0 4 A student isolated chloroplasts from spinach leaves into a solution to form a chloroplast suspension. He used the chloroplast suspension and DCPIP solution to investigate the light-dependent reaction of photosynthesis. DCPIP solution is blue when oxidised and colourless when reduced.

The student set up three test tubes as follows:

- **Tube 1** – 1 cm^3 of solution without chloroplasts and 9 cm^3 of DCPIP solution in light.
- **Tube 2** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in darkness.
- **Tube 3** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in light.

The student recorded the colour of the DCPIP in each of the tubes at the start and after the tubes had been left at 20 °C for 30 minutes.

His results are shown in **Table 1**.

Table 1

Tube	Colour of DCPIP in tube	
	At start	After 30 minutes
1	blue	blue
2	blue	blue
3	blue	colourless

0 4 . 1 The solution that the student used to produce the chloroplast suspension had the same water potential as the chloroplasts.

Explain why it was important that these water potentials were the same.

[2 marks]

0 4 . 2 Explain why the student set up **Tube 1**.

[2 marks]

0 4 . 3 Explain the results in **Tube 3**.

[2 marks]

0 4 . 4 The student evaluated the effectiveness of different chemicals as weed-killers by assessing their ability to prevent the decolourisation of DCPIP in chloroplast suspensions.

He added different concentrations of each chemical to illuminated chloroplast suspensions containing DCPIP. He then determined the IC_{50} for each chemical. The IC_{50} is the concentration of chemical which inhibits the decolourisation of DCPIP by 50%.

Explain the advantage of the student using the IC_{50} in this investigation.

[1 mark]

Question 4 continues on the next page

0 4 . 5 Explain how chemicals which inhibit the decolourisation of DCPIP could slow the growth of weeds.

[2 marks]

9