

Food Supply, Plant Growth and Productivity

20. An action spectrum is a measure of the ability of a plant to
- A absorb all wavelengths of light
 - B absorb light of different intensities
 - C use light to build up food
 - D use light of different wavelengths for photosynthesis.

10. Nettles are plants which often grow below trees. Their leaves contain photosynthetic pigments X and Y. The table shows the percentage of light of different wavelengths absorbed by these pigments.

Wavelength of light (nm)	Colour of light	Light absorbed (%)	
		Pigment X	Pigment Y
400	violet	40	20
440	blue	60	30
550	green	5	60
680	red	50	5

- (a) State what else can happen to light striking the leaves of plants, apart from it being absorbed. 1

- (b) Identify which of the pigments in the table, X or Y, is chlorophyll a. 1

Explain your choice.

Pigment _____

Explanation _____

- (c) (i) Describe the relationship between the wavelength of light and the percentage of light absorbed by pigment Y. 2

- (ii) Describe how the presence of pigment Y in their leaves would benefit nettle plants growing below trees. 1

8. The following statements describe stages in the Calvin Cycle (carbon fixation).

- 1 Carbon dioxide attaches to ribulose biphosphate (RuBP) producing 3-phosphoglycerate (3PG).
- 2 3-phosphoglycerate (3PG) forms glyceraldehyde-3-phosphate (G3P).
- 3 Glyceraldehyde-3-phosphate (G3P) regenerates ribulose biphosphate (RuBP).

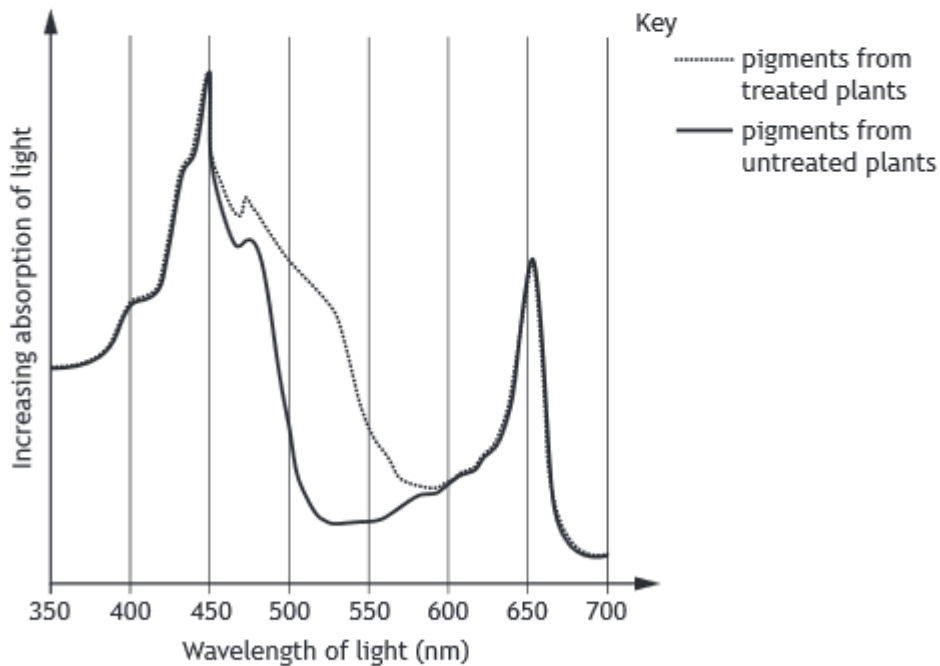
Which row in the table identifies the stage which is catalysed by RuBisCO and the stage which requires hydrogen?

	<i>Catalysed by RuBisCO</i>	<i>Requires hydrogen</i>
A	1	2
B	1	3
C	3	1
D	3	2

7. Oil extracted from the seeds of the crop false flax (*Camelina sativa*) can be used as fuel. An investigation was carried out into the effect of a plant growth regulator paclobutrazol (PBZ) on the photosynthetic pigment content of the leaves and the oil yield from the seeds of false flax. The results are shown in the table.

Treatment	Average photosynthetic pigment content (mg/g of leaf)		Average oil yield (g/plant)
	Chlorophyll a and b	Carotenoids	
Untreated	3.28	3.02	1.7
Treated with PBZ	3.27	3.98	2.4

Absorption spectra for pigments from the treated and untreated plants were produced and are shown in the graph.



- (a) (i) Use values from the graph to describe the difference in absorption spectra of the pigments from treated and untreated plants.

1

(ii) Use evidence from the table to explain the difference in the absorption spectra. 1

(iii) State one use that plants make of the light energy absorbed by pigments during photosynthesis. 1

(b) Suggest why seeds from the plants treated with PBZ yield more oil. 2

14. Livestock production generates less food per unit area of land than crop production because

- A energy is gained between trophic levels of the food chain
- B livestock production degrades natural resources
- C energy is lost between trophic levels of the food chain
- D it is easier to grow crops than raise livestock in difficult habitats.

11. During photosynthesis light energy is absorbed by photosynthetic pigments in the chloroplasts.

(a) (i) State one fate of the light which is not absorbed by the photosynthetic pigments. 1

(ii) Describe the effect of absorbed light energy on the pigment molecules. 1

(iii) Plants contain several pigments including chlorophyll a, chlorophyll b and carotenoids. Explain the advantage to a plant of having more than one type of photosynthetic pigment. 1

(b) Following photolysis, hydrogen is transferred to the coenzyme NADP. State the source of this hydrogen. 1

(c) Describe the role of the NADPH in the Calvin cycle (carbon fixation). 1

MARK:

12. Potato plants are attacked by leaf eating caterpillars. *Bacillus thuringiensis* is a bacterium which can be used to control these pests. The bacteria produce a protein (Bt toxin) which kills these caterpillars.

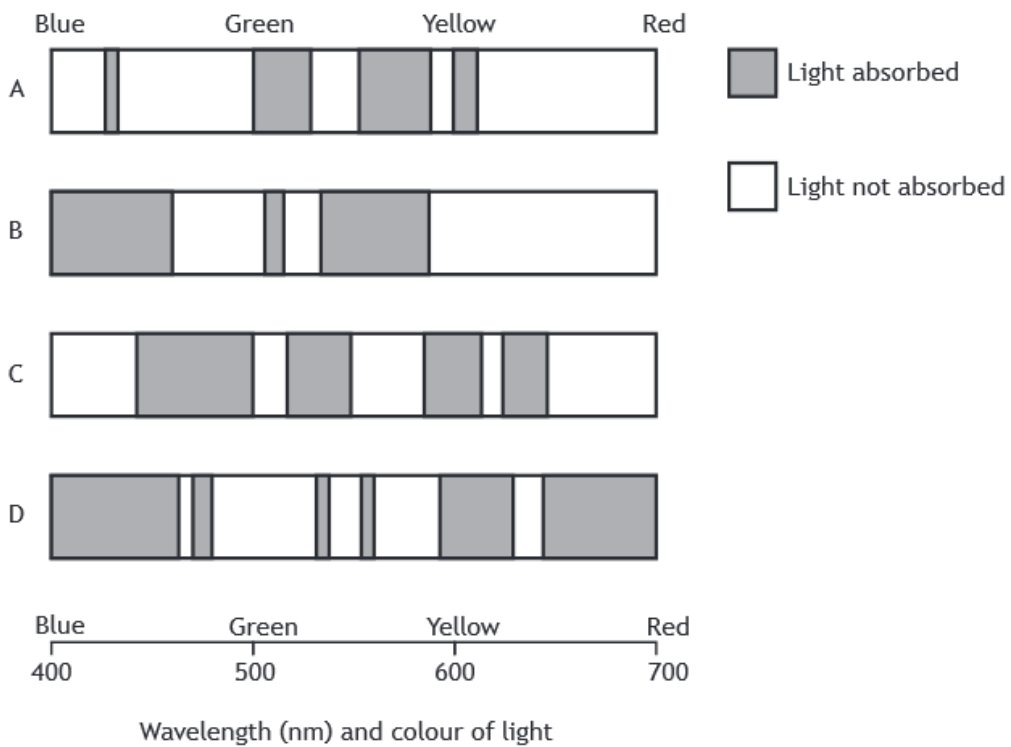
(a) (i) Explain how an attack by leaf eating caterpillars causes a reduction in crop yield. 2

14. Which compound combines with hydrogen during carbon fixation (Calvin cycle)?

- A Ribulose biphosphate
- B NADP
- C Oxygen
- D 3-phosphoglycerate

15. The following absorption spectra were obtained by testing four different plant extracts.

Which extract contains chlorophyll?



16. The table below shows the biological and economic yields of four different crops.

<i>Crop</i>	<i>Biological yield</i> (tonnes of dry mass/hectare)	<i>Economic yield</i> (tonnes of dry mass/hectare)
pea	10	2
rice	15	10
wheat	30	8
potato	30	10

The crop with the highest harvest index is

- A pea
- B rice
- C wheat
- D potato.