Questions are for both separate science and combined science students unless indicated in the question

Q1.

The nucleus of a cell contains DNA.

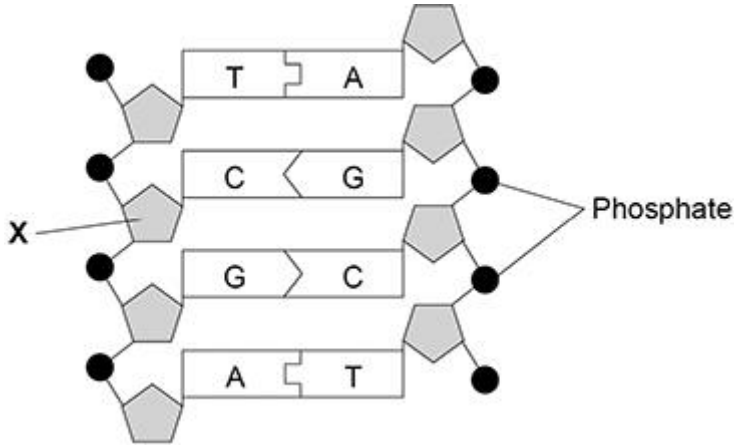
(a) Name the structures inside the cell nucleus that contain DNA.

_____

(1)

Figure 1 shows part of a DNA molecule.

Figure 1



(b) Name the part of the DNA molecule labelled **X**. **(separate only)**

_____

(1)

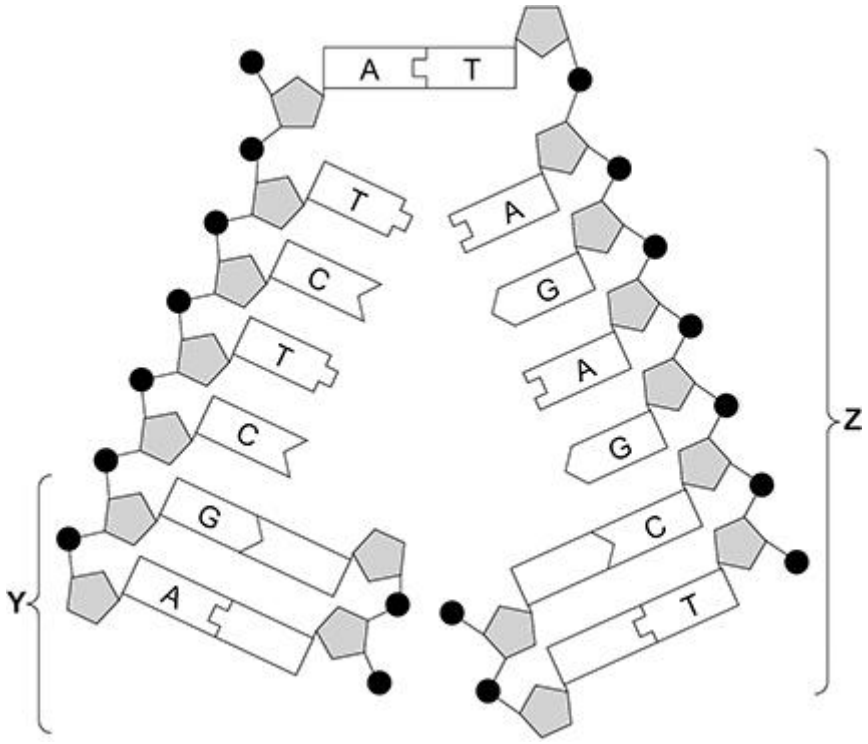
(c) What type of substances are labelled **A**, **C**, **G** and **T** in **Figure 1**? **(separate only)**

_____

(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. **(separate only)**

(1)

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

Tick (✓) **one** box. **(separate only)**

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.

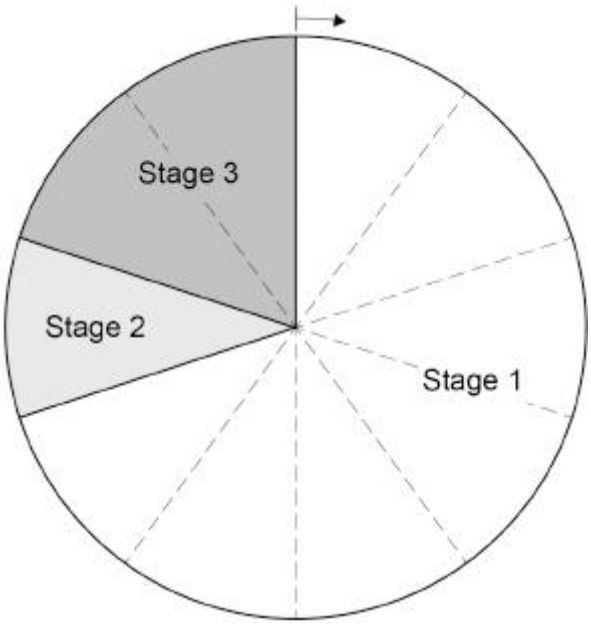
Differentiation ☐

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.

_____

_____

_____

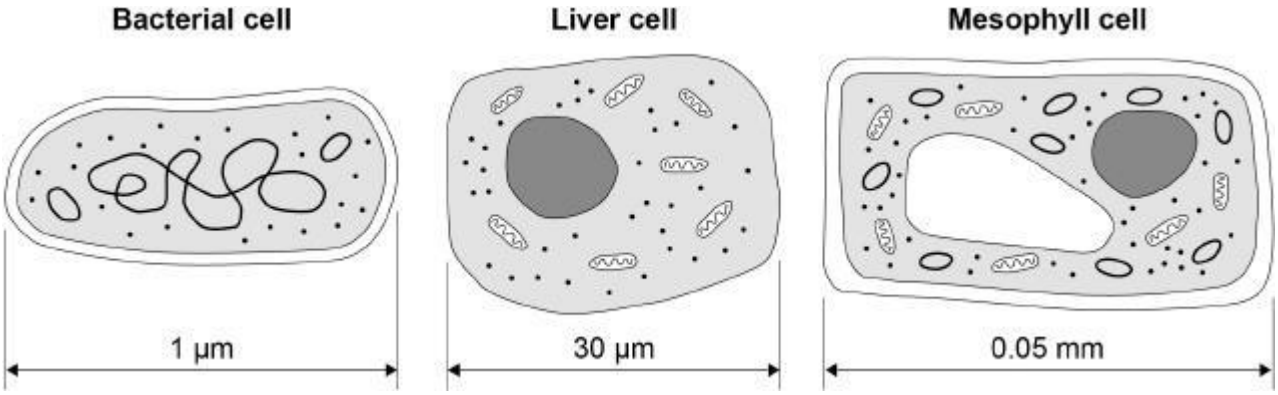
_____

(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 : _____

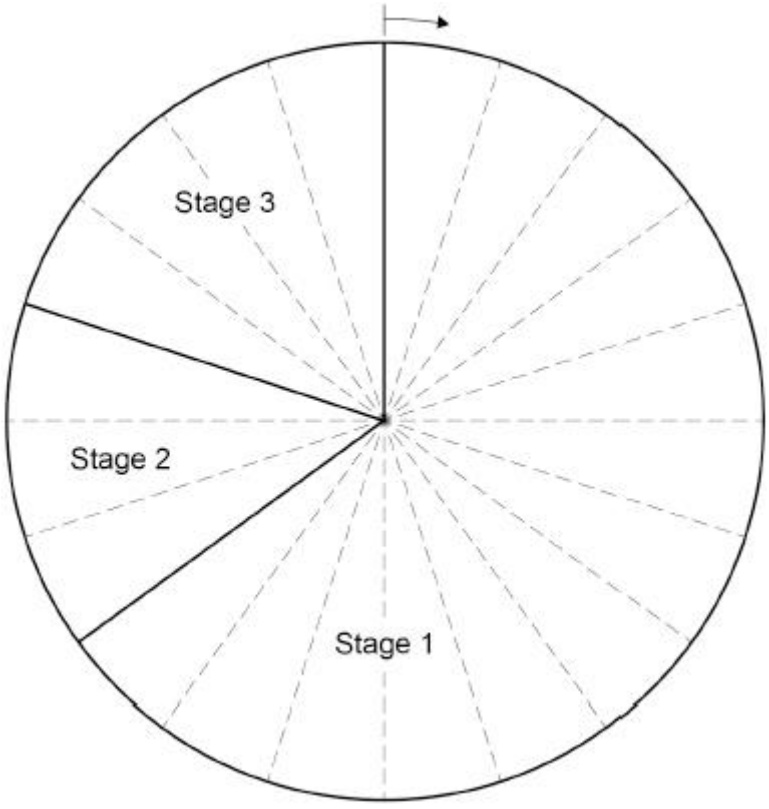
(2)

(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.

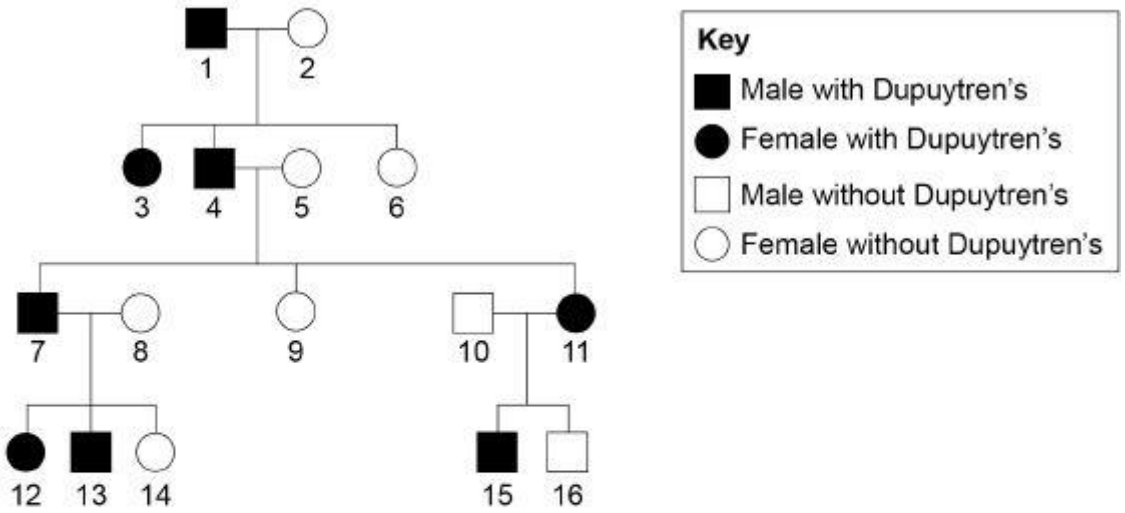
_____

_____

(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.

_____

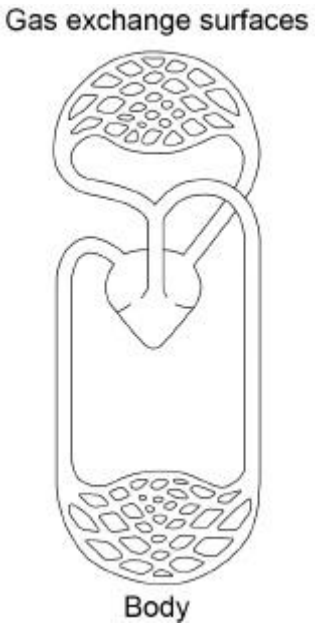
_____

_____

(1)

Figure 1 shows the double circulatory system of the axolotl.

Figure 1



(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.

_____

_____

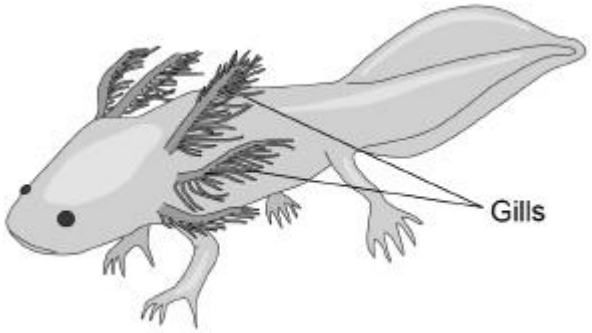
_____

_____

(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.

_____

_____

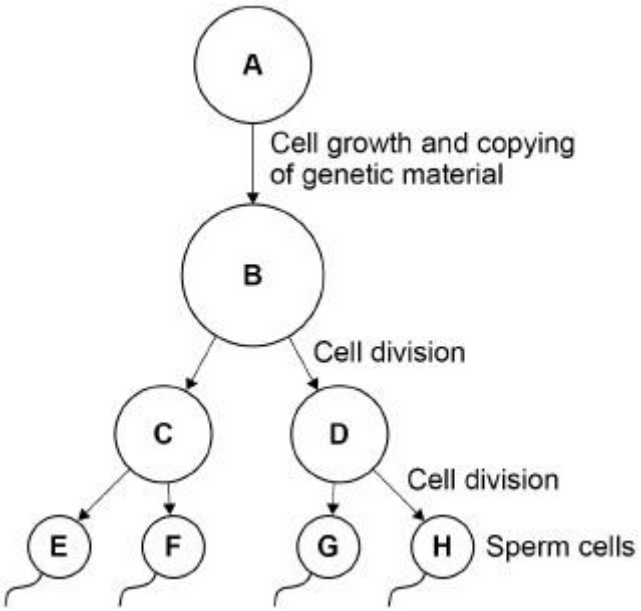
(1)

(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?

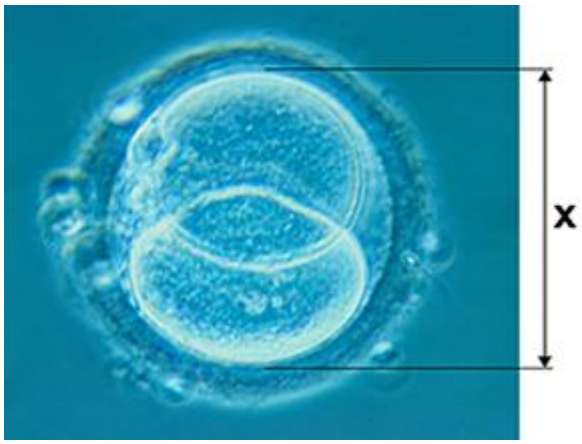
Tick (✓) **one** box.

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 × 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	☐
Nucleus	☐
Ribosomes	☐
Vacuole	☐

(1)

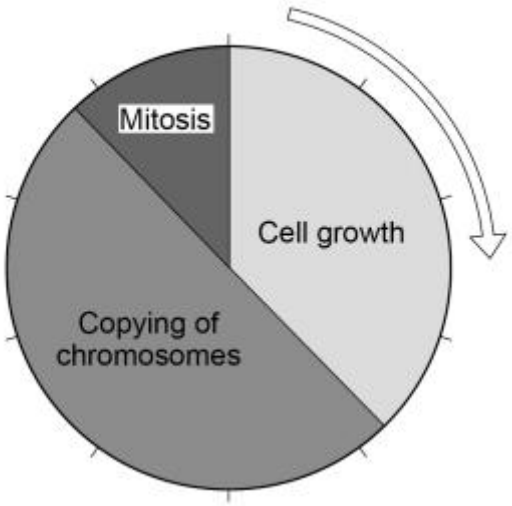
(b) What is the name of a section of a chromosome that controls a characteristic?

_____

(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.

_____

_____

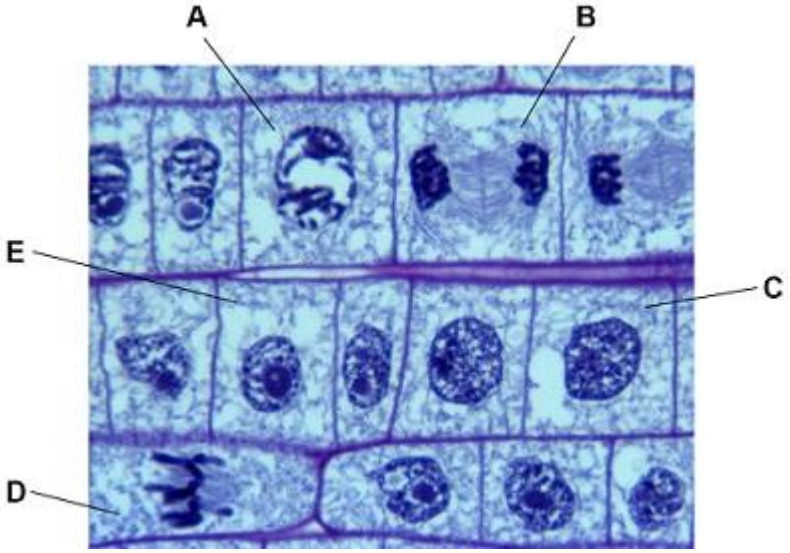
_____

_____

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)

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 is true for		
Statement	**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. **(separate only)**

1. _____

_____

2. _____

_____

(2)

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

_____

_____

_____

_____

(4)

(Total 8 marks)

Q9.

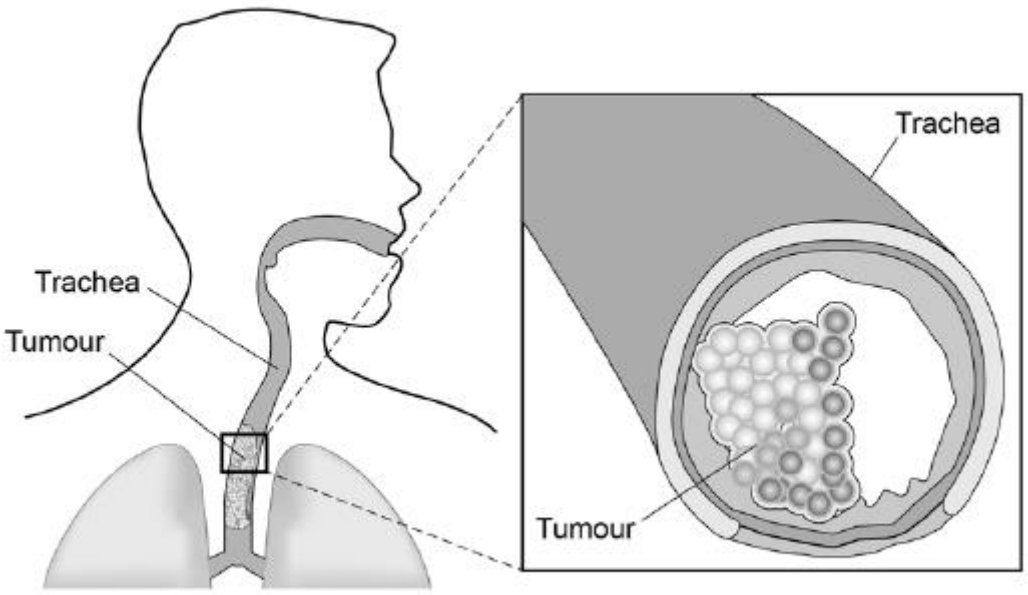
Stem cells can be used to treat some diseases.

(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.

_____

_____

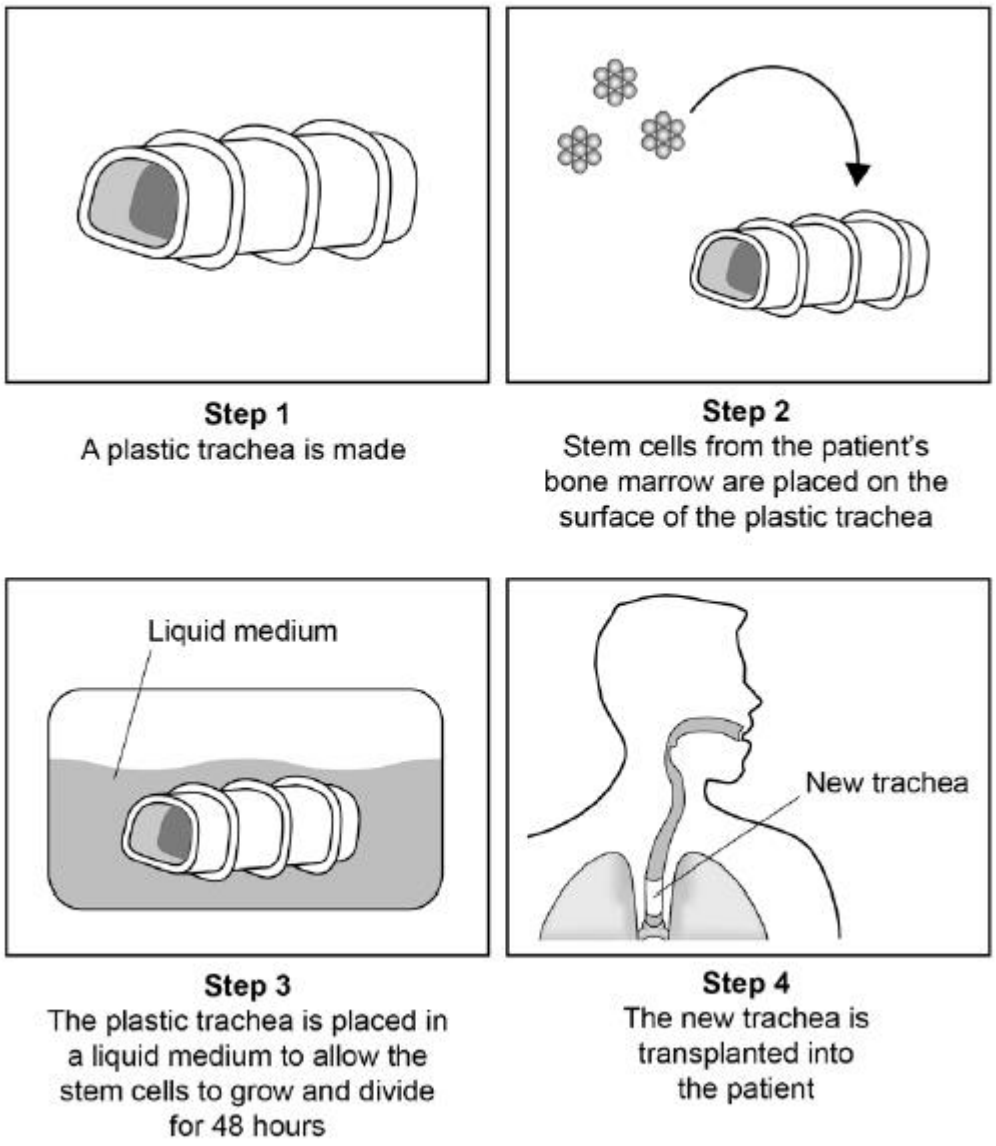
(1)

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)

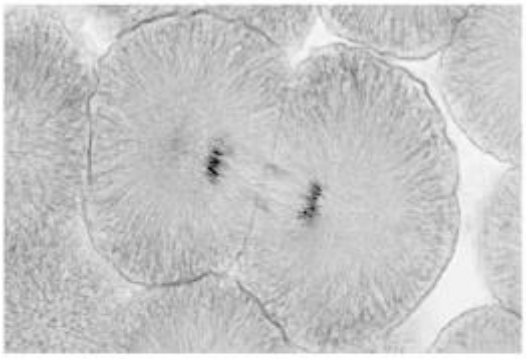
(Total 16 marks)

Q10.

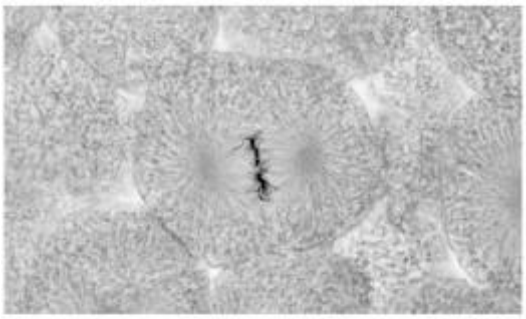
Figure 1 shows photographs of some animal cells at different stages during the cell cycle.

Figure 1

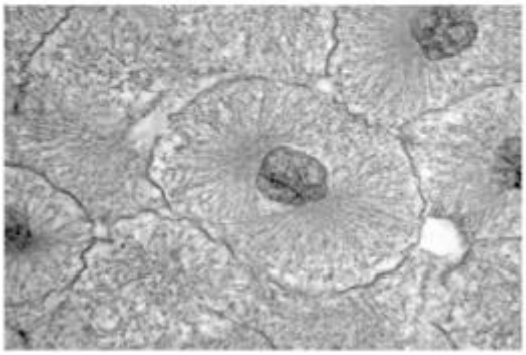
A



B



C



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

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

Tick **one** 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				
	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.

_____

_____

_____

_____

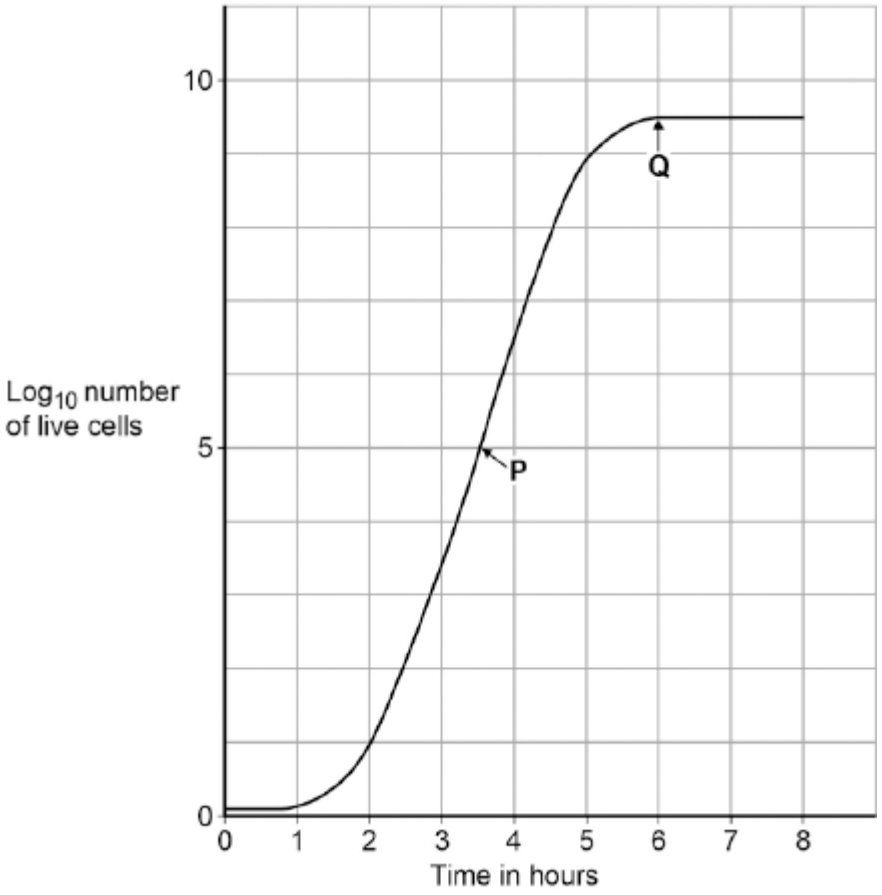
Time in **Stage 2** = _____ minutes

(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**.

_____

_____

_____

_____

_____

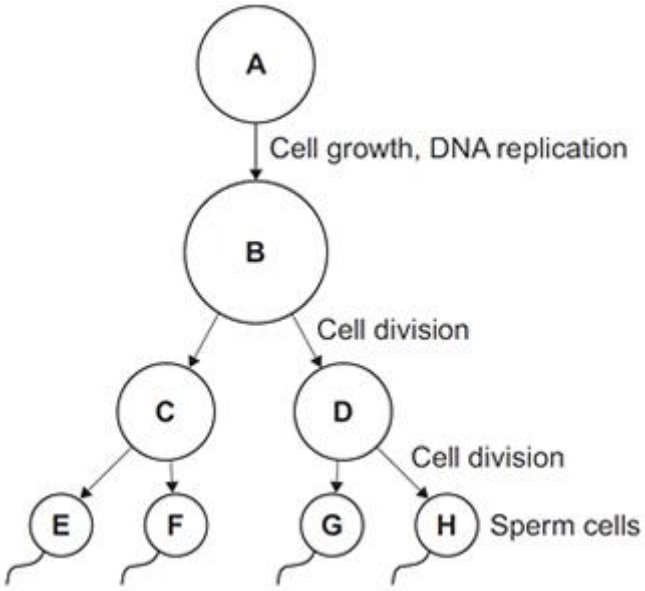
_____

(2)

(Total 11 marks)

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. **(separate only)**

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. **(separate only)**

1. _____

_____

2. _____

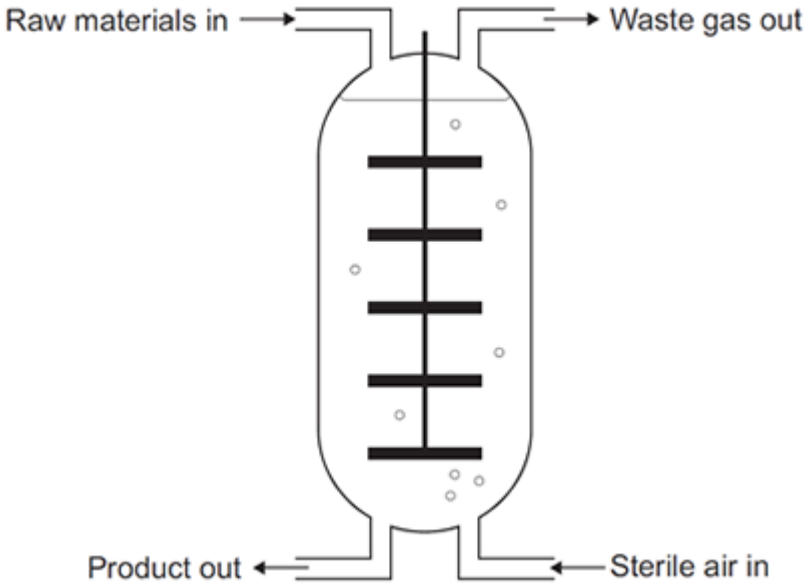
_____

(2)

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

Figure 2 shows a fermenter used to produce mycoprotein.

Figure 2



Describe how mycoprotein is produced. **(separate only)**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

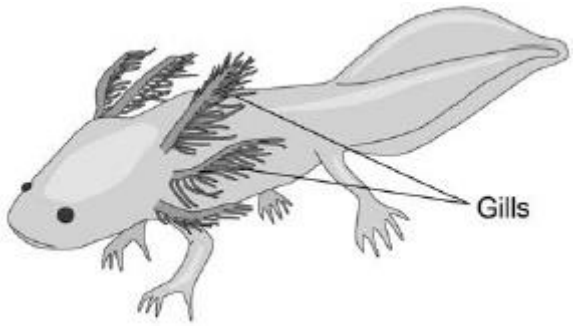
(Total 8 marks)

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 ☐

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. ☐

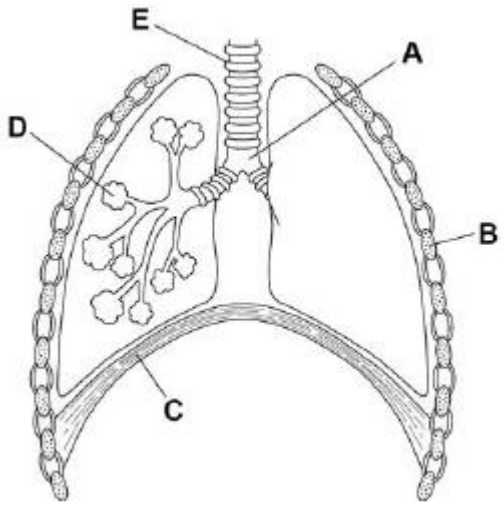
Axolotl research is cruel. ☐

(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 4**.

_____

(1)

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

Tick (✓) **one** box.

Aorta ☐

Pulmonary artery ☐

Vena cava ☐

(1)

(Total 11 marks)