1 **(a)** State the balanced chemical equation for photosynthesis.

$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$

[2]

A student investigated the effect of different wavelengths of light on the rate of photosynthesis of the water plant, *Cabomba*.

The student used the apparatus shown in Fig. 6.1.

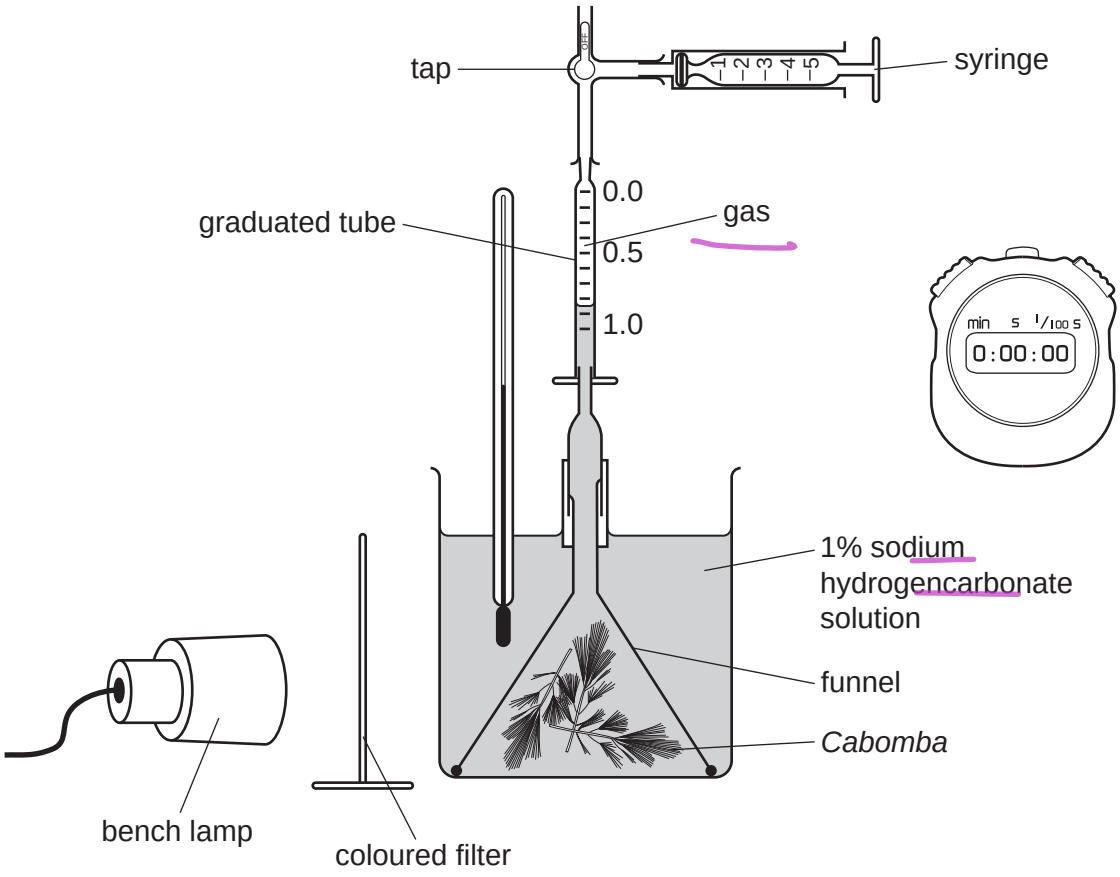

Fig. 6.1

(b) The student collected the gas produced by the plant for five minutes. The results are shown in Table 6.1.

Table 6.1

colour of filter	wavelength of light / nm	volume of gas collected / cm^3
violet	400	0.80
blue	475	0.80
green	550	0.20
yellow	600	0.40
red	675	0.90

Describe the effect of wavelength of light on the rate of photosynthesis as shown in the student's results in Table 6.1.

You will gain credit if you use data from the table.

as wavelength increases → Rate of photosynthesis decreases and increases

Max Rate → 0.9cm³ at 675nm/red

Min Rate → 0.2cm³ at 550nm/green

..... [3]

(c) State how the student would calculate the rates of photosynthesis from the results in Table 6.1.

Divide the volumes → Average Rate

5

..... [1]

(d) State why the student:

(i) kept the lamp at the same distance during the investigation,

to keep the light intensity same

[1]

(ii) used sodium hydrogencarbonate solution.

to provide CO_2, so CO_2 is not a limiting factor
only limiting factor is light

[1]

(e) State **three** uses in a plant of the carbohydrate produced in photosynthesis.

1 for respiration, energy, converted to sucrose
2 To make nectar, cellulose, starch (storage)
3 To make amino acids, (cell walls)
chloroplyll

[3]

[Total: 11]

2 Fig. 2.1 is a flow chart that shows the events that occur as light travels through the eye.

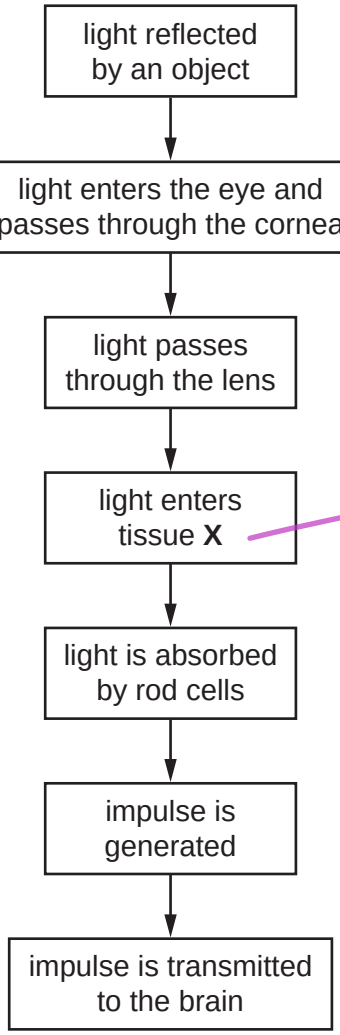

Fig. 2.1

(a) **(i)** State the name of the tissue **X**.

..... [1]

(ii) State the name of the nerve that transmits impulses from the eye to the brain.

..... [1]

(iii) State what happens to rays of light as they enter the cornea and the lens.

..... [1]

(iv) Describe the role of rod cells.

sensitive to ~~detect~~ light in low light intensity
pass impulse to optic nerve

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[2]

(b) A plant, *Arabidopsis thaliana*, was placed on its side in the dark. Fig. 2.2 is a series of drawings made of the plant, over seven days, as it responded to a change in its surroundings.

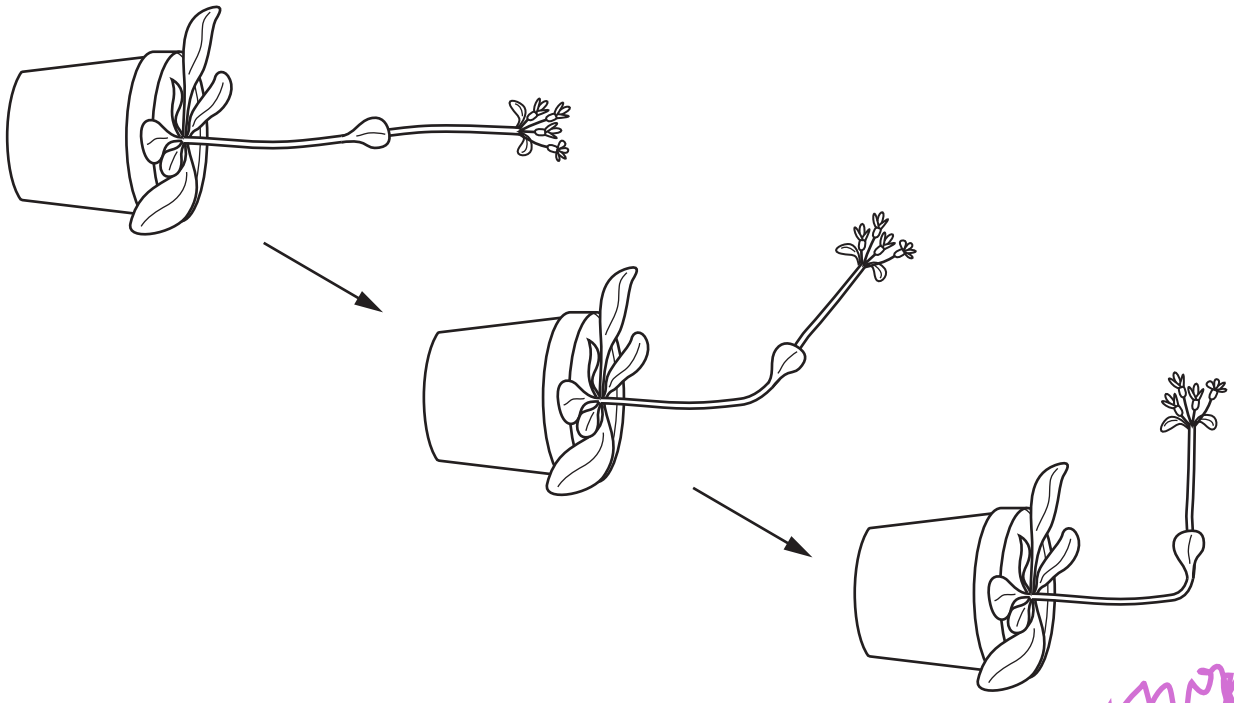

Fig. 2.2

(i) State the stimulus to which the plant responded.

gravity → shoot is negative geotropic

.....

.....

[1]

(ii) Name the growth response shown by the plant.

Negative geotropism

.....

.....

[2]

(iii) Explain the advantage to plants of the growth response shown in Fig. 2.2.

upward — grow towards while light should be
more light absorbed — more photosynthesis more gro
flowers more likely to attract insects (pollinators)
more likely to release / shed / disperse seeds
downward — better anchorage — absorb H_2O & mineral ions

[2]

(iv) Auxins control the growth responses of seedlings.

Explain how auxins control the growth response of *A. thaliana*, shown in Fig. 2.2.

Auxins → made in shoot tip → spread / diffuse — away
stimulates cell elongation ← auxin effect ← distribution auxin in lower side (where it accumulates) of stem

[4]

[Total: 14]

3 A student carried out an investigation to find the effect of carbon dioxide concentration on the rate of photosynthesis of an aquatic plant.

The apparatus that the student used is shown in Fig. 2.1. The student was advised to use a light meter positioned at the same distance from the lamp as the pond plant. The student counted the number of bubbles produced by the cut end of the stem.

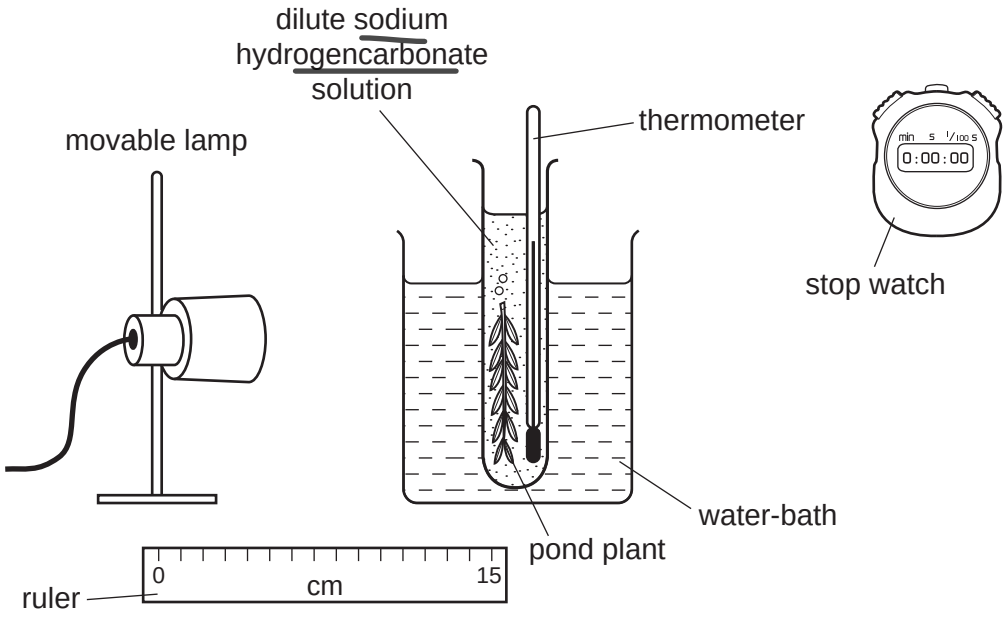

Fig. 2.1

(a) Explain why the student included the following in the apparatus.

(i) The beaker of water and the thermometer.

maintain constant temp, prevent heat from lamp heating the water, absorb heat from lamp
Thermometer → to monitor, check, record, measure
prevent temp change, affecting the results (rate of
controls

.....[2]

(ii) The light meter and the ruler.

maintain constant light intensity
light meter → to measure, check, record light intensity

.....[2]

(b) The results obtained by the student are shown in Fig. 2.2.

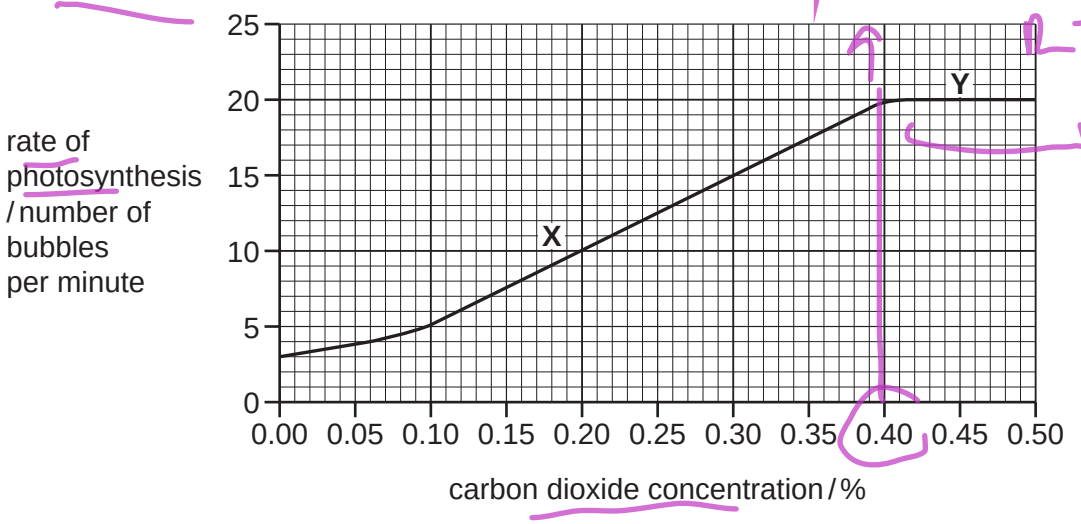

Fig. 2.2

(i) Describe the student's results.

You will gain credit if you use data from Fig. 2.2 in your answer.

.....

.....

.....

.....

.....

.....[3]

(ii) State the factor that is limiting the rate of photosynthesis in region **X** of the graph.

.....[1]

(iii) Suggest **and** explain the reasons for the shape of the graph in region **Y**.

CO2 is no longer limiting factor in region Y
light intensity could be a limiting factor
but light providing energy for photosynthesis is
Temp could be a limiting factor
but temp influencing activity of enzymes

.....[4]

(c) Counting bubbles may not be the best way to measure the rate of photosynthesis. The volume of the bubbles is not always exactly the same.

Suggest and explain **one** alternative way of measuring the gas given off to solve this problem.

measure volume of O2 gas → by inverted test tube,
cylinder / syringe → graduations / marking
filled with H2O
readings from → gas pushes to top → low
displacement of H2O → Gas syringe

attach by tube

or O2 sensor

flask

volcano

(d) Fig. 2.3 shows the carbon dioxide concentration in the atmosphere as determined at Mauna Loa in Hawaii between 1959 and 2013.

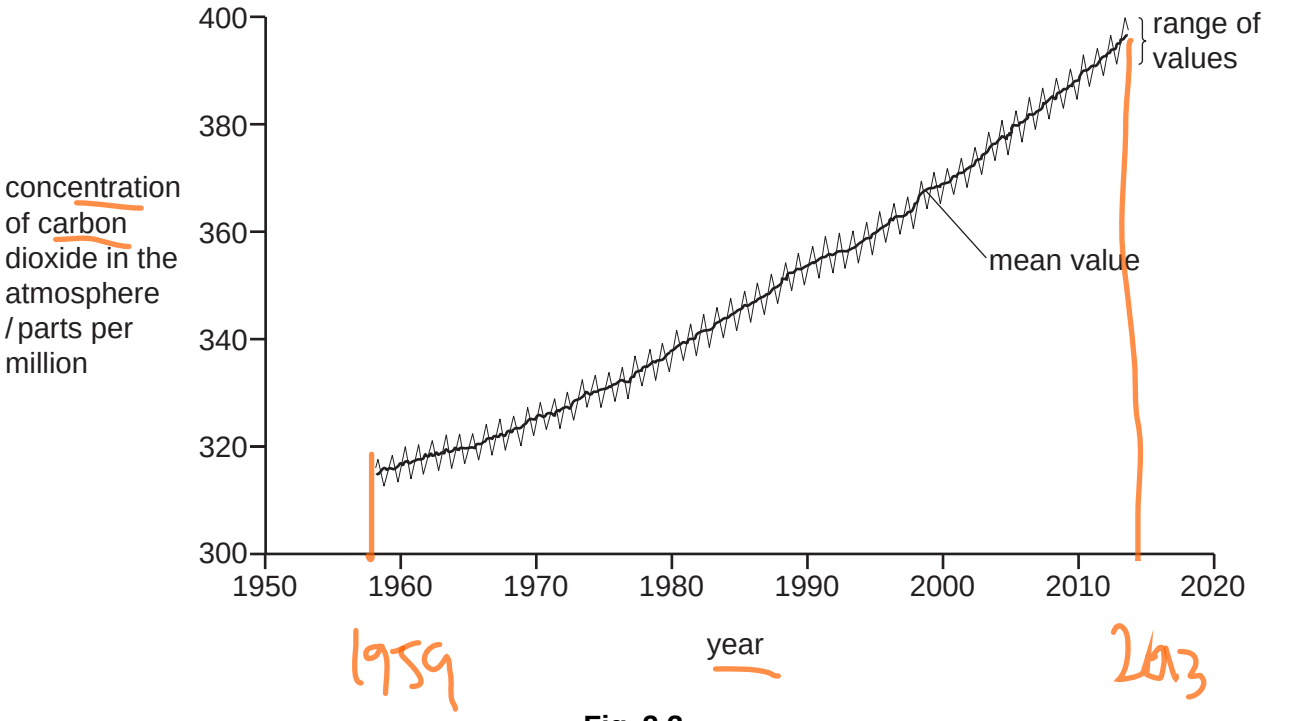

Fig. 2.3

(i) Explain why the concentration of carbon dioxide has increased between 1959 and 2013.

combustion / burning of fossil fuels

increased demand of energy

CO_2 from volcano activity

Deforestation — burning of forests

.....[2]

(ii) Global warming is largely due to this increase in atmospheric carbon dioxide.

Explain how increases in atmospheric carbon dioxide concentrations contribute to global warming.

CO2 → greenhouse gas → greenhouse effect

heat infra-red / long wavelength radiation emitted from earth → trapped / absorbed by greenhouse gas → travel back to earth — heat atmosphere → temp ↑

.....[4]

[Total: 21]