M1.(a) (140 + 240 + 380 + 450 =) 1210

1

(b) the local people decided to farm cattle

1

a company starts growing plants for biofuels

1

(c) carbon dioxide

in this order only

1

photosynthesis

1

(d) animals and birds migrate because there is less food

1

more habitats are destroyed

1

(e) any **one** from:

- breeding programmes (for endangered species)
- regeneration (programmes)
- reintroduction of field margins / hedgerows
- awareness raising with politicians / public
- recycling

1

[8]

M2. (a) water

1

oxygen

in this order only

accept correct chemical symbols

allow H_2O / OH_2

1

(b) allow light (in / through) / need light

*do **not** accept attracts light*

ignore heat / moisture / carbon dioxide

ignore so the plants can be seen

accept the converse, ie the black plastic bag would not let light in (1)

1

for photosynthesis / make sugar / glucose

so there would be no photosynthesis (1)

*do **not** allow make food unqualified*

1

(c) Increase (in leaves / new leaves)

ignore growth unqualified

1

(then) level off **or** number of (new) leaves (then) stays the same

1

numerical statement eg max at 3 tablets / 5 (new) leaves

should refer to one of the first two marking points

*for every extra tablet get 1 extra leaf = **2** marks*

*for every extra tablet get 1 extra leaf then it levels off = **3** marks*

1

[7]

M3. (a) xylem **and** phloem

either order
allow words ringed in box
allow mis-spelling if unambiguous

1

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

ignore names of substances / 'gases'

1

from high to low concentration

accept down concentration gradient
ignore 'along' / 'across' gradient
ignore 'with' gradient

1

(ii) oxygen / water (vapour)

allow O_2 / O2
ignore O^2/ O
allow H_2O / H2O
ignore H^2O

1

[4]

M4. (a) protein

1

(b) (i) (more) magnesium gives more growth / more leaves / more duckweed

if converse must be clear that less magnesium gives less growth

1

(ii) **A** gave highest number of leaves / plants **or** more than others

*it equals **'A'***

*use of numbers must compare **A** with at least one other*

or

A gave most growth / most duckweed **or** more than others

allow faster / fastest / better / best growth

allow more growth with nitrate / less growth without nitrate

do not allow 'no' growth without nitrate

(c) (i) mark (c) as a whole

sensible method:

e.g. mass / weighing

ignore dry or fresh

allow other sensible method involving measuring eg length of roots – ignore 'size' of roots or measure roots unqualified

1

(ii) corresponding explanation:

ignore accuracy

e.g. includes roots / includes <u>whole</u> plant**or**leaves vary in size**or**(length / mass / surface area given in c(i)) is a continuous variable

1

[5]

M5.(a) oxygen

allow O_2 / O2
*do **not** accept O^2 or O*

1

(b) (i) light

1

(ii) chlorophyll

1

(iii) decrease

1

(c) any **three** from:

- for respiration / energy
  *do **not** accept use energy for photosynthesis*
- to make cellulose / starch
  accept named carbohydrate other than glucose
- to make lipid / fat / oil
  accept fatty acid / glycerol
- to make protein
  accept named protein / amino acid / named amino acid
- to build big molecules from small molecules / metabolism
  *if no other marks awarded for making molecules allow **1** mark for growth / repair / new cells*

3

[7]

M6. (a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

M7.(a) chlorophyll is needed for photosynthesis

1

light is needed for photosynthesis

1

(b) increases

1

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

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

allow stops increasing

1

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

(c) (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

(ii) any **two** from:

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

allow water

allow ions / nutrients

ignore ref to surface area of the leaf

2

[8]

M8.(a) (i) in the direction of the force of gravity

1

(ii) against the force of gravity

1

(b) (i) diagram completed to show stem bending / leaning towards the window

the bend / lean can be at / from any point above pot level

ignore any leaves

1

(ii) more light (for leaves)

ignore heat

1

more photosynthesis / biomass / glucose

ref to 'more' needed once only, eg 'more light for photosynthesis' = 2 marks

if no other marks given allow 1 mark for 'to get light for photosynthesis'

1

[5]

M9.(a) (i) LHS = water

accept H_2O

*do **not** accept H^2O / H2O*

1

RHS = oxygen

accept O_2

*do **not** accept O / O^2 / O2*

1

(ii) light / sunlight

ignore solar / sun / sunshine

*do **not** allow thermal / heat*

1

(iii) chloroplasts

allow chlorophyll

1

(b) (i) 20

1

(ii) any **one** from:

- light (intensity)
- temperature.

1

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

1

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

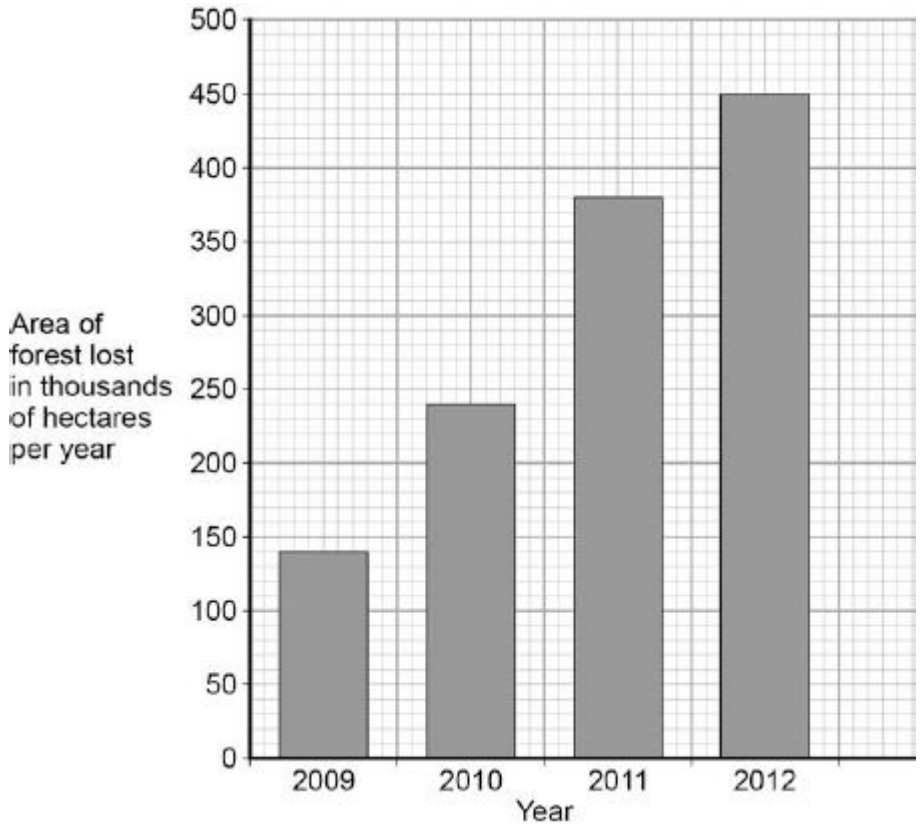
1

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

1

[9]

Q1. The graph below shows the area of forest lost in Madagascar from 2009 to 2012.



(a) The area of forest lost each year in Madagascar increased between 2009 and 2012.

Determine the total area of forest lost from the start of 2009 to the end of 2012.

.....

.....

Total area of forest lost = ... thousand hectares

(1)

(b) What are the possible reasons for the change in the area of forest lost per year between 2009 and 2012?

Tick **two** boxes.

The local people stop growing rice ☐

Fewer new houses are needed for the population ☐

The local people decided to farm cattle	☐
More trees have been planted	☐
A company starts growing plants for biofuels	☐

(2)

(c) More forest was lost in 2012 than in 2009.

Use words from the box to complete the sentences.

carbon dioxide	**excretion**	**nitrogen**
oxygen	**photosynthesis**	**respiration**

The increase in the area of forest lost has caused an increase in the gas .....

The increase of this gas has been caused because less of the gas is being absorbed by plants for the process of ..... .

(2)

(d) Deforestation can have negative effects on our ecosystems.

What are the negative effects of deforestation?

Tick **two** boxes.

Animals and birds migrate because there is less food	☐
More habitats are destroyed	☐
There is less acid rain	☐
There is more biodiversity	☐
The global temperature decreases	☐

(2)

(e) Scientists try to reduce the negative effects of human activity on our ecosystems.

One way is to protect rare habitats.

Give **one other** way of reducing the negative effects of human activity on our ecosystems.

.....

.....

(1)
(Total 8 marks)

Q2. (a) Complete the word equation for photosynthesis.

Use words from the box.

chlorophyll	**minerals**	**oxygen**	**water**

carbon dioxide + ... → glucose + ...

(2)

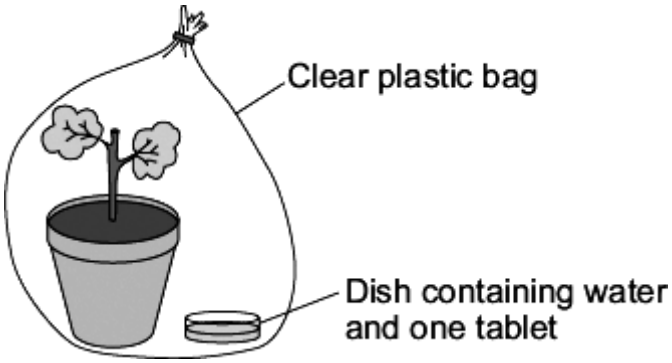
(b) Plants may grow faster if they have more carbon dioxide.

Indigestion tablets dissolve in water to form a solution.
This solution slowly gives off carbon dioxide.

A student set up an investigation to see what concentration of carbon dioxide is best for increasing the growth of geranium plants.

The student:

- put a geranium plant in a clear plastic bag
- put a dish containing water and one tablet in the bag
- sealed the top of the bag.



The student:

- set up 5 more experiments each with water and a different number of tablets
- left all the plants in a well-lit place for four weeks.

The student used a clear plastic bag, not a black plastic bag.

Explain why.

.....

.....

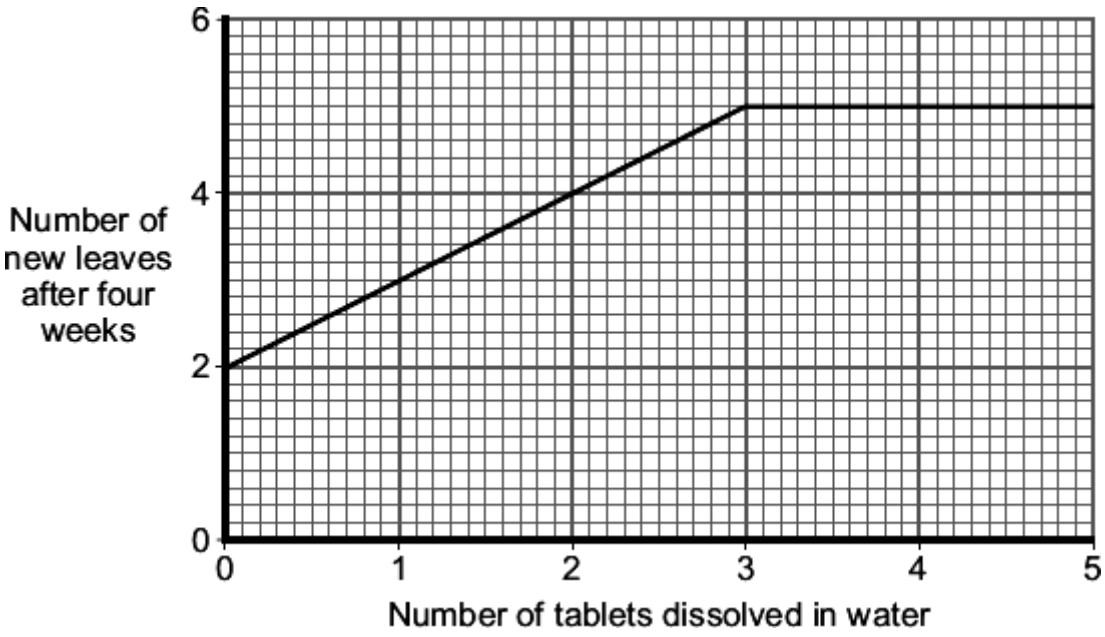
.....

.....

(2)

(c) After four weeks, the student counted the number of new leaves on each plant.

The graph shows his results.



Describe the effect of increasing the number of tablets dissolved in water on the number of new leaves that grew in four weeks.

.....

.....

.....

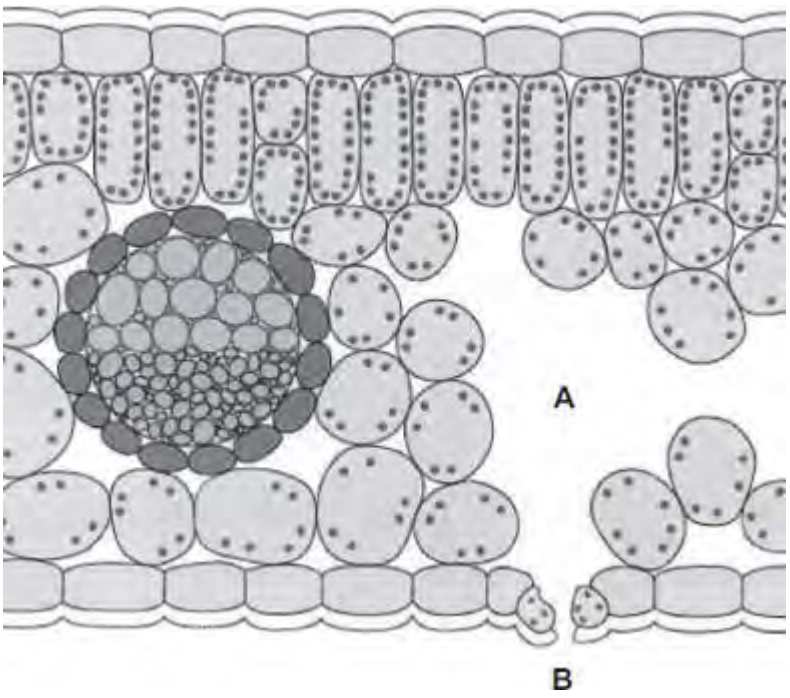
.....

.....

.....

(3)
(Total 7 marks)

Q3. The diagram shows a section through a plant leaf.



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

epidermis	**mesophyll**	**phloem**	**xylem**

..... and
.....

(1)

(b) Gases *diffuse* between the leaf and the surrounding air.

(i) What is *diffusion*?

.....

.....

.....

.....

(2)

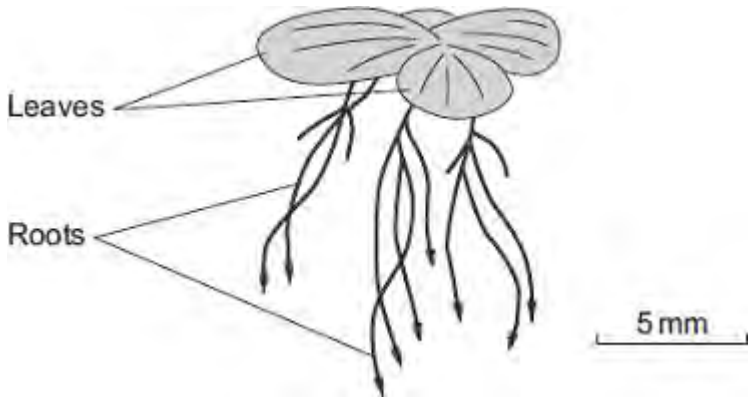
(ii) Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

.....

(1)
(Total 4 marks)

Q4. Duckweed is a plant. Duckweed grows in ponds. The leaves of duckweed float on the surface of the water and its roots hang down in the water.

The drawing shows a duckweed plant.



(a) Duckweed roots absorb nitrate ions from the water.
The nitrate ions help the duckweed to grow.

Draw a ring around the correct answer to complete the sentence.

Duckweed needs nitrate ions to make

carbohydrate.

fat.

protein.

(1)

(b) Some students grew duckweed plants in three different solutions of mineral ions, **A**, **B** and **C**, and in distilled water (**D**).

Table 1 shows the concentrations of mineral ions in each of **A**, **B**, **C** and **D** at the start of the investigation.

Table 1

Mineral ion	**Concentration of mineral ions**

	in mg per dm ^{3} at the start of the investigation			
	A	**B**	**C**	**D**
Nitrate	1000	4	4	0
Phosphate	300	0	0	0
Magnesium	200	84	24	0

The students counted the number of duckweed leaves in **A**, **B**, **C** and **D** at the start of the investigation and after 28 days.

Table 2 shows their results.

Table 2

	A	**B**	**C**	**D**
Number of leaves at start	4	4	4	4
Number of leaves after 28 days	50	27	14	6

(i) Using **Table 1** and **Table 2**, describe the effect of magnesium ions on the growth of duckweed.

.....

.....

(1)

(ii) Solution **A** contained the highest concentration of nitrate ions.

One student said, 'The results show that nitrate ions are needed for the growth of duckweed.'

What evidence in **Table 2** supports what the student said?

.....

.....

(1)

(c) The students measured the growth of the duckweed by counting the number of leaves.

(i) Suggest a better method of measuring the growth of the duckweed.

.....

.....

(1)

(ii) Suggest why your method is better than the students' method.

.....

.....

(1)
(Total 5 marks)

Q5.(a) Complete the word equation for photosynthesis.

carbon dioxide + water $\xrightarrow{\text{energy}}$ glucose + ...

(1)

(b) Draw a ring around the correct answer to complete each sentence.

(i) The energy needed for photosynthesis comes from

light.
osmosis.
respiration.

(1)

(ii) Energy is absorbed by a green pigment called

chloride.
chloroplast.

chlorophyll.

(1)

(iii) If the temperature is decreased the rate of photosynthesis will

decrease.

increase.

stay the same.

(1)

(c) Give **three** ways in which plants use the glucose made in photosynthesis.

1 .....

.....

2 .....

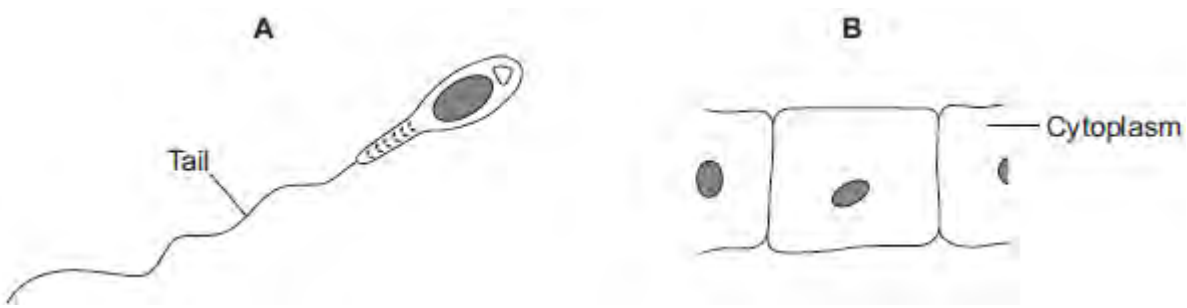
.....

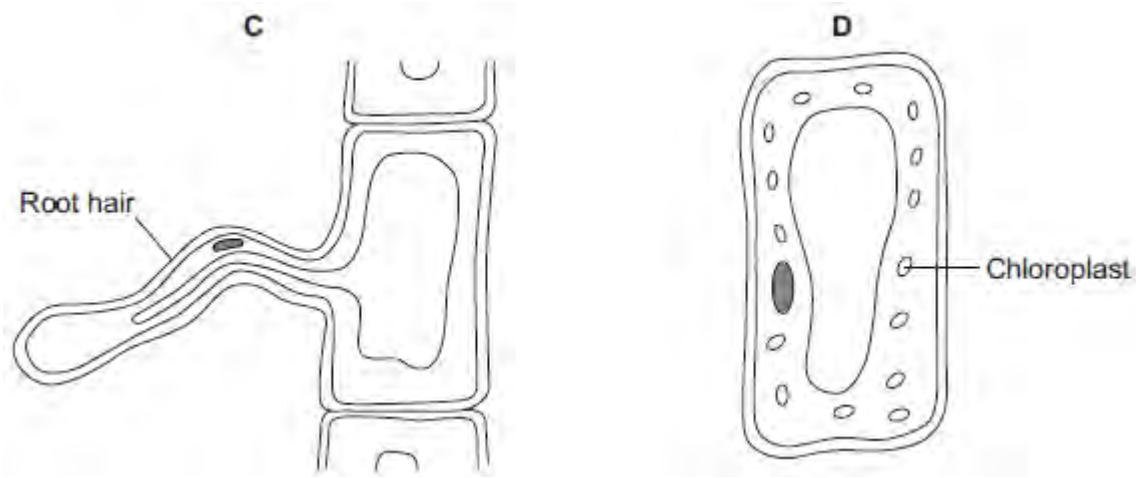
3 .....

.....

(3)
(Total 7 marks)

Q6. The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.





(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Give **one** reason for your answer.

.....

.....

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming? ☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis? ☐

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis **photosynthesis** **respiration**

(1)
(Total 5 marks)

Q7.(a) A student carried out the following investigation using a plant with variegated leaves.
A variegated leaf has green and white stripes.

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**

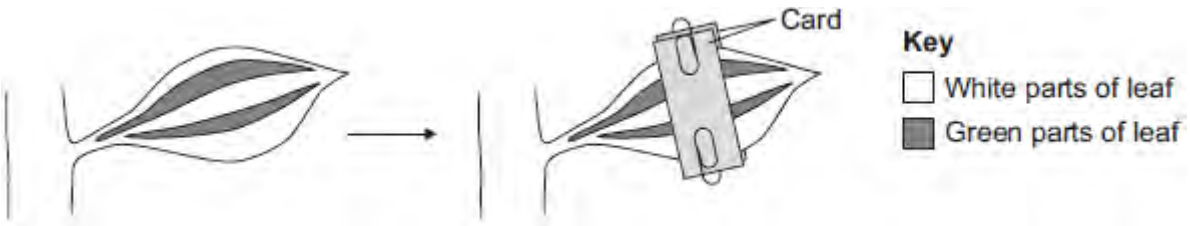
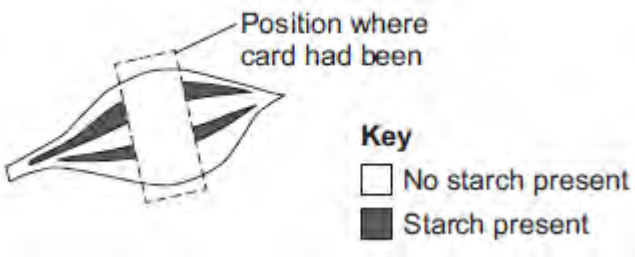


Figure 2 shows the same leaf after 2 days in the light.
The leaf has been tested for starch.

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. ☐

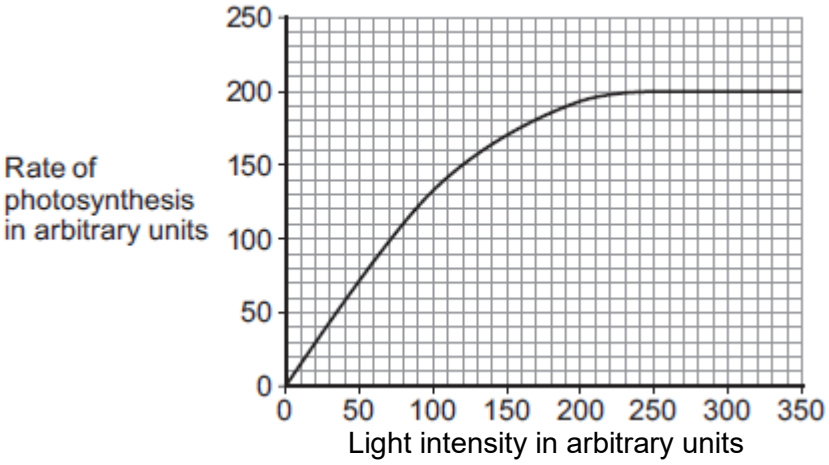
Water is needed for photosynthesis. ☐

(2)

(b) Scientists investigated the effect of light intensity on the rate of photosynthesis.

Figure 3 shows the scientists' results.

Figure 3



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

.....

.....

.....

.....

.....

.....

(3)

(c) At a light intensity of 250 arbitrary units, light is **not** a limiting factor of photosynthesis.

(i) What is the evidence for this in **Figure 3**?

.....

.....

(1)

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

1 .....

2 .....

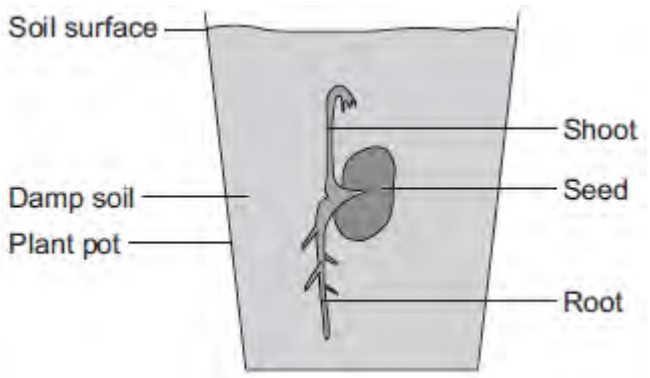
(2)
(Total 8 marks)

Q8.A student investigated growth in plants.

The student:

- planted a seed in damp soil in a plant pot
- put the plant pot in a dark cupboard.

The image below shows the result after 5 days.



(a) Draw a ring around the correct answer to complete each sentence.

(i) After the 5 days, the root had grown

away from water.
in the direction of the force of gravity.
towards light.

(1)

(ii) After the 5 days, the shoot had grown

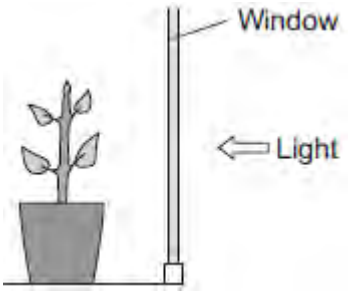
against the force of gravity.

away from light.
towards water.

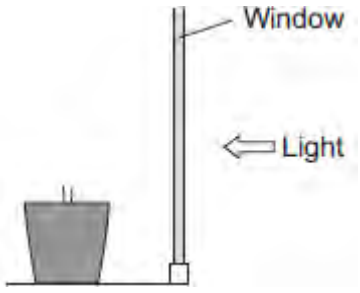
(1)

(b) After the plant had grown, the student put the plant pot by a window with lots of light.

The illustration below shows this.



(i) Complete the diagram below to show the appearance of the student's plant after 20 days by the window.



(1)

(ii) Explain the advantage to the plant of growing in the way that you have drawn in part **(b)(i)**.

.....

.....

.....

.....

(2)
(Total 5 marks)

Q9. Photosynthesis uses carbon dioxide to make glucose.

(a) (i) Complete the equation for photosynthesis.

carbon dioxide + ... $\xrightarrow{\text{energy}}$ glucose + ...

(2)

(ii) What type of energy does a plant use in photosynthesis?

.....

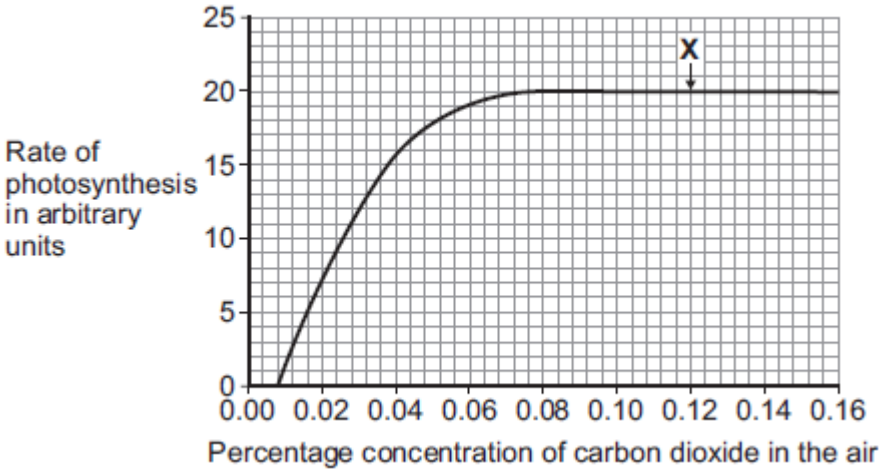
(1)

(iii) Which part of a plant cell absorbs the energy needed for photosynthesis?

.....

(1)

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



(i) What is the maximum rate of photosynthesis of the tomato plants shown in the graph?

..... arbitrary units

(1)

(ii) 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)

(c) 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%.

(i) 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)

(ii) 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)

M1. (a) (i) chloroplast

1

(ii) cell wall

1

(b) (i) osmosis

accept diffusion

1

(ii) cell wall (prevents bursting)

1

(c) (i) carbon dioxide

allow correct formula

1

glucose

allow sugar / starch

1

(ii) any **two** from:

- light sensitive spot detects light
- tells flagellum to move towards light
- more light = more photosynthesis

2

(d) (cell has) larger SA:volume ratio

1

short (diffusion) distance

allow correct description

1

(diffusion) via cell membrane is sufficient / good enough

or

flow of water maintains concentration gradient

1

[11]

M2. (a) LHS = water

1

RHS = glucose

1

(b) any **three** from:

- (measure) temperature
  ignore reference to fair test
- to check that the temperature isn't changing
- rate of reaction changes with temperature
- temperature is a variable that needs to be controlled
  allow lamp gives out heat

3

(c) (i) 10

*correct answer = **2** marks*

*allow **1** mark for:* $\frac{(10+9+11)}{3}$

*allow **1** mark for correct calculation without removal of anomalous result ie 15*

2

(ii) graph:

*allow ecf from **(c)(i)***

label on y-axis as 'number of bubbles per minute'

1

three points correct = **1** mark
allow ± 1 mm

four points correct = **2** marks

2

line of best fit = smooth curve

1

(iii) as distance increases, rate decreases – pro
allow yes between 20 – 40

1

but should be a straight line / but line curves – con / not quite pro

allow not between 10 – 20

if line of best fit is straight line, allow idea of poor fit

1

(d) any **four** from:

- make more profit / cost effective
- raising temp. to 25 °C makes very little difference at 0.03% CO_2
- (at 20 °C) with CO_2 at 0.1%, raises rate
- (at 20 °C with CO_2 at 0.1%) → >3x rate / rises from 5 to 17
- although 25 °C → higher rate, cost of heating not economical
- extra light does not increase rate / already max. rate with daylight

accept ref to profits c.f. costs must be favourable

4

[17]

M3. (a) to kill virus
or
to prevent virus spreading

1

(b) take (stem) cells from meristem
or
tissue culture
allow take cuttings

1

(c) use Benedict's solution

1

glucoses turns solution blue to orange

1

(d) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points that explain why plants with TMV have stunted growth.

Level 1 (1–2 marks):
Simple statements are made, but not precisely. The logic is unclear.

0 marks:
No relevant content.

Indicative content
- less photosynthesis because of lack of chlorophyll
- therefore less glucose made
  so
- less energy released for growth
- because glucose is needed for respiration
  and / or
- therefore less amino acids / proteins / cellulose for growth
- because glucose is needed for making amino acids / proteins / cellulose

4

[8]

M4. (a) $6H_2O$

in the correct order

1

$C_6H_{12}O_6$

1

(b) (i) control

do not accept *'control variable'*

allow:

to show the effect of the organisms

or

to allow comparison

or

to show the indicator doesn't change on its own

1

(ii) snail respires

1

releases CO_2

1

(iii) turns yellow

1

plant can't photosynthesise so CO_2 not used up

1

but the snail (and plant) still respires so CO_2 produced

1

[8]

M5. (a) methane is produced

ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:

- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)

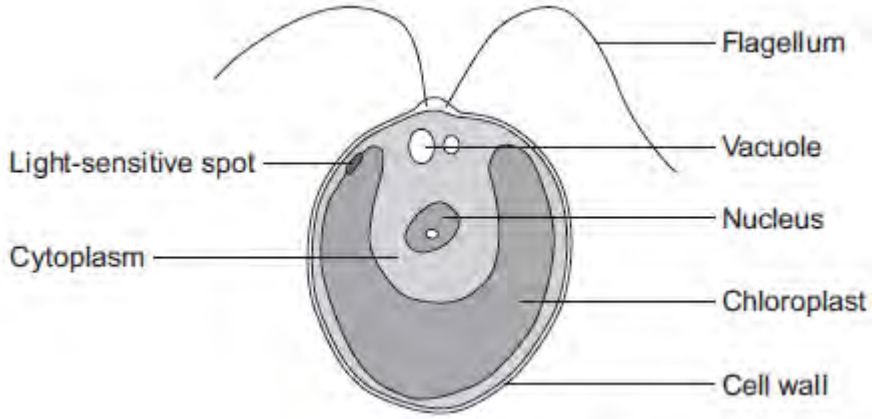
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

Q1. The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

.....

(1)

(ii) is made of cellulose?

.....

(1)

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

.....

(1)

(ii) Give the reason why the algal cell does not burst.

.....

.....

(1)

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.

water + ... $\xrightarrow{\text{Light energy}}$ ..... + oxygen

(2)

(ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

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(2)

(d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

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(3)

(Total 11 marks)

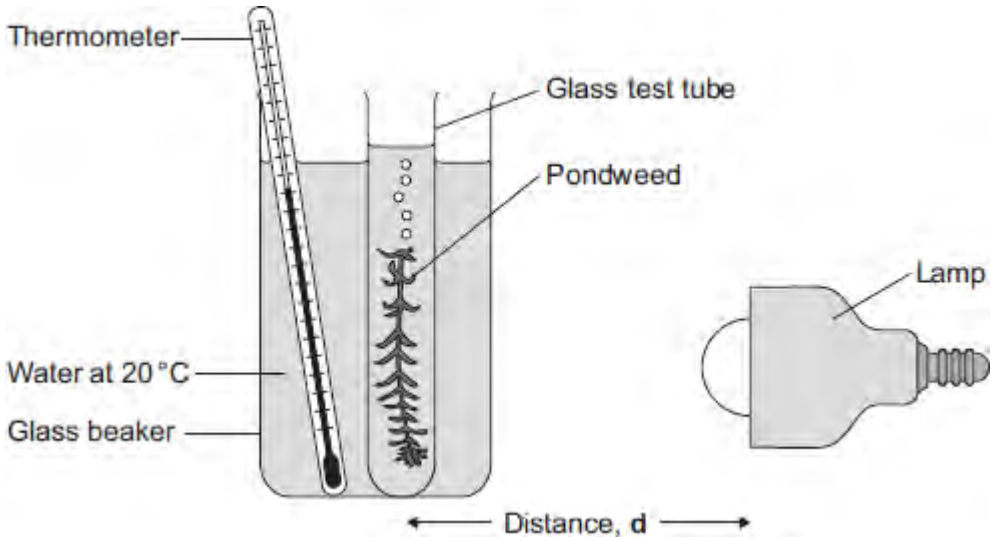
Q2.(a) Complete the equation for photosynthesis. Draw a ring around each correct answer.

Carbon dioxide	+	hydrogen nitrogen water	light energy →	alcohol glucose methane	+ oxygen

(2)

Some students investigated the effect of light intensity on the rate of photosynthesis in pondweed.

The diagram shows the apparatus the students used.



The closer the lamp is to the pondweed, the more light the pondweed receives.

The students placed the lamp at different distances, **d**, from the pondweed.

They counted the number of bubbles of gas released from the pondweed in 1 minute for each distance.

(b) A thermometer was placed in the glass beaker.

Why was it important to use a thermometer in this investigation?

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(3)

(c) The students counted the bubbles four times at each distance and calculated the correct mean value of their results.

The table shows the students' results.

Distance d in cm	Number of bubbles per minute				
	1	**2**	**3**	**4**	**Mean**
10	52	52	54	54	53
20	49	51	48	52	50
30	32	30	27	31	30
40	30	10	9	11	

(i) Calculate the mean number of bubbles released per minute when the lamp was 40 cm from the pondweed.

.....

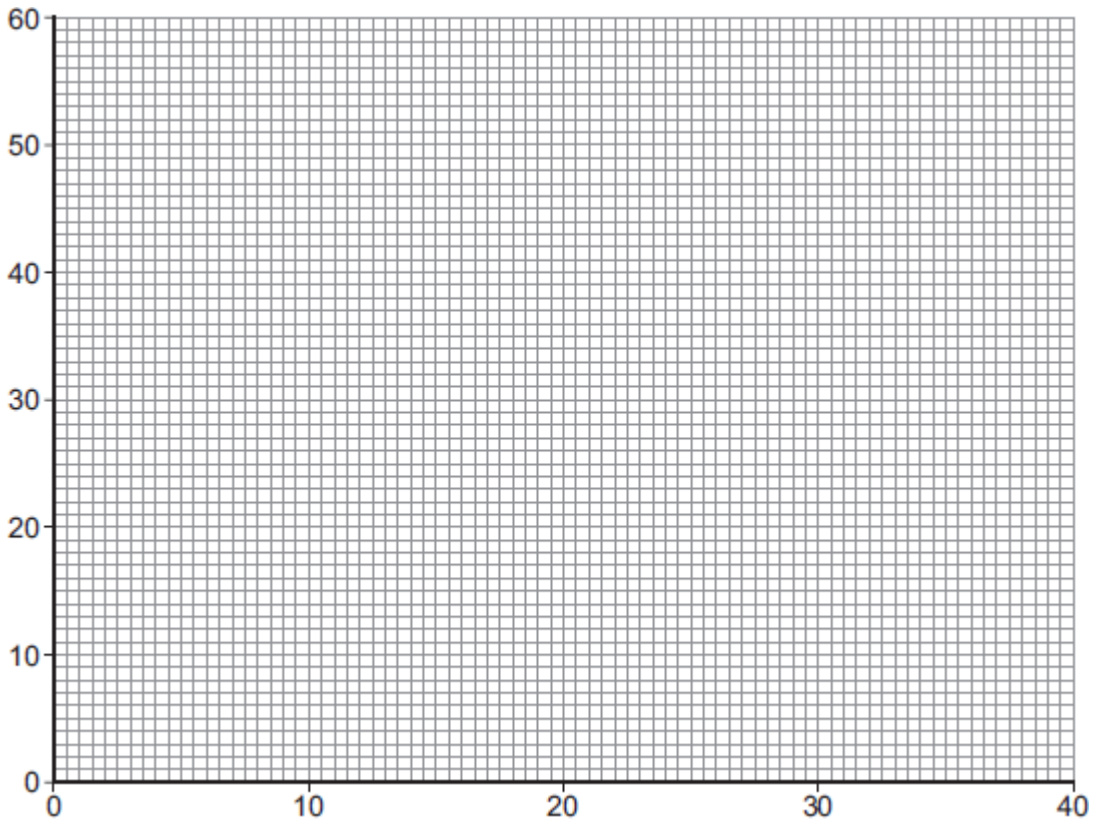
.....

Mean number of bubbles at 40 cm = ...

(2)

(ii) On the graph paper below, draw a graph to show the students' results:

- add a label to the vertical axis
- plot the **mean values** of the number of bubbles
- draw a line of best fit.



(4)

(iii) One student concluded that the rate of photosynthesis was inversely proportional to the distance of the lamp from the plant.

Does the data support this conclusion?

Explain your answer.

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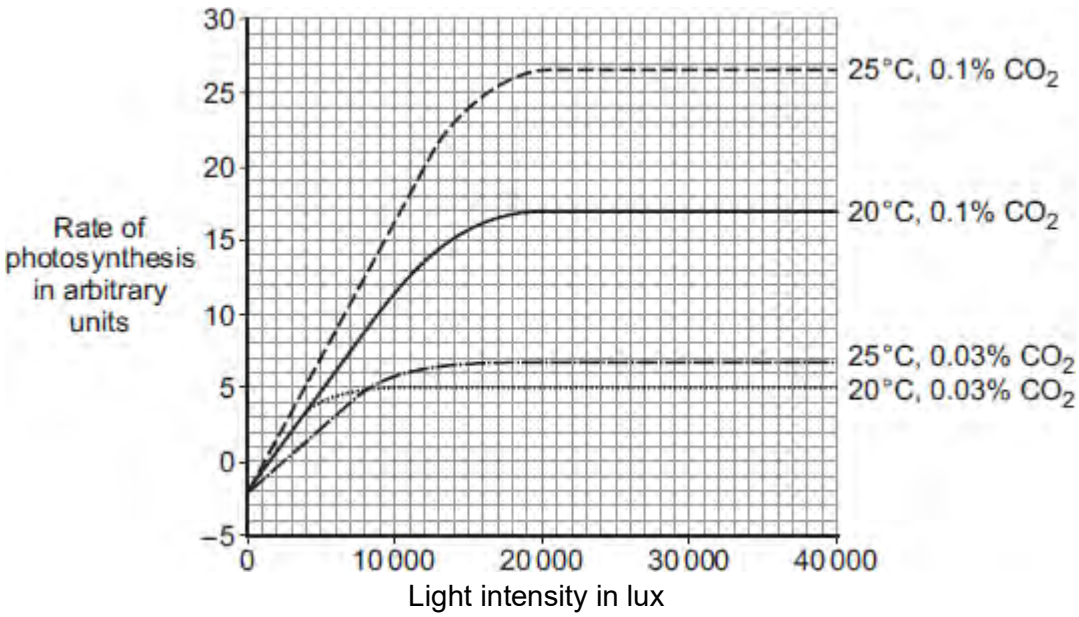
.....

(2)

(d) Light intensity, temperature and concentration of carbon dioxide are factors that affect the rate of photosynthesis.

Scientists investigated the effects of these three factors on the rate of photosynthesis in tomato plants growing in a greenhouse.

The graph below shows the scientists' results.



A farmer in the UK wants to grow tomatoes commercially in a greenhouse.

The farmer read about the scientists' investigation.

During the growing season for tomatoes in the UK, natural daylight has an intensity higher than 30 000 lux.

The farmer therefore decided to use the following conditions in his greenhouse during the day:

- 20°C
- 0.1% CO_2
- no extra lighting.

Suggest why the farmer decided to use these conditions for growing the tomatoes.

You should use information from the scientists' graph in your answer.

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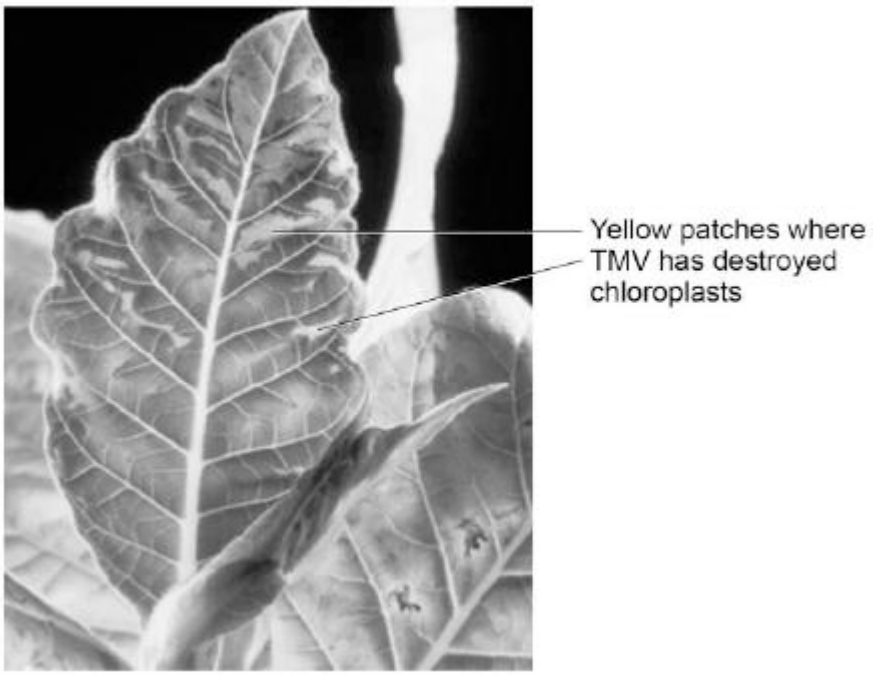
(4)
(Total 17 marks)

Q3. Tobacco mosaic virus (TMV) is a disease affecting plants.

The diagram below shows a leaf infected with TMV.



(a) All tools should be washed in disinfectant after using them on plants infected with TMV.

Suggest why.

.....

.....

(1)

(b) Scientists produced a single plant that contained a TMV-resistant gene.

Suggest how scientists can use this plant to produce **many** plants with the TMV-resistant gene.

.....

.....

(1)

(c) Some plants produce fruits which contain glucose.

Describe how you would test for the presence of glucose in fruit.

.....

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.....

(2)

(d) TMV can cause plants to produce less chlorophyll.

This causes leaf discoloration.

Explain why plants with TMV have stunted growth.

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(4)
(Total 8 marks)

Q4. Photosynthesis needs light.

(a) Complete the **balanced symbol** equation for photosynthesis.

$$6CO_2 + \text{.....} \xrightarrow{\text{light}} \text{.....} + 6O_2$$

(2)

(b) A green chemical indicator shows changes in the concentration of carbon dioxide (CO_2) in a solution.

The indicator solution is **green** when the concentration of CO_2 is normal.

The indicator solution turns **yellow** when the concentration of CO_2 is high.

The indicator solution turns **blue** when the concentration of CO_2 is very low or when there is no CO_2.

The indicator solution does not harm aquatic organisms.

Students investigated the balance of respiration and photosynthesis using an aquatic snail and some pondweed.

The students set up four tubes, **A**, **B**, **C** and **D**, as shown in the table below.

The colour change in each tube, after 24 hours in the light, is recorded.

Tube A	**Tube B**	**Tube C**	**Tube D**
			
Indicator solution only	Indicator solution + pondweed	Indicator solution + snail	Indicator solution + pondweed + snail
Stays green	Turns blue	Turns yellow	Stays green

(i) What is the purpose of **Tube A**?

.....

.....

(1)

(ii) Explain why the indicator solution in **Tube C** turns yellow.

.....

.....

.....

.....

(2)

(iii) Predict the result for **Tube D** if it had been placed in the dark for 24 hours and **not** in the light.

Explain your prediction.

Prediction.....

.....

Explanation.....

.....

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.....

(3)
(Total 8 marks)

Q5.A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

.....

.....

.....

.....

(2)

(b) The gardener finds this research on the Internet:

'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

.....

Ratio .....

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

.....

.....

(1)

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

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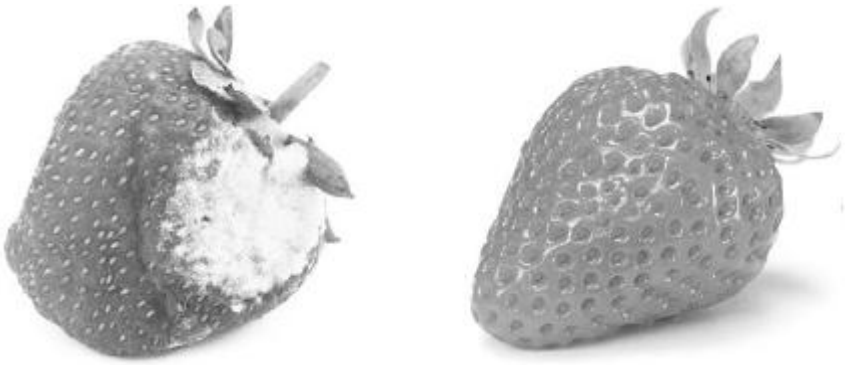
(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1 .....

.....

2 .....

.....

3 .....

.....

(3)
(Total 13 marks)

M1. (a) light is trapped / absorbed / used

extra answers cancel mark

ignore solar / sunshine

1

by chlorophyll / chloroplasts

if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis

1

(b) (to make) starch (for storage)

ignore 'for growth' unqualified

ignore respiration

1

(to make) fat / oil (for storage)

1

(to make) amino acids / proteins / enzymes

1

(to make) cellulose / cell walls

allow for active transport

allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone)

*if no named examples, allow 'to make **named** cell structures' for max. 1 mark*

1

[6]

M2. (a) (i) oxygen produced

1

(ii) any **one** from:

- average / mean / median
  ignore reliable / precise / accurate
- some may be anomalous
  allow some may not float

1

(b) (i) *do **not** allow answers in terms of time only*
*if candidate answers in terms of comparing rate of change then the rate of change of photosynthesis must be in the correct direction for **1** mark*

any **two** from:

- low intensity / below 12.5 / 2.5 - 12.5 (units of light) flat wrack /it, rate of photosynthesis faster **or** saw wrack rate of photosynthesis slower
  allow any value in range
- high intensity / above 12.5 / 12.5 - 15 (units of light) flat wrack / it,rate of photosynthesis slower **or** saw wrack rate of photosynthesis faster
  allow any value in range
- same (rate) at 12.5 units

2

(ii) any **two** from:

- saw wrack receives less light
  accept converse if clear reference to bladder wrack
- less photosynthesis
  if first and second responses, 'less' needed only once

  or
  less carbohydrate / sugar / starch production
- when tide is in **or** at high tide **or** any tide above low tide
  accept saw wrack covered by water / submerged longer /

more
reference to position on shore is insufficient

2

[6]

M3. (a) (i) increase (and then level off) **and** max / up to at 0.15 (%) (carbon dioxide)

ignore references to oxygen concentration only

ignore mention of 23

1

(ii) $\underline{CO_2}$ is limiting at low CO_2 / at first

ignore specific numbers

1

light is limiting at high CO_2 / at end

1

(b) ***mark both parts together***

effect: (oxygen) falls

1

explanation: (oxygen) used for respiration

if no other marks *awarded allow (effect) no change* ***and*** *(explanation) no photosynthesis for* ***1*** *mark*

1

(c) more chlorophyll / chloroplasts

1

allows more photosynthesis / description

for both marks must refer to more at least once

1

[7]

M4. (a) 7.15 to 7.45 am **and** 7.15 to 7.45 pm

both *required, either order*

accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33

allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used

  allow more food made than used
- so plant able to grow / flower

  accept plant able to store food

2

[5]

M5. (a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols

*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions **or** particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

<u>40 – 50 °C</u>

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

M6. (a) use of quadrat / point frame
allow description

1

randomly placed / random sampling
ignore reference to transects

1

(b) (i) 6

1

(ii) more light in A / in field / where sunny
ignore sun

1

more / better / faster photosynthesis in A / with more light
allow converse

1

(iii) use light meter / measure light intensity in both habitats

1

take many measurements at same time of the day

1

or

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)
counting point is dependent on investigation point

(c) more glucose / energy available

allow other named product eg protein
allow if more energy produced

1

for growth

dependent on 1st mark

1

[9]

\

M7. (a) LHS – carbon dioxide / CO_2

allow CO2

ignore CO^2

1

RHS

in either order

glucose / carbohydrate / sugar

allow starch

allow $C_6H_{12}O_6$ / C6H12O6

ignore $C^6H^{12}O^6$

1

oxygen

allow O_2 / O2

ignore O^2 / O

1

(b) any **five** from:

- factor 1: CO^2 (concentration)
- effect - as CO_2 increases so does rate and then it levels off or shown in a graph
- explanation:(graph increases) because CO_2 is the raw material or <u>used</u> in photosynthesis / converted to organic substance / named eg**or**(graph levels off) when another factor limits the rate.

  accept points made via an annotated / labelled graph
- factor 2: temperature

  allow warmth / heat
- effect – as temperature increases, so does the rate and then it decreases or shown in a graph

  allow 'it peaks' for description of both phases
- explanation:(rise in temp) increases rate of chemical reactions / more kinetic energy

  allow molecules move faster / more collisions

or(decreases) because the enzyme is denatured.

context must be clear = high temperature

allow other factor plus effect plus explanation:

eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves

2nd or 3rd mark can be gained from correct description and explanation

5

[8]

Q1. Green plants can make glucose.

(a) Plants need energy to make glucose.

How do plants get this energy?

.....

.....

.....

.....

(2)

(b) Plants can use the glucose they have made to supply them with energy.

Give **four** other ways in which plants use the glucose they have made.

.....

.....

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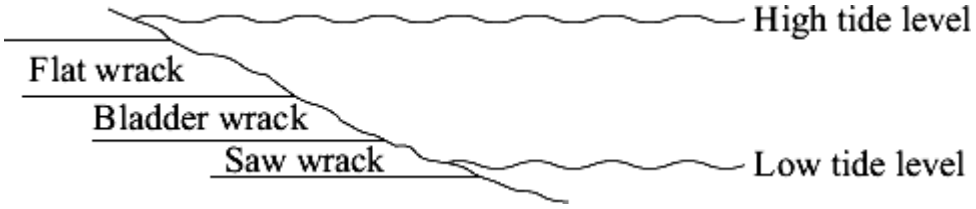
.....

.....

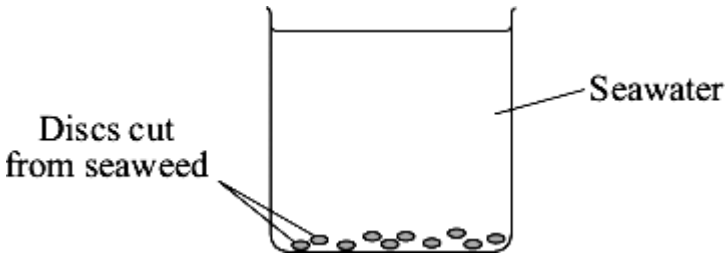
(4)
(Total 6 marks)

Q2. The diagram shows where three seaweeds live on a seashore.
As the tide moves in and out, these seaweeds are covered with seawater for different lengths of time.



Some students investigated the rate of photosynthesis in these seaweeds.

- They cut ten small discs from one seaweed.
- They dropped the discs into seawater in a beaker.
- They recorded the time taken for the fifth disc to float to the surface.
- They repeated this experiment with the other two seaweeds.



(a) (i) Suggest why the discs floated to the surface.

.....

.....

(1)

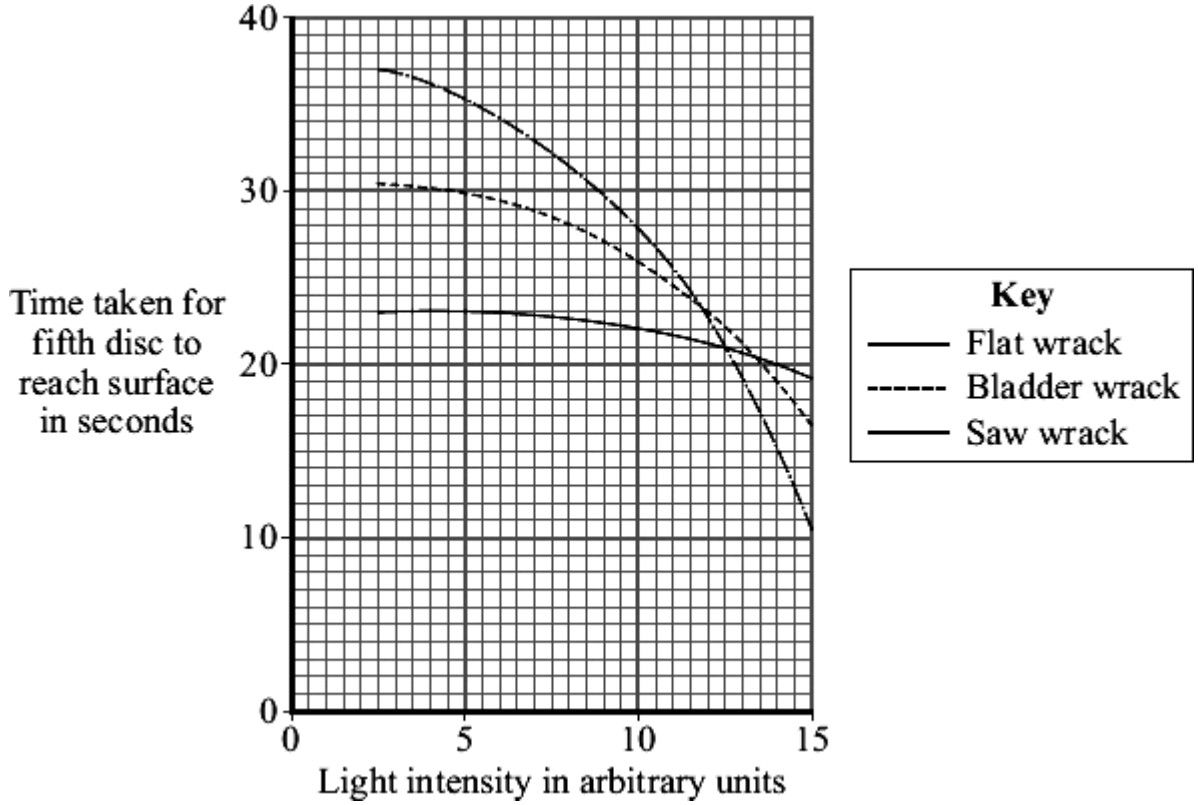
(ii) Suggest the advantage of recording the time taken for the fifth disc to reach the surface, rather than for the tenth disc.

.....

.....

(1)

(b) The students carried out their experiments at different light intensities.
The graph shows the results they collected.



(i) Compare the rate of photosynthesis for flat wrack with the rate for saw wrack at different light intensities.

.....

.....

.....

.....

(2)

(ii) Seawater absorbs light.

The growth rate of saw wrack is less than the growth rate of bladder wrack.

Suggest why.

.....

.....

.....

.....

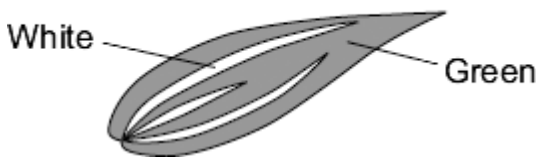
(2)

(Total 6 marks)

Q3. Students investigated the effect of changing the carbon dioxide concentration on the rate of photosynthesis in pieces of leaf.

Diagram 1 shows the type of leaf used by the students.

Diagram 1

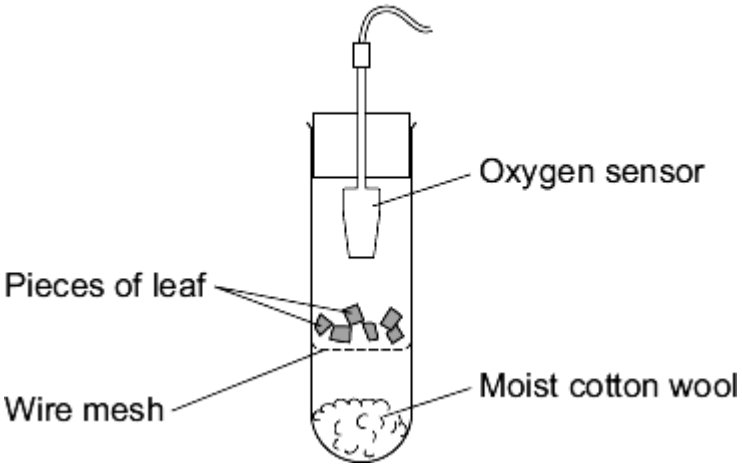


The students:

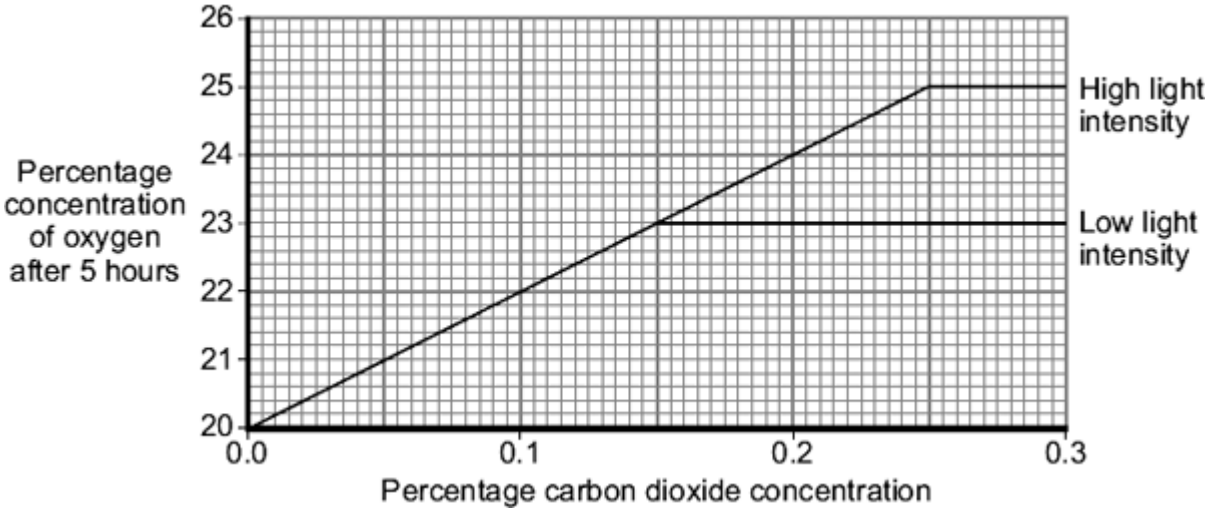
- cut pieces of leaf from the green region
- put the pieces into tubes
- added different concentrations of carbon dioxide to each tube
- shone lights on the tubes with either high or low light intensity
- recorded the concentration of oxygen in the tubes after 5 hours.

Diagram 2 shows how each experiment was set up.

Diagram 2



The graph shows the results of the investigation.



(a) (i) Describe the effect of increasing carbon dioxide concentration on the rate of photosynthesis at low light intensity.

.....

.....

(1)

(ii) Explain the effect that you have described.

In your answer you should refer to limiting factors.

.....

.....

.....

.....

(2)

(b) What would have been the effect on oxygen concentration over the five-hour period if a white region of the leaf had been used, instead of a green region?

Effect .....

Explain your answer.

Explanation .....

.....

.....

(2)

(c) Some people keep indoor plants which have variegated leaves (leaves with green and white regions).

If plants with variegated leaves are kept in dim light conditions the white areas of the leaves start to turn green.

This is an advantage to the plant.

Suggest why.

.....

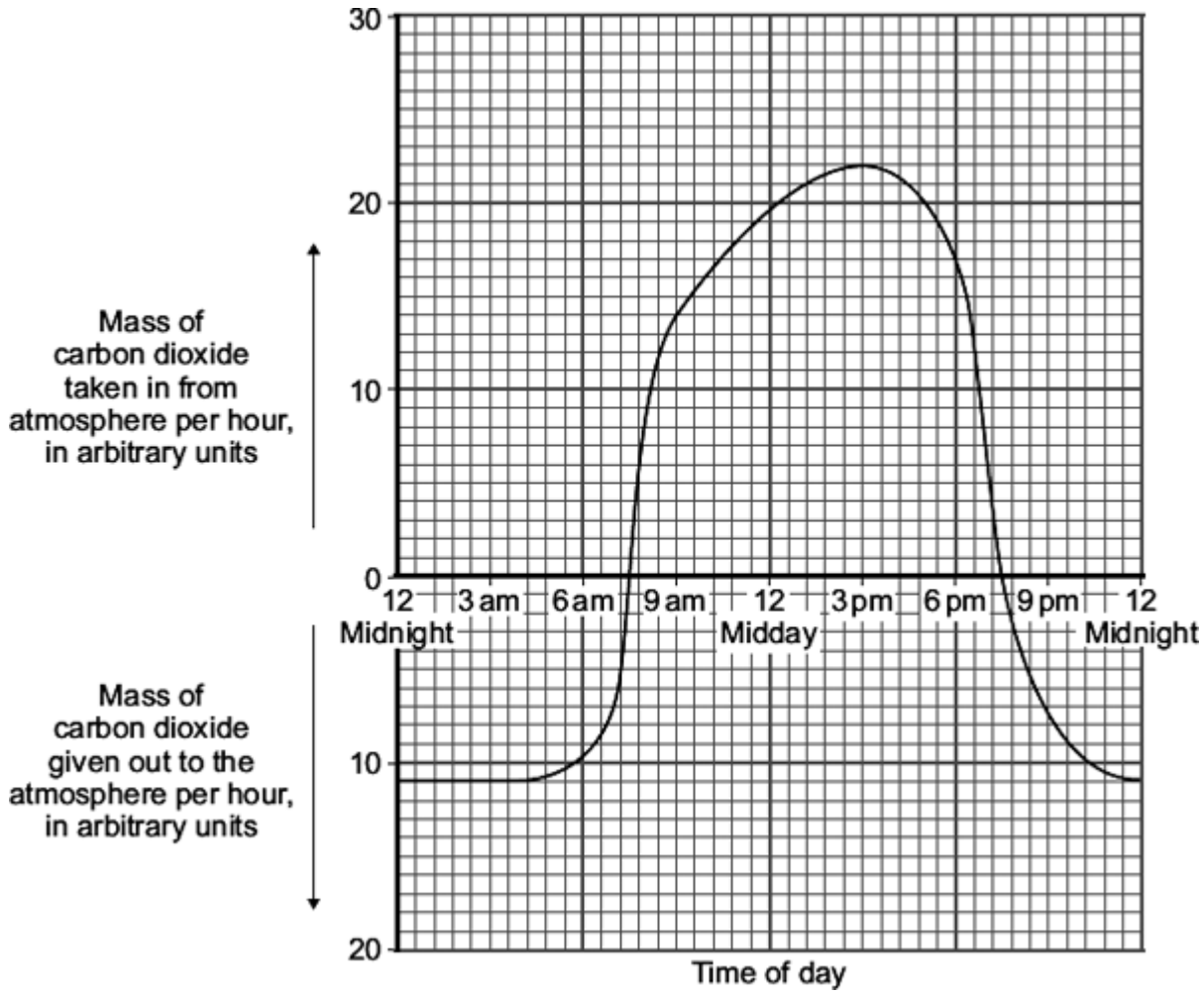
.....

.....

.....

(2)
(Total 7 marks)

Q4. The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



(a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1 ..... 2 .....

(1)

(b) The bean plant respires at the same rate all through the 24 hour period.

(i) How much carbon dioxide is released each hour during respiration?

..... arbitrary units

(1)

(ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

.....

.....

Answer = ... arbitrary units

(1)

(c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean plant.

Explain, in detail, why this was important for the bean plant.

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(2)
(Total 5 marks)

Q5. (a) Complete the equation for photosynthesis.

..... + ... $\xrightarrow{\text{lightenergy}}$ ..... + oxygen

(2)

(b) Scientists investigated how temperature affects the rate of photosynthesis.
The scientists grew some orange trees in a greenhouse.
They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

(i) The leaf discs did not produce any oxygen in the dark.

Why?

.....

.....

(1)

(ii) The leaf discs took in oxygen in the dark.

Explain why.

.....

.....

.....

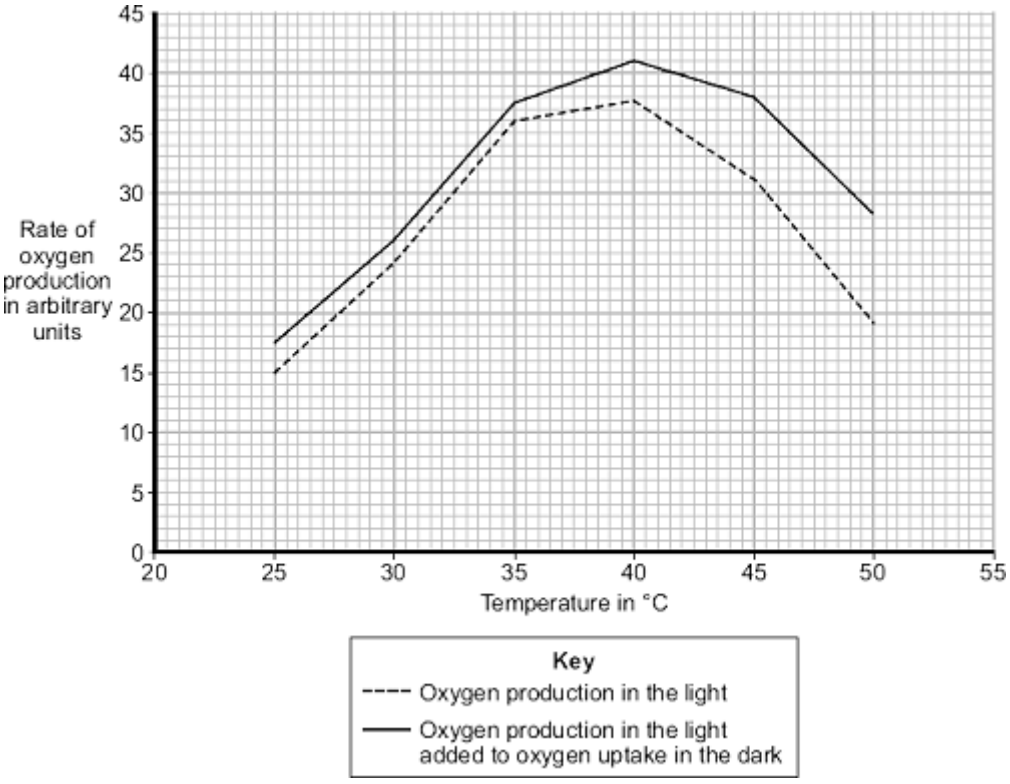
.....

(2)

(c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

(i) Describe the effect of temperature on oxygen production in the light.

.....

.....

.....

.....

(2)

(ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

.....

.....

.....

from 40 °C to 50 °C.

.....

.....

.....

(2)

(d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

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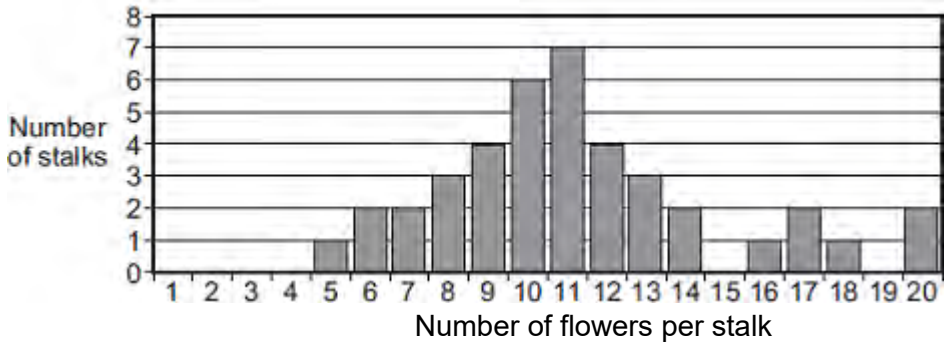
(3)
(Total 12 marks)

Q6. Some students studied bluebell plants growing in two different habitats.

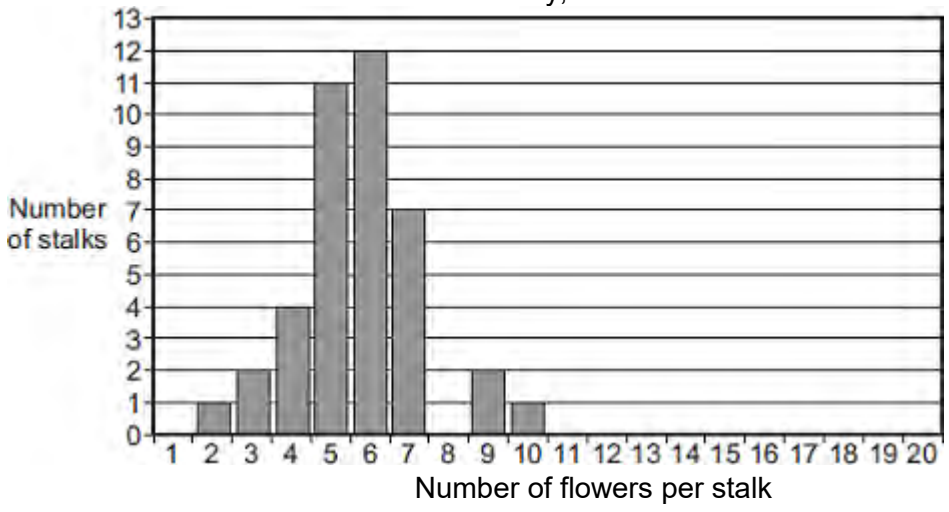
Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.

Habitat A: Sunny field next to woodland



Habitat B: Shady, moist woodland



(a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

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.....

.....

(2)

(b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = ...

(1)

(ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

.....

.....

.....

.....

(2)

(iii) Suggest how the students could test their hypothesis for the two habitats.

.....

.....

.....

.....

(2)

(c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

.....

.....

.....

.....

(2)
(Total 9 marks)

Q7.(a) Complete the equation for photosynthesis.

..... + water $\xrightarrow{\text{light energy}}$ ..... + ...

(3)

(b) The rate of photosynthesis in a plant depends on several factors in the environment.
These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5)
(Total 8 marks)

M1. (a) any **two** from:

or *allow converse for outdoors*

- constant speed
  - *variable speed*
- constant effort
  - *variable terrain*
- constant temperature
  - *traffic conditions*
  - *variable temperature*
  - *wind (resistance)*
  - *rain / snow*

allow
weather

allow pollution only if qualified by effect on body function but ignore pollution unqualified

if no other marks obtained allow variable conditions outdoors

2

(b) Brain

1

(c) (i) 20 800

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow **1** mark for use of 1200 and 22 000 only*

2

(ii) oxygen

apply list principle

1

*do **not** accept other named substances eg CO_2 water*

glucose / sugar

allow glycogen

ignore food / carbohydrate

1

(iii) respire aerobically

1

(iv) carbon dioxide

1

lactic acid

1

(d) increased heart rate

ignore adrenaline / drugs

accept heart beats more but not heart pumps more

1

[11]

M2. (a) (i) 150

1

(ii) any **two** from:

accept correct use of numbers

accept pulse rate

- lower resting rate
- lower rate during exercise
- recovers faster after exercise

allow a general statement about lower rate if neither of the first two points given

2

(b) glucose

1

oxygen

1

[5]

M3. (a) microorganisms **1**

(b) moist **1**

(c) respiration **1**

(d) roots **1**

[4]

M4. (a) (i) C and D **1**

(ii) cell wall **1**

(b) (i) A **1**

(ii) D **1**

(c) respiration **1**

[5]

M5. (a) (i) glycogen

1

(ii) respiration

1

(b) (i) 483 kJ

1

(ii) oxygen

1

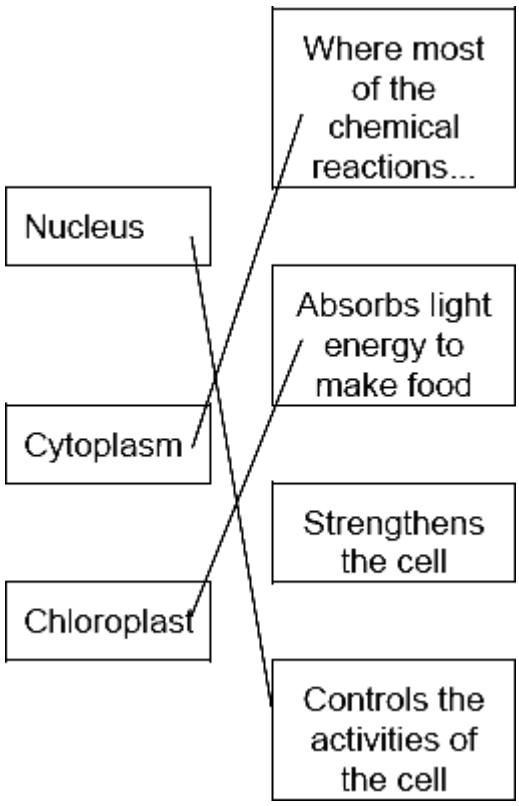
(iii) dilate

1

(c) supplies more / a lot of oxygen **or** removes more carbon dioxide **or** release more energy / faster respiration

1

[6]



M6. (a)

1 *mark for each correct line*
mark each line from left hand box
two lines from left hand box cancels mark for that box

3

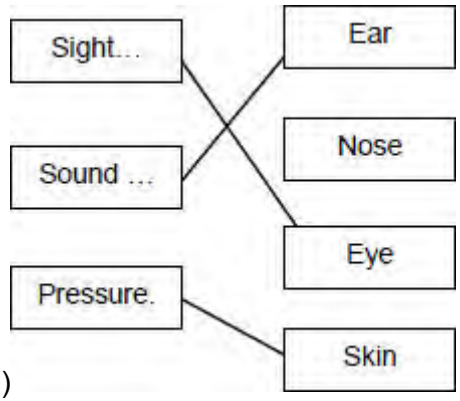
(b) energy

1

[4]

M7 (a)

(i)



1 *mark for each line*
do ***not*** *award a mark for a 'change' that has two lines*

3

(ii) receptor cells

1

(b) used to provide (extra) energy
allow (more) used in respiration
allow suitable reference to muscles
do ***not*** *accept used for sweat*

1

(c) (i) growth of muscles

1

(ii) (these drugs have) possible side / harmful effects**or**answers that refer to 'fairness of competition' e.g. cheating

1

[7]

M8. (a) 40 – 60 hours

1

(b) (i) decrease

1

1st slowly then faster / appropriate detail from the graph – e.g. from 7.8 to 0 / faster after 4 – 10h

1

(ii) oxygen after glucose

extra box ticked cancels 1 mark

1

oxygen less than glucose

1

(iii) respiration

1

[6]

M9.(a) a higher concentration would be difficult to stir

1

(b) (i) methane

1

(ii) 60

100 - (5 + 35) but incorrect answer allow 1 mark

2

(c) (i) aerobic respiration

1

(ii) oxygen

1

[6]

M10.(a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

Q1. Scientists investigated how exercise affects blood flow to different organs in the body.

The scientists made measurements of blood flow to different organs of:

- a person resting in a room at 20°C
- the same person, in the same room, doing vigorous exercise at constant speed on an exercise cycle.

The table shows the scientists' results.

Organ	Blood flow in cm^3 per minute whilst …	
	resting	**doing vigorous exercise**
Brain	750	750
Heart	250	1000
Muscles	1200	22 000
Skin	500	600
Other	3100	650

(a) In this investigation, it was better to do the exercise indoors on an exercise cycle than to go cycling outdoors on the road.

Suggest **two** reasons why.

Do **not** include safety reasons.

1 .....

.....

.....

2 .....

.....

.....

(2)

(b) Blood flow to **one** organ did **not** change between resting and vigorous exercise.

Which organ? .....

(1)

(c) (i) How much more blood flowed to the muscles during vigorous exercise than when resting?

.....

.....

Answer = ... cm^3 per minute

(2)

(ii) Name **two** substances needed in larger amounts by the muscles during vigorous exercise than when resting.

1 .....

2 .....

(2)

(iii) Tick (✓) **one** box to complete the sentence.

The substances you named in part (c)(ii) helped the muscles to

make more lactic acid. ☐

respire aerobically. ☐

make more glycogen. ☐

(1)

(iv) The higher rate of blood flow to the muscles during exercise removed larger amounts of waste products made by the muscles.

Which **two** substances need to be removed from the muscles in larger amounts during vigorous exercise?

Tick (✓) **two** boxes.

Amino acids ☐

Carbon dioxide ☐

Glycogen ☐

Lactic acid ☐

(2)

(d) The total blood flow was much higher during exercise than when resting.

One way to increase the total blood flow is for the heart to pump out a larger volume of blood each beat.

Give **one** other way to increase the blood flow.

.....

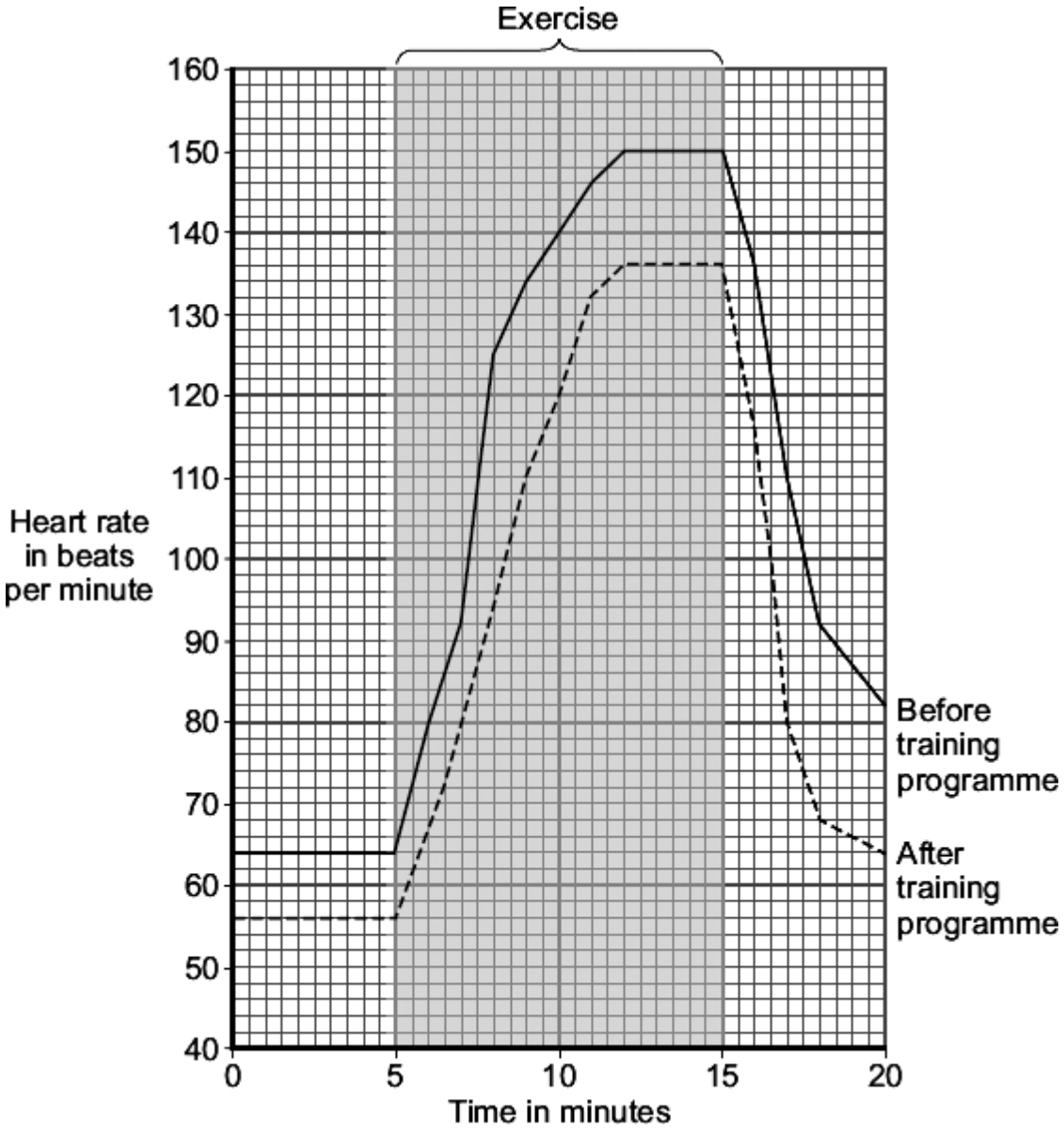
.....

(1)

(Total 11 marks)

Q2. An athlete did a 6-month training programme.

The graph shows the effect of the same amount of exercise on his heart rate before and after the training programme.



(a) (i) What was the maximum heart rate of the athlete during exercise before the training programme?

..... beats per minute

(1)

(ii) Give **two** differences between the heart rate of the athlete before and after the training programme.

After the training programme

Difference 1 .....

.....

Difference 2 .....

.....

(2)

(b) Which **two** substances need to be supplied to the muscles in larger amounts during exercise?

Tick (✓) **two** boxes.

Carbon dioxide ☐

Glucose ☐

Lactic acid ☐

Oxygen ☐

Urea ☐

(2)
(Total 5 marks)

Q3. This question is about what happens during decay.

Draw a ring around the correct word to complete each sentence.

(a) After living things die, they are decayed by

animals.
microorganisms.
plants.

(1)

(b) Decay happens faster when there is plenty of oxygen and conditions are

cold.
dry.
moist.

(1)

(c) During decay carbon dioxide is produced by

osmosis.
respiration.
photosynthesis.

(1)

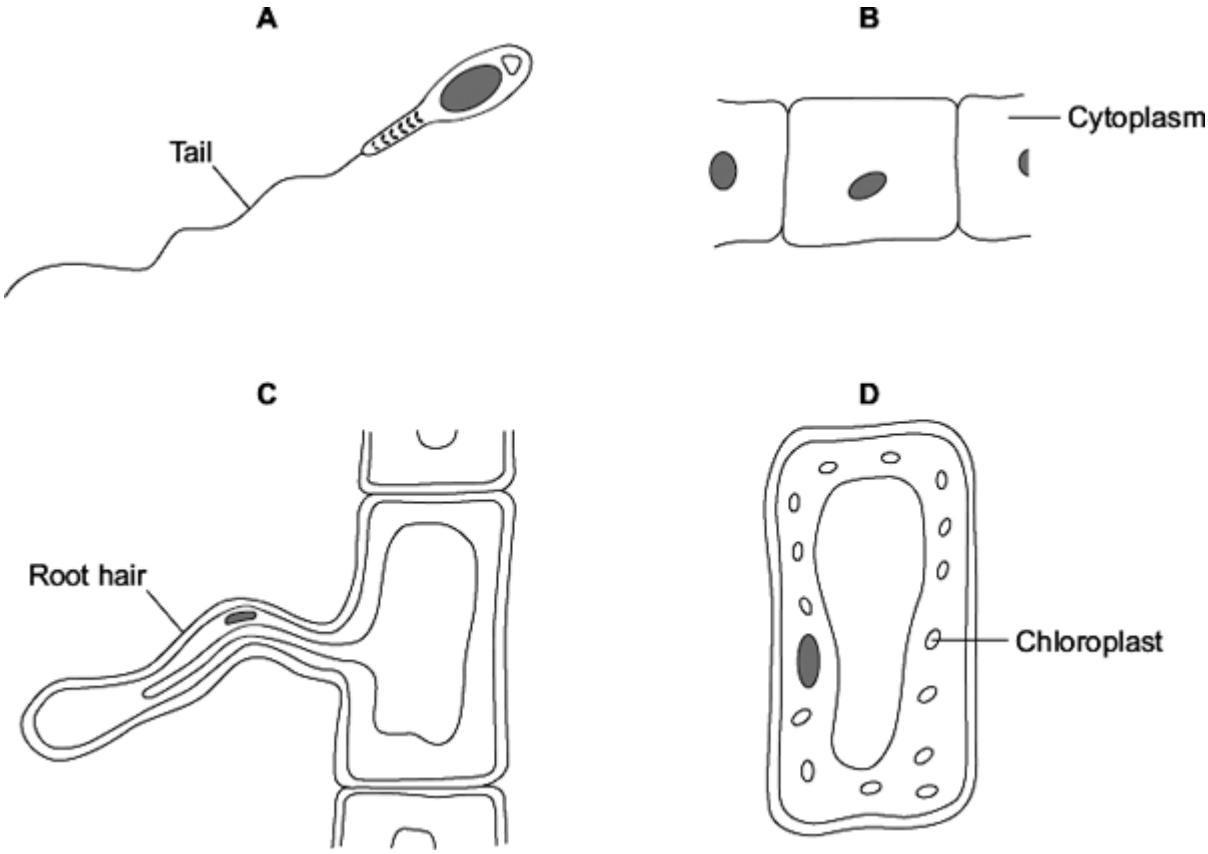
(d) Decay releases mineral salts into the soil.

These mineral salts are absorbed by plant

eaves.
roots.
stems.

(1)
(Total 4 marks)

Q4. The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.



(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Which part is found **only** in plant cells?

Draw a ring around **one** answer.

cell membrane **cell wall** **nucleus**

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming?

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis?

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis **photosynthesis** **respiration**

(1)
(Total 5 marks)

Q5. Muscles need energy during exercise.

Draw a ring around the correct answer in parts (a) and (b) to complete each sentence.

(a) (i) The substance stored in the muscles and used during exercise is

glycogen.

actic acid.

protein.

(1)

(ii) The process that releases energy in muscles is

digestion.

respiration.

transpiration.

(1)

(b) The table shows how much energy is used by two men of different masses when swimming at different speeds.

Speed of swimming in metres per minute	**Energy used in kJ per hour**	
	34 kg man	**70 kg man**
25	651	1155
50	1134	2103

(i) When the 34 kg man swims at 50 metres per minute instead of at 25 metres per minute,

the extra energy he uses each hour is

36 kJ.

483 kJ.

948 kJ.

(1)

(ii) When swimming at 50 metres per minute, each man's heart rate is faster than when swimming at 25 metres per minute.

A faster heart rate helps to supply the muscles with more

carbon dioxide.
glycogen.
oxygen.

(1)

(iii) During the exercise the arteries supplying the muscles would

constrict.
dilate.
pump harder.

(1)

(c) When a person starts to swim, the breathing rate increases.

Give **one** way in which this increase helps the swimmer.

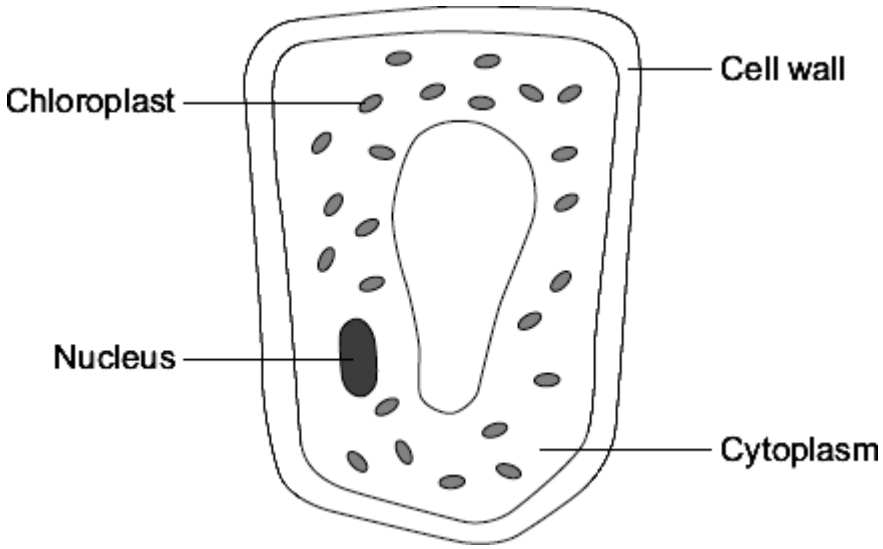
.....

.....

(1)

(Total 6 marks)

Q6. The diagram shows a plant cell from a leaf.



(a) **List A** gives the names of three parts of the cell.**List B** gives the functions of parts of the cell.

Draw a line from each part of the cell in **List A** to its function in **List B**.

List A **Parts of the cell**	**List B** **Functions**
	Where most of the chemical reactions take place
Nucleus	
	Absorbs light energy to make food
Cytoplasm	
	Strengthens the cell
Chloroplast	
	Controls the activities of the cell

(3)

(b) Respiration takes place in the cell.

Draw a ring around the correct answer to complete the sentence.

All cells use respiration to release

energy
oxygen.
sugar.

(1)
(Total 4 marks)

Q7. The photograph shows an athlete at the start of a race.

© Wavebreakmedia Ltd./Thinkstock

(a) The athlete's sense organs contain special cells.
These special cells detect changes in the environment.

(i) **List A** shows changes in the environment.

List B shows some of the athlete's sense organs.

Draw **one** line from each change in the environment in **List A** to the sense organ detecting the change in **List B**.

List A **Change in the environment**	**List B** **Sense organ**
	Ear
Sight of the finishing line	
	Nose
Sound of the starting gun	
	Eye
Pressure of the ground on the fingers	
	Skin

(3)

(ii) Which cells detect changes in the environment?

Tick (✓) **one** box.

Gland cells	☐
Muscle cells	☐
Receptor cells	☐

(1)

(b) During the race, the concentration of sugar in the athlete's blood decreases.

Why?

.....

.....

(1)

(c) Some athletes use anabolic steroids to improve performance.

(i) Draw a ring around the correct answer to complete the sentence.

Anabolic steroids increase

- breathing rate.
- growth of muscles.
- heart rate.

(1)

(ii) Sporting regulations ban the use of anabolic steroids.

Suggest **one** reason why.

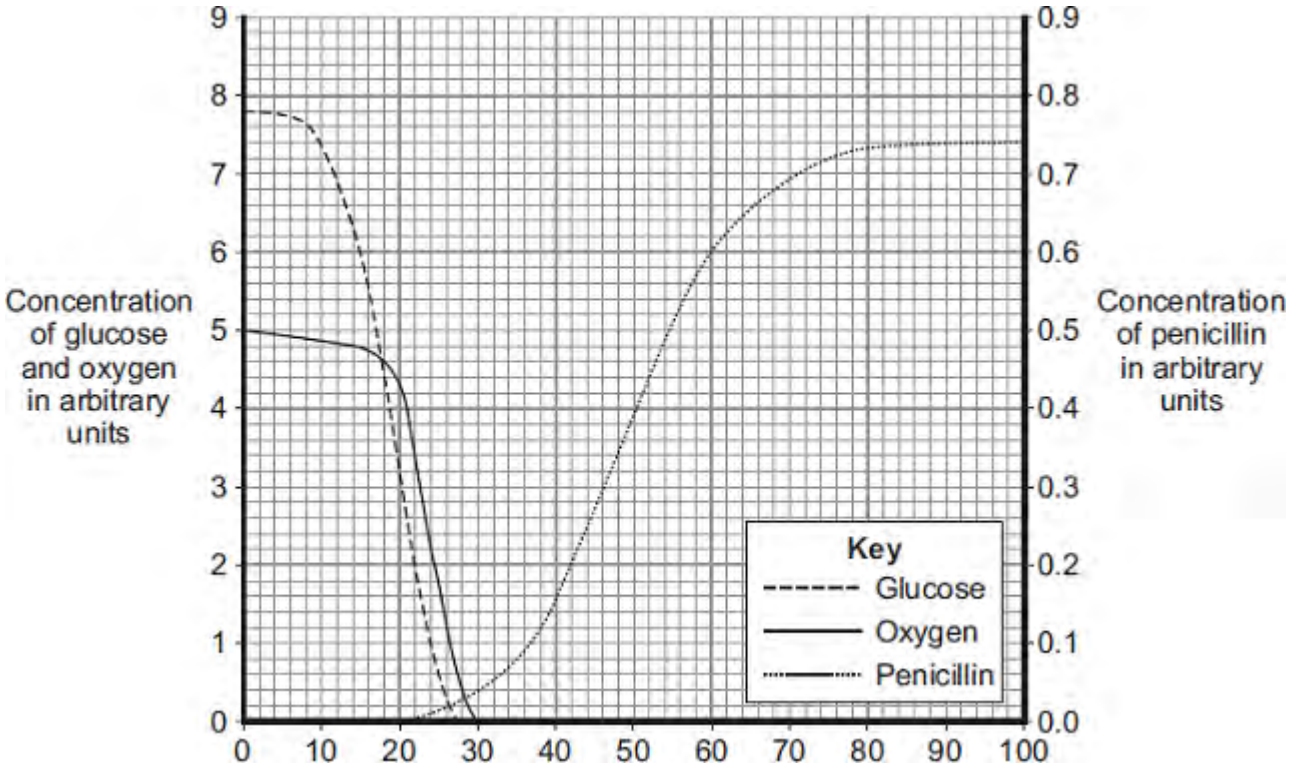
.....

.....

(1)
(Total 7 marks)

Q8. The mould *Penicillium* can be grown in a fermenter. *Penicillium* produces the antibiotic penicillin.

The graph shows changes that occurred in a fermenter during the production of penicillin.



(a) During which time period was penicillin produced most quickly?

Draw a ring around **one** answer.

0 – 20 hours **40 – 60 hours** **80 – 100 hours**

(1)

(b) (i) Describe how the concentration of glucose in the fermenter changes between 0 and 30 hours.

.....

.....

.....

.....

(2)

(ii) How does the change in the concentration of oxygen in the fermenter compare with the change in concentration of glucose between 0 and 30 hours?

Tick (✓) **two** boxes.

The oxygen concentration changes after the glucose concentration.	☐
The oxygen concentration changes before the glucose concentration.	☐
The oxygen concentration changes less than the glucose concentration.	☐
The oxygen concentration changes more than the glucose concentration.	☐

(2)

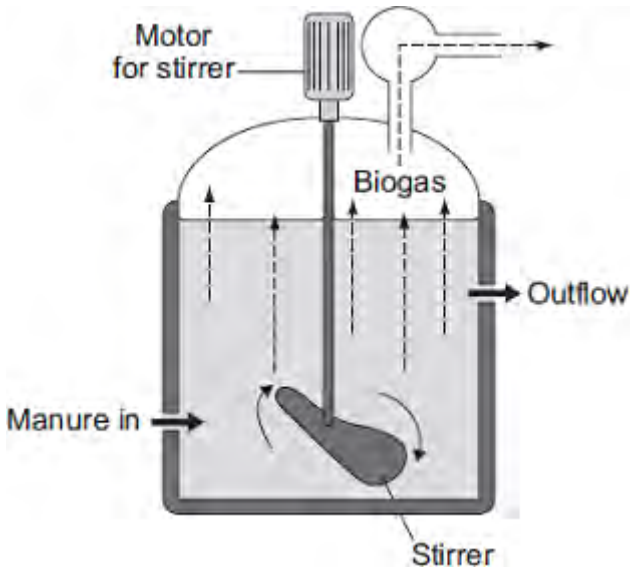
(iii) What is the name of the process that uses glucose?

Draw a ring around **one** answer.

distillation **filtration** **respiration**

(1)
(Total 6 marks)

Q9. The diagram shows one type of biogas generator.



(a) With this type of biogas generator, the concentration of solids that are fed into the reactor must be kept very low.

Suggest **one** reason for this.

Tick (✓) **one** box.

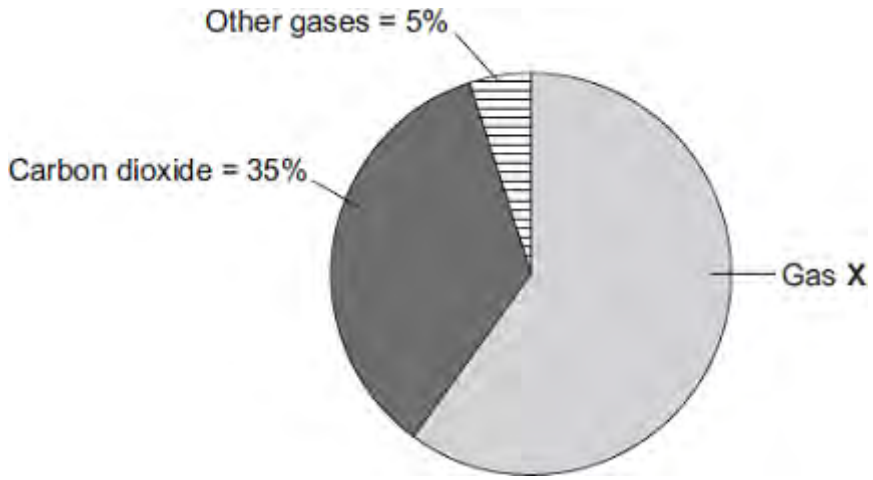
A higher concentration contains too little oxygen. ☐

A higher concentration would be difficult to stir. ☐

A higher concentration contains too much carbon dioxide. ☐

(1)

(b) The pie chart shows the percentages of the different gases found in the biogas.



Gas **X** is the main fuel gas found in the biogas.

(i) What is the name of gas **X**?

Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

(ii) What is the percentage of gas **X** in the biogas?

Show clearly how you work out your answer.

.....

.....

Percentage of gas **X** = ...

(2)

(c) If the biogas generator is not airtight, the biogas contains a much higher percentage of carbon dioxide.

Draw a ring around **one** answer in each part of this question.

(i) The air that leaks in will increase the rate of

aerobic respiration.
anaerobic respiration.

fermentation.

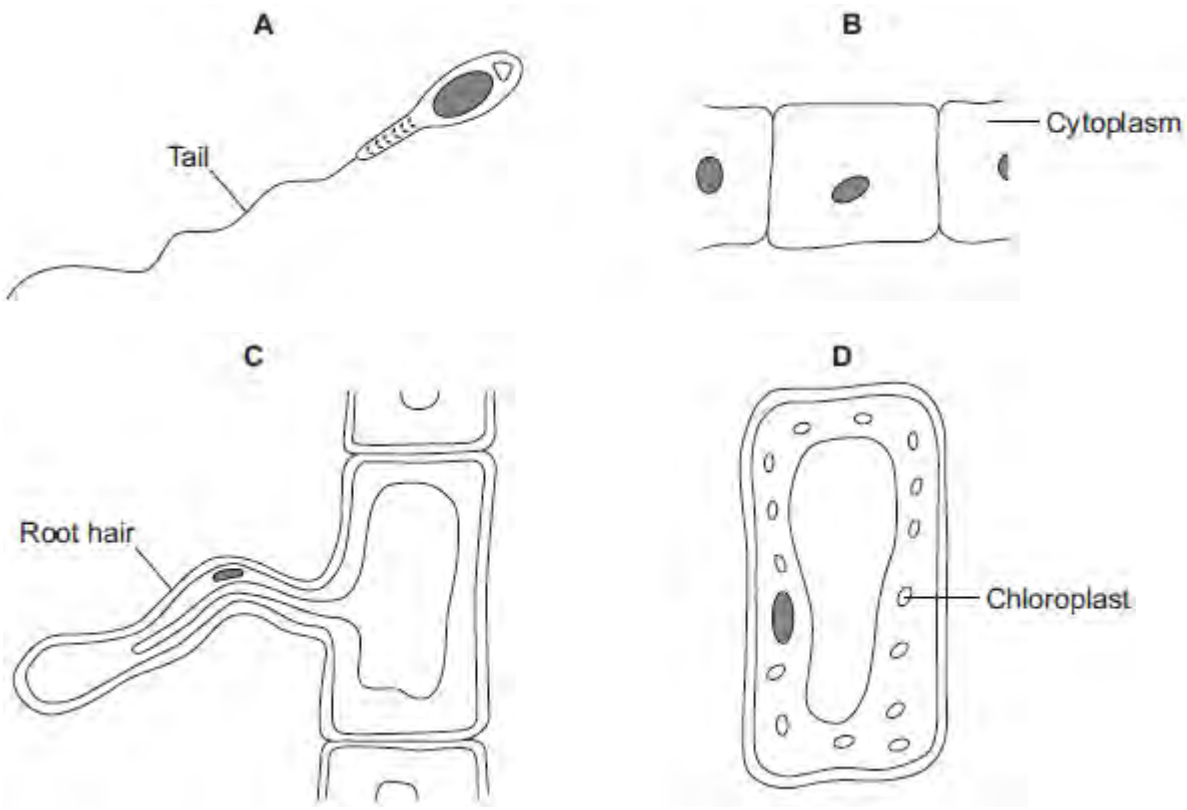
(1)

(ii) The process in part (c)(i) occurs because the air contains

ammonia.
nitrogen.
oxygen.

(1)
(Total 6 marks)

Q10. The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.



(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Give **one** reason for your answer.

.....

.....

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming? ☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis? ☐

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis **photosynthesis** **respiration**

(1)
(Total 5 marks)

M1. (a) methane is produced

ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire

- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

M2. (a) (i) **A** lung

1

B rib

1

C diaphragm

1

D alveolus / alveoli

1

(ii) (**B** moves) up(wards) / out / up and out

1

(**C** moves) down(wards) / flattens

*do **not** allow inwards*
ignore outwards
*if neither mark gained allow **1** mark for correct reference to muscle contraction*

1

(b) (i) 1640

1

1440

1

1720

*allow max **1** for 3 correct values using of bottom of piston:*
1380 + 1180 + 1480 to 1485

1

(ii) 1600

*correct answer gains **2** marks*
*if answer incorrect allow **1** mark for evidence of*
(1640 + 1440 + 1720) ÷ 3
*allow ecf from **(b)(i)***
allow use of two numbers divided by two if one is considered anomalous:
$\frac{(1640 + 1720)}{2}$ *= 1680*
*for **2** marks*

2

(c) two groups of students − one group sports activity participants, other not

allow students as a group

1

fair test eg groups same height / same mass / same sex

1

measure air breathed in by each student / repeat previous experiment then calculate mean for group

1

(d) pointer remains still after breathing / cylinder will move down after breathing (in)

1

error reading volume less likely

allow more accurate / reliable

1

(e) (i) operator squeezes bag

1

air forced / pushed into lungs

or

positive pressure ventilator

1

(ii) any **two** from:

- air pressure / volume not regulated
- operator will tire / must be present at all times / variable intervals
- too much / too little air

allow may 'overbreathe' the patient

2

[20]

M3. (a) A

no mark - can be specified in reason part
if B given - no marks throughout
if unspecified + 2 good reasons = 1 mark

high(er) pressure in A

allow opposite for B
*do **not** accept 'zero pressure' for B*

pulse / described in A

accept fluctuates / 'changes'
allow reference to beats / beating
ignore reference to artery pumping

2

(b) (i) 17

1

(ii) 68

accept correct answer from student's (b)(i) × 4

1

(c) oxygen / oxygenated blood

allow adrenaline
ignore air

glucose / sugar

extra wrong answer cancels - eg sucrose / starch / glycogen / glucagon / water
allow fructose
ignore energy
ignore food

2

[6]

M4. (a) anaerobic respiration

allow phonetic spelling

1

(b) (i) 4.4

4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks

4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark

correct readings from graph in the ranges of 6.7 to 6.9 ***and*** *2.3 to 2.5 but no answer / wrong answer gains 1 mark*

2

(ii) more energy is needed / used / released

do ***not*** *allow energy production*

(at 14 km per hour)

ignore work

1

not enough oxygen (can be taken in / can be supplied to muscles)

allow reference to oxygen debt

do ***not*** *allow less / no oxygen*

1

so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid

allow not enough aerobic respiration

1

[6]

M5. (a) $6H_2O$

in the correct order

1

$C_6H_{12}O_6$

1

(b) (i) control

do not accept *'control variable'*

allow:

to show the effect of the organisms

or

to allow comparison

or

to show the indicator doesn't change on its own

1

(ii) snail respires

1

releases CO_2

1

(iii) turns yellow

1

plant can't photosynthesise so CO_2 not used up

1

but the snail (and plant) still respires so CO_2 produced

1

[8]

Q1. A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

.....

.....

.....

.....

(2)

(b) The gardener finds this research on the Internet:

'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

.....

Ratio .....

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

.....

.....

(1)

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

.....

.....

.....

.....

.....

.....

.....

.....

.....

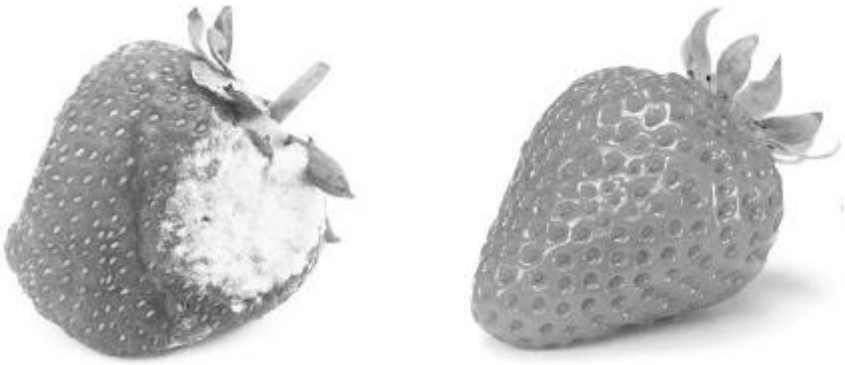
.....

(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1 .....

.....

2 .....

.....

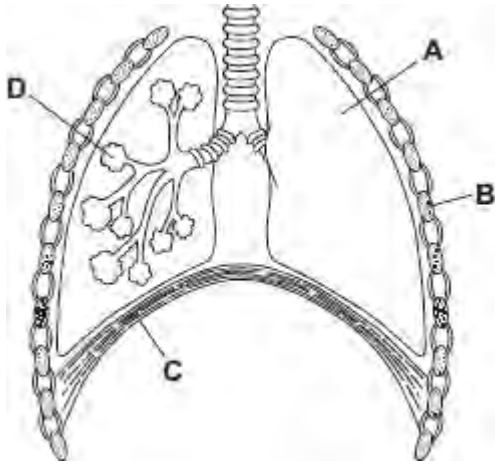
3 .....

.....

(3)
(Total 13 marks)

Q2.(a) **Diagram 1** shows part of the breathing system.

Diagram 1



(i) Use words from the box to name the parts labelled **A**, **B**, **C** and **D**.

alveolus	**diaphragm**	**lung**	**rib**	**trachea**

A .....

B .....

C .....

D .....

(4)

(ii) Parts **B** and **C** move when we breathe **in**.

Part **B** moves .....

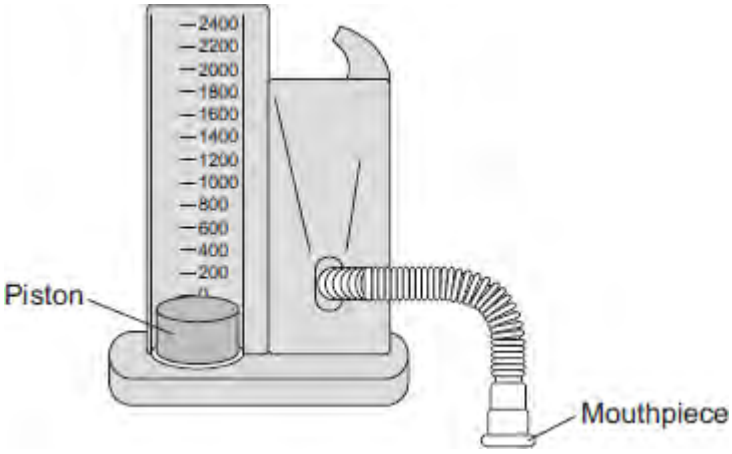
Part **C** moves .....

(2)

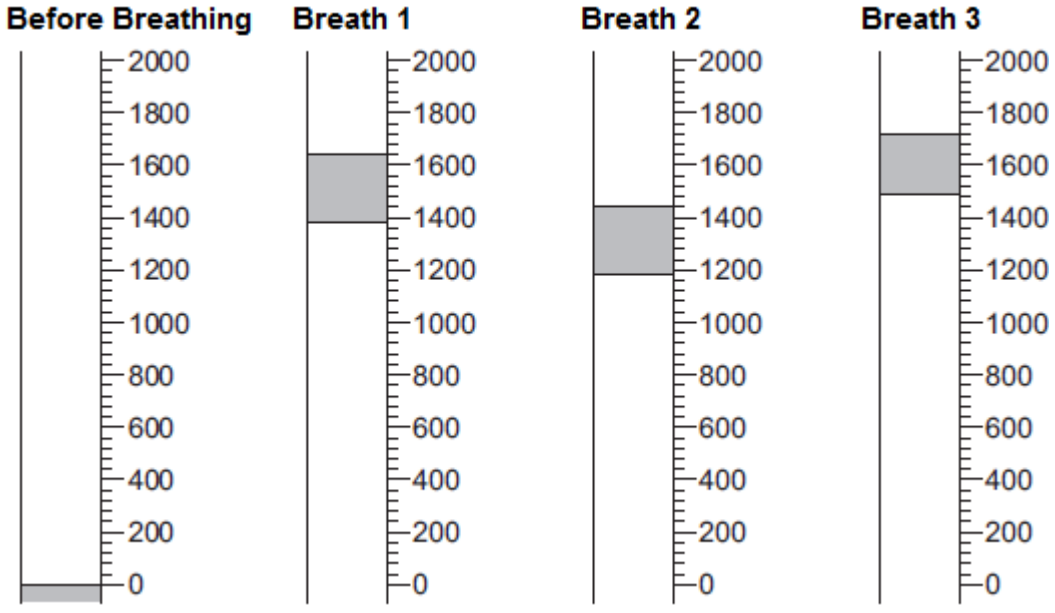
(b) A student used the apparatus shown in **Diagram 2** to measure the maximum volume of air that he could breathe in one breath.
When the student breathes in, the piston moves upwards.

The piston moves back down after the student has breathed out.

Diagram 2



The student breathes in through the apparatus three times.
The drawings show the position of the piston after each of the three breaths.
The volumes are measured in cm^3.



(i) Read the volume of each breath and write the volume in the table.

	Breath 1	Breath 2	Breath 3
Volume in cm^3	.....	.....	.....

(3)

(ii) Calculate the mean volume of air breathed in.

.....

.....

Mean volume of air breathed in = ... cm^3

(2)

(c) A teacher asks the student to investigate if students who take part in sports activities can breathe in a larger volume of air than students who do not take part.

Describe briefly how the student could use the **same** apparatus to do the investigation.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(d) **Photograph 1** shows a different piece of apparatus used to measure the volume of air that a person can breathe in one breath.

Photograph 1

© Digital Vision/Photodisc

When the student breathes out through the apparatus the pointer on the scale moves. The pointer stays in the same position when the student has finished.

Explain **one** advantage, apart from size, of using this apparatus rather than the apparatus described in part **(b)**.

.....

.....

.....

.....

(2)

(e) **Photograph 2** shows one type of mechanical ventilator.

Photograph 2

© Emine Donmaz/iStock

(i) Use information from **Photograph 2** to suggest how this type of ventilator works.

.....

.....

.....

.....

(2)

(ii) Use information from **Photograph 2** to suggest two disadvantages of this type of ventilator.

1.....

.....

2.....

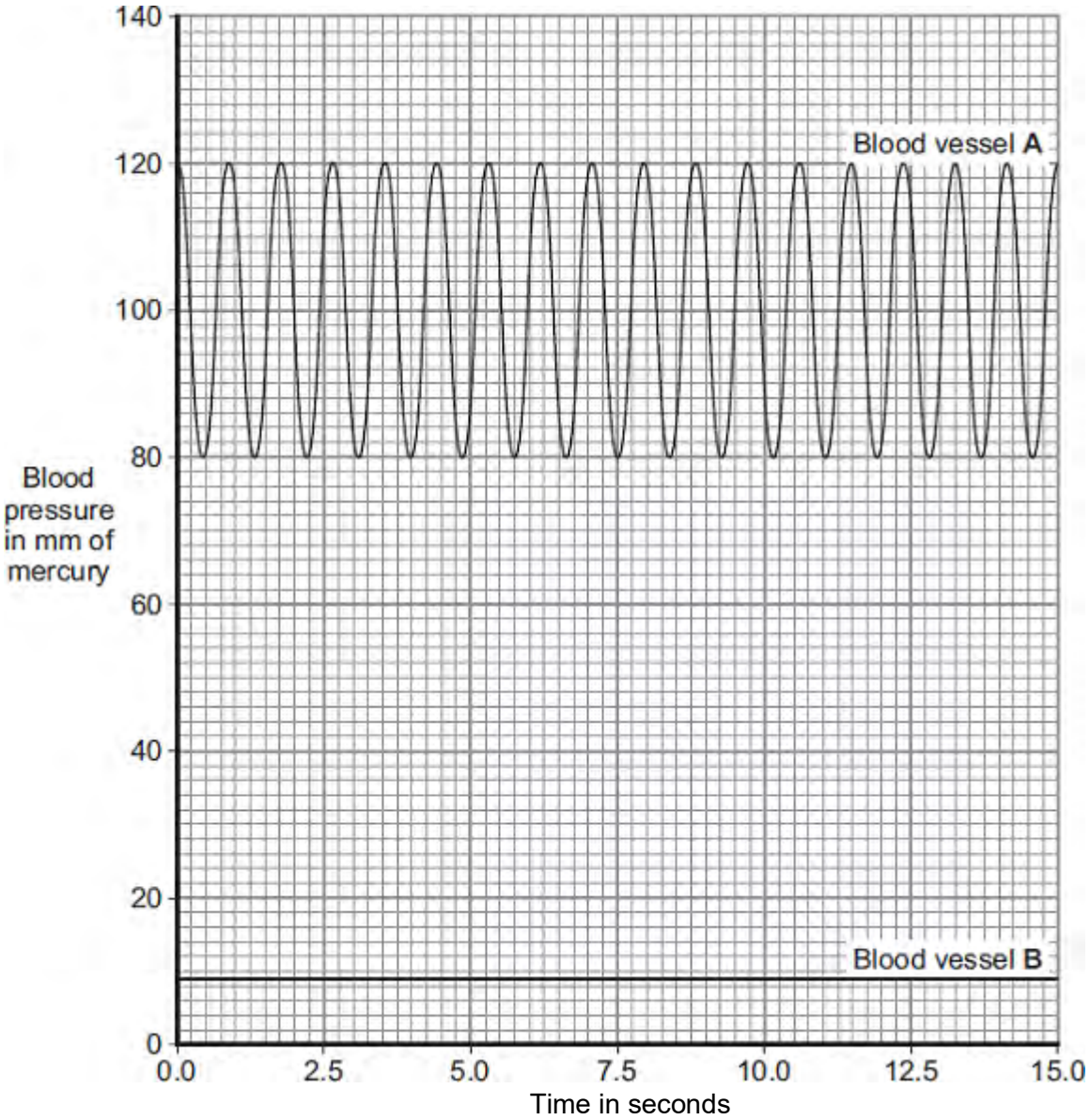
.....

(2)

(Total 20 marks)

Q3. The heart pumps the blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest.
The blood pressure was measured in an artery and in a vein.



(a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel .....

Give **two** reasons for your answer.

Reason 1 .....

.....

Reason 2 .....

.....

(2)

(b) Use information from the graph to answer these questions.

(i) How many times did the heart beat in 15 seconds? .....

(1)

(ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

.....

.....

Heart rate = ... beats per minute

(1)

(c) During exercise, the heart rate increases.

The increased heart rate supplies useful substances to the muscles at a faster rate.

Name **two** useful substances that must be supplied to the muscles at a faster rate during exercise.

1 .....

2 .....

(2)

(Total 6 marks)

Q4.Figure 1 shows an athlete running on a treadmill.

Figure 1

© Starush/istock/Thinkstock

After running for several minutes, the athlete's leg muscles began to ache.
This ache was caused by a high concentration of lactic acid in the muscles.

(a) The equation shows how lactic acid is made.

glucose ⟶ lactic acid (+ energy)

Name the process that makes lactic acid in the athlete's muscles.

.....

(1)

(b) Scientists investigated the production of lactic acid by an athlete running at different speeds.

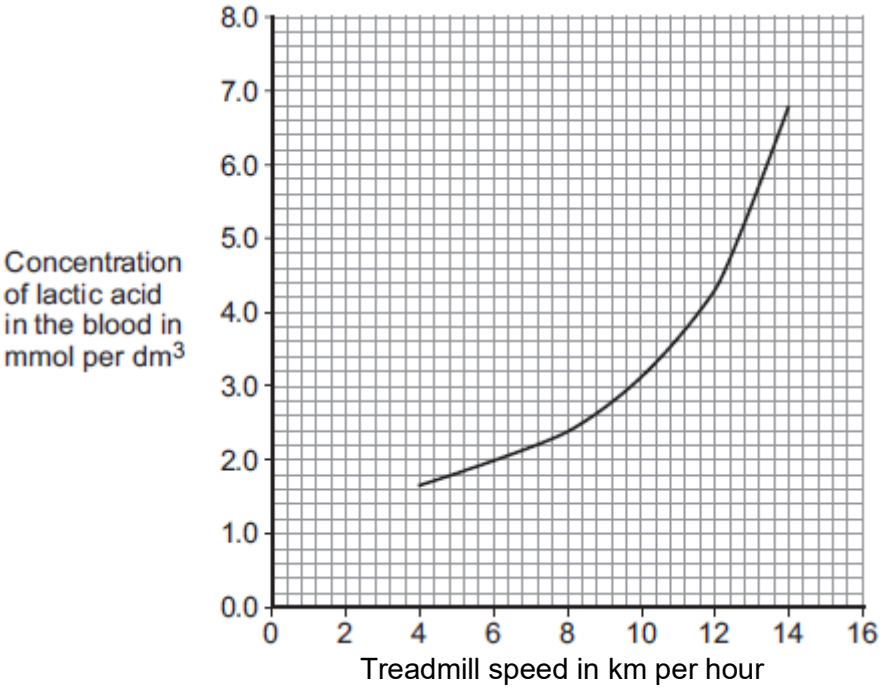
In the investigation:

- the athlete ran on the treadmill at 4 km per hour
- the scientists measured the concentration of lactic acid in the athlete's blood after 2 minutes of running.

The investigation was repeated for different running speeds.

Figure 2 shows the scientists' results.

Figure 2



(i) How much more lactic acid was there in the athlete's blood when he ran at 14 km per hour than when he ran at 8 km per hour?

.....

.....

.....

Answer = ... mmol per dm^3

(2)

(ii) Why is more lactic acid made in the muscles when running at 14 km per hour than when running at 8 km per hour?

.....

.....

.....

.....

.....

.....

(3)
(Total 6 marks)

Q5. Photosynthesis needs light.

(a) Complete the **balanced symbol** equation for photosynthesis.

$$6CO_2 + \text{.....} \xrightarrow{\text{light}} \text{.....} + 6O_2$$

(2)

(b) A green chemical indicator shows changes in the concentration of carbon dioxide (CO_2) in a solution.

The indicator solution is **green** when the concentration of CO_2 is normal.

The indicator solution turns **yellow** when the concentration of CO_2 is high.

The indicator solution turns **blue** when the concentration of CO_2 is very low or when there is no CO_2.

The indicator solution does not harm aquatic organisms.

Students investigated the balance of respiration and photosynthesis using an aquatic snail and some pondweed.

The students set up four tubes, **A**, **B**, **C** and **D**, as shown in the table below.

The colour change in each tube, after 24 hours in the light, is recorded.

Tube A	**Tube B**	**Tube C**	**Tube D**
			
Indicator solution only	Indicator solution + pondweed	Indicator solution + snail	Indicator solution + pondweed + snail
Stays green	Turns blue	Turns yellow	Stays green

(i) What is the purpose of **Tube A**?

.....

.....

(1)

(ii) Explain why the indicator solution in **Tube C** turns yellow.

.....

.....

.....

.....

(2)

(iii) Predict the result for **Tube D** if it had been placed in the dark for 24 hours and **not** in the light.

Explain your prediction.

Prediction.....

.....

Explanation.....

.....

.....

.....

(3)
(Total 8 marks)

M1. (a) circulating / mixing / described **or** temperature maintenance

1

supply oxygen
or for <u>aerobic</u> conditions
or for <u>faster</u> respiration

*do **not** allow oxygen for anaerobic respiration*

1

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*
ignore reference to aerobic / anaerobic

or <u>material</u> for growth / to <u>make</u> mycoprotein

1

(c) <u>respiration</u>

allow exothermic reaction
allow catabolism
ignore metabolism
ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*

*do **not** allow harmful unqualified*

1

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

or

steam / heat treat / steriliseglucose / minerals / nutrients / water (before use)
or
filter / sterilise air intake
or
check there are no leaks

*allow sterilisation unqualified **not** just use pure glucose*

1

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein <u>mainly</u> better than wheat
- more phenylalanine in wheat than in mycoprotein

  allow equivalent numerical statements
- but no information given on other amino acids / costs / foods

3

<u>overall conclusion:</u>

statement is incorrect because
either
it would be the best source for vegetarians
or
for given amino acids, beef is the best source
or
three foods provide insufficient data to draw a valid conclusion

1

[10]

M2. (a) circulation / mixing / described

1

or

temperature maintenance

supply <u>oxygen</u>

*do **not** allow oxygen for anaerobic respiration*

or

for <u>aerobic</u> conditions

or

for <u>faster</u> respiration

1

(b) any **one** from:

- energy supply / fuel
  or use in respiration

  *do **not** allow just food / growth*

  ignore reference to aerobic / anaerobic

- <u>material</u> for growth
  or to <u>make</u> mycoprotein

1

(c) (heat / energy) from <u>respiration</u>

allow <u>exothermic</u> reactions

allow description eg <u>breakdown</u> of glucose / catabolism

ignore metabolism

ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with Fusarium) for food / oxygen
  or reduce yield of Fusarium

- make toxic waste products
  or they might cause disease / pathogenic
  or harmful to people / Fusarium

  *do **not** allow harmful unqualified*

1

(ii) any **two** from:

- steam / heat treat / sterilise fermenter (before use)
  ***not** just clean*
  *allow sterilisation unqualified for **1** mark*
- steam / heat treat / sterilise glucose / minerals / nutrients / water (before use)
  ***not** just use pure glucose*
- filter / sterilise air intake
- check there are no leaks

2

(e) any **three** from:

- beef is best **or** beef is better than mycoprotein(*)
- mycoprotein <u>mainly</u> better than wheat(*)
- more phenylalanine in wheat than in mycoprotein(*)
  allow equivalent numerical statements(*)
- but no information given on other amino acids / costs / foods

3

<u>overall conclusion</u>:

statement is incorrect

or

it would be the best source for vegetarians

or

for given amino acids, beef is the best source

or

three foods provide insufficient data to draw a valid conclusion

1

[11]

M3. (a) No

no mark
if yes max 1 for correct statement

diffusion is down the concentration gradient

accept by diffusion ions would leave the root

1

to enter must go up / against the concentration gradient
or concentration higher in the root
or concentration lower in the soil

1

(b) (i) 0.9 **or** 3.25

for correct answer with or without working
if answer incorrect 1.3 ***or*** *their rate – 0.4 gains 1 mark*
or *130 – 40* ***or*** *90 gains 1 mark*

2

(ii) (uptake) by active transport

1

requires energy

more energy from aerobic respiration

1

or

more energy when oxygen is present

1

[7]

M4. (a) (i) 120

1

(ii) 11 760 **or**
correct answer from candidate's answer to (a)(i)

correct answer with or without working

if answer incorrect

120 × 98 ***or***
candidate's answer to (a)(i) × corresponding SV gains ***1*** *mark*

if candidate uses dotted line / might have used dotted line(bod) in (a)(i) ***and*** *(a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 x 88 = 12320 gains* ***2*** *marks*

2

(b) trained athlete has higher stroke volume / more blood per beat

1

same volume blood expelled with fewer beats

or for same heart rate more blood is expelled

1

(c) increased aerobic respiration

or

decreased anaerobic respiration

allow correct equation for aerobic respiration

accept don't have to respire anaerobically

1

increased energy supply / need

1

less lactic acid formed

or to breakdown lactic acid **or** less O_2-debt

1

can do more work **or** can work harder / faster / longer

accept muscle contraction for work

or less fatigue / cramp / pain

1

[9]

M5. insufficient / no oxygen available

1

for (just) aerobic <u>respiration</u>

or
<u>respires</u> anaerobically

1

[2]

M6. (a) 7.15 to 7.45 <u>am</u> **and** 7.15 to 7.45 <u>pm</u>
both *required, either order*
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33
allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used
  allow more food made than used
- so plant able to grow / flower
  accept plant able to store food

2

[5]

M7. (a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols
*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions **or** particles

have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

<u>40 – 50 °C</u>

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

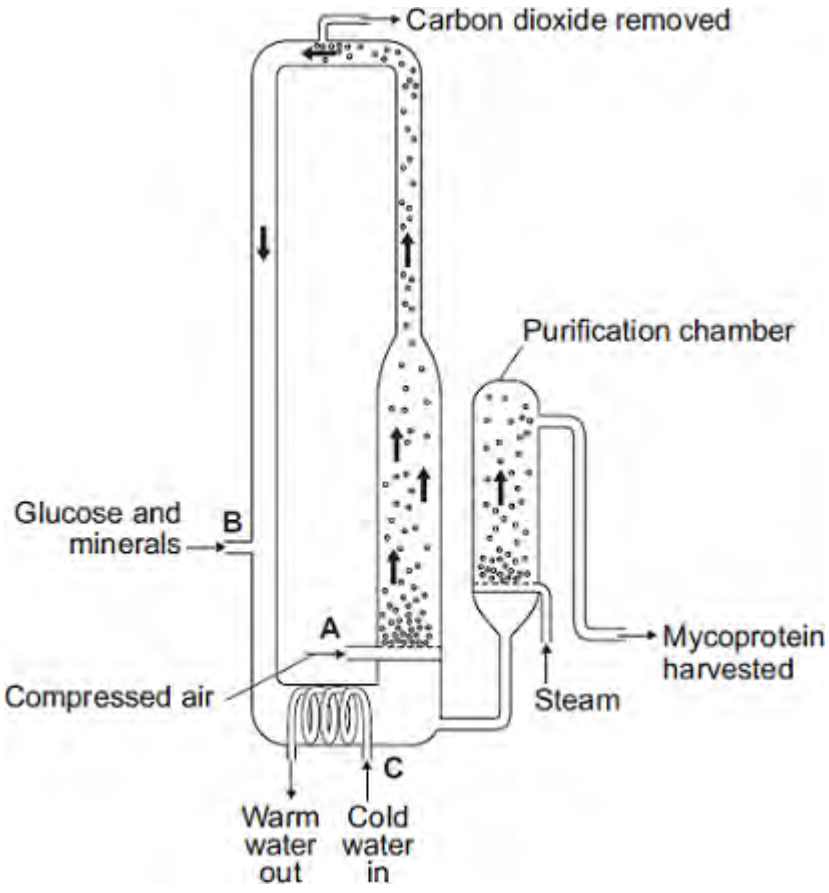
because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

Q1. The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.

Fusarium is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1.....

.....

2.....

.....

(2)

(b) Why is glucose added to the fermenter?

.....

.....

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

.....

(1)

(d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

(i) Why is this important?

.....

.....

(1)

(ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

.....

.....

(1)

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980

Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

.....

.....

.....

.....

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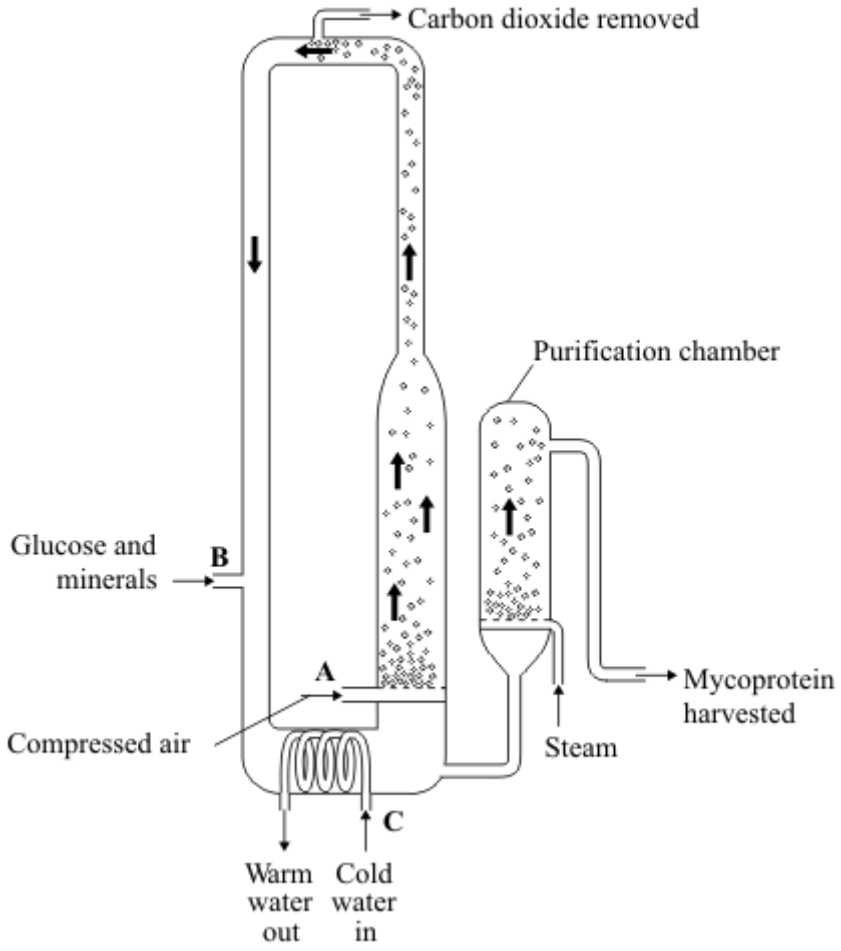
.....

.....

(4)
(Total 10 marks)

Q2. The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium* which is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A.**

Give **two** functions of the air bubbles.

1 .....

.....

2 .....

.....

(2)

(b) Glucose is added to the fermenter at **B.**

Explain why glucose is added.

.....

.....

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C.**

Explain what causes the fermenter to heat up.

.....

.....

(1)

(d) It is important to prevent microorganisms other than *Fusarium* from growing in the fermenter.

(i) Why is this important?

.....

.....

(1)

(ii) Suggest **two** ways in which contamination of the fermenter by microorganisms could be prevented.

1

.....
.....

.....
.....

2

.....
.....

.....
.....

(2)

(e) Human cells cannot make some of the amino acids which we need. We must obtain

these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(Total 11 marks)

Q3. (a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

	Concentration of sulfate ions in mmol per dm^3
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

.....

.....

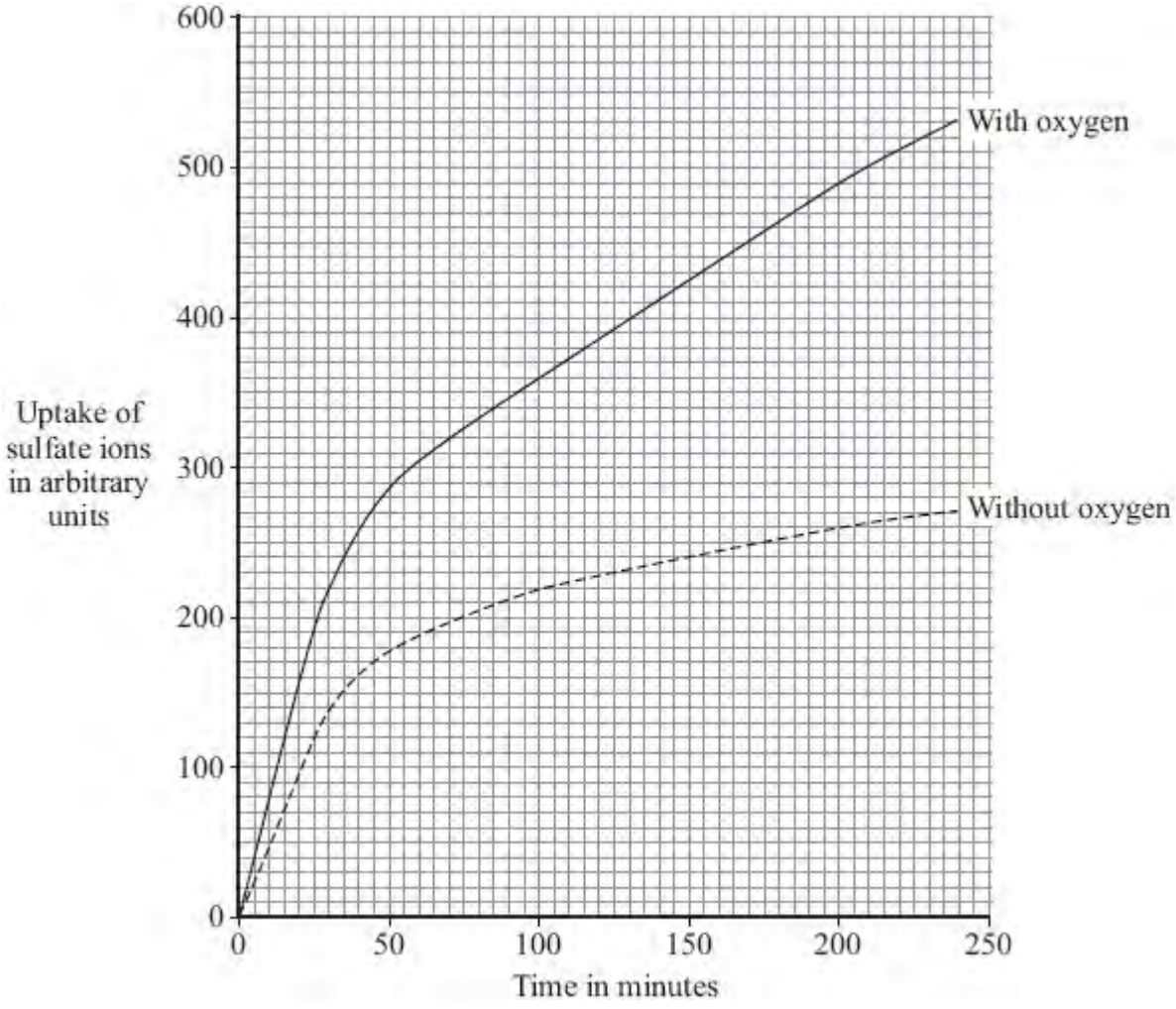
.....

.....

(2)

(b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph below shows the results.



(i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

.....

.....

.....

Answer ..... arbitrary units

(2)

(ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

.....

.....

.....

.....

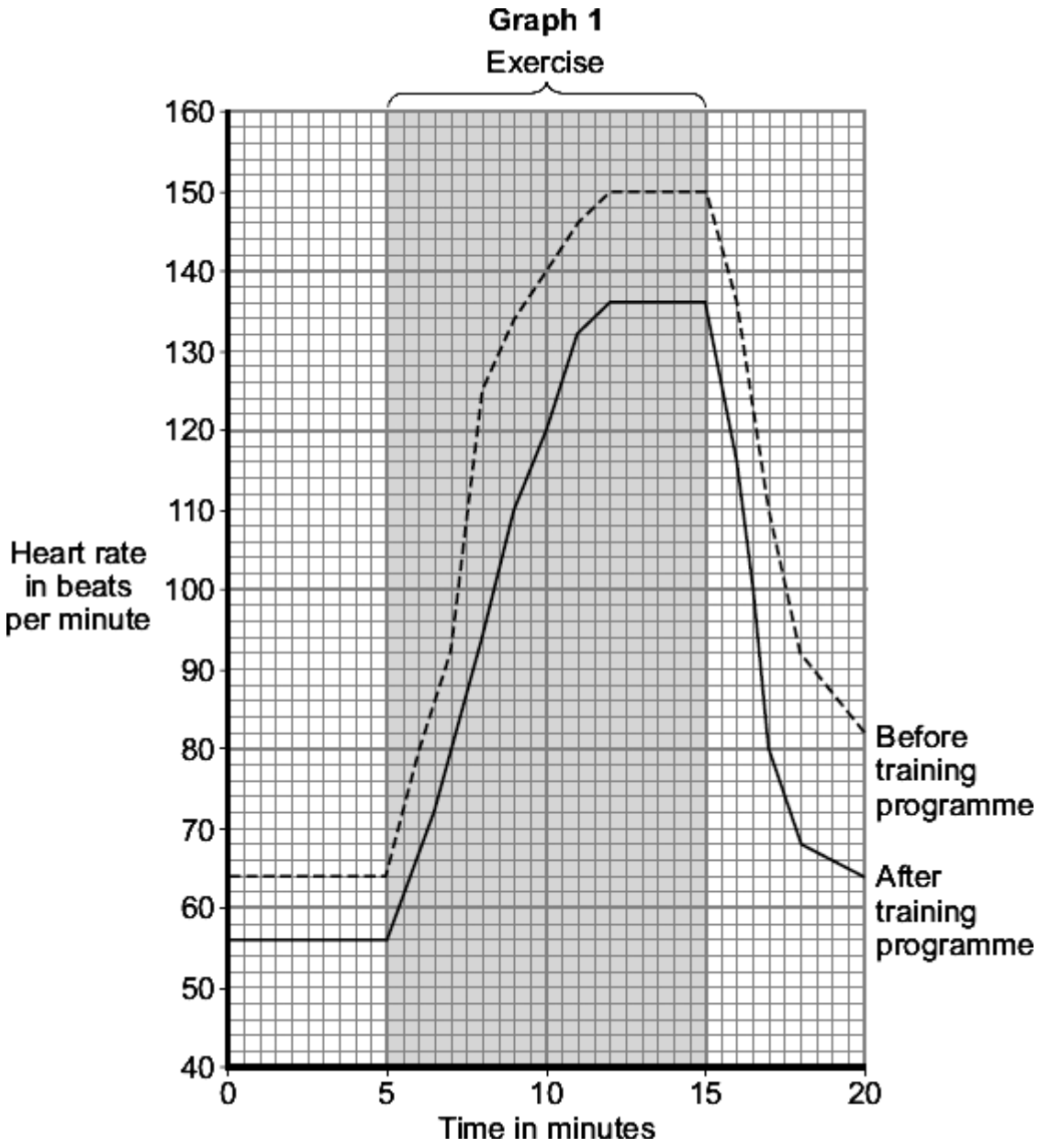
.....

.....

(3)
(Total 7 marks)

Q4. An athlete carried out a 6-month training programme.

Graph 1 shows the effect of the same amount of exercise on his heart rate before and after the training programme.



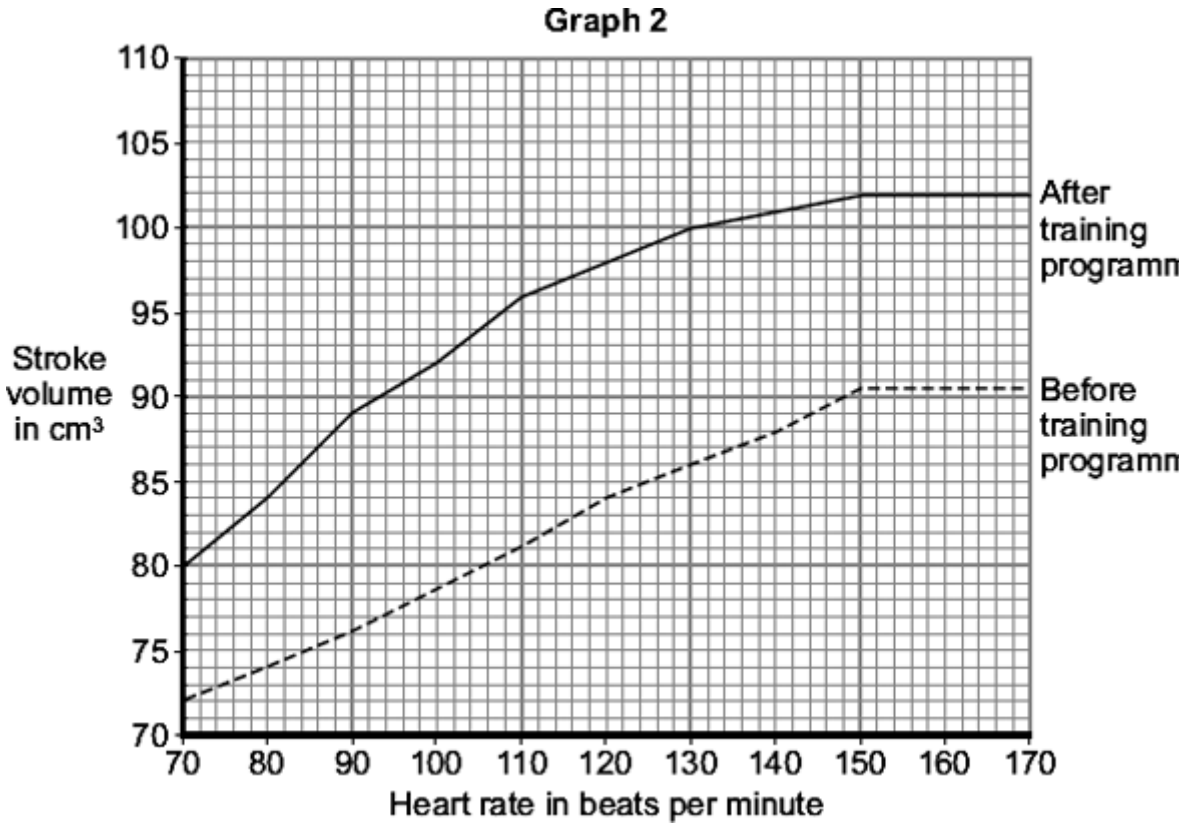
(a) (i) Use **Graph 1** to find the heart rate of the **trained** athlete 5 minutes after the start of the exercise.

Heart rate = ... beats per minute

(1)

The stroke volume of the heart is the volume of blood pumped out of the left side of the heart in one heart beat.

Graph 2 shows the relationship between the stroke volume and the heart rate before and after the athlete did the training programme.



(ii) The *cardiac output* is defined as

cardiac output = heart rate × stroke volume

Calculate the cardiac output of the **trained** athlete 5 minutes after the start of the exercise. Use your answer to part (a)(i), and information from **Graph 2**.

Show clearly how you work out your answer.

.....

.....

Cardiac output = ... cm^3 blood per minute

(2)

(b) **Graph 1** shows that, for the same amount of exercise, the heart of the trained athlete was beating more slowly than it did before the training programme.

Use information from **Graph 2** to explain why.

.....

.....

.....

.....

(2)

(c) An increased cardiac output will provide more oxygen and more glucose to the working muscles.

Explain how this helps the athlete during exercise.

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 9 marks)

Q5. Lactic acid production during exercise affects an athlete's performance.

Explain why lactic acid is produced during exercise.

.....

.....

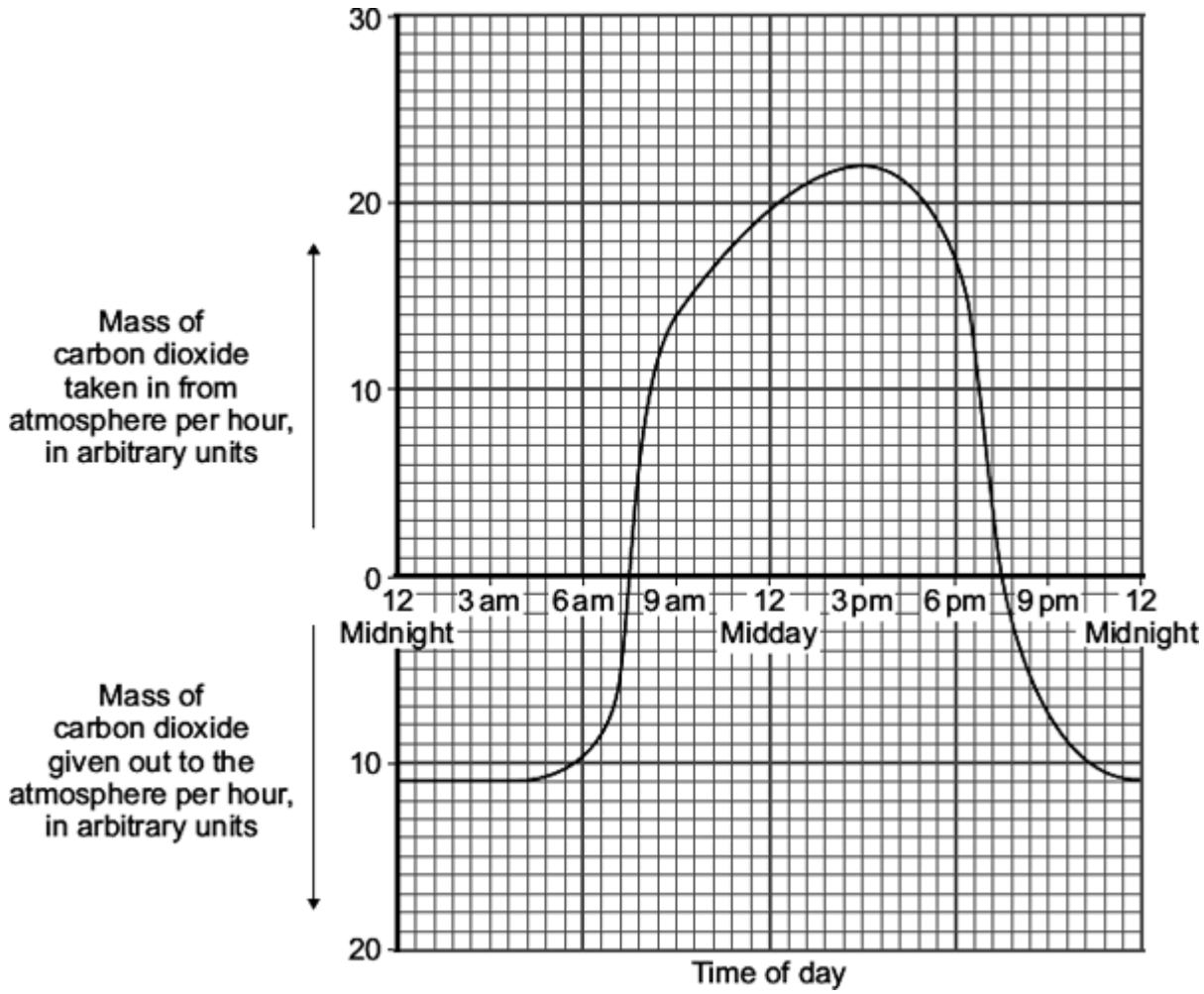
.....

.....

.....

(Total 2 marks)

Q6. The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



(a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1 ..... 2 .....

(1)

(b) The bean plant respires at the same rate all through the 24 hour period.

(i) How much carbon dioxide is released each hour during respiration?

..... arbitrary units

(1)

(ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

.....

.....

Answer = ... arbitrary units

(1)

(c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean plant.

Explain, in detail, why this was important for the bean plant.

.....

.....

.....

.....

.....

.....

(2)
(Total 5 marks)

Q7. (a) Complete the equation for photosynthesis.

..... + ... $\xrightarrow{\text{lightenergy}}$ ..... + oxygen

(2)

(b) Scientists investigated how temperature affects the rate of photosynthesis.
The scientists grew some orange trees in a greenhouse.
They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

(i) The leaf discs did not produce any oxygen in the dark.

Why?

.....

.....

(1)

(ii) The leaf discs took in oxygen in the dark.

Explain why.

.....

.....

.....

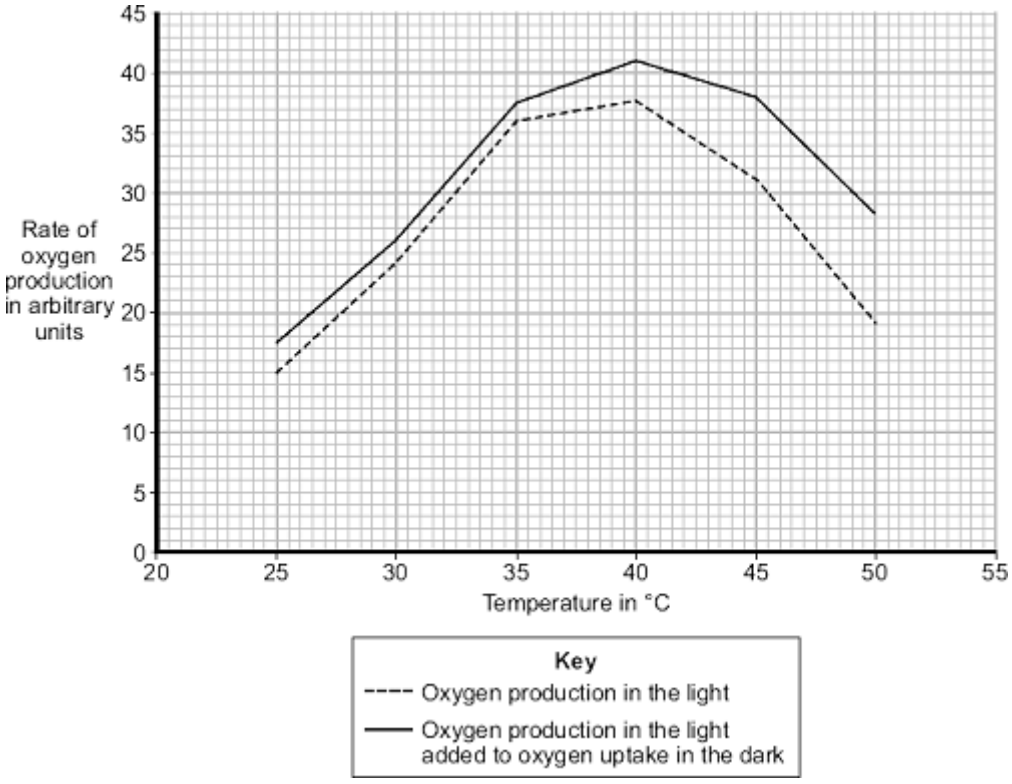
.....

(2)

(c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

(i) Describe the effect of temperature on oxygen production in the light.

.....

.....

.....

.....

(2)

(ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

.....

.....

.....

from 40 °C to 50 °C.

.....

.....

.....

(2)

(d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(3)
(Total 12 marks)