1. What is the name of the process which takes place in living cells in your body and which releases energy from oxygen and glucose?

**1**

.....................................................................................................................................

**(1)**

1. Name the **two** products of the process in part (i).

............................................................... and ..............................................................

**(1)**

**(Total 2 marks)**

1. Yeast cells can respire anaerobically.

**2**

The equation for anaerobic respiration in yeast is:

glucose  alcohol + carbon dioxide (+ energy)

Give **one** way in which anaerobic respiration in yeast cells is different from anaerobic respiration in human muscle cells.

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**(1)**

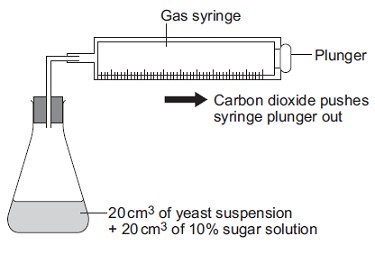
1. Yeast can use other types of sugar instead of glucose.

Some scientists investigated the effect of three different types of sugar on the rate of anaerobic respiration in yeast.

The scientists:

* + used the apparatus shown in **Diagram 1** with glucose sugar
  + kept the apparatus at 20 °C
  + repeated the investigation with fructose sugar and then with mannose sugar
  + repeated the investigation with water instead of the sugar solution.

# Diagram 1



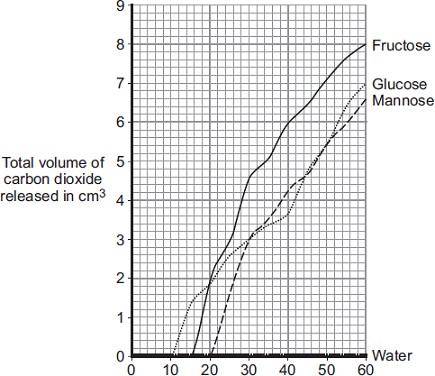
1. Give **two** control variables the scientists used in this investigation.

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**(2)**

1. The graph shows the scientists’ results.



Time in minutes

From this information, a company decided to use fructose to produce alcohol and **not**

mannose or glucose.

Explain the reason for the company’s choice.

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**(2)**

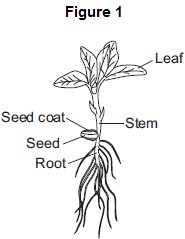
**(Total 5 marks)**

Catalase is an enzyme found in many different tissues in plants and animals.It speeds up the rate of the following reaction.

**3**

hydrogen peroxide  water + oxygen

**Figure 1** shows a 25-day-old broad bean seedling.



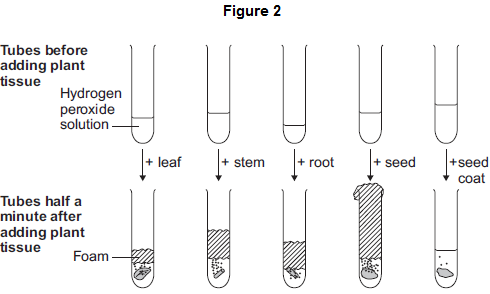
Some students investigated whether different parts of bean seedlings contained different amounts of catalase.

The students:

* + put hydrogen peroxide into five test tubes
  + added a different part of a bean seedling to each tube
  + recorded the results after half a minute.

If there was catalase in part of the seedling, oxygen gas was given off. When oxygen gas is given off, foam is produced in the tubes.

**Figure 2** shows the results.



The students made the following conclusions:

* most parts of a bean seedling contain catalase
* the seed contains a lot of catalase
* stems and roots have quite a lot of catalase
* the leaves have a little bit of catalase
* the seed coat has hardly any catalase.

The students’ teacher said that the students needed to improve their investigation in order to make valid conclusions.

# In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe how you would carry out an investigation to compare the amounts of catalase in different parts of bean seedlings.

You should include details of how you would make sure your results give a valid comparison of the amounts of catalase.

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**(6)**

1. Scientists investigated the effect of pH on the activity of the enzyme catalase in a fungus.

The table below shows the scientists’ results.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **pH** | **Enzyme activity in arbitrary units** | | | | | |
| **Test 1** | **Test 2** | **Test 3** | **Test 4** | **Test 5** | **Mean** |
| 3.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4.0 | 6 | 5 | 8 | 4 | 7 | 6 |
| 5.0 | 38 | 65 | 41 | 42 | 39 |  |
| 5.5 | 80 | 86 | 82 | 84 | 88 | 84 |
| 6.0 | 100 | 99 | 96 | 103 | 102 | 100 |
| 6.5 | 94 | 92 | 90 | 93 | 91 | 92 |
| 7.0 | 61 | 63 | 61 | 62 | 63 | 62 |
| 8.0 | 22 | 22 | 21 | 24 | 21 | 22 |

* 1. Calculate the mean enzyme activity at pH 5.0.

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Mean = ......................... arbitrary units

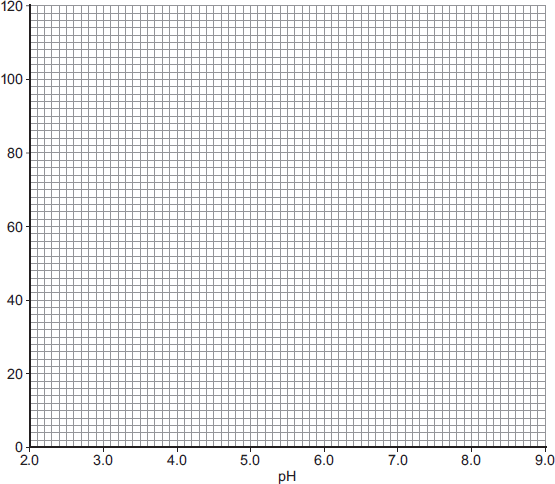
**(2)**

* 1. On the graph paper in **Figure 3**, draw a graph to show the scientists’ results.

Remember to:

* + - add a label to the vertical axis
    - plot the mean values of enzyme activity
    - draw a line of best fit.

# Figure 3



**(4)**

* 1. At what pH does the enzyme work best?

........................................

**(1)**

* 1. Predict the activity of the enzyme at pH 9.0.

........................................ arbitrary units

**(1)**

* 1. Suggest why the enzyme’s activity at pH 3.0 is zero.

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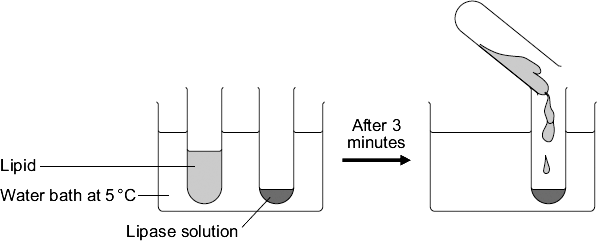
**(1)**

**(Total 15 marks)**

A group of students investigated the effect of temperature on the action of the enzyme lipase. The students:

**4**

* put 1 cm 3 of lipase solution into a test tube
* put 5 cm 3 of lipid into a different test tube
* put both tubes in a water bath at 5 °C for 3 minutes
* mixed the lipid with the lipase solution.



Every five minutes the students tested a sample of the mixture for lipid, until no lipid remained. The students repeated the experiment at different temperatures.

1. To make their investigation fair the students needed to control some variables.

Give **one** variable the students controlled in their investigation.

........................................................................................................................

**(1)**

1. The tubes of lipase solution and lipid were kept separately in the water bath for 3 minutes before mixing. Why?

Tick ( ) **one** box.

So that the lipase broke down the lipid quickly  So that the lipase and the lipid reached the right temperature  To give enough time for the lipase to break down the lipid 

To give enough time for the water bath to heat up 

**(1)**

The table shows the students’ results.

|  |  |
| --- | --- |
| **Temperature in °C** | **Time taken until no lipid remained in minutes** |
| 5 | 40 |
| 20 | 15 |
| 35 | 5 |
| 50 | 30 |
| 95 | lipid still there after 120 minutes |

1. Describe the effect on the breakdown of the lipid of increasing the temperature from 5 °C to 50 °C.

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**(2)**

1. Suggest **two** ways in which the students could have improved their investigation.

Use information from the students’ method and the results table to help you. 1 .....................................................................................................................

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2 .....................................................................................................................

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**(2)**

1. (i) The lipase did **not** break down the lipid at 95 °C. Why?

...............................................................................................................

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**(1)**

1. At 35 °C the lipase broke down the lipid after 5 minutes.

What new substances will be in the tube? Draw a ring around **one** answer.

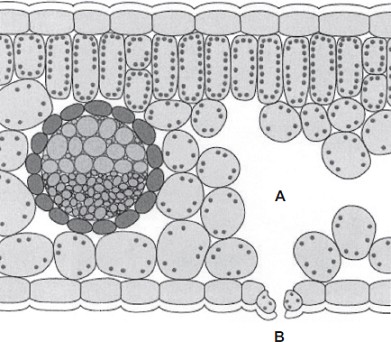
# amino acids fatty acids and glycerol sugars

**(1)**

**(Total 8 marks)**

The diagram shows a section through a plant leaf.

**5**



* 1. Use words from the box to name **two** tissues in the leaf that transport substances around the plant.

**epidermis mesophyll phloem xylem**

.................................................................. and ..................................................................

**(1)**

* 1. Gases *diffuse* between the leaf and the surrounding air.
     1. What is *diffusion*?

...............................................................................................................

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**(2)**

* + 1. Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

...............................................................................................................

**(1)**

**(Total 4 marks)**

Photosynthesis uses carbon dioxide to make glucose.

**6**

1. (i) Complete the equation for photosynthesis.

carbon dioxide + .......................... glucose + ....................

**(2)**

1. What type of energy does a plant use in photosynthesis?

...............................................................................................................

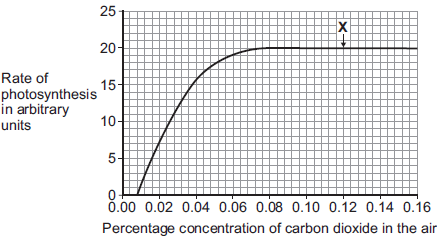
**(1)**

1. Which part of a plant cell absorbs the energy needed for photosynthesis?

...............................................................................................................

**(1)**

1. The graph shows the effect of the concentration of carbon dioxide on the rate of photosynthesis in tomato plants at 20 °C.



* 1. What is the maximum rate of photosynthesis of the tomato plants shown in the graph?

.......................... arbitrary units

**(1)**

* 1. At point **X**, carbon dioxide is **not** a limiting factor of photosynthesis.

Suggest **one** factor that is limiting the rate of photosynthesis at point **X**.

...............................................................................................................

**(1)**

1. A farmer plans to grow tomatoes in a large greenhouse.

The concentration of carbon dioxide in the atmosphere is 0.04%.

The farmer adds carbon dioxide to the greenhouse so that its concentration is 0.08%.

* 1. Why does the farmer use 0.08% carbon dioxide?

Tick ( ) **one** box.

To increase the rate of growth of the tomato plants  To increase the rate of respiration of the tomato

plants

To increase water uptake by the tomato plants 

**(1)**

* 1. Why does the farmer **not** use a concentration of carbon dioxide higher than 0.08%?

Tick ( ) **two** boxes.

Because it would cost more money than using 0.08% 

Because it would decrease the temperature of the greenhouse  Because it would not increase the rate of photosynthesis of the

tomato plants any further

Because it would increase water loss from the tomato plants 

**(2)**

**(Total 9 marks)**

* + 1. A student carried out the following investigation using a plant with variegated leaves. A variegated leaf has green and white stripes.

**7**

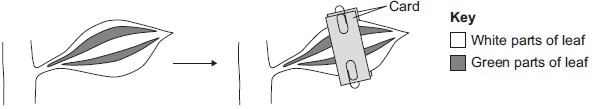
The student:

* + - * left the plant in the dark for 3 days to remove the starch
      * fixed two pieces of card to a leaf on the plant
      * left the plant in the light for 2 days
      * removed the leaf from the plant
      * tested the leaf for starch.

**Figure 1** shows how the two pieces of card were attached to the leaf.

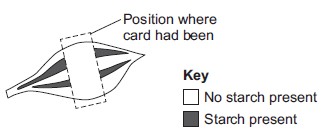
# Figure 1

**Leaf without card Leaf with card**



**Figure 2** shows the same leaf after 2 days in the light. The leaf has been tested for starch.

# Figure 2



Give **two** conclusions from this investigation. Tick ) **two** boxes.

Carbon dioxide is needed for photosynthesis.  Chlorophyll is needed for photosynthesis.  Light is needed for photosynthesis. 

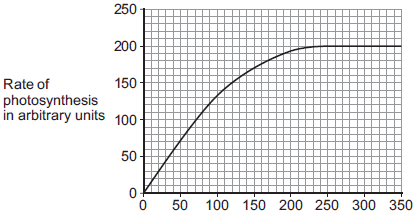
Water is needed for photosynthesis. 

**(2)**

* + 1. Scientists investigated the effect of light intensity on the rate of photosynthesis.

**Figure 3** shows the scientists’ results.

# Figure 3



Light intensity in arbitrary units

Describe the effect of increasing light intensity on the rate of photosynthesis. You should include numbers from **Figure 3** in your description.

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**(3)**

* + 1. At a light intensity of 250 arbitrary units, light is **not** a limiting factor of photosynthesis.

1. What is the evidence for this in **Figure 3**?

...............................................................................................................

...............................................................................................................

**(1)**

1. Give **two** factors that could be limiting the rate of photosynthesis at a light intensity of 250 arbitrary units.

1 ............................................................................................................

2 ............................................................................................................

**(2)**

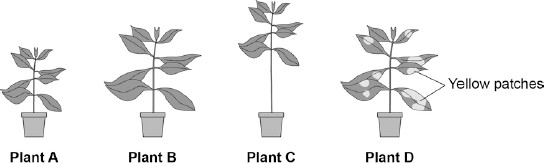
**(Total 8 marks)**

To be healthy, plants need the right amount of mineral ions from the soil. The diagram below shows four plants.

**8**

The plants were grown in four different growing conditions:

* + sunny area, with nitrate and magnesium added to the soil
  + sunny area, with magnesium but **no** nitrate added to the soil
  + sunny area, with nitrate but **no** magnesium added to the soil
  + dark area, with nitrate and magnesium added to the soil.



1. Which plant was grown with no **nitrate?**

Tick **one** box.

# A B C D

**(1)**

1. Which plant was grown with no **magnesium?**

Tick **one** box.

# A B C D

**(1)**

1. Give **one** variable that was kept constant in this experiment.

........................................................................................................................

........................................................................................................................

**(1)**

1. Plants need other minerals for healthy growth such as potassium ions and phosphate ions.

A farmer wanted to compare the percentage of minerals in two types of manure.

* Cow manure from her own farm.
* Chicken manure pellets she could buy.

The table below shows data for each type of manure.

|  |  |  |
| --- | --- | --- |
|  | **Phosphate ions in %** | **Potassium ions in %** |
| Cow manure | 0.4 | 0.5 |
| Chicken manure pellets | 2.5 | 2.3 |

Suggest **one** advantage and **one** disadvantage of using the chicken manure pellets compared to the cow manure.

Advantage ......................................................................................................

........................................................................................................................

Disadvantage .................................................................................................

........................................................................................................................

**(2)**

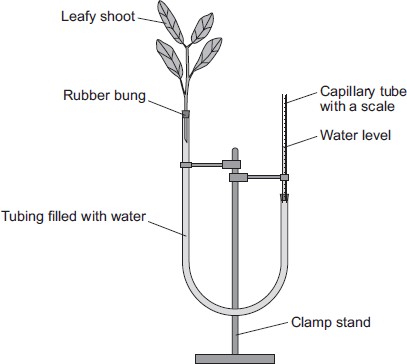
**(Total 5 marks)**

A potometer is a piece of apparatus that can be used to measure water uptake by a leafy shoot.

**9**

**Figure 1** shows a potometer.

# Figure 1



Some students used a potometer like the one shown in **Figure 1.**

* + They measured the water taken up by a shoot in normal conditions in a classroom.
  + As the water was taken up by the shoot, the level of water in the capillary tube went down.
  + The students recorded the level of the water in the capillary tube at 2-minute intervals for 10 minutes.

**Table 1** shows the students’ results.

# Table 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time in minutes | 0 | 2 | 4 | 6 | 8 | 10 |
| Level of water (on scale) in capillary tube in mm | 2.5 | 3.6 | 4.4 | 5.4 | 6.5 | 7.5 |

The area of the cross section of the capillary tube was 0.8 mm2.

1. (i) Complete the following calculation to find the volume of water taken up by the shoot in mm3 per minute.

Distance water moved along the scale in 10 minutes = ...........mm Volume of water taken up by the shoot in 10 minutes = ..........mm3

Therefore, volume of water taken up by the shoot in 1 minute = ...........mm3

**(3)**

(ii) The students repeated the investigation but this time placed the potometer next to a fan blowing air over the leafy shoot.

Suggest how the results would be different. Give a reason for your answer.

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**(2)**

1. The students repeated the investigation at different temperatures.

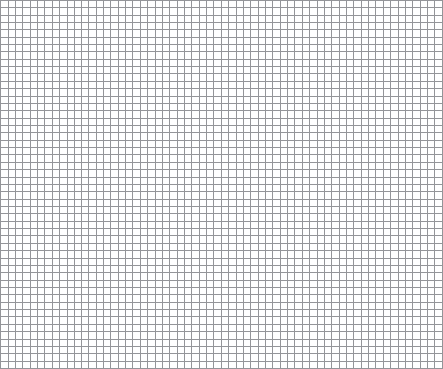
The results are shown in **Table 2.**

# Table 2

|  |  |
| --- | --- |
| **Temperature in °C** | **Rate of water uptake in mm3 per minute** |
| 10 | 0 |
| 15 | 0.4 |
| 20 | 1.0 |
| 25 | 2.1 |
| 30 | 3.2 |
| 35 | 4.0 |
| 40 | 4.4 |

Plot the data from **Table 2** on the graph paper in **Figure 2**. Choose suitable scales, label both axes and draw a line of best fit.

# Figure 2



**(5)**

1. What would happen to the leaves if the potometer was left for a longer time at 40 °C?

Explain your answer.

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**(3)**

**(Total 13 marks)**

Mark schemes

* 1. (aerobic) respiration

**1**

*do not credit anaerobic respiration accept cellular respiration*

* 1. carbon dioxide and water (vapour)

*both required*

*do not credit heat*

**1**

**1**

**[2]**

1. in yeast:

**2**

*’it’ equals yeast*

makes alcohol / makes CO2 / does not make lactic acid

*do not allow uses / involves alcohol / CO2*

**1**

1. (i) any two from:

*allow amount of yeast*

* + volume of yeast / suspension
  + volume of sugar / solution
  + concentration of sugar

*amount of sugar = max 1 for sugar*

* + temperature

*(total) volume = 1 mark if no other volume ignore concentration of yeast*

**2**

(ii) most / more CO2 given off with fructose **or**

*’it’ equals fructose*

faster CO2 production

# or

faster respiration

*allow faster fermentation*

**1**

*do* ***not*** *allow aerobic respiration*

so (rate of) alcohol production will be greatest / more (with fructose)

**1**

1. Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance and apply a ‘best-fit’ approach to the marking.

**3**

# 0 marks

No relevant content.

# Level 1 (1−2 marks)

The method described is weak and could not be used to collect valid results, however does show some understanding of the sequence of an investigation.

# Level 2 (3−4 marks)

The method described could be followed and would enable some valid results to be collected, but lacks detail.

# Level 3 (5−6 marks)

The method described could be easily followed and would enable valid results to be collected.

# Examples of the points made in the response:

* + bean seedlings of same age
  + cut material from same part of each organ (for repeats) e.g. top 1 cm of stem / a whole cotyledon / seed
  + equal mass of each organ

*accept weight for mass*

* + grind / homogenise
  + in equal amounts of water / buffer
  + equal volumes of hydrogen peroxide solution
  + equal concentrations of hydrogen peroxide solution
  + same temperature
  + temperature maintained in water bath
  + quantitative measure of gas production eg height of foam in mm / collect gas in graduated syringe in cm3
  + for same time period
  + repetitions (3+ times)
  + calculate mean for each.

**6**

**[5]**

1. (i) correct answer: 40

***1*** *mark for 45 as the anomalous result has been included in the calculation*

*or*

***1*** *mark for*

*or*

1. vertical axis correctly labelled: ‘Enzyme activity in arbitrary units’

*allow ecf from (b)(i)*

points plotted correctly ±1 mm

*deduct* ***1*** *mark for each incorrect plot*

suitable line of best fit

*not feathery, not point to point*

1. 6.0 / 6

*allow ± 0.1*

*if 6.0 not given, allow correct for candidate’s graph ± 0.1*

1. in range 0 to 14 units

*allow correct for candidate’s graph*

1. enzyme denatured / enzyme (active site) shape changed

*allow substrate no longer fits (active site) ignore reference to temperature*

*do not allow enzyme dies*

**2**

**1**

**2**

**1**

**1**

**1**

**1**

**[15]**

* 1. any **one** from:

**4**

*ignore reference to recording results every 5 minutes* ***or***

*concentrations of lipid / lipase*

* + - (same) volume / amount / 1 cm 3 lipase

*allow amount of solution*

* + - (same) volume / amount / 5 cm 3 lipid

*allow keep same volumes in the test tubes*

* + - mixed after 3 minutes / same time before mixing

*do* ***not*** *accept temperature*

**1**

* 1. so that the lipase and the lipid reached the right temperature

**1**

* 1. any **two** from

*ignore explanations*

* + - decrease in time **or** faster (breakdown)
    - then increase in time **or** then slower (breakdown)
    - fastest / least time / optimum at 35°C

**2**

* 1. any **two** from:

*ignore ‘test at more temperatures’ unqualified*

* + - test more regularly eg test every minute

*any interval < 5min*

* + - test at smaller temperature intervals

*any value <15°C*

*allow test more temperatures in the range*

* + - test between 50 (°C) and 95 (°C)

*any value in range, eg test at 70*

* + - repeat at same temperatures

**or** repeat the investigation

**or** compare results with others

*allow do* ***it*** *again*

**2**

* 1. (i) (lipase / it) denatured / destroyed / changed shape

*allow damaged / deformed do* ***not*** *accept killed*

*ignore broken (down)*

(ii) fatty acids and glycerol

**1**

**[8]**

1. xylem **and** phloem

**5**

*either order*

*allow words ringed in box*

*allow mis-spelling if unambiguous*

1. (i) movement / spreading out of particles / molecules / ions / atoms

*ignore names of substances / ‘gases’*

from high to low concentration

*accept down concentration gradient ignore ‘along’ / ‘across’ gradient ignore ‘with’ gradient*

(ii) oxygen / water (vapour)

*allow O2 / O2*

*ignore O2/ O allow H2O / H2O*

*ignore H2O*

(a) (i) LHS = water

**6**

*accept H2O*

*do* ***not*** *accept H2O / H2O*

RHS = oxygen

*accept O2*

*do* ***not*** *accept O / O2 / O2*

1. light / sunlight

*ignore solar / sun / sunshine do* ***not*** *allow thermal / heat*

1. chloroplasts

*allow chlorophyll*

**1**

**1**

**1**

**1**

**[4]**

**1**

**1**

**1**

**1**

(b) (i) 20

1. any **one** from:
   * light (intensity)
   * temperature.

(c) (i) To increase the rate of growth of the tomato plants

(ii) Because it would cost more money than using 0.08%

Because it would not increase the rate of photosynthesis of the tomato plants any further

1. chlorophyll is needed for photosynthesis

**7**

light is needed for photosynthesis

1. increases

levels off / reaches a maximum / remains constant / stays the same / plateaus

*do* ***not*** *allow stops / stationary / peaks allow stops increasing*

goes up to / reaches a maximum / levels off at (a rate of) 200 (arbitrary units)

# or

levels off at 225 – 240 (light units)

*ignore references to other numerical values*

1. (i) higher light intensity does not increase rate of photosynthesis

*accept the graph stays level (above this value) allow stops increasing*

*allow the rate of photosynthesis stays the same (above this value)*

**1**

**1**

**1**

**1**

**1**

**[9]**

**1**

**1**

**1**

**1**

**1**

**1**

(ii) any **two** from:

# A

**8**

1. **D**

* carbon dioxide (concentration)
* temperature / heat
* (amount of) chlorophyll / chloroplasts

*allow water*

*allow ions / nutrients*

*ignore ref to surface area of the leaf*

**2**

**[8]**

**1**

**1**

1. use the same type of plant

# or

give equal amount of water to each plant

*ignore size of pot*

1. (advantage) more minerals

(disadvantage) cost / not free

(a) (i) 5.0

**9**

(5 × 0.8) **or** 4

*allow ecf from distance*

**1**

**1**

**1**

**[5]**

**1**

**1**

0.4

*allow ecf from 10-min volume*

**1**

(ii) increased (rate of uptake)

**1**

more transpiration / evaporation

**1**

1. correct scales

*allow reversed axes*

**1**

correctly labelled axes with units

**1**

correct points

*one plot error = max* ***1*** *mark*

**2**

curved line of best fit

*allow correct straight line*

**1**

1. leaves wilt

because plants lose too much water (by evaporation)

through the stomata

# or

because cells become plamolysed

# or

stomata close controlled by guard cells to prevent wilting

**1**

**1**

**1**

**[13]**