

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.

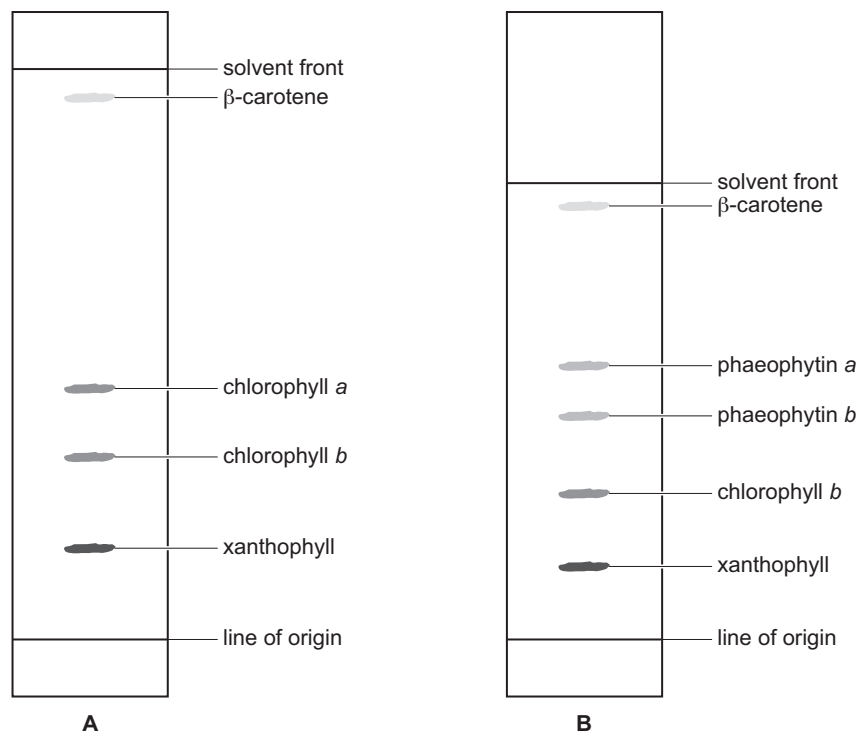


Fig. 3.1

- (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.

- 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.

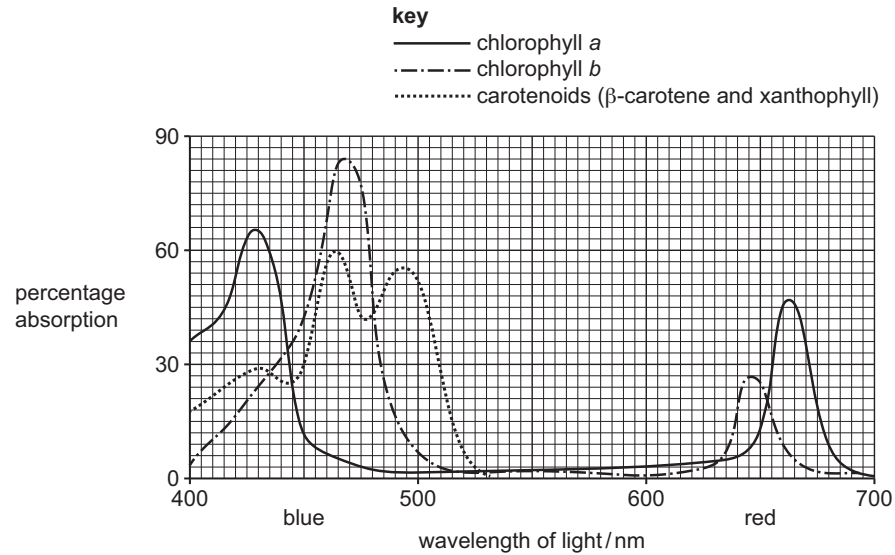


Fig. 3.2

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

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(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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[Total: 13]

- (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]