

Q1.

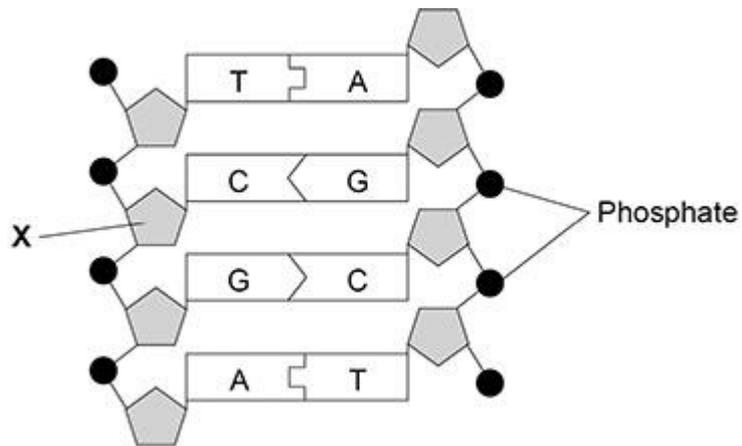
The nucleus of a cell contains DNA.

- (a) Name the structures inside the cell nucleus that contain DNA.

(1)

Figure 1 shows part of a DNA molecule.

Figure 1



- (b) Name the part of the DNA molecule labelled X.

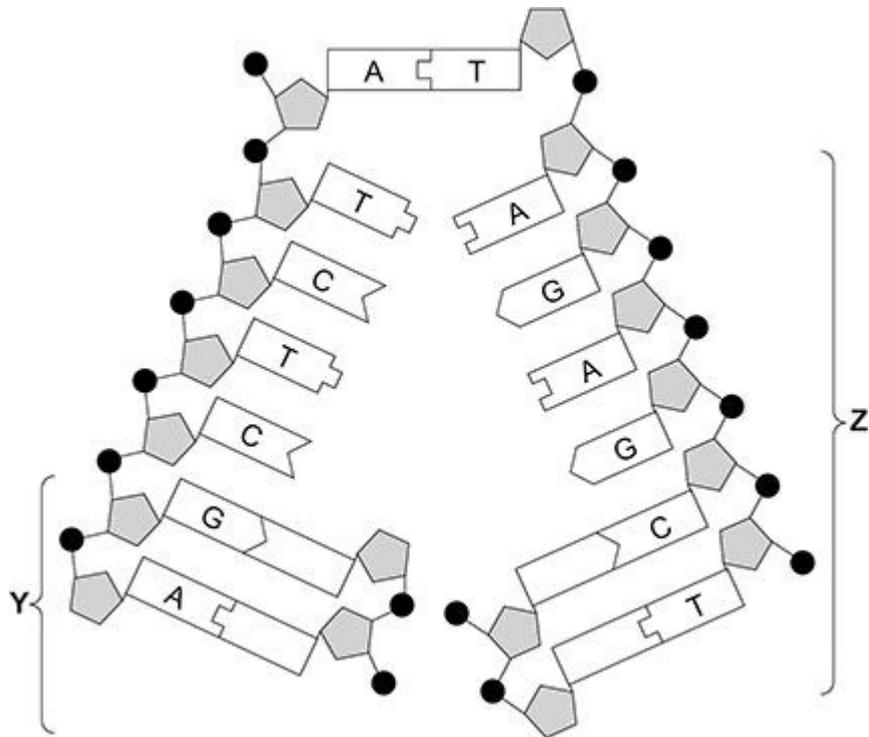
(1)

- (c) What type of substances are labelled A, C, G and T in Figure 1?

(1)

Figure 2 shows another section of a DNA molecule.

Figure 2



(d) Four of the substances you named in part (c) are not labelled in part Y of Figure 2.

Label each of these substances with the correct letter, A, C, G or T.

Use information from other parts of Figure 2 to help you.

(1)

(e) What is happening to the DNA in part Z of Figure 2?

Tick (✓) one box.

Differentiation

Evolution

Fertilisation

Replication

(1)

- (f) A gene is a length of DNA.

What type of substance does a gene code for?

(1)

- (g) Most human body cells contain 6×10^{-12} grams of DNA.

What mass of DNA will a human sperm cell contain?

Tick (✓) one box.

6×10^{-6} grams

6×10^{-12} grams

3×10^{-6} grams

3×10^{-12} grams

(1)

- (h) What is the name of the type of cell division that produces sperm cells?

Tick (✓) one box.

Binary fission

Differentiation

Meiosis

Mitosis

(1)

(Total 8 marks)

Q2.

This question is about cell division.

(a) Which process makes two identical new body cells for growth and repair?

Tick (✓) one box.

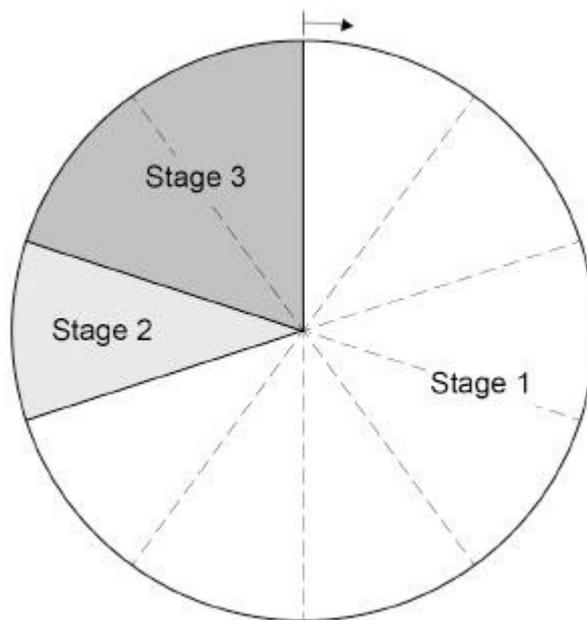
Differentiation

Fertilisation

Mitosis

(1)

The chart shows the three stages of a cell cycle.



- (b) Draw one line from each stage of the cell cycle to what happens during that stage.

Stage of cell cycle	What happens during that stage
Stage 1	One set of chromosomes is pulled to each end of the cell
Stage 2	The cytoplasm and cell membrane divide to form two new cells
Stage 3	The cell grows and the chromosomes replicate

(2)

- (c) What percentage of the total time for the cell cycle is taken by stage 1?

Percentage = _____ %

(2)

- (d) A cell divides to form two new cells every 24 hours.

How many days will it take for the original cell to divide into 8 cells?

Tick (✓) one box.

1 3 6 8

(1)

- (e) The chromosomes contain the genetic material.

Name the chemical which the genetic material is made from.

(1)

- (f) The genetic material is made of many small sections.

Each section codes for a specific protein.

What is one section of genetic material on a chromosome called?

Tick (✓) one box.

A gamete

A gene

A nucleus

(1)

- (g) Stem cells are cells which have not yet been specialised to carry out a particular job.

Bone marrow cells are one example of stem cells.

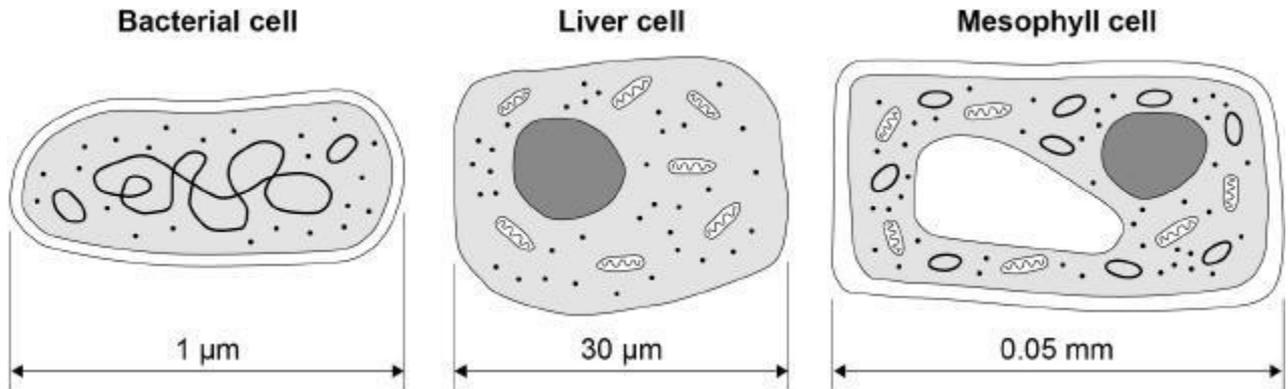
Explain how a transplant of bone marrow cells can help to treat medical conditions.

(2)

(Total 10 marks)

Q3.

The diagram below shows three types of cell.



- (a) Give two similarities between the prokaryotic cell and the eukaryotic cells in the diagram above.

1 _____
-
2 _____
-

(2)

- (b) Give three differences between the prokaryotic cell and the eukaryotic cells in the diagram above.

1 _____

2 _____

3 _____

(3)

- (c) Calculate the ratio of the size of the bacterial cell to the size of the mesophyll cell.

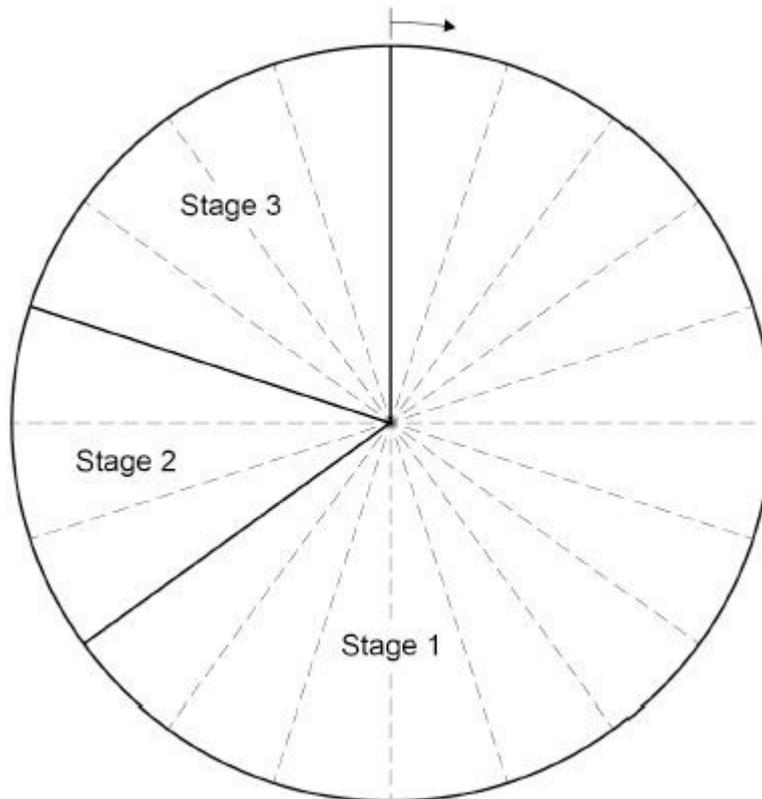
Ratio = 1 : _____

(2)

- (d) Name the type of cell division that produces genetically identical body cells for growth and repair.

(1)

The chart below shows a cell cycle.



- (e) What percentage of the time for one cell cycle is represented by stage 2 and stage 3 together?

Tick (✓) one box.

7% 35% 40% 65%

(1)

- (f) Describe what happens during each stage of the cell cycle.

Stage 1

Stage 2

Stage 3

(4)

(Total 13 marks)

Q4.

There are two types of cell division: mitosis and meiosis.

(a) Describe three differences between the processes of mitosis and meiosis.

1 _____

2 _____

3 _____

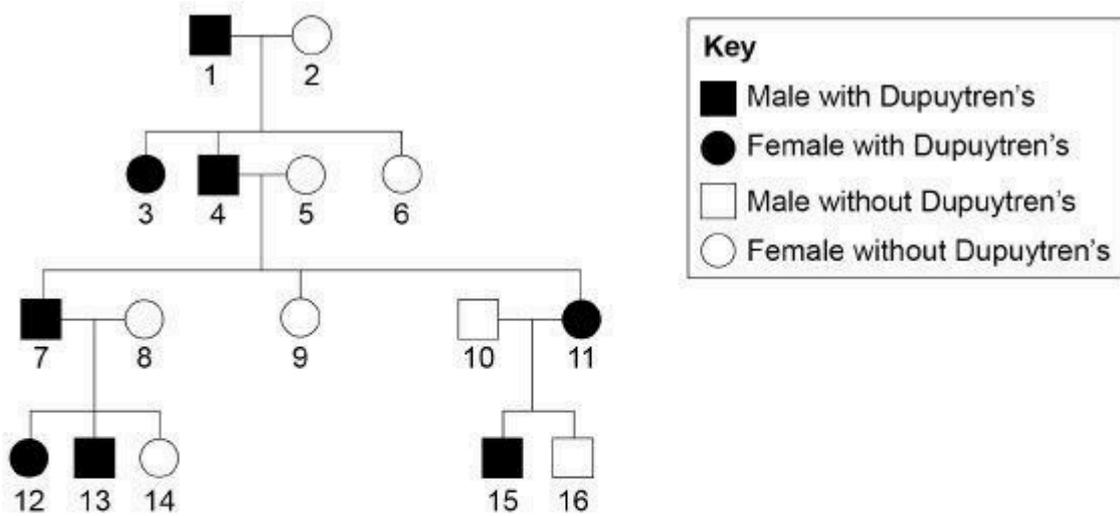
(3)

(b) Describe one similarity between the processes of mitosis and meiosis.

(1)

Dupuytren's is a disorder that affects the hands.

The diagram below shows the inheritance of Dupuytren's in one family.



Dupuytren's is caused by a dominant allele in this family.

D = dominant allele

d = recessive allele

(c) Give the genotype of person 1.

Explain your answer. Genotype _____

(2)

(d) Person 7 and person 8 in the diagram above are expecting a fourth child.

What is the probability of the child having Dupuytren's?

You should:

- draw a Punnett square diagram
- identify which offspring have Dupuytren's

Probability = _____

(5)

(e) Explain how the diagram above shows the allele for Dupuytren's is not on the Y chromosome.

(2)

(Total 13 marks)

Q5.

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

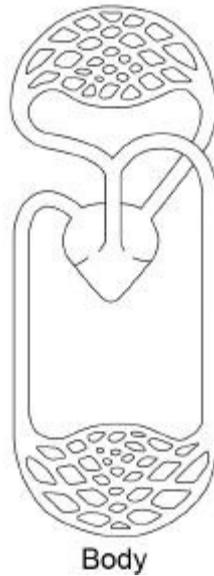
(a) Define the term double circulatory system.

(1)

Figure 1 shows the double circulatory system of the axolotl.

Figure 1

Gas exchange surfaces



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

Label the ventricle on Figure 1.

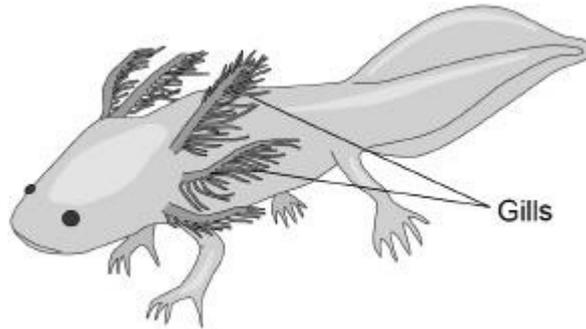
(1)

(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.

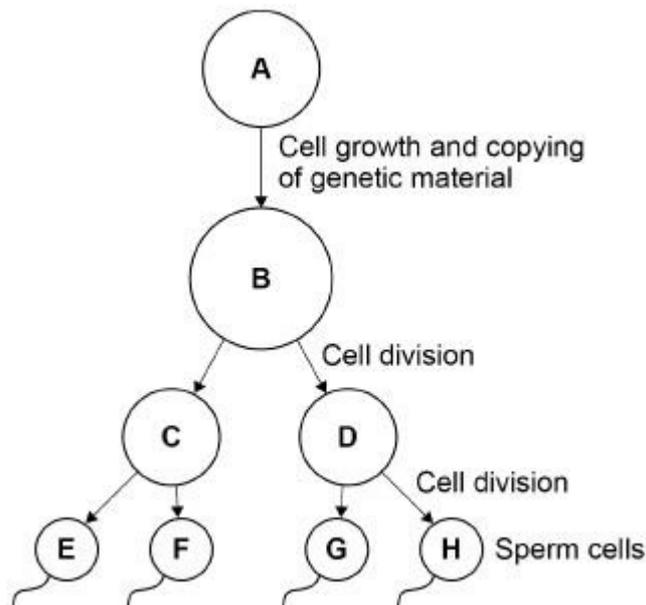
(1)

(Total 12 marks)

Q6.

Figure 1 shows the production of sperm cells in humans.

Figure 1



(a) Cell A is a normal body cell.

How many chromosomes are there in cell A?

Tick (✓) one box.

23 46 48 92

(1)

(b) What is the mass of DNA in cell E ?

Tick (✓) one box.

A quarter of the mass of the DNA in cell A

Half the mass of the DNA in cell A

The same mass as the DNA in cell A

Twice the mass of the DNA in cell A

(1)

(c) What type of cell division produces sperm cells?

Tick (✓) one box.

Binary fission

Differentiation

Meiosis

(1)

(d) Sometimes there are errors in copying the genetic material.

What term describes an error in the genetic material?

Tick (✓) one box.

- Absorption
- Fertilisation
- Mitosis
- Mutation

(1)

(e) A woman has three children, aged 4, 6 and 9 years.

Why are the children not genetically identical?

(2)

In sexual reproduction, a sperm cell fuses with an egg cell to form a new single cell.

An embryo develops from the single cell.

The cell divides three times to produce the embryo.

(f) How many cells are there in the embryo after three cell divisions?

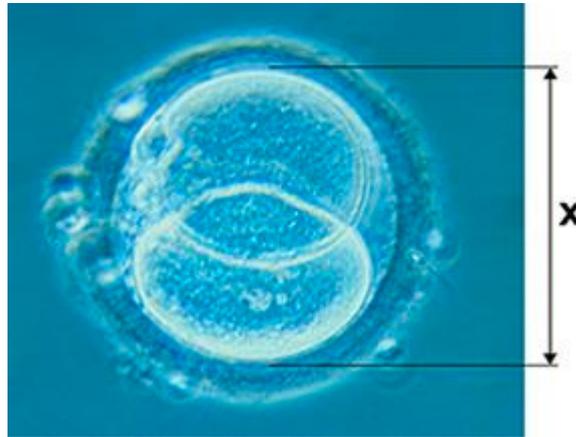
Tick (✓) one box.

- 3 6 8 9

(1)

Figure 2 shows a different human embryo.

Figure 2



(g) Measure image length X on Figure 2.

Give your answer in millimetres (mm).

X = _____ mm

(1)

(h) The image in Figure 2 has been magnified $\times 500$

Calculate the real length of the embryo.

Use the equation:

$$\text{real length of the embryo} = \frac{\text{image length}}{\text{magnification}}$$

Give your answer in micrometres (μm). 1 mm = 1000 μm

Real length of the embryo = _____ μm

(3)

- (i) The embryo may not implant in the lining of the uterus.

The embryo will then be lost from the woman's body several days later.

Explain why the woman may not notice this has happened.

(2)
(Total 13 marks)

Q7.

This question is about the cell cycle.

- (a) Chromosomes are copied during the cell cycle.

Where are chromosomes found?

Tick one box.

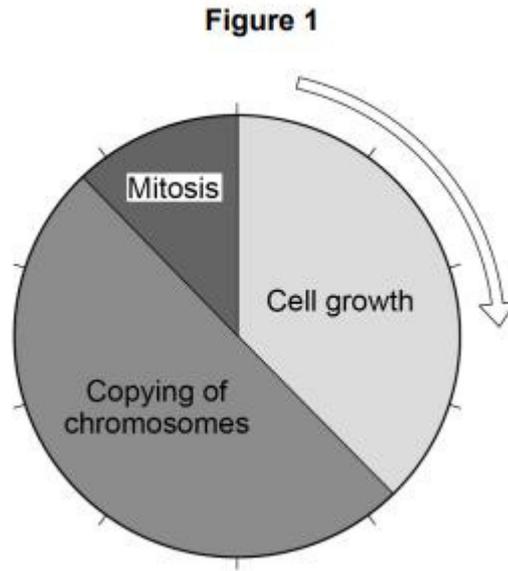
Cytoplasm	<input type="checkbox"/>
Nucleus	<input type="checkbox"/>
Ribosomes	<input type="checkbox"/>
Vacuole	<input type="checkbox"/>

(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.



(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

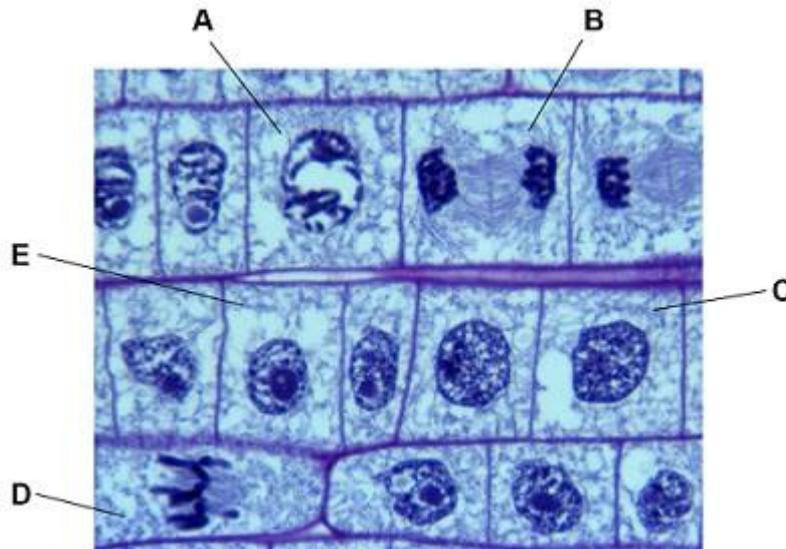
(1)

- (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)

Q8.

Cell division is needed for growth and for reproduction.

(a) The table below contains three statements about cell division.

Complete the table.

Tick one box for each statement.

Statement	Statement is true for		
	Mitosis only	Meiosis only	Both mitosis and meiosis
All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

(2)

Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds. Bluebells can also reproduce asexually by making new bulbs.

(b)

One advantage of asexual reproduction for bluebells is that only one parent is needed.

Suggest two other advantages of asexual reproduction for bluebells.

1. _____

2. _____

(2)

(c) Explain why sexual reproduction is an advantage for bluebells.

(4)
(Total 8 marks)

Q9.

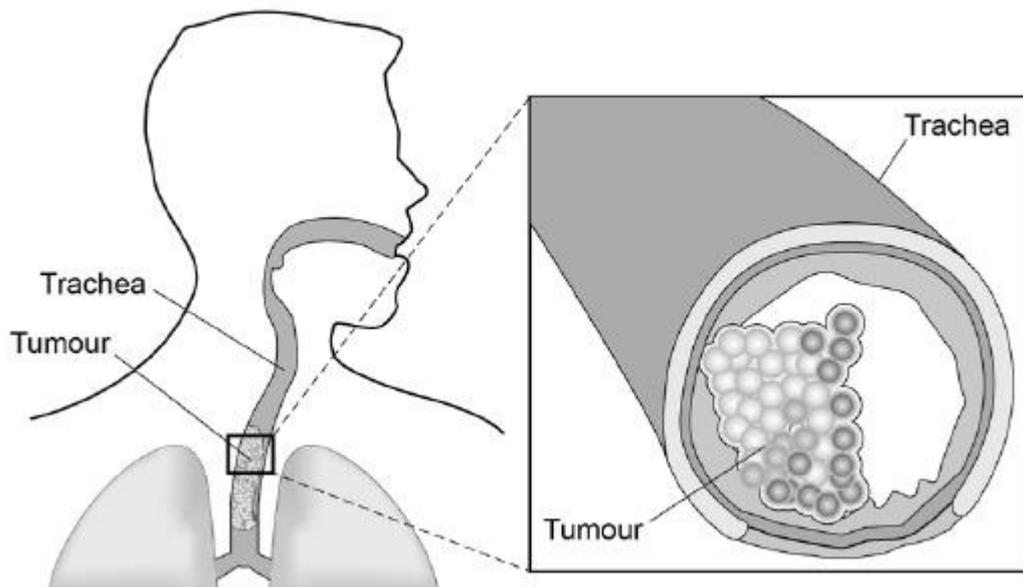
Stem cells can be used to treat some diseases.

(a) What is a stem cell?

(2)

Figure 1 shows a malignant tumour in the trachea of a patient.

Figure 1



(b) Give one way a malignant tumour differs from a benign tumour.

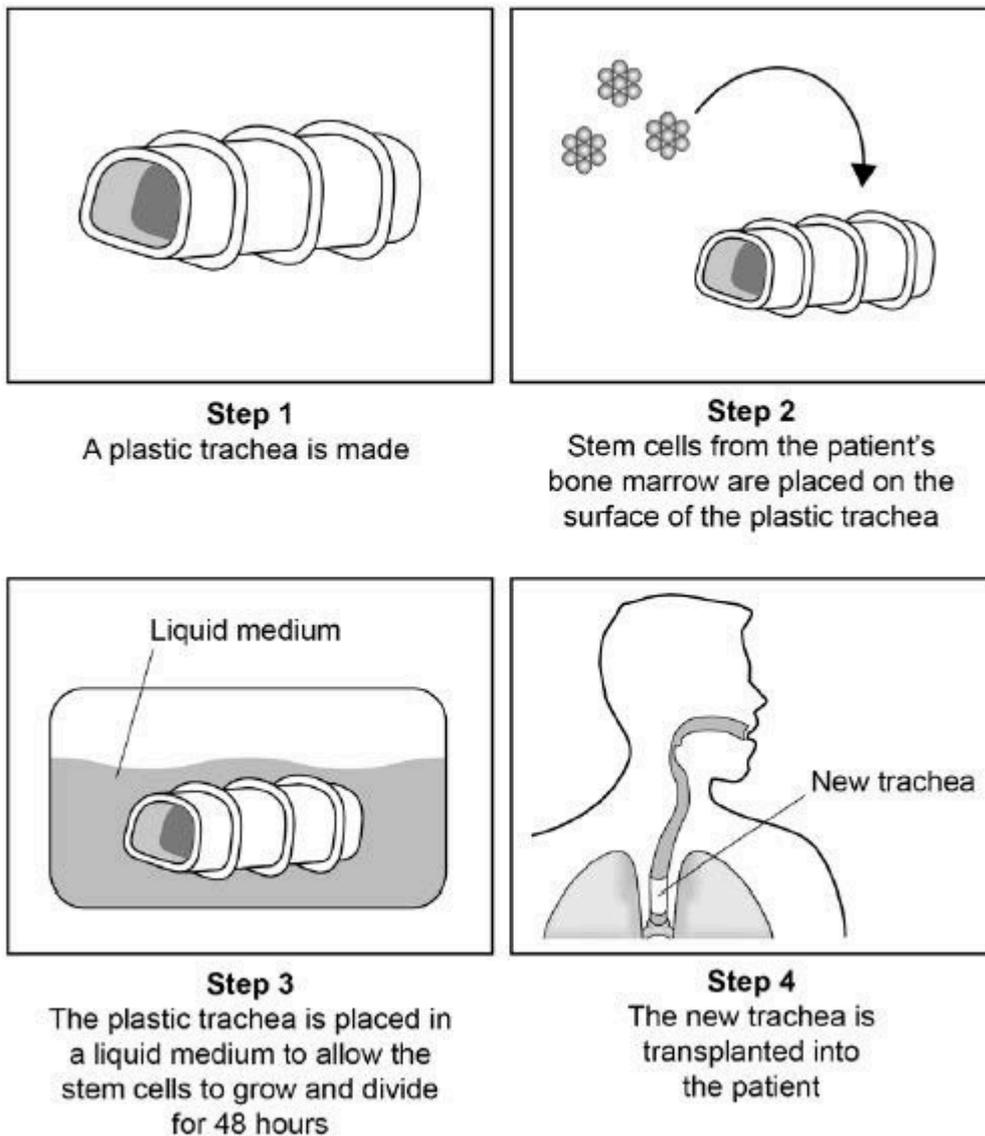
(1)

Scientists can treat the patient's tumour by replacing the trachea with a plastic trachea.

The plastic trachea has a layer of the patient's own stem cells covering it.

Figure 2 shows the procedure.

Figure 2



(c) In Step 3 the cells are left for 48 hours to divide.

Name the type of cell division in Step 3.

(1)

(d) In Step 3 the cells are given oxygen and water. Name two other substances the cells need so they can grow and divide. 1.

----- 2.

(2)

(e) Give two advantages of using the stem cell trachea compared with a trachea from a dead human donor.

1. -----

2. -----

(2)

(f) Sometimes the stem cell trachea is not strong enough. Doctors can put a stent into the trachea. Suggest how a stent in the trachea helps to keep the patient alive.

(2)

- (g) Stem cells can also be obtained from human embryos. Evaluate the use of stem cells from a patient's own bone marrow instead of stem cells from an embryo.
Give a conclusion to your answer.

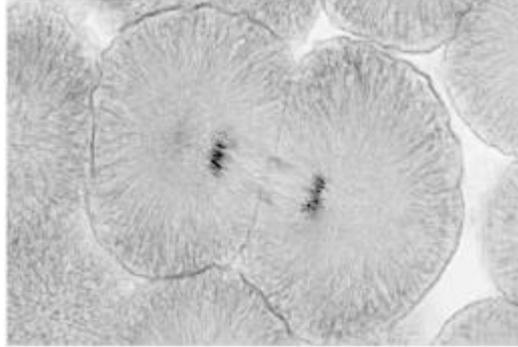
(6)
(Total 16 marks)

Q10.

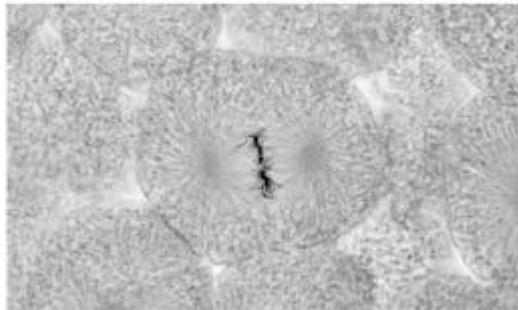
Figure 1 shows photographs of some animal cells at different stages during the cell cycle.

Figure 1

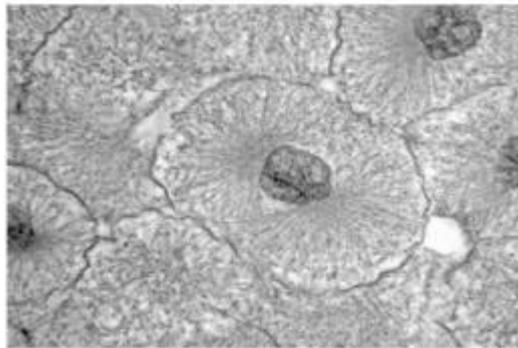
A



B



C



A © Ed Reschke/Photolibary/Getty Images
B © Ed Reschke/Oxford Scientific/Getty Images
C © Ed Reschke/Photolibary/Getty Images

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

Tick box.

A B C

(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					Total
	Non-dividing cells	Stage 1	Stage 2	Stage 3	Stage 4	
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)

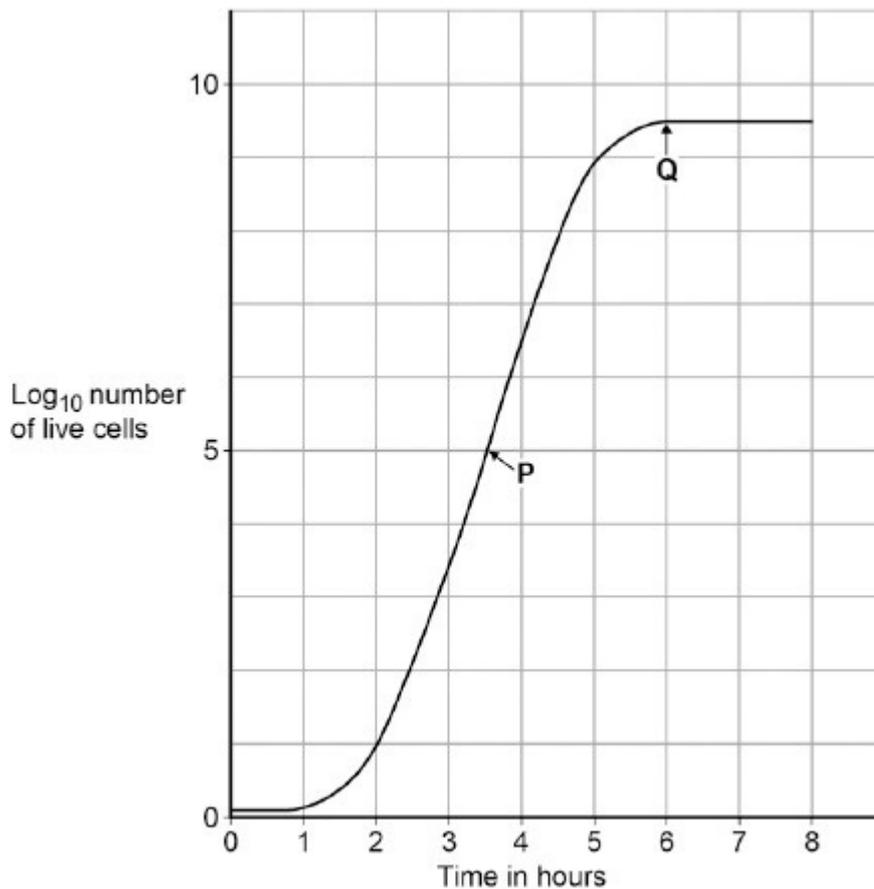
- (d) The cell cycle in an onion root tip cell takes 16 hours. Calculate the length of time Stage 2 lasts in a typical cell. Give your answer to 2 significant figures.

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)

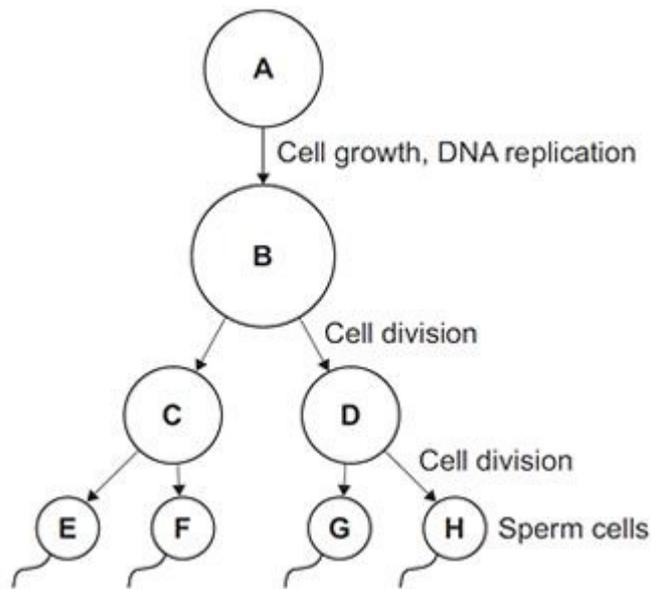
(f) Suggest why the number of cells levels out at Q.

(2)

(Total 11 marks)

Q11.

The diagram below shows the production of human sperm cells.



(a) Name the organ where the processes shown in the diagram above take place.

(1)

- (b) (i) Not every cell in the diagram above contains the same amount of DNA.

Cell A contains 6.6 picograms of DNA (1 picogram = 10⁻¹² grams).

How much DNA is there in each of the following cells?

Cell B _____ picograms

Cell C _____ picograms

Cell E _____ picograms

(2)

- (ii) How much DNA would there be in a fertilised egg cell?

_____ picograms

(1)

- (iii) A fertilised egg cell divides many times to form an embryo.

Name this type of cell division.

(1)

- (c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

- (i) What are stem cells?

(2)

- (ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

(1)

- (iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give one advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

(1)

- (iv) Why would it not be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

(1)

(Total 10 marks)

Q12.

Figure 1 shows some information about 'stem cell burgers'.

Figure 1

The first laboratory burger has now been cooked

In July 2013 the first burger grown from cow stem cells was cooked. Muscle stem cells from cows were grown into strands of beef in a laboratory. About 20000 strands of beef were then made into a burger. The burger can be cooked and eaten by humans. This type of meat is called cultured meat. The cultured meat is exactly the same as normal cow muscle tissue and the cells are not genetically modified.

- (a) (i) Some scientists think using cultured meat instead of traditionally-produced meat will help reduce global warming. Suggest two reasons why using cultured meat may slow down the rate of global warming.

1. _____

2. _____

(2)

- (ii) Suggest two other possible advantages of producing cultured meat instead of farmed meat.

Do not refer to cost in your answer.

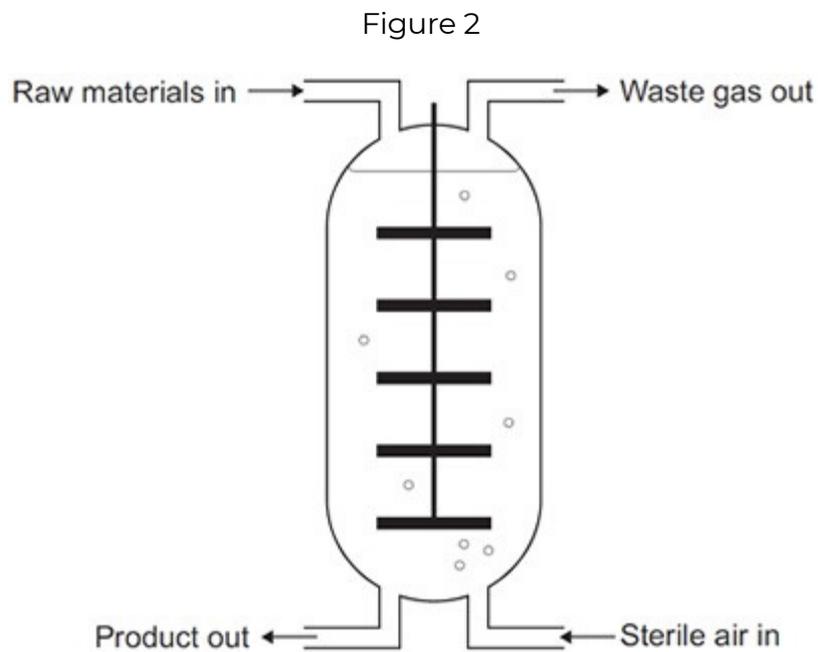
1. _____

2. _____

(2)

- (b) Mycoprotein is one type of food that is mass-produced.

Figure 2 shows a fermenter used to produce mycoprotein.



Describe how mycoprotein is produced.

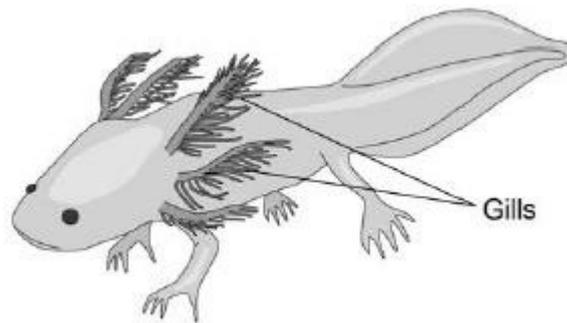
(4)
(Total 8 marks)

Q13.

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 | <input type="checkbox"/> |
| Embryos | <input type="checkbox"/> |
| Hair | <input type="checkbox"/> |
| Meristem tissue | <input type="checkbox"/> |

(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.

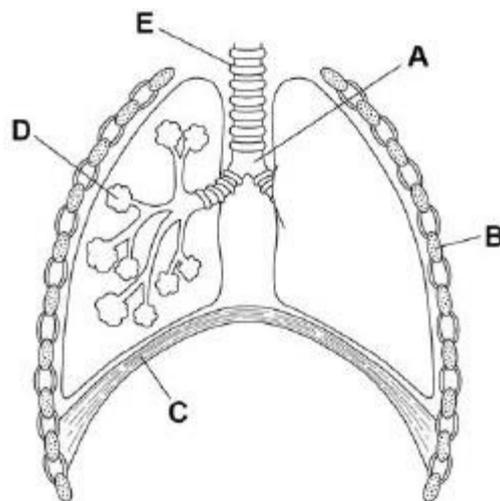
- Axolotls are cheap to feed.
- Axolotls are easy to breed.
- Axolotls are endangered.
- Axolotls live in water.
- Axolotl research is cruel.

(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 4.

(1)

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

Tick (✓) one box.

Aorta

Pulmonary artery

Vena cava

(1)

(Total 11 marks)