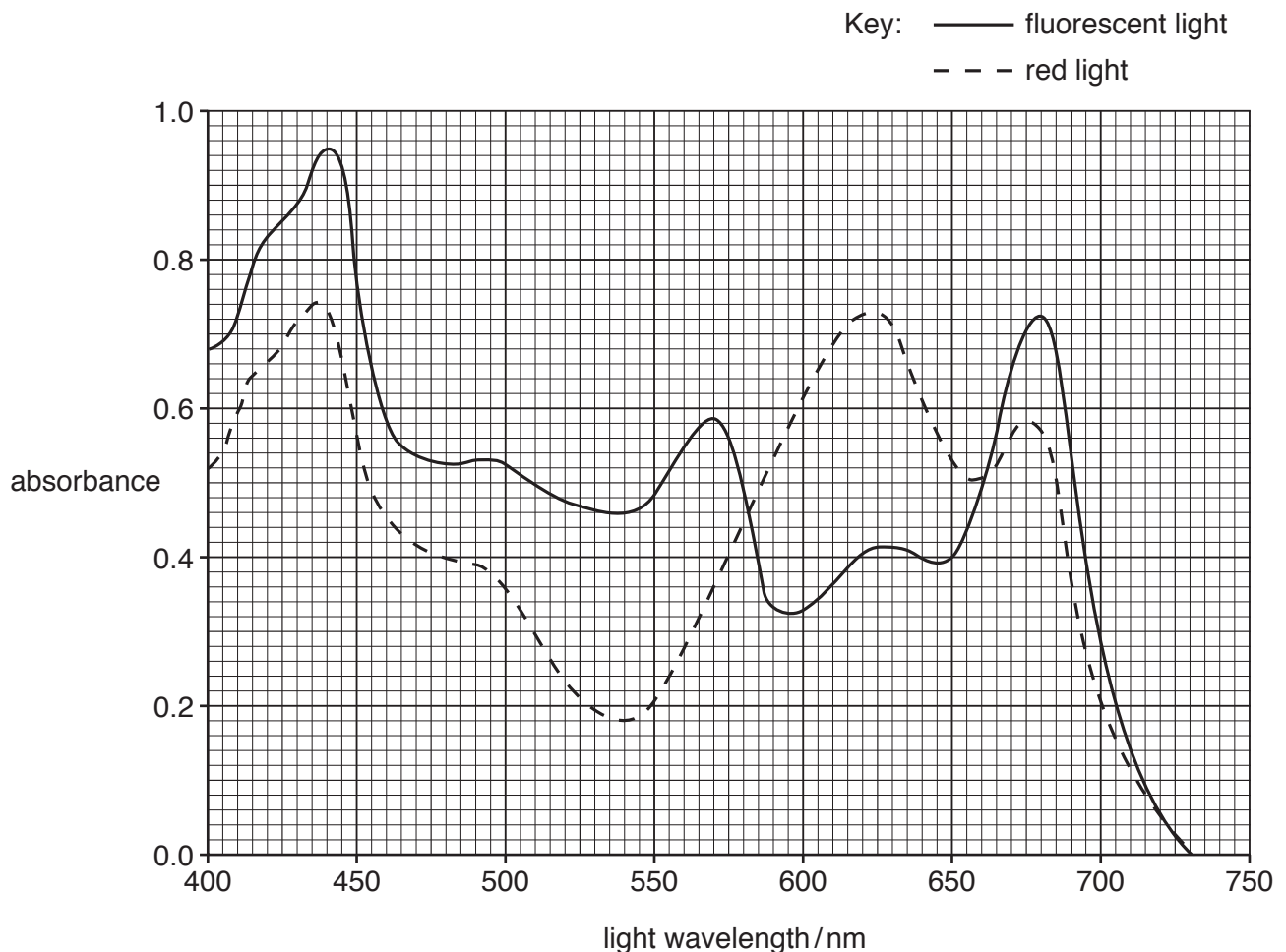


Fig. 2.1

With reference to Fig. 2.1 and the information given on pages 4 and 5, explain the effect of different lighting conditions on the absorption spectra of the two groups of cyanobacteria.

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[Total: 9]

Section B

- 9 (a) Explain the mechanism by which guard cells open stomata. [9]
- (b) State the changes in the external environment that lead to stomatal opening and closure. [6]
Explain why these stomatal responses are necessary.

[Total: 15]

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