

- 3 Plants have several different photosynthetic pigments in their chloroplasts.
- (a) A student separated and identified the chloroplast pigments present in a leaf extract from a spinach plant using two slightly different methods.

Method A

- A type of chromatography known as thin layer chromatography (TLC) was used to separate the pigments.
- A mixture of ether and cyclohexane was used as a solvent in TLC.

Method B

- The student repeated TLC but treated the spinach leaf extract with a chemical. The chemical causes a magnesium ion in a pigment to be replaced by two hydrogen ions.
- The student used a leaf from the same spinach plant, and used the same solvent as in method A.

The student calculated R_f values and compared these to reference values to identify the pigments.

Fig. 3.1 shows the results for method A and method B.

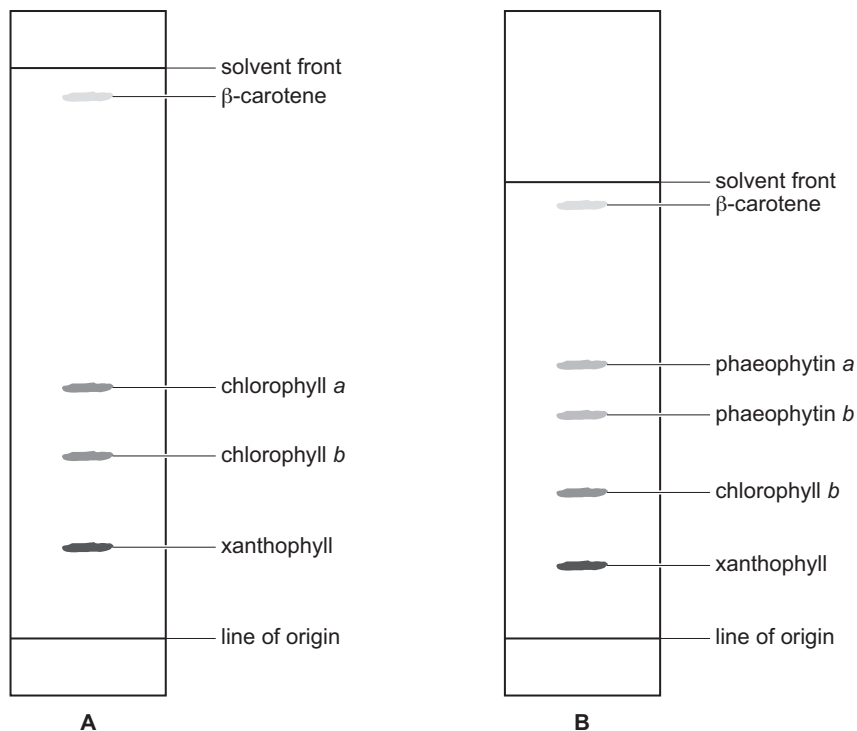


Fig. 3.1

- (i) Calculate the R_f value of β -carotene in Fig. 3.1.

$$R_f = \dots\dots\dots [2]$$

- (ii) Suggest **two** explanations for the differences in appearance of chromatograms A and B in Fig. 3.1.

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- 2
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- [2]

- (iii) The student found some different R_f values for the chloroplast pigments of spinach in a scientific paper.

The values in the scientific paper were different from the reference values that the student originally used to identify the pigments on chromatograms A and B in Fig. 3.1.

Suggest **one** reason, other than measurement error, for the different R_f values.

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- [1]

(b) Fig. 3.2 shows the absorption spectra of some chloroplast pigments.

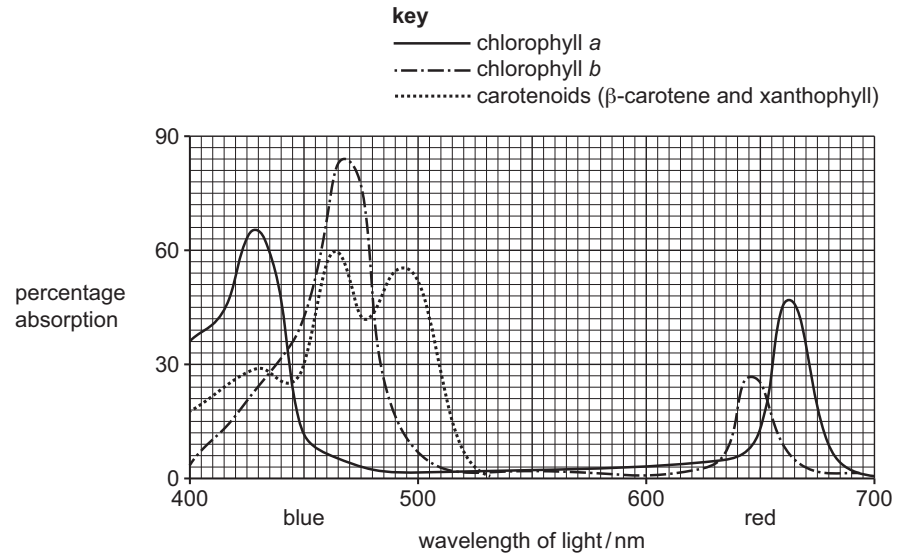


Fig. 3.2

Use Fig. 3.2 to compare the similarities and differences between the absorption spectra of chlorophyll *a* and carotenoids.

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..... [4]

(c) In some species of plant, the absorption of light stimulates seed germination.

The absorption of light increases the production of gibberellin in the embryo of a seed.

Describe the role of gibberellin in the germination of a seed.

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..... [4]

[Total: 13]

10 (a) Cyclic photophosphorylation and non-cyclic photophosphorylation occur during the light-dependent stage of photosynthesis.

Outline the **differences** between cyclic photophosphorylation and non-cyclic photophosphorylation.

[3]

[3]

(b) Complete the passage about the Calvin cycle using the most appropriate word or words.

A molecule of combines with a five-carbon molecule, ribulose biphosphate (RuBP), catalysed by the enzyme

This reaction produces a six-carbon compound that splits into two molecules of a three-carbon compound, glycerate 3-phosphate (GP).

ATP and are used to convert GP molecules into molecules of a three-carbon sugar, triose phosphate (TP).

Some TP molecules are used to make, while others are recycled to regenerate RuBP using ATP.

[4]

[Total: 7]

4 Scientists have invented a way of producing food by artificial photosynthesis.

- Solar panels convert sunlight energy into electricity.
- The electricity powers an electrolysis reaction between carbon dioxide gas and water to form the organic product acetate.
- The single-celled alga *Chlamydomonas*, a protocist, can use acetate to grow and reproduce in the dark, instead of photosynthesising in the light.
- The algae can be processed to make a food product.

Fig. 4.1 shows an outline of the artificial photosynthesis process.

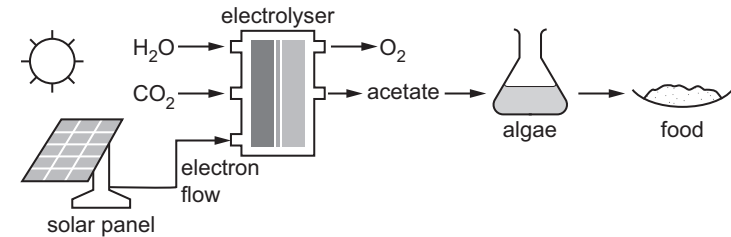


Fig. 4.1

(a) Identify **three** similarities between the artificial photosynthesis process shown in Fig. 4.1 and the normal process of photosynthesis.

[3]

[3]

- (b) Fig. 4.2 shows the single-celled alga *Chlamydomonas*. It contains a large, cup-shaped chloroplast for photosynthesis.



Fig. 4.2

Structures **A** and **B** in Fig. 4.2 are found within the chloroplast.

Name structures **A** and **B**.

A

B

[2]

- (c) Thylakoid membranes are the site of the light-dependent stage of photosynthesis.

- (i) Name the products of the light-dependent stage of photosynthesis.

..... [1]

- (ii) Some of the protein components of the thylakoid membrane have a role in the light-dependent stage of photosynthesis.

Explain the roles of the different proteins that function in the light-dependent stage of photosynthesis.

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- (d) The products of the light-dependent stage of photosynthesis are used in the Calvin cycle. Calvin cycle intermediates are used to produce amino acids, carbohydrates and lipids.

Name the Calvin cycle intermediate that can be used to produce starch.

..... [1]

- (e) Scientists claim that the artificial photosynthesis process shown in Fig. 4.1 is more efficient at converting light energy into food than normal photosynthesis by crop plants.

Give reasons why this claim may or may **not** be true.

true

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not true

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..... [3]

[Total: 14]

- 8 The presence of gibberellins in a plant cell leads to the expression of genes involved in stem elongation.

Describe how gibberellin causes stem elongation in plants.

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[Total: 6]