1. Mistletoe is a green plant that is often seen growing high in a tree in winter.

Mistletoe can photosynthesise, but not at a very fast rate.

It therefore needs to act as a parasite on the tree.

Scientists investigate two different species of mistletoe growing on a tree. One species of mistletoe has greener leaves than the other.

They give the tree carbon dioxide which contains radioactive carbon.

The carbon dioxide is not supplied to the mistletoe.

They then measure:

- the chlorophyll content of the mistletoe plants,
- the percentage of sugar that is radioactive in each type of mistletoe.

The table shows their results.

Species of mistletoe	**Chlorophyll content in mg / g of tissue**	**Percentage of sugar in the mistletoe that is radioactive (%)**
Dwarf mistletoe	0.4	39
Eastern mistletoe	0.9	1

i. Explain why sugar in the mistletoe becomes radioactive.

_____

_____

_____

_____ **[2]**

ii. Explain the relationship between the chlorophyll content and the percentage of radioactive sugar in each species of mistletoe.

[3]

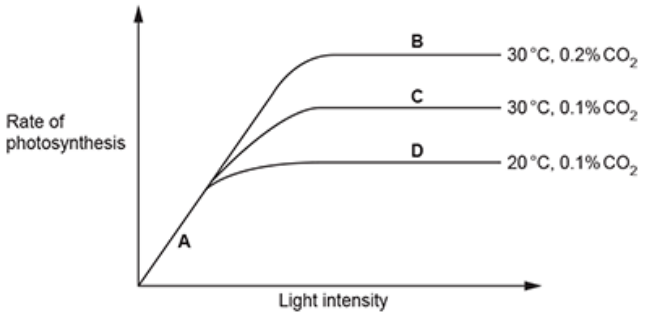
2. What is the balanced equation for photosynthesis?

A $3CO_2 + 3H_2O \rightarrow C_6H_{12}O_6 + 3O_2$
B $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
C $C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$
D $6H_2O + 6O_2 \rightarrow C_6H_{12}O_6 + 6CO_2$

Your answer ☐ **[1]**

3. The graph shows the effect of light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis.

At which point, **A**, **B**, **C** or **D** is light the limiting factor for photosynthesis?

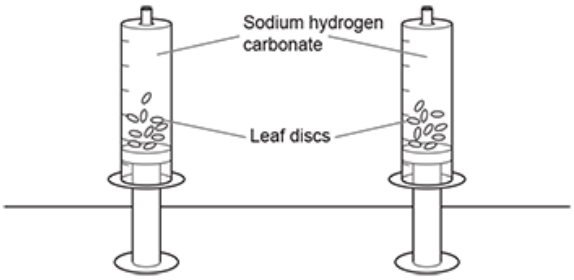


Your answer ☐ **[1]**

4(a). A student investigates the rate of photosynthesis in two different species of plant.

The student's method:

- Cut 10 leaf discs from a leaf of one of the plants.
- Place the discs into a syringe containing sodium hydrogen carbonate solution.
- Repeat this using a leaf from the other plant.
- Record the time it takes for the leaf discs to rise to the top of each syringe.



Give **three** variables that the student must control to ensure that data collected for the two species of plant is valid.

1 _____

_____

2 _____

_____

3 _____

[3]

(b). Explain why the leaf discs rise to the top of the syringes.

_____

[1]

(c). Describe how the student could change their investigation to find the effect of light intensity on the rate of photosynthesis for **one** type of leaf.

_____

_____

_____

_____

[3]

5. Single-celled algae found in the ocean absorb large amounts of carbon dioxide.

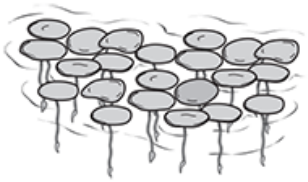
Which process inside the cells of the algae uses this carbon dioxide?

A Homeostasis
B Photosynthesis
C Respiration
D Temperature regulation

Your answer ☐ **[1]**

6(a). Some students investigate the effect of run-off water from a farm on the growth of plants. The run-off water is washed off the fields in the farm when it rains.

They use a pond plant called duckweed, shown in the diagram. A duckweed plant has a single leaf that floats on the surface of the water.
They chose duckweed because it is easy to count the plants.



This is the method they follow:

- Put different volumes of clean pond water and run-off water into 4 beakers.
- Add 3 duckweed plants into each beaker.
- Leave the beakers for ten days at the same temperature.

The table shows the results.

Beaker number	Contents	Number of duckweed plants after ten days
1	250 cm^3 of pond water	6
2	230 cm^3 of pond water + 20 cm^3 of run-off	12
3	210 cm^3 of pond water + 40 cm^3 of run-off	24
4	190 cm^3 of pond water + 60 cm^3 of run-off	48

i. Explain why the students put different volumes of clean pond water into each beaker.

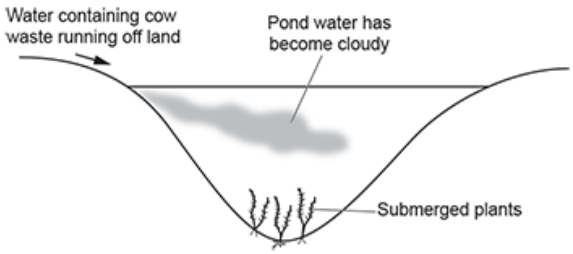
[2]

ii. To improve their experiment, the students should make sure that the carbon dioxide levels are the same in each beaker.

Describe how they could achieve this.

[1]

(b). An article said that the run-off water contains waste from cows and this makes the pond water cloudy. The run-off water is reducing the growth of submerged plants that grow in the pond.
The diagram shows this process.



Explain the results of the students' experiment and why using duckweed produces results that do **not** agree with the effect of run-off water described in the article.

[3]

(c). The students change their method to use a submerged plant rather than using duckweed.

Describe how the students could change their method to measure the growth of the submerged plant.

[1]

7. In experiments about photosynthesis, it is often necessary to compare light intensities.

Which equation gives the light intensity at a distance (d) from a light source?

A Light intensity = $1/d$

B Light intensity = $1/d^2$

C Light intensity = $d - 1$

D Light intensity = $\frac{d \times 2}{1}$

Your answer ☐ **[1]**

END OF QUESTION PAPER