5. *(a)* Name the mineral ion that is required for chlorophyll synthesis. [1]

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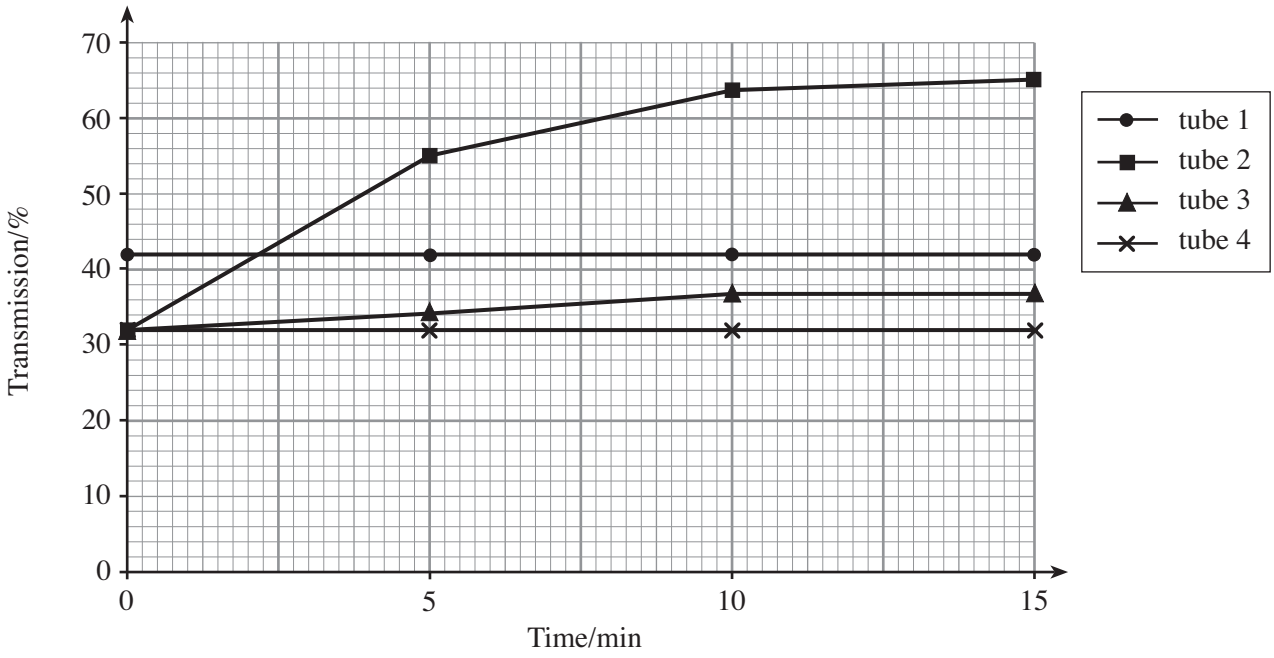
(b) An experiment was carried out to investigate the photosynthetic activity of isolated chloroplasts.
The photosynthetic activity was indicated by the reduction of a dye, DCPIP. When oxidised, DCPIP is blue but when reduced, by gaining electrons, it is colourless.

Four test tubes were prepared as follows:

Tube	*Contents*	*Treatment*	*DCPIP decolourised?*
1	$2cm^3$ buffer solution $5cm^3$ DCPIP	Placed in bright light	
2	$2cm^3$ chloroplast suspension $5cm^3$ DCPIP	Placed in bright light	
3	$2cm^3$ boiled chloroplast suspension $5cm^3$ DCPIP	Placed in bright light	
4	$2cm^3$ chloroplast suspension $5cm^3$ DCPIP	Placed in darkness	

At intervals during the experiment, the percentage of light transmitted (passing through) each tube was measured. This was recorded and plotted on a graph.



(i) Complete the table above, using a tick (✓) or a cross (×), to show whether the DCPIP is decolourised in each tube. [2]

(ii) Explain the difference in transmission observed in the contents of tubes 2 and 4 during the experiment. [5]

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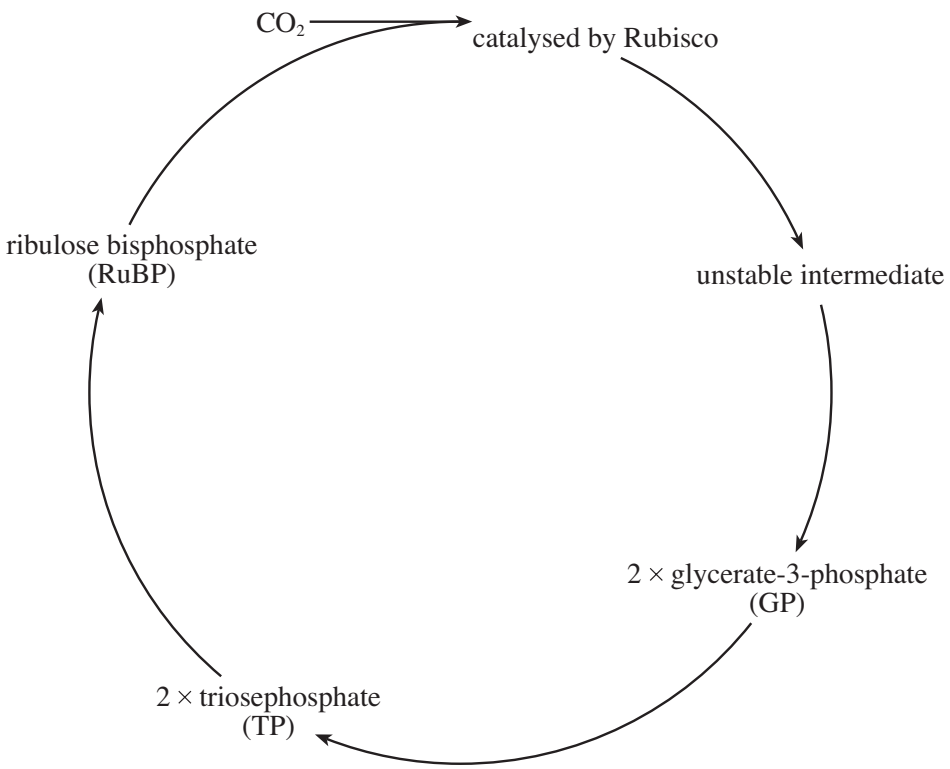
(c) The Calvin cycle is outlined in the diagram below.



Complete the diagram to show

(i) where reduced NADP is required; [1]

(ii) where ATP is required; [2]

(iii) a 3-carbon compound; [1]

(iv) a 5-carbon compound. [1]

(d) The enzyme Rubisco is able to catalyse more than one reaction. In addition to its role in the Calvin cycle, it is also able to catalyse the combination of oxygen with ribulose bisphosphate. This has the effect of the cells taking up oxygen and releasing carbon dioxide when exposed to very bright light. This process is known as photorespiration.

Using this information, suggest why photorespiration is a disadvantage to the plant. [3]

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(Total 16 marks)

Question			Answer/Explanatory Notes	Marks Available
5.	(a)		Magnesium	1 mark
	(b)	(i)	× ✓ × ×; *all correct = 2, 1 mistake = 1, 2 or more mistakes = 0*	2 marks
		(ii)	*tube 2* transmission has increased; DCPIP has lost blue colour; DCPIP has been reduced; by electrons; *Allow hydrogen* released from chlorophyll/reaction centre when light absorbed; (not: chloroplast) *tube 4* transmission remains the same; no light for light dependent reaction; (not: photolysis)	Max 5
	(c)	(i)	between GP and TP;	1 mark
		(ii)	between GP and TP; between TP and RuBP;	2 marks
		(iii)	GP/TP;	1 mark
		(iv)	RuBP;	1 mark

Question	Answer/Explanatory Notes	Marks Available
(d)	loss of available RuBP/not bonding with CO_2; less carbon dioxide fixed; less productivity/photosynthesis less efficient/rate limited; does not take advantage of bright light/products of light dependent reaction;	Max 3
		Question Total: 16