Name: _____

Class: _____

Date: _____

Cell Biology part 3 AQA Triple Biology

Time: **94 minutes**

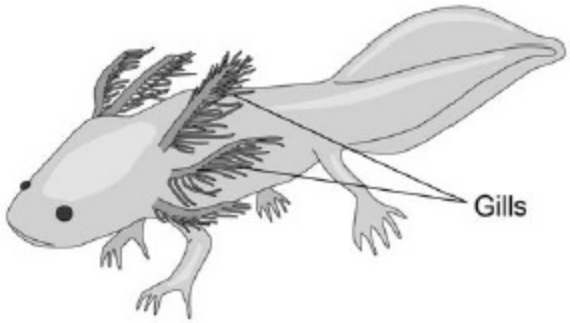
Marks: **88 marks**

Comments:

1. An animal called an axolotl lives in water.

Figure 1 shows an axolotl.

Figure 1



Oxygen enters the axolotl's bloodstream through the gills by diffusion.

(a) What is diffusion?

Tick (✓) **one** box.

The movement of particles from a high concentration to a low concentration	☐
The movement of particles from a low concentration to a high concentration	☐
The movement of water from a concentrated solution to a more dilute solution	☐

(1)

(b) Describe how **one** feature of the axolotl's gills increases the rate of diffusion of oxygen.

Use information from **Figure 1**.

Feature _____

Description _____

_____

_____

(2)

If a gill of an axolotl is removed, stem cells in the damaged area will divide and a new gill will grow.

(c) Complete the sentence.

Choose the answer from the box.

adaptation	**differentiation**	**evolution**	**variation**

When stem cells specialise to produce gill cells, this process is

known as _____.

(1)

(d) Complete the sentence.

Choose the answer from the box.

binary fission	**mitosis**	**mutation**

To grow a new gill the stem cells divide by _____.

(1)

(e) Which **one** of the following does **not** contain stem cells?

Tick (✓) **one** box.

Bone marrow ☐

Embryos ☐

Hair ☐

Meristem tissue ☐

(1)

(f) Axolotls are small animals. Axolotls are used in stem cell research.

What are **two** advantages of using axolotls in stem cell research?

Tick (✓) **two** boxes.

Axolotls are cheap to feed. ☐

Axolotls are easy to breed. ☐

Axolotls are endangered. ☐

Axolotls live in water. ☐

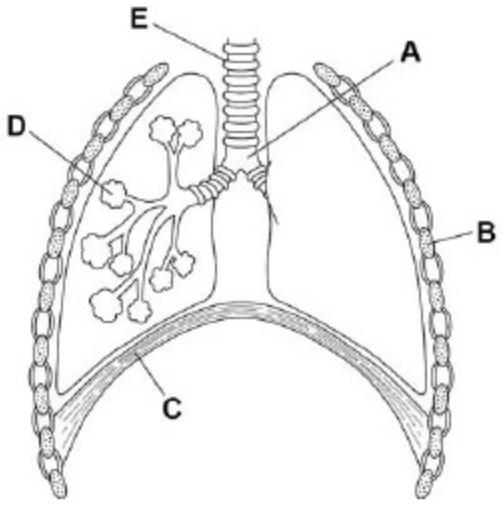
Axolotl research is cruel. ☐

(2)

Oxygen uptake in humans takes place in the lungs.

Figure 2 shows the human breathing system.

Figure 2



(g) Where does oxygen enter the bloodstream?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(h) Name part **E** on **Figure 2**.

_____

(1)

(i) Which blood vessel carries blood to the lungs?

Tick (✓) **one** box.

Aorta ☐

Pulmonary artery ☐

Vena cava ☐

(1)

(Total 11 marks)

2. This question is about the cell cycle.

(a) Chromosomes are copied during the cell cycle.

Where are chromosomes found?

Tick **one** box.

- Cytoplasm ☐
- Nucleus ☐
- Ribosomes ☐
- Vacuole ☐

(1)

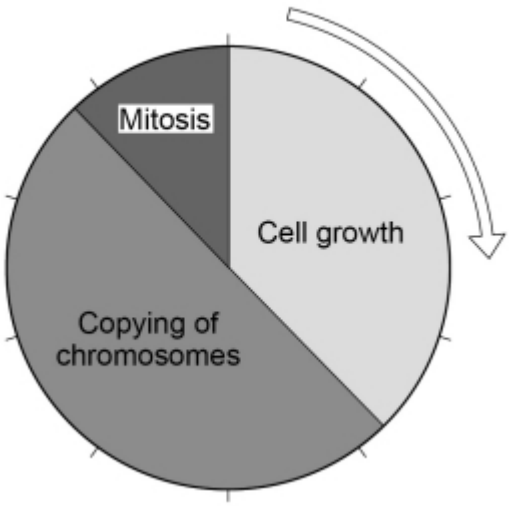
(b) What is the name of a section of a chromosome that controls a characteristic?

_____

(1)

Figure 1 shows information about the cell cycle.

Figure 1



(c) Which stage of the cell cycle in **Figure 1** takes the most time?

Tick **one** box.

Cell growth ☐

Copying of chromosomes ☐

Mitosis ☐

(1)

(d) During mitosis cells need extra energy.

Which cell structures provide most of this energy?

Tick **one** box.

Chromosomes ☐

Cytoplasm ☐

Mitochondria ☐

Ribosomes ☐

(1)

(e) The cell cycle in **Figure 1** takes two hours in total.

The cell growth stage takes 45 minutes.

Calculate the time taken for mitosis.

_____

_____

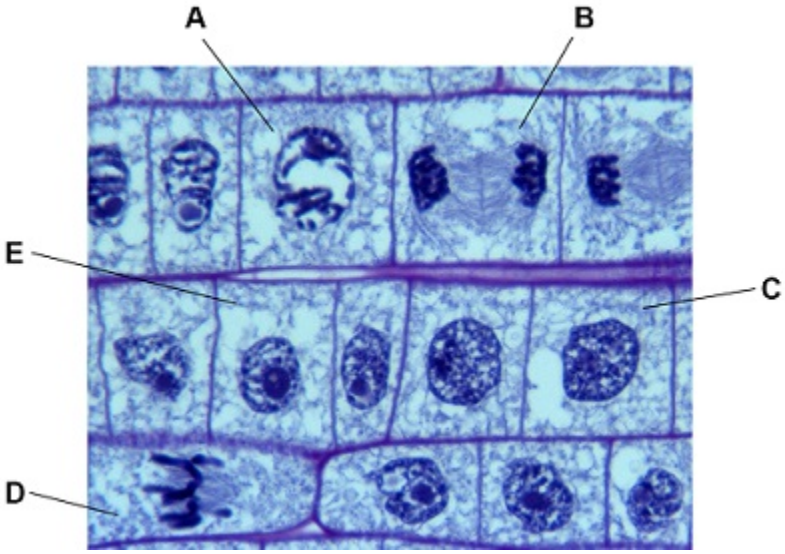
_____

_____

Time = _____ minutes

(2)

Figure 2 shows some cells in different stages of the cell cycle.



(f) Which cell is **not** dividing by mitosis

Tick **one** box.

A		B		C		D	

(1)

(g) Cell **E** in **Figure 2** contains 8 chromosomes.

Cell **E** divides by mitosis.

How many chromosomes will each new cell contain?

Tick **one** box.

2 ☐

4 ☐

8 ☐

16 ☐

(1)

(h) Why is mitosis important in living organisms?

Tick **one** box.

To produce gametes ☐

To produce variation ☐

To release energy ☐

To repair tissues ☐

(1)

(Total 9 marks)

3. Cells can be classified according to their structure.

(a) Complete **Table 1** to show which features each cell type has.

Write a tick or a cross in each box.

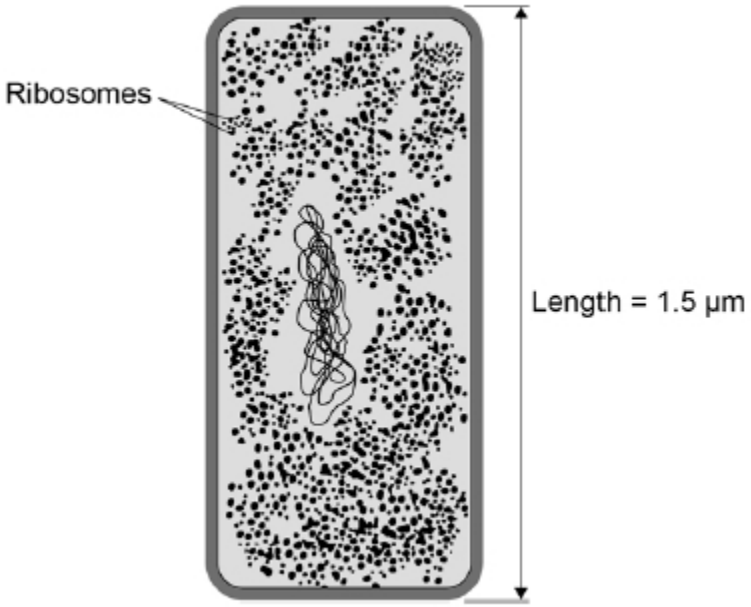
Table 1

	Nucleus	**Plasmids**	**Cytoplasm**
Prokaryotic cell			
Eukaryotic cell			

(2)

Figure 1 shows a cell.

Figure 1



(b) What type of cell is shown in **Figure 1**.

Tick **one** box.

An animal cell ☐

A bacterial cell ☐

A plant cell ☐

(1)

(c) The cell in **Figure 1** contains ribosomes.

What is the function of ribosomes?

_____

_____

(1)

(d) There are 1000 micrometres (μm) in a millimetre (mm).

The length of the cell in **Figure 1** is 1.5 micrometres (μm).

Give the length of the cell in millimetres (mm).

_____

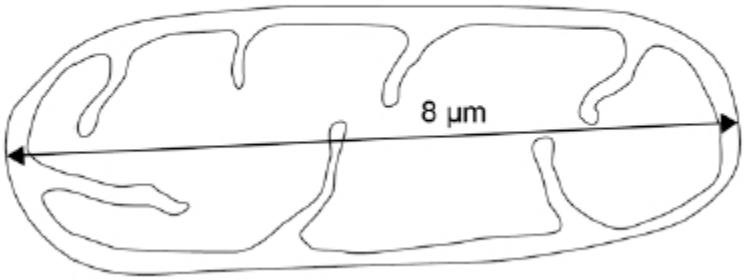
_____

Length of cell = _____ mm

(1)

Figure 2 shows a mitochondrion viewed with a microscope.

Figure 2



(e) Give **one** reason why the cell in **Figure 1** does **not** contain mitochondria.

Use information from **Figure 1** and **Figure 2**.

_____

_____

(1)

The cell in **Figure 1** divides once every 30 minutes.

Table 2 shows how many cells are present after a given time.

Table 2

Time in minutes	Number of cells present
0	1
30	2
60	4

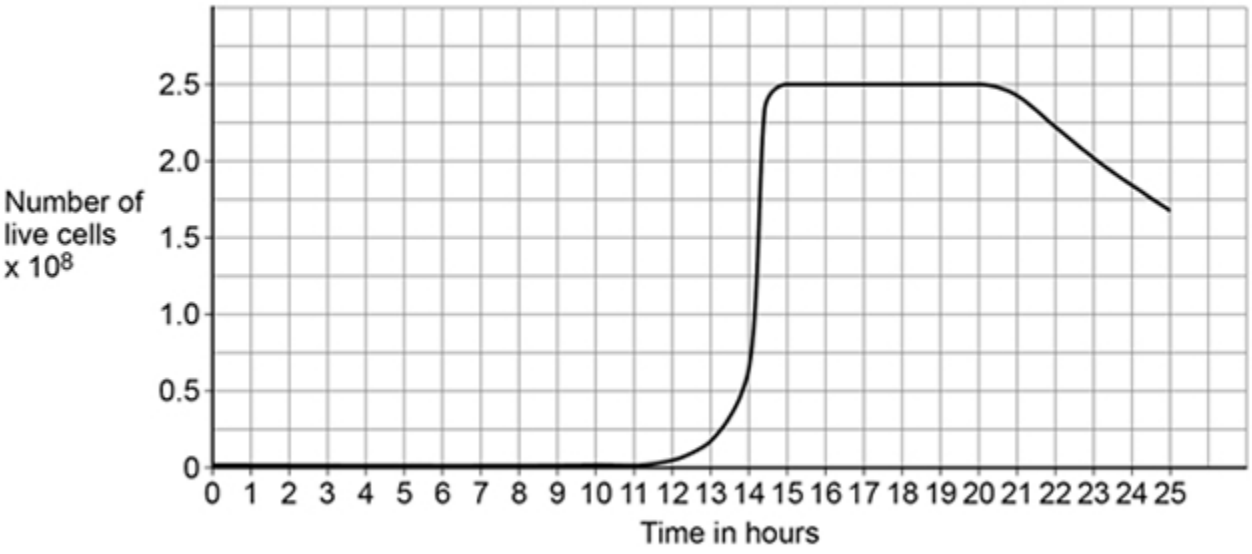
(f) Calculate how many cells will be present after 2 hours.

Number of cells = _____

(2)

Cells like the one in **Figure 1** are kept in a culture solution for 25 hours.

The graph below shows the number of live cells present.



(g) Describe the changes in the number of live cells shown in the graph above in the first 20 hours.

Use data from the graph in your answer.

(3)

(h) Suggest **one** reason why the number of live cells decreases after 20 hours.

_____

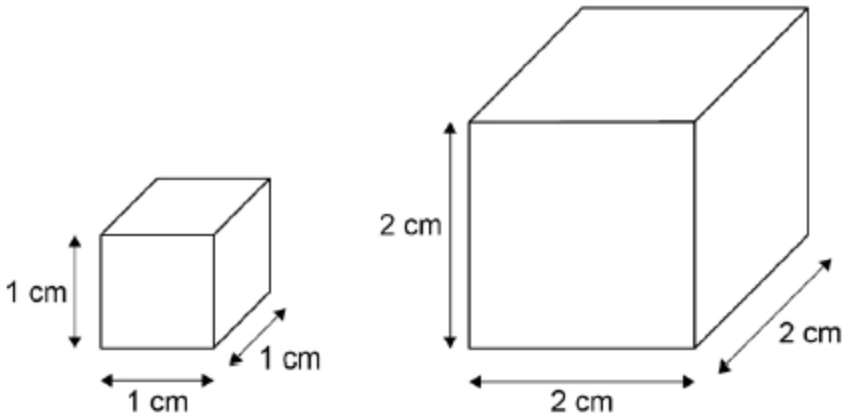
_____

(1)

(Total 12 marks)

4. A student used cubes of potato to investigate the effect of surface area and volume on the rate of osmosis.

The diagram shows two of the cubes of potato the student used.



Cube 1 **Cube 2**

The surface area to volume ratio of **cube 1** is 6:1.

(a) Calculate the total surface area of **cube 2**.

_____

_____

Total surface area of **cube 2** = _____ cm^2

(1)

(b) Calculate the volume of **cube 2**.

_____

_____

Volume of **cube 2** = _____ cm^3

(1)

(c) Calculate the surface area to volume ratio of **cube 2**.

Use the equation:

$$\text{surface area to volume ratio} = \frac{\text{surface area}}{\text{volume}}$$

_____

_____

Surface area to volume ratio of **cube 2** = _____ : 1

(1)

This is the method used.

1. Cut two cubes of potato of size 2 cm × 2 cm × 2 cm
   - Cut one of these cubes into 8 cubes of potato of size 1 cm × 1 cm × 1 cm (sample **A**).
   - Do not cut the other cube (sample **B**).
2. Measure the mass of each sample **A** and the mass of sample **B**.
3. Place all the cubes into a beaker of distilled water.
4. Leave for 30 minutes.
5. Remove the cubes from the beaker and dry the surfaces with a paper towel.
6. Measure the mass of each sample of cubes.

(d) Why were 8 cubes of size 1 cm × 1 cm × 1 cm but only one cube of size 2 cm × 2 cm × 2 cm cube used?

_____

_____

(1)

(e) Why did the student dry the surface of each potato cube in step **5** of the method?

_____

_____

(1)

The table below shows the student's results.

	Mass at start in g	Mass at end in g	Mass change in g
Sample A **Eight cubes, each measuring 1 cm × 1 cm × 1 cm**	10.4	12.2	1.8
Sample B **One cube, measuring 2 cm × 2 cm × 2 cm**	9.9	10.7	**X**

(f) Calculate mass change **X** in the table above.

_____

_____

Mass change **X** = _____ g

(1)

(g) Explain why the masses of both samples of cubes increased.

_____

_____

_____

_____

(2)

(h) It would be better to calculate percentage change in mass rather than change in mass.

Why is this a more valid method?

Tick **one** box.

Because it makes it a fair test. ☐

Because it makes the investigation of the samples of cubes more accurate. ☐

Because the samples of cubes were different masses at the start of the investigation. ☐

(1)

(i) Explain why the mass of the cubes in sample **A** increased more than the mass of the cube in sample **B**.

_____

_____

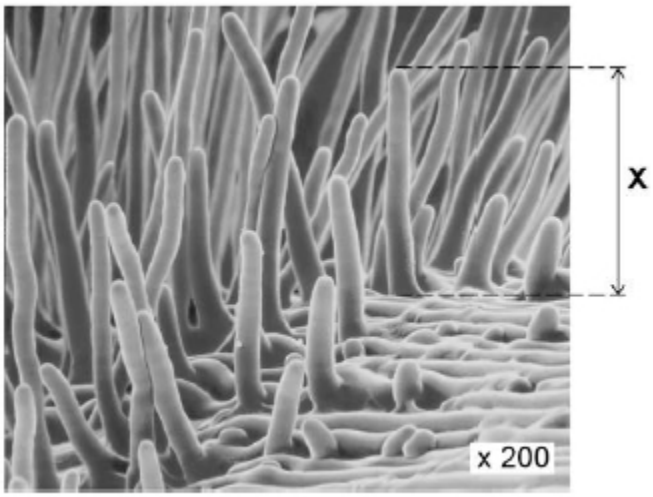
_____

_____

(2)

(Total 11 marks)

5. The image below shows part of a root from a cress plant.



(a) What type of microscope was used to create the image above?

_____

(1)

(b) The magnification of the cress root in the image above is × 200.

There are 1000 micrometres (μm) in a millimetre (mm).

Calculate the real length of the root hair, **X**.

Give your answer in micrometres (μm).

_____

_____

_____

_____

Real length **X** = _____ μm

(2)

(c) Root hair cells take up water from the soil.

Explain **one** way in which the root hair cell is adapted to this function.

(2)

The table shows the water uptake by a plant's roots on two different days.

	Mean water uptake in cm^3 per hour
Cold day	1.8
Hot day	3.4

(d) Explain why the mean rate of water uptake is higher on a hot day than on a cold day.

(3)

(e) The concentration of mineral ions in the soil is lower than in root hair cells.

Root hair cells take up mineral ions from the soil.

Root hair cells contain mitochondria.

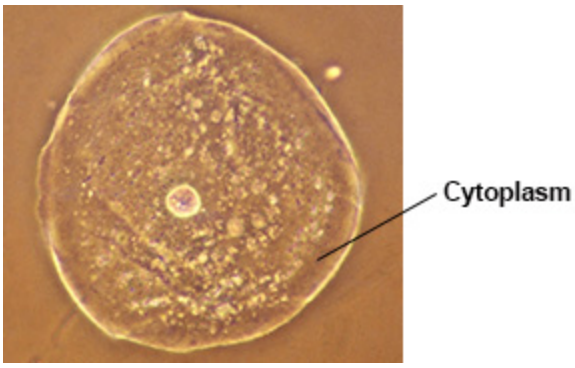
Explain why root hair cells contain mitochondria.

(4)

(Total 12 marks)

6. **Figure 1** shows a human cheek cell viewed under a light microscope.

Figure 1



(a) Label the nucleus **and** cell membrane on **Figure 1**.

(2)

(b) Cheek cells are a type of body cell.

Body cells grow through cell division.

What is the name of this type of cell division?

Tick **one** box.

Differentiation ☐

Mitosis ☐

Specialisation ☐

(1)

(c) Ribosomes and mitochondria are **not** shown in **Figure 1**.

What type of microscope is needed to see ribosomes and mitochondria?

_____

(1)

(d) What is the advantage of using the type of microscope you named in part **(c)**?

Tick **one** box.

Cheaper ☐

Higher magnification ☐

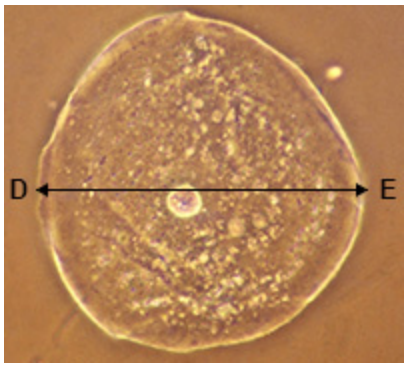
Lower resolution ☐

(1)

(e) The cheek cell in **Figure 2** is magnified 250 times.

The width of the cell is shown by the line **D** to **E**.

Figure 2



Calculate the width of the cheek cell in micrometres (µm).

Complete the following steps.

Measure the width of the cell using a ruler _____ mm

Use the equation to work out the real width of the cell in mm:

$$\textbf{real size} = \frac{\textbf{image size}}{\textbf{magnification}}$$

_____ mm

Convert mm to µm _____ µm

(3)

(f) A red blood cell is 8 µm in diameter.

A bacterial cell is 40 times smaller.

Calculate the diameter of the bacterial cell.

Tick **one** box.

0.02 µm ☐

0.2 µm ☐

2.0 µm ☐

20.0 µm ☐

(1)

(Total 9 marks)

7. A student investigated the effect of different sugar solutions on potato tissue.

This is the method used.

1. Add 30 cm^3 of 0.8 mol dm^{-3} sugar solution to a boiling tube.
2. Repeat step **1** with equal volumes of 0.6, 0.4 and 0.2 mol dm^{-3} sugar solutions.
3. Use water to give a concentration of 0.0 mol dm^{-3}.
4. Cut five cylinders of potato of equal size using a cork borer.
5. Weigh each potato cylinder and place one in each tube.
6. Remove the potato cylinders from the solutions after 24 hours.
7. Dry each potato cylinder with a paper towel.
8. Reweigh the potato cylinders.

The table below shows the results.

Concentration of sugar solution in mol dm^{-3}	Starting mass in g	Final mass in g	Change of mass in g	Percentage (%) change
0.0	1.30	1.51	0.21	16.2
0.2	1.35	1.50	0.15	**X**
0.4	1.30	1.35	0.05	3.8
0.6	1.34	1.28	−0.06	−4.5
0.8	1.22	1.11	−0.11	−9.0

(a) Calculate the value of **X** in the table above.

_____

_____

Percentage change in mass = _____ %

(2)

(b) Why did the student calculate the percentage change in mass as well as the change in grams?

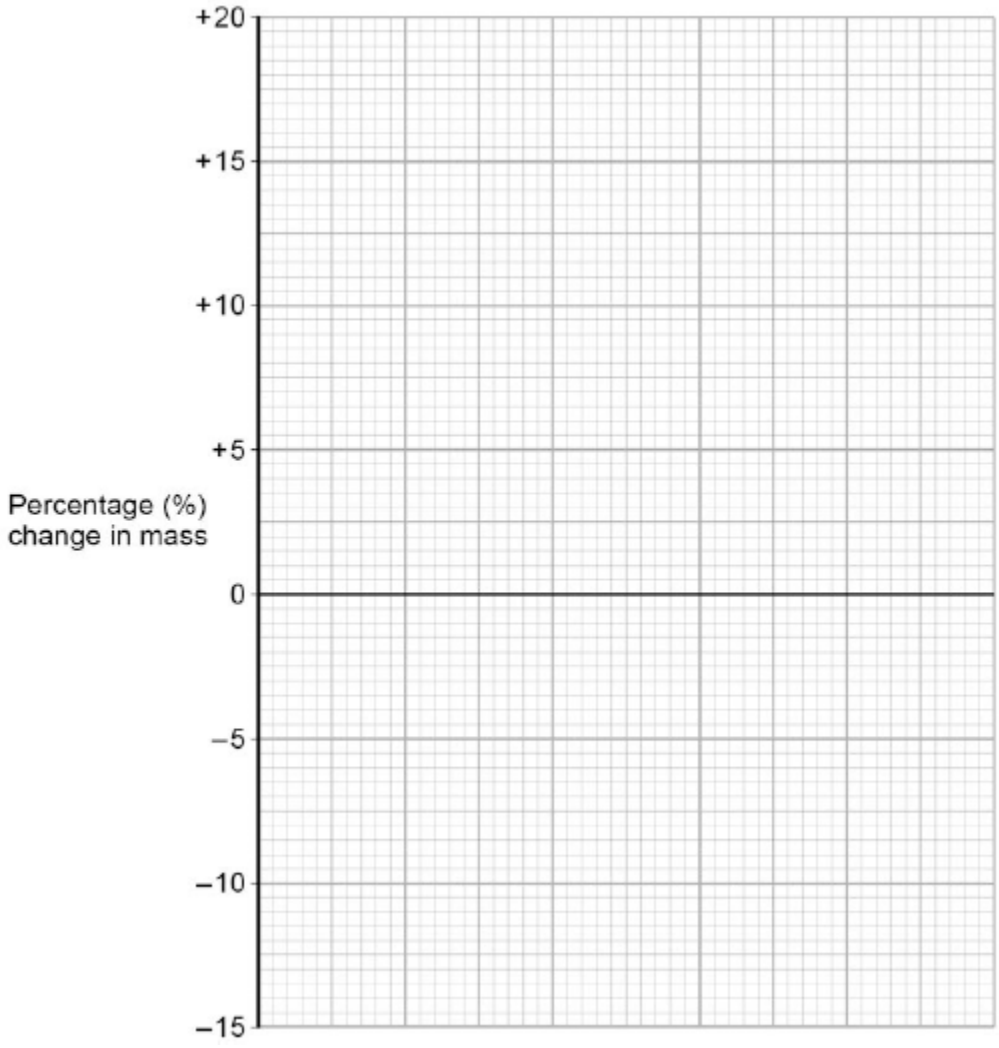
_____

_____

(1)

(c) Complete the graph using data from the table above.

- Choose a suitable scale and label for the *x*-axis.
- Plot the percentage (%) change in mass.
- Draw a line of best fit.



(4)

(d) Use your graph to estimate the concentration of the solution inside the potato cells.

Concentration = _____ mol dm^{-3}

(1)

(e) The results in the table above show the percentage change in mass of the potato cylinders.

Explain why the percentage change results are positive **and** negative.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(f) Suggest **two** possible sources of error in the method given above.

1. _____

_____

2. _____

_____

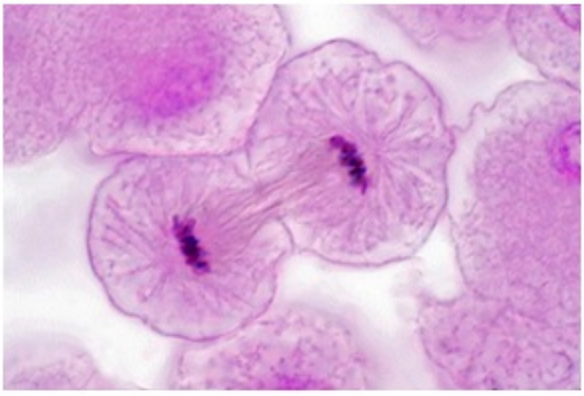
(2)

(Total 13 marks)

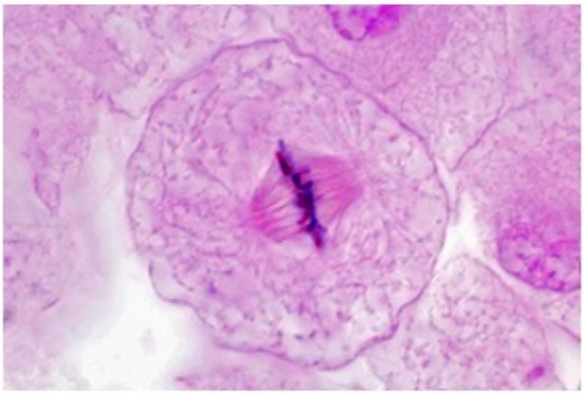
8. **Figure 1** shows photographs of some animal cells at different stages during the cell cycle.

Figure 1

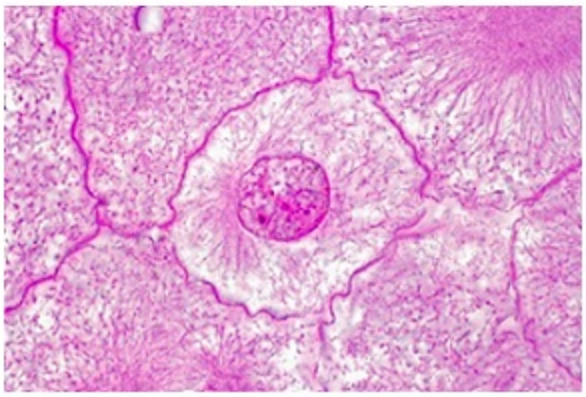
A



B



C



(a) Which photograph in **Figure 1** shows a cell that is **not** going through mitosis?

Tick **one** box.

(1)

(b) Describe what is happening in photograph **A**.

_____

_____

_____

_____

_____

(2)

(c) A student wanted to find out more about the cell cycle.

The student made a slide of an onion root tip.

She counted the number of cells in each stage of the cell cycle in one field of view.

The table below shows the results.

		Stages in the cell cycle				
	Non-dividing cells	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Total**
Number of cells	20	9	4	2	1	36

Each stage of the cell cycle takes a different amount of time.

Which stage is the fastest in the cell cycle?

Give a reason for your answer.

Stage _____

Reason _____

_____

(2)

(d) The cell cycle in an onion root tip cell takes 16 hours.

Calculate the length of time **Stage 2** lasts in a typical cell.

Give your answer to 2 significant figures.

_____

_____

_____

_____

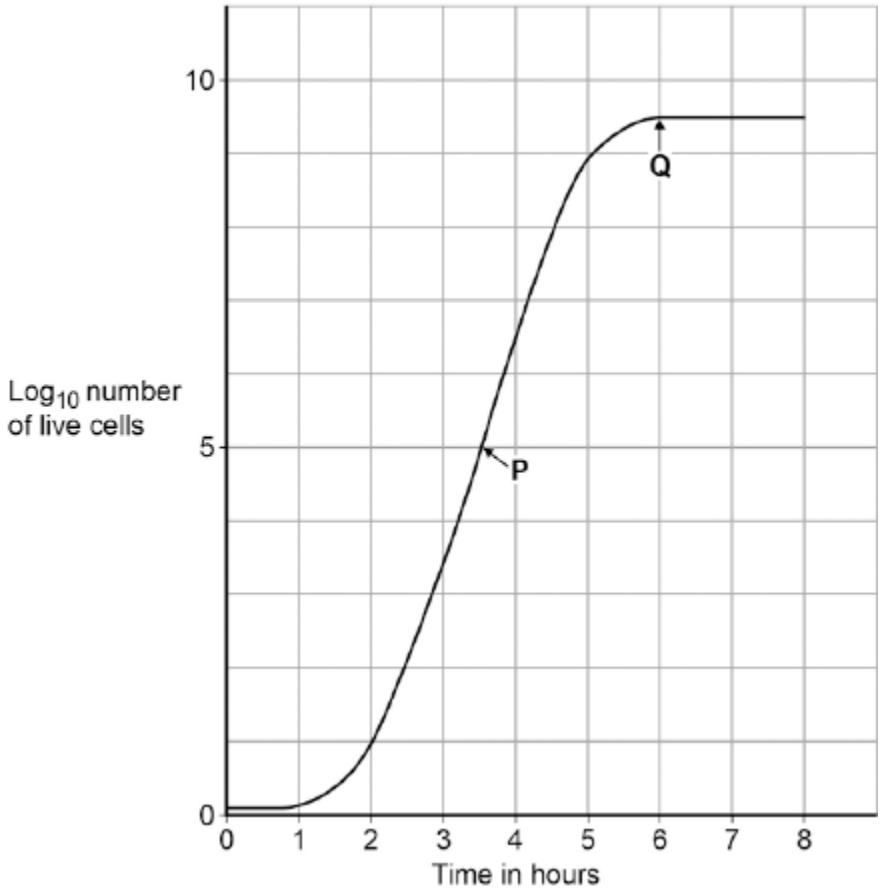
Time in **Stage 2** = _____ minutes

(3)

(e) Bacteria such as *Escherichia coli* undergo cell division similar to mitosis.

Figure 2 shows a growth curve for *E. coli* grown in a nutrient broth.

Figure 2



What type of cell division causes the change in number of *E. coli* cells at **P**?

_____

(1)

(f) Suggest why the number of cells levels out at **Q**.

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

1. (a) the movement of particles from a high concentration to a low concentration

1

(b) (gills) have (many) projections
allow description of projections
allow have lots of / five gills

1

(for) large(r) surface / area

or

(gills) are on the outside of the body (1)

for good access to water (1)

1

(c) differentiation

1

(d) mitosis
*do **not** accept meiosis*

1

(e) hair

1

(f) axolotls are cheap to feed

1

axolotls are easy to breed

1

(g) D

1

(h) trachea
allow windpipe
allow cartilage (ring)

1

(i) pulmonary artery

1

[11]

2. (a) nucleus

1

(b) gene(s)
allow allele(s)

1

(c) copying of chromosomes

1

(d) mitochondria

1

(e) 60 − 45
or
120 − 105

1

15 (minutes)

1

*an answer of 15 (minutes) scores **2** marks*

(f) C

1

(g) 8

1

(h) to repair tissues

1

[9]

3. (a)

×	✓	✓
✓	×	✓

***1** mark for each correct row if no other marks awarded allow a mark for one correct column*

2

(b) a bacterial cell

1

(c) make / synthesise / produce protein

allow produce enzymes

1

(d) 0.0015 (mm)

allow 1.5×10^{-3} (mm)

1

(e) mitochondria are longer / bigger (than the cell)

allow too big

1

(f)

2^4

*an answer of 16 scores **2** marks*

allow 2 × 2 × 2 × 2 or a correct list showing doubling at each time interval

1

16

*allow 90 mins = 8 for **1** mark*

1

(g) (number of live cells / bacteria) stays level / the same <u>until 11 hours</u>

*answer must refer to number of live cells / bacteria (**not** the shape of the graph)*

allow (number of cells / bacteria) is very low until 11 hours allow number in the range 10-11 hours

1

then (number of live cells / bacteria) increases rapidly to 2.5×10^8
or
from 11 hours to 14.5 hours

allow (then) increases exponentially

1

then (number of live cells / bacteria) stays at 2.5×10^8

allow (number of live cells / bacteria) stays the same for the next 5 hours

or
stays the same from 15 to 20.5 hours

*if no other mark awarded allow for **1** mark the idea that the graph is level, then increases, then levels off again*

1

(h) any **one** from:

- lack of food / nutrients / oxygen / space
  or
  competition for space
- build-up of toxins

  allow ethanol
- temperature too high

1

[12]

4. (a) (surface area =) 24 (cm^2)

1

(b) (volume =) 8 (cm^3)

1

(c) 3 (:1)

allow ecf from (a) and (b)

1

(d) to keep the volume (of the cubes) the same in both sets

allow to compare with the 2 × 2 × 2 cube

or

so both sets of cubes are 8 cm^3

ignore to keep it fair

1

(e) so that excess water does not contribute to the mass of the cubes

1

(f) 0.8 (g)

if no answer given, check for answer in the table

1

(g) (because) water moved into the cubes (by osmosis)

allow water moves in by diffusion

1

because the solution outside the cubes was more dilute than inside the cells

allow converse

allow because the concentration of water was higher outside the cubes / in the beaker / solution than inside the cells

1

(h) because the samples of cubes were different masses at the start of the investigation

1

(i) more water was taken in

allow ecf for answer to (d)

1

because they had a larger surface area to volume ratio

allow more / faster osmosis happened

1

[11]

5. (a) electron (microscope)

1

(b) $\frac{30000}{200}$

*an answer of 150 (µm) scores **2** marks*

1

150 (µm)

*if answer is incorrect allow for **1** mark sight of 0.015 / 0.15 / 1.5 / 15*

*allow ecf for incorrect measurement of line **X** for max **1** mark*

1

(c) **either**
large surface area
allow (vacuole contains) cell sap that is more concentrated than soil water (1)
1

for more / faster osmosis
create / maintain concentration / water potential gradient (1)

or

allow thin (cell) walls

for short(er) diffusion distance
1

(d) (on hot day) more water lost
allow converse for a cold day if clearly indicated
1

more transpiration
or
more evaporation
1

so more water taken up (by roots) to replace (water) loss (from leaves)
1

(e) (aerobic) respiration occurs in mitochondria
*do **not** accept anaerobic respiration*
1

(mitochondria / respiration) release energy
*do **not** accept energy produced / made / created*
1

(energy used for) active transport
1

to transport ions, against the concentration gradient
or
from a low concentration to a high concentration
1

[12]

6. (a) nucleus labelled correctly
1

cell membrane labelled correctly
1

(b) mitosis
1

(c) electron (microscope)
1

(d) higher magnification

1

(e) 45 (mm)

1

45 / 250 **or** 0.18 (mm)

allow ecf

1

180 (µm)

1

*allow 180 (µm) with no working shown for **3** marks*

(f) 0.2 µm

1

[9]

7. (a) (0.15 / 1.35) × 100

1

11.1 (%)

*allow 11.1 (%) with no working shown for **2** marks*

1

(b) to allow results to be compared
or
they had different masses at the start

1

(c) axis correct scale and labelled

1

5 points correctly plotted

*allow ecf from **05.1***

*allow **1** mark for 4 points correctly plotted*

2

line of best fit

1

(d) 0.5

allow 0.45–0.55

1

(e) (0.0 to 0.4) water moves into cells

1

(0.6 to 0.8) water leaves cells

1

by osmosis

1

(f) any **two** from:
- concentration of solutions
- drying of chips
- accuracy of balance
- evaporation from tubes

2

[13]

8.

(a) **C**

1

(b) cytoplasm **and** cell membrane dividing

*accept cytokinesis for **1** mark*

1

to form two identical daughter cells

1

(c) stage 4

1

only one cell seen in this stage

1

(d) (4 / 36) × 16 × 60

1

107 / 106.7

1

110 (minutes)

*allow 110 (minutes) with no working shown for **3** marks*

1

(e) binary fission

*do **not** accept mitosis*

1

(f) shortage of nutrients / oxygen

1

so cells die
or
death rate = rate of cell division

1

[11]