Bioenergetics part 4 AQA Triple Biology

Name: _____

Class: _____

Date: _____

Time: **69 minutes**

Marks: **65 marks**

Comments:

1. A student investigated respiration in yeast.

This is the method used.

1. Add 5 cm^3 of a yeast and water mixture to each measuring cylinder.

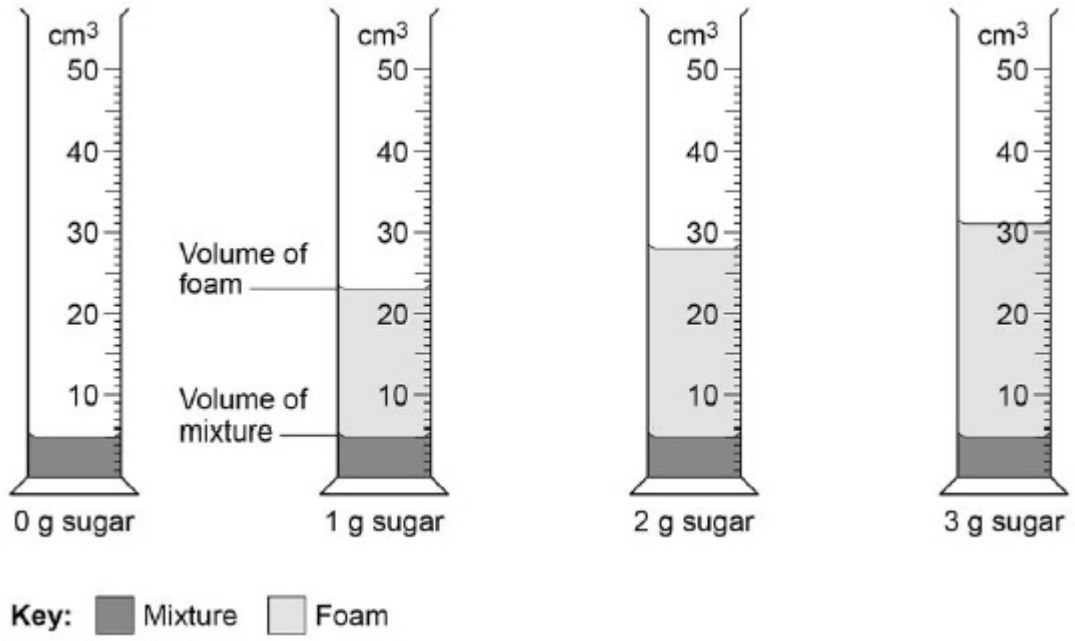
2. Add different masses of sugar to each measuring cylinder.

3. Mix the contents of each measuring cylinder gently for 5 seconds.

4. Put the measuring cylinders in a water bath at 25 °C

5. Over the next 20 minutes, record the maximum volume the foam reaches in each measuring cylinder.

The figure below shows the student's results.



(a) Which **two** variables did the student control in the method?

Tick (✓) **two** boxes.

Mass of sugar ☐

pH of the mixture ☐

Temperature ☐

Volume of foam ☐

Volume of yeast and water ☐

(2)

The following table shows the results.

Mass of sugar in g	Maximum volume in cm^3
0	5
1	23
2	**X**
3	31

(b) What is value **X** in the table?

Use the figure above.

X = _____ cm^3

(1)

In the investigation, the yeast respires and releases a gas which causes the foam to rise.

(c) Which gas causes the foam to rise?

Tick (✓) **one** box.

Carbon dioxide ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

(1)

(d) What conclusion can you make about the relationship between the mass of sugar used and the volume of gas produced?

_____

_____

_____

_____

(1)

(e) Why was no foam produced in the mixture with 0 g of sugar?

_____

_____

(1)

(f) Why was the measuring cylinder with 0 g of sugar included in the investigation?

_____

_____

(1)

(g) The top of the mixture can be covered with a layer of oil after step 3 in the method.

Suggest why the layer of oil stops the yeast respiring aerobically.

_____

_____

(1)

(h) What other substance is produced during **anaerobic** respiration in yeast?

Tick (✓) **one** box.

Ethanol	☐
Hydrochloric acid	☐
Lactic acid	☐
Water	☐

(1)

(Total 9 marks)

2. A small animal called an axolotl lives in water. The axolotl has a double circulatory system.

(a) Define the term double circulatory system.

_____

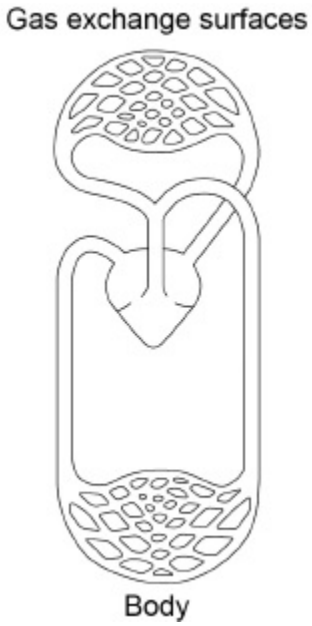
_____

_____

(1)

Figure 1 shows the double circulatory system of the axolotl.

Figure 1



(b) The heart of the axolotl has only one ventricle.

Label the ventricle on **Figure 1**.

(1)

(c) Explain why having only one ventricle makes the circulatory system less efficient than having two ventricles.

_____

_____

_____

_____

(2)

Figure 2 shows an axolotl.

Figure 2

(d) Explain why an axolotl may die in water with a low concentration of oxygen.

(4)

If a gill of an axolotl is removed, a new gill will grow in its place.

Scientists hope to use information on how axolotls grow new gills to help with regenerating human tissue.

(e) Name the type of cell that divides when a new gill grows.

(1)

(f) Name **one** condition that could be treated using regenerated human tissue.

_____

(1)

(g) Suggest **one** reason why an axolotl is a suitable animal for research in the laboratory.

_____

_____

(1)

(h) An axolotl may **not** be a suitable animal to study when researching regeneration in human tissue.

Suggest **one** reason why.

_____

_____

(1)

(Total 12 marks)

3. This question is about photosynthesis.

(a) Complete the word equation for photosynthesis:

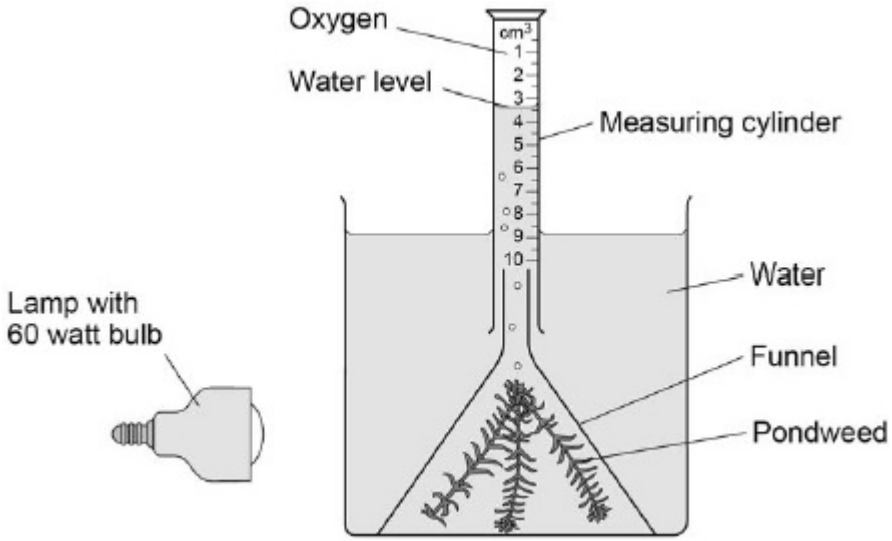
_____ + _____ → _____ + oxygen

(2)

A student investigated photosynthesis using pondweed.

Figure 1 shows the apparatus the student used.

Figure 1



This is the method used.

1. Set up the apparatus as shown in **Figure 1**.

2. Switch on the lamp.

3. After 20 minutes, record the volume of oxygen collected in the measuring cylinder.

4. Repeat steps 1–3 using bulbs of different power output.

(b) What was the independent variable in the investigation?

Tick (✓) **one** box.

- Power output of bulb ☐
- Rate of photosynthesis ☐
- Time to collect oxygen ☐
- Volume of oxygen collected ☐

(1)

(c) Suggest **two** ways the method could be improved so the results would be more valid.

1 _____

_____

2 _____

_____

(2)

The table below shows the student's results.

Power output of bulb in watts	**Volume of oxygen collected in 20 minutes in cm^3**	**Rate of photosynthesis in cm^3/hour**
60	0.5	1.5
100	0.8	2.4
150	1.1	**X**
200	1.2	3.6
250	1.2	3.6

(d) Calculate value **X** in the table above.

X = _____ cm^3/hour

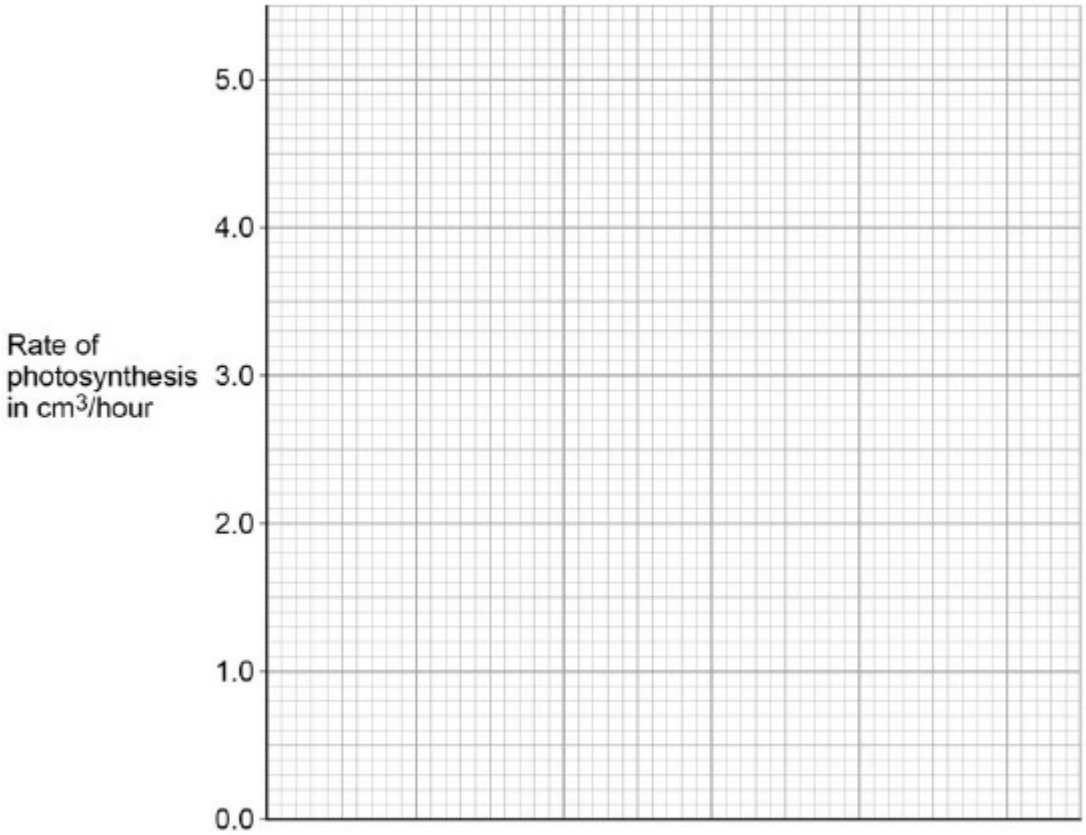
(1)

(e) Complete **Figure 2**.

You should:

- label the x-axis
- use a suitable scale
- plot the data from the table above and your answer to part (d)
- draw a line of best fit.

Figure 2



(4)

(f) Determine the expected rate of photosynthesis with a bulb of power output 75 watts.

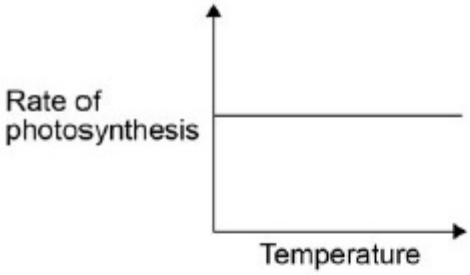
Use **Figure 2**.

Rate of photosynthesis at 75 watts = _____ cm^3/hour

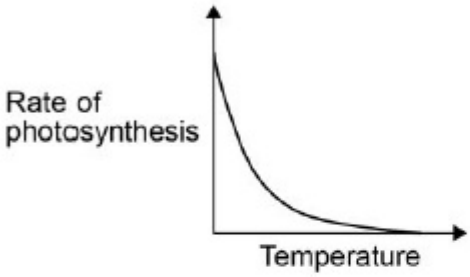
(1)

(g) Which graph shows the effect of temperature on the rate of photosynthesis?

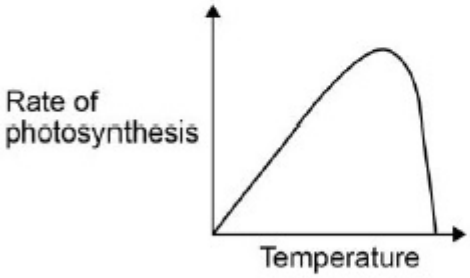
Tick (✓) **one** box.



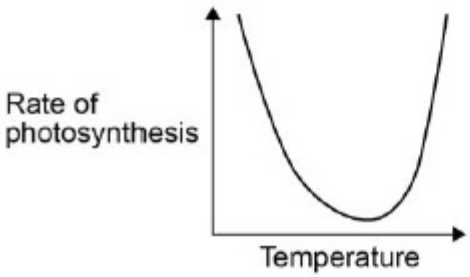
☐



☐



☐



☐

(1)

(Total 12 marks)

4. Plants are made up of cells, tissues and organs.

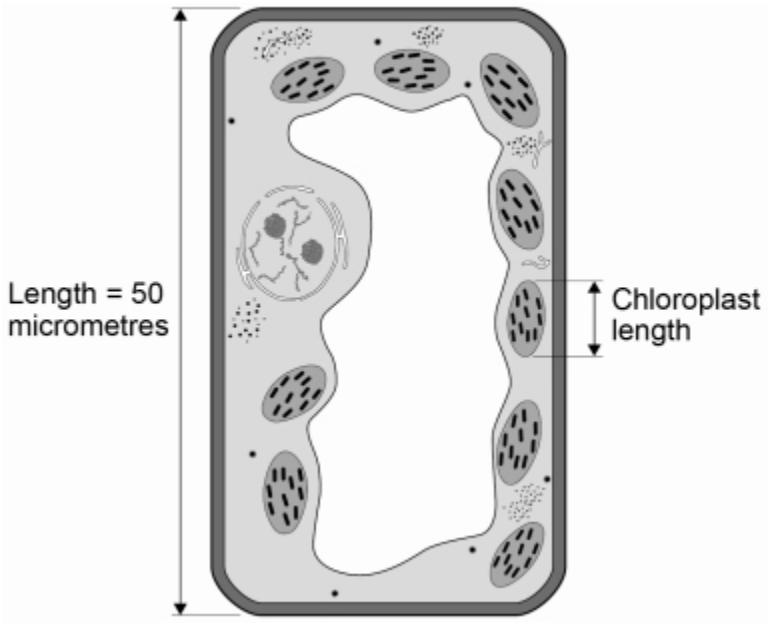
(a) Draw **one** line from each level of organisation to the correct plant part.

Level of organisation	Plant part
	Leaf
Organ	Root hair
	Spongy mesophyll
Tissue	Vacuole
	Xylem cell

(2)

Figure 1 shows a plant cell drawn to scale.

Figure 1



(b) Where in a plant would the cell in **Figure 1** be found?

Tick **one** box.

Epidermis ☐

Palisade mesophyll ☐

Phloem ☐

Xylem ☐

(1)

(c) Calculate the length of the chloroplast labelled in **Figure 1**.

_____

_____

_____

_____

Length = _____ micrometres

(2)

(d) Cells in plant roots do **not** photosynthesise.

Give **one** reason why.

_____

_____

(1)

(e) As a plant grows, new root hair cells are formed from unspecialised cells.

How does an unspecialised cell become a new root hair cell?

Tick **one** box.

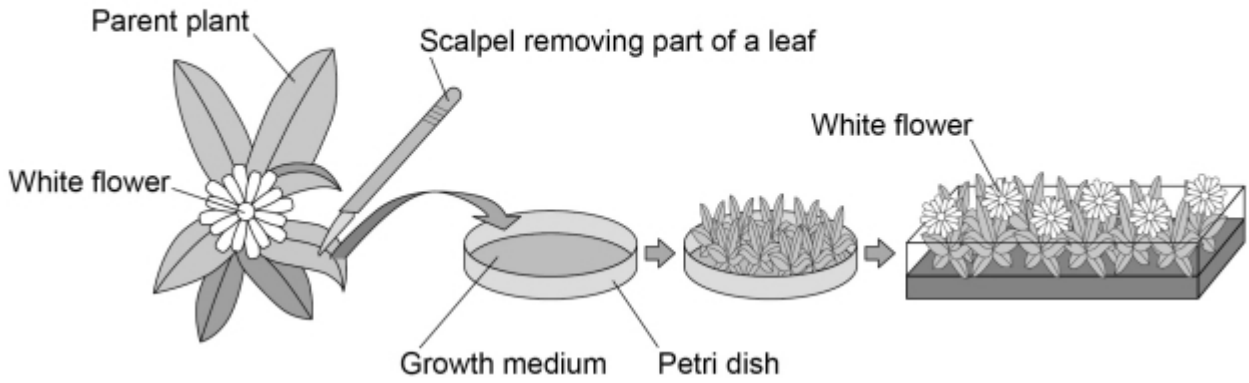
- Differentiation ☐
- Metabolism ☐
- Transpiration ☐
- Transport ☐

(1)

Scientists can clone plants using tissue culture.

Figure 2 shows the process of tissue culture.

Figure 2



(f) Why might scientists want to clone plants?

Tick **one** box.

To create new species of plants. ☐

To introduce variation into plants. ☐

To protect endangered plants from extinction. ☐

To reduce disease resistance in plants. ☐

(1)

(g) What is the advantage of cloning plants using tissue culture?

Tick **one** box.

No special equipment is needed. ☐

Plants can be produced quickly. ☐

The flowers are all different colours. ☐

The offspring are all genetically different. ☐

(1)

(h) The growth medium in **Figure 2** helps the plants to grow.

Name **one** substance in the growth medium.

_____

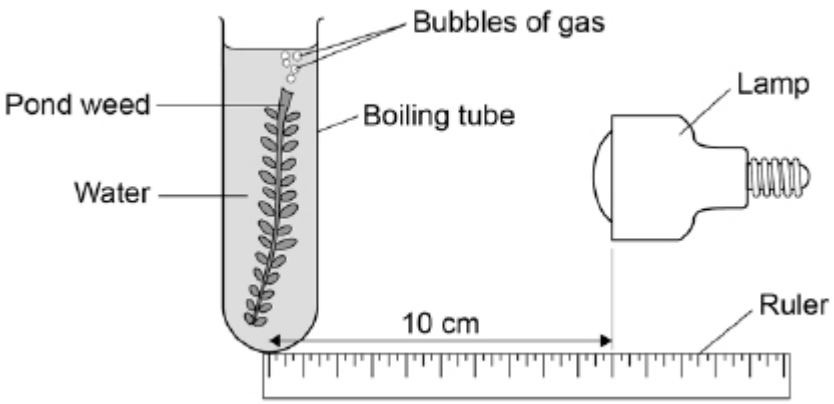
_____

(1)

(Total 10 marks)

5. A student investigated the effect of light intensity on the rate of photosynthesis.

The diagram shows the apparatus the student used.



This is the method used.

1. Set up the apparatus as shown in the diagram above.
2. Place the lamp 10 cm from the pondweed.
3. Turn the lamp on and count the number of bubbles produced in one minute.
4. Repeat with the lamp at different distances from the pondweed.

(a) Complete the hypothesis for the student's investigation.

'As light intensity increases, _____

_____ .'

(1)

(b) What was the independent variable in this investigation?

Tick **one** box.

Light intensity ☐

Number of bubbles produced ☐

Temperature ☐

Time ☐

(1)

(c) The teacher suggests putting the boiling tube into a beaker of water during the investigation.

Suggest why this would make the results more valid.

_____

_____

(1)

Table 1 shows the student's results.

Table 1

Distance of lamp from pondweed in cm	**Number of bubbles produced per minute**			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
10	67	66	69	67
20	61	64	62	62.3
30	53	51	52	**X**
40	30	32	31	31
50	13	15	15	14

(d) Calculate value **X** in **Table 1**.

_____

_____

X = _____ bubbles per minute

(1)

(e) State **one** error the student has made when completing the results at 20 cm.

_____

_____

(1)

(f) What evidence in **Table 1** shows that the data is repeatable?

Tick **one** box.

The number of bubbles decreases as distance decreases. ☐

The numbers of bubbles at each distance are similar. ☐

The student calculated a mean for each distance. ☐

The student did the experiment three times. ☐

(1)

Another student investigated the effect of the colour of light on the rate of photosynthesis.

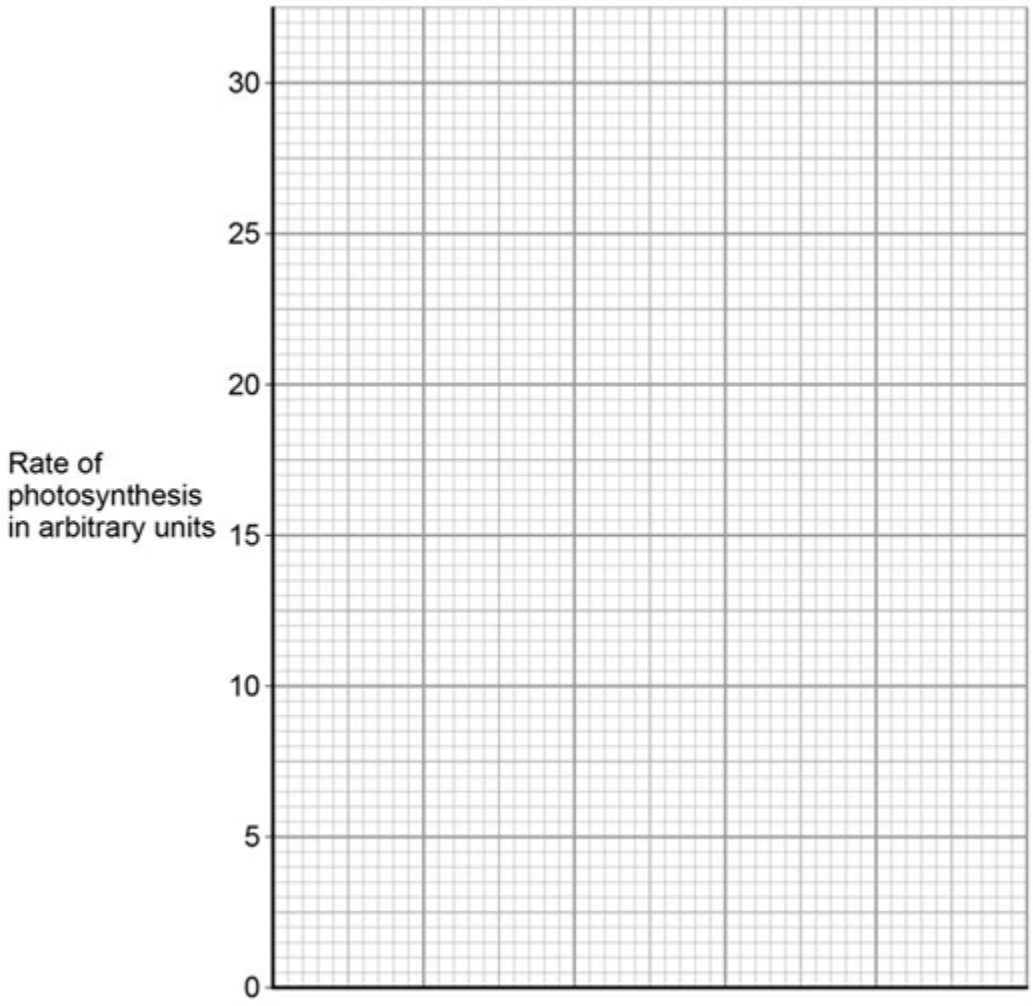
The results are shown in **Table 2**.

Table 2

Colour of light	**Rate of photosynthesis in arbitrary units**
Blue	24
Green	4
Red	17
Yellow	8

(g) Plot the data from **Table 2** on the graph.

You should label the x-axis.



(3)

(h) Give **two** conclusions from the graph above.

1. _____

_____

2. _____

_____

(2)

(i) The glucose produced in photosynthesis can be converted into amino acids to make new proteins for the plant.

Complete the sentences.

The glucose produced in photosynthesis can also be used in other ways.

Glucose can be used in respiration to release _____ .

Glucose can be converted to cellulose to strengthen the _____ .

Glucose can be stored as _____ .

(3)

(Total 14 marks)

6. Glucose is broken down in respiration.

(a) What is the chemical formula for glucose?

Tick **one** box.

$C_6H_6O_6$ ☐

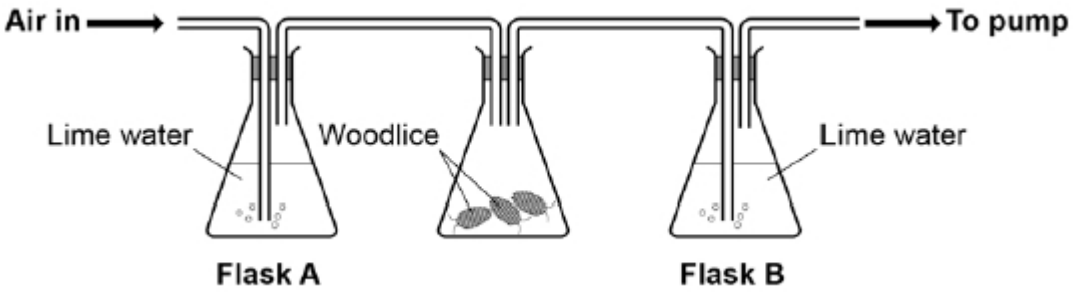
$C_3H_6O_3$ ☐

$C_6H_{12}O_6$ ☐

$C_6H_{10}O_6$ ☐

(1)

The diagram shows the apparatus a student used to investigate aerobic respiration.



Limewater goes cloudy when carbon dioxide is added to it.

(b) After 10 minutes the limewater in flask **B** was cloudy, but the limewater in flask **A** remained colourless.

Explain why.

_____

_____

_____

_____

(2)

(c) Flask **A** acts as a control in this investigation.

What is the purpose of a control?

_____

_____

(1)

(d) The student repeated the investigation with no woodlice.

Describe the appearance of the limewater in flask **A** and flask **B** after 10 minutes.

Flask **A** _____

_____

Flask **B** _____

_____

(2)

Anaerobic respiration is another form of respiration in living organisms.

(e) What is produced during anaerobic respiration in humans?

Tick **one** box.

Carbon dioxide	☐
Carbon dioxide and lactic acid	☐
Lactic acid	☐
Oxygen and water	☐

(1)

(f) Complete the equation for anaerobic respiration in yeast.

glucose ⟶ carbon dioxide + _____

(1)

(Total 8 marks)

1. (a) temperature

1

volume of yeast and water

1

(b) 28

1

(c) carbon dioxide

1

(d) the greater the mass of sugar, the greater the volume of foam / gas produced

allow reference to weight / amount of sugar
allow reference to amount of foam / gas
allow positive correlation
ignore names of gases
ignore directly proportional

1

(e) no respiration occurs
or
sugar / glucose is needed for respiration

ignore no reaction occurs

1

(f) for comparison / to compare

allow as a control (experiment)
allow as a base line
*do **not** accept as a control variable*

or
to check that no other factor / variable is influencing the results

allow answers in the context of the investigation e.g. to prove that the results obtained were due to the sugar (and nothing else)

or
to ensure validity

ignore fair test / accuracy

1

(g) (it) stops the oxygen / air getting in / through

ignore (it) stops the oxygen / air getting out
ignore gases unqualified

1

(h) ethanol

1

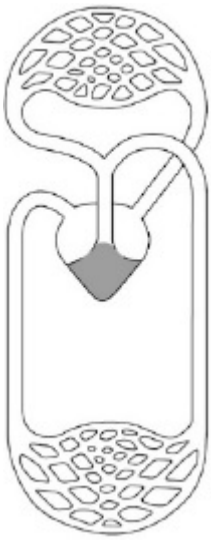
[9]

2.

(a) blood is pumped to the lungs by one / right side of the heart
and
blood is pumped to the body by the other / left side of the heart
allow blood enters the heart twice for every (one) circuit around the body

1

(b) ventricle correctly identified as any part of grey area below:



1

(c) oxygenated and deoxygenated blood mixes
allow some deoxygenated blood is sent to the body / tissues / cells

1

(so) less oxygen reaches the body / tissues / cells
allow named tissues / organs

1

(d) concentration gradient (of oxygen) is shallow(er) / less steep

1

(therefore) less oxygen diffuses into blood / cells / gills

1

allow idea that concentration gradient is negative (i.e. out of axolotl) (1)
so oxygen diffuses out of axolotl's blood / cells / gills (1)

(so) less (aerobic) respiration occurs so less energy is released / available
or
(so more) anaerobic respiration occurs so less energy is released / available

*do **not** accept no respiration occurs*

*do **not** accept energy production*

1

(so) less metabolism

ignore reduced living processes unqualified

*allow reduction of building larger molecules **or** movement / muscle contraction **or** keeping warm **or** urea formation **or** chemical reactions*

or
(so when) anaerobic respiration occurs, lactic acid is produced (and is toxic)

1

(e) stem (cells)

*do **not** accept embryonic stem cell*

1

(f) any **one** from:

- paralysis
- diabetes

allow other examples such as Parkinson's / heart disease / stroke / cystic fibrosis / cancer / burns

*do **not** accept infectious diseases*

1

(g) any **one** from:

- easy to breed

allow reproduce quickly

- easy / cheap to keep / rear (as are small)
- don't take up much space

allow reference to not being dangerous (to the scientist)
allow they are not endangered
allow removal of gill will not kill the axolotl

1

(h) any **one** from:

- it's not a mammal **or** it is an amphibian
- regeneration in gills may be different to that in other organs
- metabolism / body processes are too different to humans

allow humans do not have gills

allow it's an endangered species ***or*** *species need to be protected from extinction*

ignore reference to genetic differences ***or*** *ethics*

1

[12]

3. (a)

words take precedence over symbols

LHS:

1

carbon dioxide **and** water

RHS:
glucose

1

allow correct symbols (ignore balancing)

in any order

do ***not*** *accept starch*

ignore carbohydrates / sugar

(b) power output of bulb

1

(c) any **two** from:

- repeat **and** calculate a mean
  or
  repeat **and** to eliminate anomalies

  ignore do a control experiment unqualified
- control the (water) temperature

  allow a method of controlling (water) temperature
- control the concentration of carbon dioxide

  allow a method of controlling carbon dioxide concentration
- control the distance of the bulb from the pondweed
- control the mass / length / species / age of the pondweed

  allow use the same piece of pondweed
- give pondweed time to equilibrate

  allow do experiment with the bulb off / in the dark

2

(d) 3.3 (cm^3/hour)

1

(e)

*max **3** marks for bar chart*

correct scale **and** axis labelled

1

all points plotted correctly

allow points plotted to within ± ½ small square
*allow 3 or 4 correct plots for **1** mark*
*allow correct plot from incorrect value calculated in part **(d)***

2

correct curved line of best fit

ignore line extended beyond 60 / 250 (W)

ignore line joined point to point with straight lines

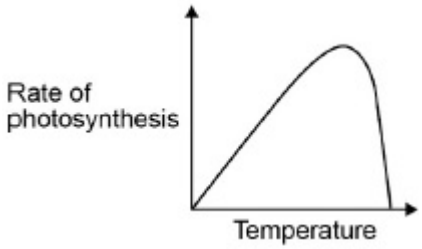
1

(f) correct answer from their line drawn on **Figure 2**

allow ± ½ small square tolerance
allow 1.8 / 1.9 if no line of best fit or incorrect graph is drawn

1

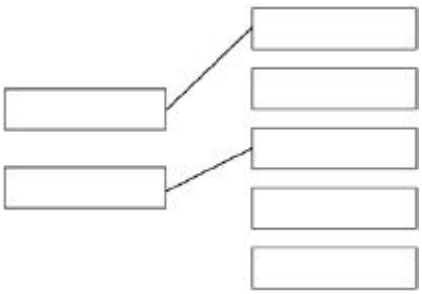
(g)



1

[12]

4. (a)



additional line from a level of organisation negates the mark for that level of organisation

2

(b) palisade mesophyll

1

(c) $\frac{50}{8}$

1

6 / 6.25 / 6.3 (micrometres)

1

*an answer of 6 / 6.25 / 6.3 scores **2** marks*

(d) they have no chloroplasts / chlorophyll

allow they are underground

allow they don't get (access to) light

allow (because) photosynthesis needs light

allow they can't absorb light

ignore 'sun'

ignore 'it is dark'

1

(e) differentiation

1

(f) to protect endangered plants from extinction

1

(g) plants can be produced quickly

1

(h) any **one** from:

- glucose / sugars / starch
- amino acids / protein
- hormones

  allow named hormones e.g. auxin
- ions / minerals

  allow magnesium / nitrate
- vitamins

  allow named vitamins e.g. vitamin B
- water

  allow H_2O / H2O

  ignore oxygen / carbon dioxide / agar / nutrients / fertiliser

1

[10]

5.

(a) rate of photosynthesis increases
or
number of bubbles produced (in one minute) increases
or
volume of gas / oxygen produced (in one minute) increases

allow decreases / stays the same throughout

1

(b) light intensity

1

(c) reduces the effect of heat from the lamp
or
prevents temperature affecting photosynthesis

1

(d) 52

1

(e) should be 62
or
is to 3 s.f. / not rounded
allow inconsistent number of significant figures / decimal places

1

(f) the numbers of bubbles at each distance are similar

1

(g) x-axis correctly labelled (colour of light) **and** bars identified as correct colour
bars can be identified by labels beneath the x-axis or with a key

1

bars plotted correctly
*all 4 correct = **2** marks 3 correct = **1** mark*
*if wrong type of graph drawn, max **2** marks*

2

(h) blue light gives highest (rate of) photosynthesis
allow ecf from candidate's graph allow blue light is best

1

green light gives the lowest (rate of) photosynthesis
allow green light is worst

1

(i) energy
in this order only

1

cell wall(s)
allow cell
*do **not** accept (cell) membrane*

1

starch / fat / oil / lipid

1

[14]

6. (a) $C_6H_{12}O_6$

1

(b) atmospheric air contains less carbon dioxide than exhaled air

allow converse

1

(flask B goes more cloudy because) carbon dioxide is produced in (aerobic) respiration (by woodlice)

*do **not** accept anaerobic respiration*

1

(c) for comparison / to compare

allow answers in the context of the investigation e.g.

or

to check that no other factor / variable is influencing the results

to prove that the results obtained were due to the woodlice respiring and nothing else

or

to prove that the woodlice produced the carbon dioxide and nothing else

1

(d) (flask **A**) would remain colourless

ignore references to clear

allow not cloudy

1

(flask **B**) would remain colourless

1

(e) lactic acid

1

(f) alcohol / ethanol

1

[8]