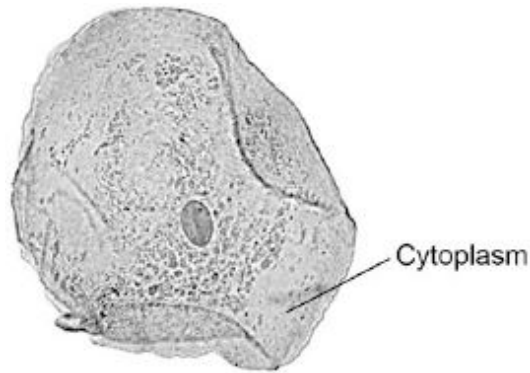


1

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

**Figure 1**



© Ed Reschke/Photolibrary/Getty Images

(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

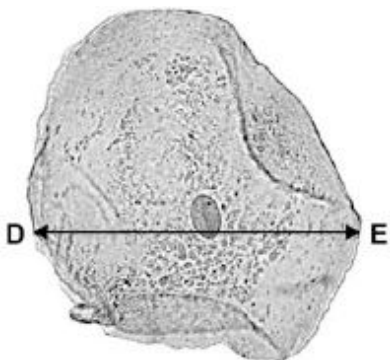
Lower resolution

(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 ( $\mu\text{m}$ ).

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:

**real size** =  $\frac{\text{image size}}{\text{magnification}}$  ..... mm

Convert mm to  $\mu\text{m}$  .....  $\mu\text{m}$

(3)

(f) A red blood cell is  $8\ \mu\text{m}$  in diameter.

A bacterial cell is 40 times smaller.

Calculate the diameter of the bacterial cell.

Tick **one** box.

$0.02\ \mu\text{m}$

$0.2\ \mu\text{m}$

$2.0\ \mu\text{m}$

$20.0\ \mu\text{m}$

(1)  
(Total 9 marks)

2

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

The diagram below shows a leaf infected with TMV.



Yellow patches where TMV has destroyed chloroplasts

© Nigel Cattlin/Visuals Unlimited/Getty Images

(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.

.....

.....

.....

.....

(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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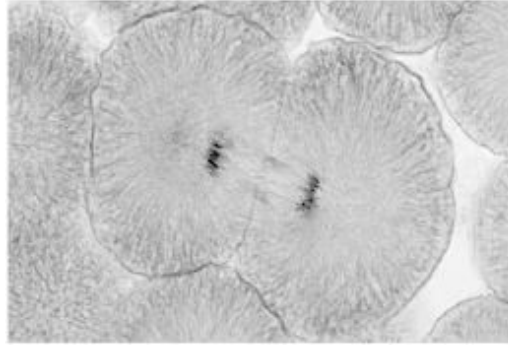
(4)  
(Total 8 marks)

3

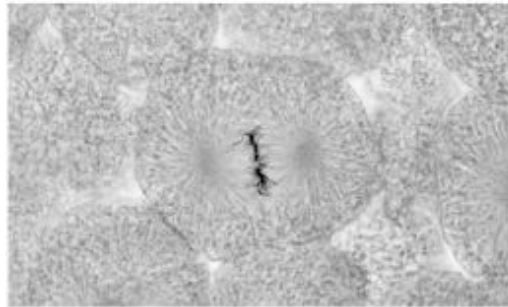
Figure 1 shows photographs of some animal cells at different stages during the cell cycle.

Figure 1

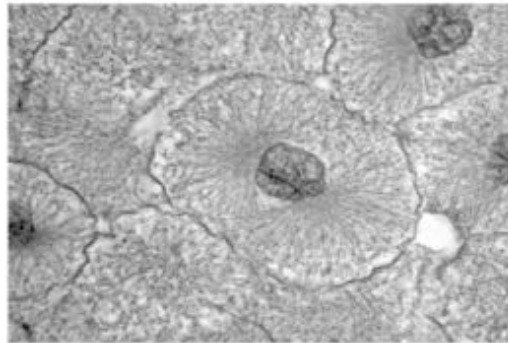
A



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 **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.

.....

.....

.....

.....

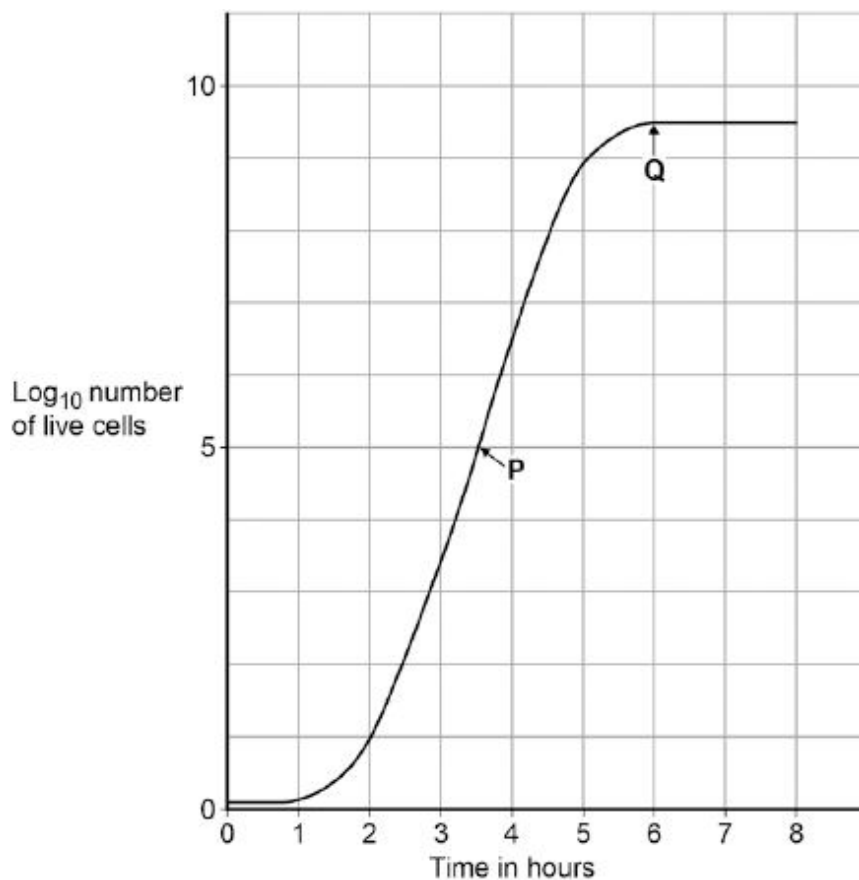
Time in **Stage 2** = ..... minutes

(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)

**4**

(a) In humans there are two types of cell division: **mitosis** and **meiosis**.

The table below gives statements about cell division.

Tick (✓) **one** box in each row to show if the statement is true for mitosis only, for meiosis only, or for both mitosis **and** meiosis.

The first row has been done for you.

Statement	Mitosis only	Meiosis only	Both mitosis and meiosis
How cells are replaced	✓		
How gametes are made			
How a fertilised egg undergoes cell division			
How copies of the genetic information are made			
How genetically identical cells are produced			

(4)

(b) Stem cells can be taken from human embryos.

In therapeutic cloning, an embryo is produced that has the same genes as the patient.

(i) Name **one** source of human stem cells, other than human embryos.

.....

(1)

- (ii) Stem cells from embryos can be transplanted into patients for medical treatment.

Give **one** advantage of using stem cells from embryos, compared with cells from the source you named in part (i).

(1)

.....

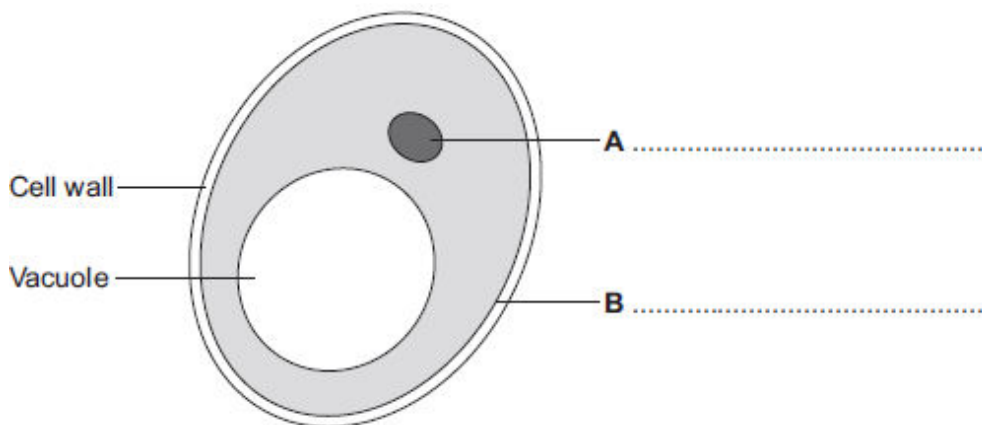
.....

(Total 6 marks)

**5**

Human cells and yeast cells have some parts that are the same.

- (a) The diagram shows a yeast cell.



Parts **A** and **B** are found in human cells and in yeast cells. On the diagram, label parts **A** and **B**.

(2)

- (b) Many types of cell can divide to form new cells.

Some cells in human skin can divide to make new skin cells.

Why do human skin cells need to divide?

.....

.....

(1)

- (c) Human stem cells can develop into many different types of human cell.

- (i) Use the correct answer from the box to complete the sentence.

<b>embryos</b>	<b>hair</b>	<b>nerve cells</b>
----------------	-------------	--------------------

Human stem cells may come from

.....

(1)

(ii) Use the correct answer from the box to complete the sentence.

<b>cystic fibrosis</b>	<b>paralysis</b>	<b>polydactyly</b>
------------------------	------------------	--------------------

Human stem cells can be used to treat

.....

(1)  
(Total 5 marks)

**6**

In sexual reproduction, an egg fuses with a sperm.

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

An egg and a sperm fuse together in the process of

cloning. fertilisation. mitosis.
--

(1)

(ii) Egg cells and sperm cells each contain the structures given in the box.

<b>chromosome</b>	<b>gene</b>	<b>nucleus</b>
-------------------	-------------	----------------

List these three structures in size order, starting with the smallest.

- 1 ..... (smallest)
- 2 .....
- 3 ..... (largest)

(2)

(iii) The egg and the sperm contain genetic material.

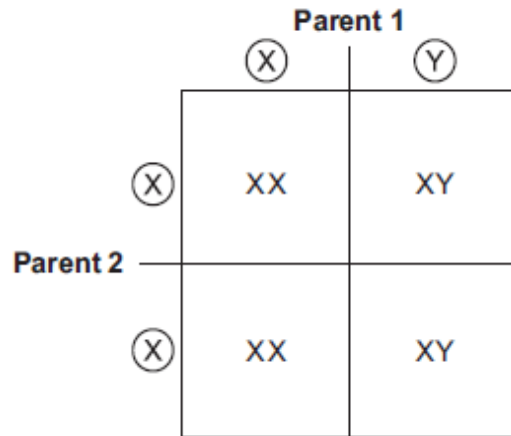
Draw a ring around the correct answer to complete the sentence.

The genetic material is made of

carbohydrate. DNA. protein.
-----------------------------------

(1)

(b) The diagram below shows the inheritance of **X** and **Y** chromosomes.



(i) Draw a tick (✓) on the part of the diagram that shows a sperm cell.

(1)

(ii) What is the chance of having a female child?

Give the reason for your answer.

.....

.....

.....

.....

(2)

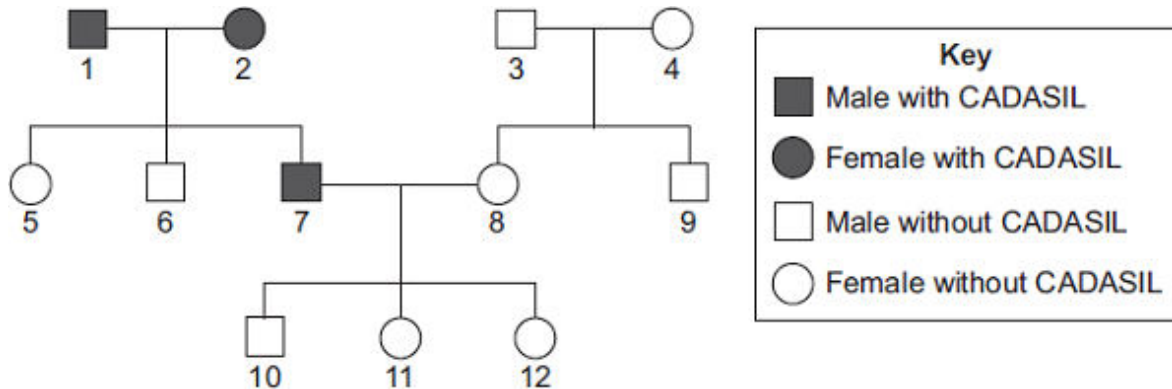
(Total 7 marks)

**7**

CADASIL is an inherited disorder caused by a dominant allele.

CADASIL leads to weakening of blood vessels in the brain.

The diagram shows the inheritance of CADASIL in one family.



(a) CADASIL is caused by a *dominant allele*.

(i) What is a *dominant allele*?

.....  
 .....

(1)

(ii) What is the evidence in the diagram that CADASIL is caused by a dominant allele?

.....  
 .....

(1)

(iii) Person 7 has CADASIL.

Is person 7 homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

.....  
 .....

(1)

- (b) Persons **7** and **8** are planning to have another baby.  
Use a genetic diagram to find the probability that the new baby will develop into a person with CADASIL.

Use the following symbols to represent alleles.

**D** = allele for CADASIL

**d** = allele for not having CADASIL

Probability = .....

(4)

- (c) Scientists are trying to develop a treatment for CADASIL using stem cells.  
Specially treated stem cells would be injected into the damaged part of the brain.

- (i) Why do the scientists use stem cells?

.....  
.....  
.....  
.....

(2)

- (ii) Embryonic stem cells can be obtained by removing a few cells from a human embryo. In 2006, scientists in Japan discovered how to change adult skin cells into stem cells. Suggest **one** advantage of using stem cells from adult skin cells.

.....  
.....

(1)

(Total 10 marks)

**8**

(a) (i) Mitosis and meiosis are types of cell division.

For each feature in the table, tick (✓) **one** box to show if the feature occurs:

- only in mitosis
- only in meiosis.

Feature	Only in mitosis (✓)	Only in meiosis (✓)
Produces new cells during growth and repair		
Produces gametes (sex cells)		
Produces genetically identical cells		

(2)

(ii) Name the organ that produces gametes (sex cells) in:

a man .....

a woman. ....

(2)

(b) **X** and **Y** chromosomes are the sex chromosomes. They determine a person's sex.

What sex chromosomes will be found in the body cells of:

(i) a man .....

(1)

(ii) a woman? .....

(1)

(c) A man and a woman decide to have a child.

What is the chance that the child will be a boy? .....

(1)

**(Total 7 marks)**

9

The photographs show the flowers of two closely-related species of plant.

**Species A**



**Species B**



Images: © iStock/Thinkstock

The drawings show chromosomes from one cell in the root of each plant during cell division.

**Species A**



**One chromosome**

**Species B**



**One chromosome**

(a) The drawings show that each chromosome has two strands of genetic material.

(i) How does a chromosome become two strands?

.....  
.....

(1)

(ii) Explain why each chromosome must become two strands before the cell divides.

.....  
.....  
.....  
.....

(2)

(b) For sexual reproduction, the plants produce gametes.

(i) Name the type of cell division that produces gametes.

.....

(1)



(ii) How many chromosomes would there be in a gamete from each of these two plant species?

**Species A**  **Species B**

(1)

(iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring

plants?

(1)

(c) (i) Look back at the information at the start of the question and the information from part (b).

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

.....  
.....  
.....  
.....

(2)

- (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.

**Species A**

**Species B**



The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

.....

.....

.....

.....

.....

.....

(2)  
(Total 10 marks)

**10**

Stem cells can be collected from human embryos and from adult bone marrow. Stem cells can develop into different types of cell.

The table gives information about using these two types of stem cell to treat patients.

<b>Stem cells from human embryos</b>	<b>Stem cells from adult bone marrow</b>
It costs £5000 to collect a few cells.	It costs £1000 to collect many cells.
There are ethical issues in using embryo stem cells.	Adults give permission for their own bone marrow to be collected.
The stem cells can develop into most other types of cell.	The stem cells can develop into only a few types of cell.
Each stem cell divides every 30 minutes.	Each stem cell divides every four hours.
There is a low chance of a patient's immune system rejecting the cells.	There is a high chance of a patient's immune system rejecting the cells.
More research is needed into the use of these stem cells.	Use of these stem cells is considered to be a safe procedure.

Scientists are planning a new way of treating a disease, using stem cells.

Use **only** the information above to answer these questions.

- (a) Give **three** advantages of using stem cells from embryos instead of from adult bone marrow.

1 .....

2 .....

3 .....

**(3)**

- (b) Give **three** advantages of using stem cells from adult bone marrow instead of from embryos.

1 .....

2 .....

3 .....

**(3)**

**(Total 6 marks)**

11

Read the information about stem cells.

Stem cells are used to treat some human diseases.

Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.

Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

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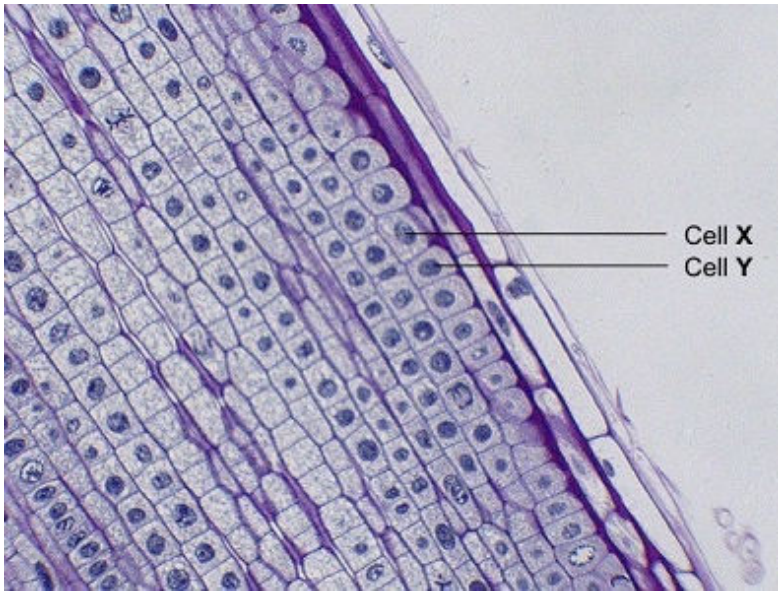
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.....

(5)  
(Total 5 marks)

12

The photograph shows some cells in the root of an onion plant.



By UAF Center for Distance Education [CC BY 2.0], via Flickr

(a) Cells X and Y have just been produced by cell division.

(i) Name the type of cell division that produced cells X and Y.

.....

(1)

(ii) What happens to the genetic material before the cell divides?

.....

(1)

(b) A gardener wanted to produce a new variety of onion.

Explain why sexual reproduction could produce a new variety of onion.

.....  
.....  
.....  
.....  
.....  
.....  
.....

(3)  
(Total 5 marks)

**13**

The diagram shows a strawberry plant.

The parent plant grows side shoots.

New plants grow on the side shoots.



© D.G. Mackean

The new plants will all have the same inherited characteristics as the original parent plant.

Complete the sentences to explain why.

Use words from the box.

<b>asexual</b>	<b>differentiation</b>	<b>embryos</b>	<b>fertilisation</b>
<b>gametes</b>	<b>genes</b>	<b>mitosis</b>	<b>sexual</b>

(a) The new plant is produced by ..... reproduction.

(1)

(b) In this type of reproduction, body cells divide by .....

(1)

(c) The new plant has the same ..... as the parent plant.

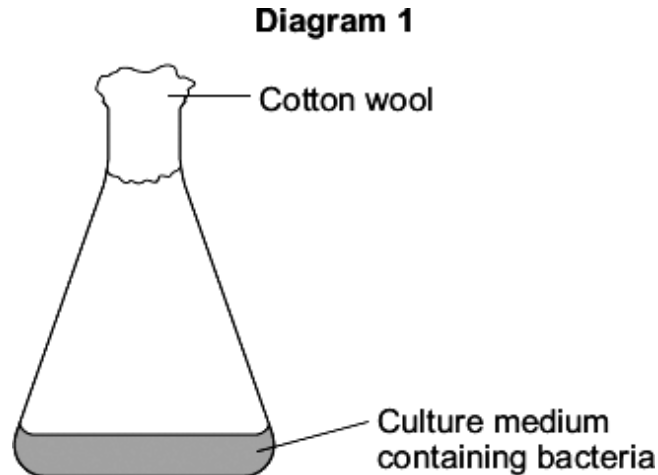
(1)

**(Total 3 marks)**

14

Some students grew one species of bacterium in a flask.

**Diagram 1** shows the flask.

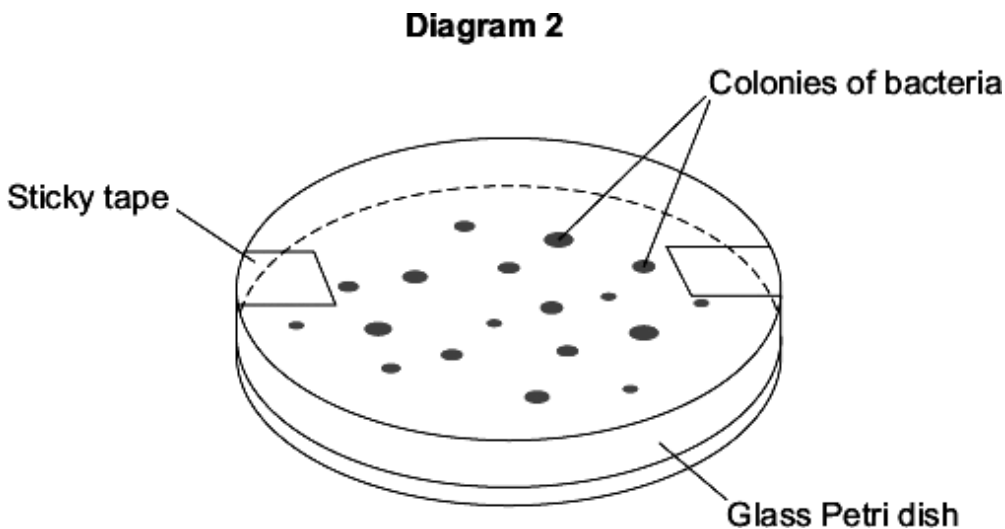


The students wanted to find the number of bacteria in  $1 \text{ cm}^3$  of the culture medium.

The students:

- diluted  $1 \text{ cm}^3$  of the culture medium from the flask with  $999 \text{ cm}^3$  of water
- added  $1 \text{ cm}^3$  of diluted culture to sterilised nutrient agar in a Petri dish
- placed the Petri dish in an incubator at  $25 \text{ }^\circ\text{C}$ .

**Diagram 2** shows the Petri dish after 3 days in the incubator.



- (a) Each colony of bacteria is formed where one bacterium landed on the agar jelly.

How is each colony formed?

.....

.....

(1)

- (b) Complete the following calculation to find how many bacteria there were in 1 cm<sup>3</sup> of the undiluted culture.

Number of colonies of bacteria in the Petri dish = .....

These colonies were formed from 1 cm<sup>3</sup> of the culture diluted × 1000.

Therefore, number of bacteria in 1 cm<sup>3</sup> of undiluted culture = .....

(2)

- (c) It is important to sterilise the culture medium and all the apparatus before use.

Explain why.

.....  
.....  
.....  
.....

(2)

- (d) The bacteria would grow faster at 35 °C. In a school laboratory, the Petri dish should **not** be incubated at a temperature higher than 25 °C.

Why?

.....  
.....

(1)

- (e) The students decided to repeat their investigation.

Why?

.....  
.....

(1)

(Total 7 marks)



**15**

The table shows the number of chromosomes found in each body cell of some different organisms.

<b>Animals</b>		<b>Plants</b>	
<b>Species</b>	<b>Number of chromosomes in each body cell</b>	<b>Species</b>	<b>Number of chromosomes in each body cell</b>
Fruit fly	8	Tomato	24
Goat	60	Potato	44
Human	46	Rice	24

(a) Nearly every organism on earth has an even number of chromosomes in its body cells.

Suggest why.

.....  
.....

(1)

(b) Chromosomes contain DNA molecules.

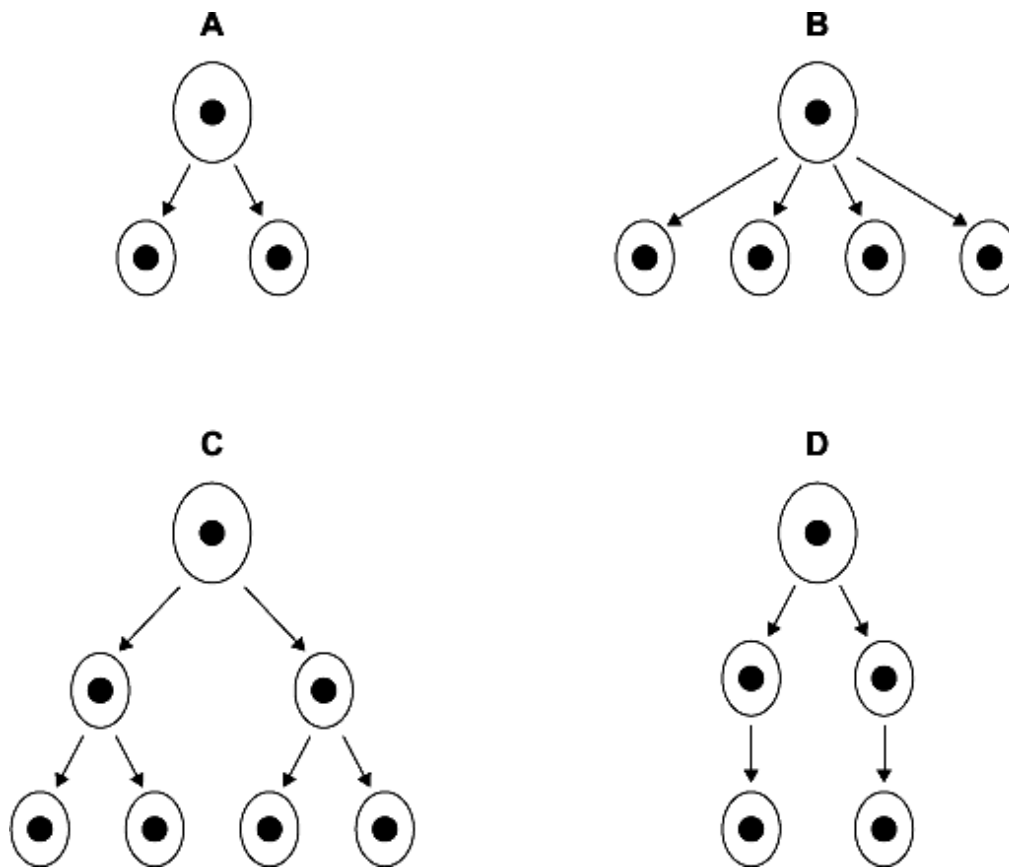
Describe the function of DNA.

.....  
.....  
.....  
.....

(2)

(c) Gametes are made in the testes by meiosis.

(i) Look at the diagrams.



Which diagram, **A**, **B**, **C** or **D**, represents how cell division by meiosis produces

gametes in the testes?

(1)

(ii) How many chromosomes will each goat gamete contain?

.....

(1)

(d) Body cells divide by mitosis.

(i) Why is the ability of body cells to divide important?

.....

.....

(1)

- (ii) When a body cell of a potato plant divides, how many chromosomes will each of the new cells contain?

.....

(1)  
(Total 7 marks)

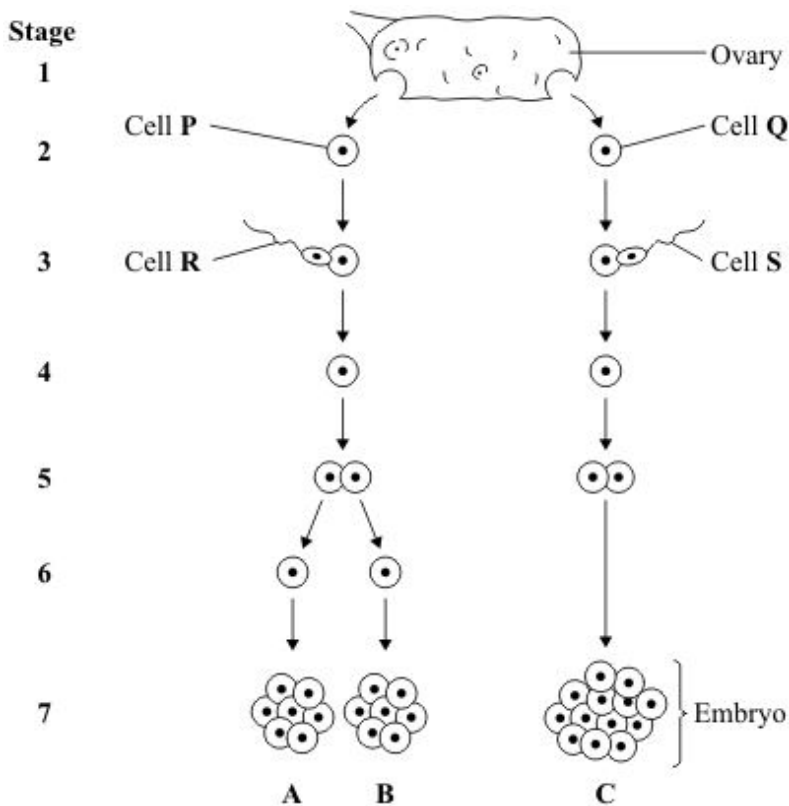
16

A woman gives birth to triplets.

Two of the triplets are boys and the third is a girl.

The triplets developed from two egg cells released from the ovary at the same time.

The diagram shows how triplets **A**, **B** and **C** developed.



- (a) Which stages on the diagram show gametes?

Draw a ring around your answer.

1 and 2      2 and 3      3 and 7      1 and 7

(1)

(b) Embryo **B** is male.

Which of the following explains why embryo **B** is male?

Tick (✓) **one** box.

Cell **P** has an X chromosome; cell **R** has an X chromosome.

Cell **P** has a Y chromosome; cell **R** has an X chromosome.

Cell **P** has an X chromosome; cell **R** has a Y chromosome.

(1)

(c) The children that develop from embryos **A** and **C** will **not** be identical.

Explain why.

You may use words from the box in your answer.

<b>egg</b>	<b>genes</b>	<b>sperm</b>
------------	--------------	--------------

.....

.....

.....

.....

.....

(2)

(d) Single cells from an embryo at **Stage 7** can be separated and grown in a special solution.

(i) What term describes cells that are grown in this way?

Draw a ring around your answer.

**lleles**                      **screened cells**                      **stem cells**

(1)

(ii) What happens when the cells are placed in the special solution?

Tick (✓) **two** boxes.

- The cells divide
- The cells fertilise
- The cells differentiate
- The cells separate

(2)

(iii) Give **one** use of cells grown in this way.

.....  
.....

(1)

(iv) Some people might object to using cells from embryos in this way.

Give **one** reason why.

.....  
.....  
.....

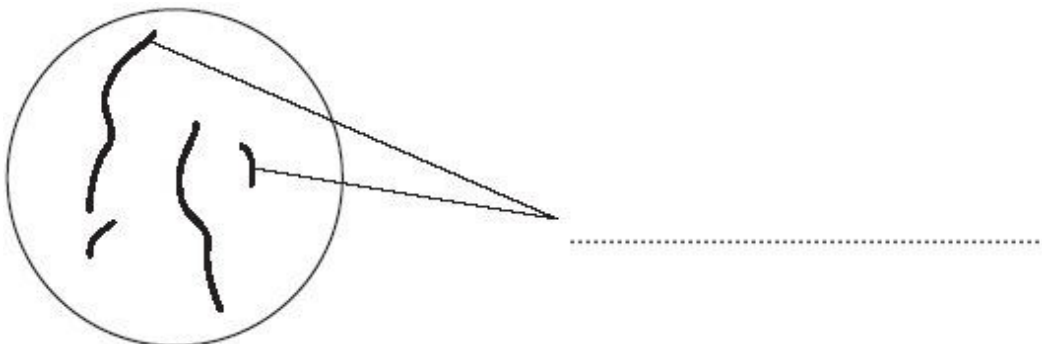
(1)

(Total 9 marks)

17

**Diagram 1** shows the nucleus of a body cell as it begins to divide by mitosis.

**Diagram 1**



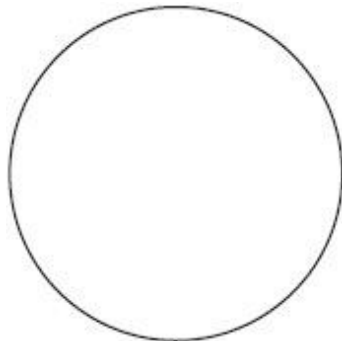
(a) Use a word from the box to label **Diagram 1**.

<b>alleles</b>	<b>chromosomes</b>	<b>gametes</b>
----------------	--------------------	----------------

(1)

(b) Complete **Diagram 2** to show what the nucleus of one of the cells produced by this mitosis would look like.

**Diagram 2**



(1)

(c) Stem cells from a recently dead embryo can be grown in special solutions.

Some facts about stem cells are given below.

- Stem cells from an embryo can grow into any type of tissue.
- Stem cells may grow out of control, to form cancers.
- Large numbers of stem cells can be grown in the laboratory.
- Stem cells may be used in medical research or to treat some human diseases.
- Patients treated with stem cells need to take drugs for the rest of their life to prevent rejection.
- Collecting and growing stem cells is expensive.

Use **only** the information above to answer these questions.

(i) Give **two** advantages of using stem cells.

1 .....

.....

2 .....

.....

(2)

(ii) Give **two** disadvantages of using stem cells.

1 .....

.....

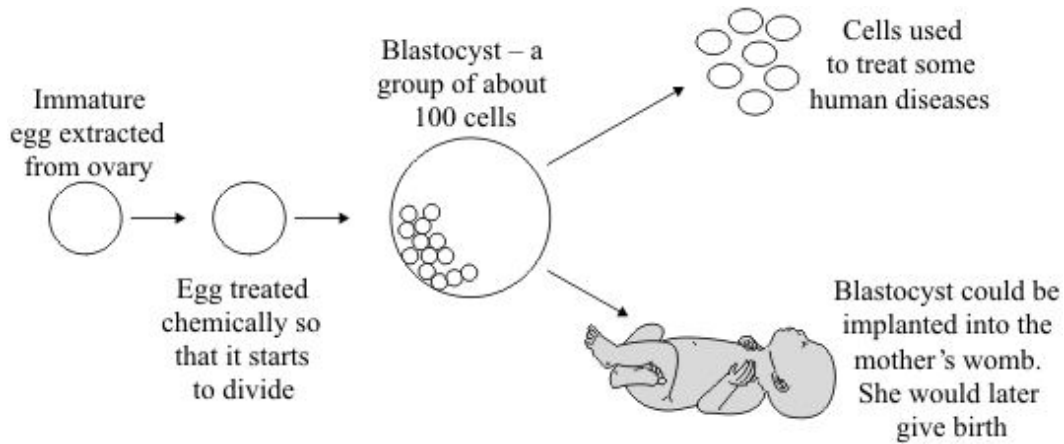
2 .....

.....

(2)  
(Total 6 marks)

18

The diagram shows how an immature egg could be used either to produce cells to treat some human diseases or to produce a baby.



Scientists may be allowed to use this technique to produce cells to treat some human diseases, but not to produce babies.

Using information from the diagram, suggest an explanation for this.

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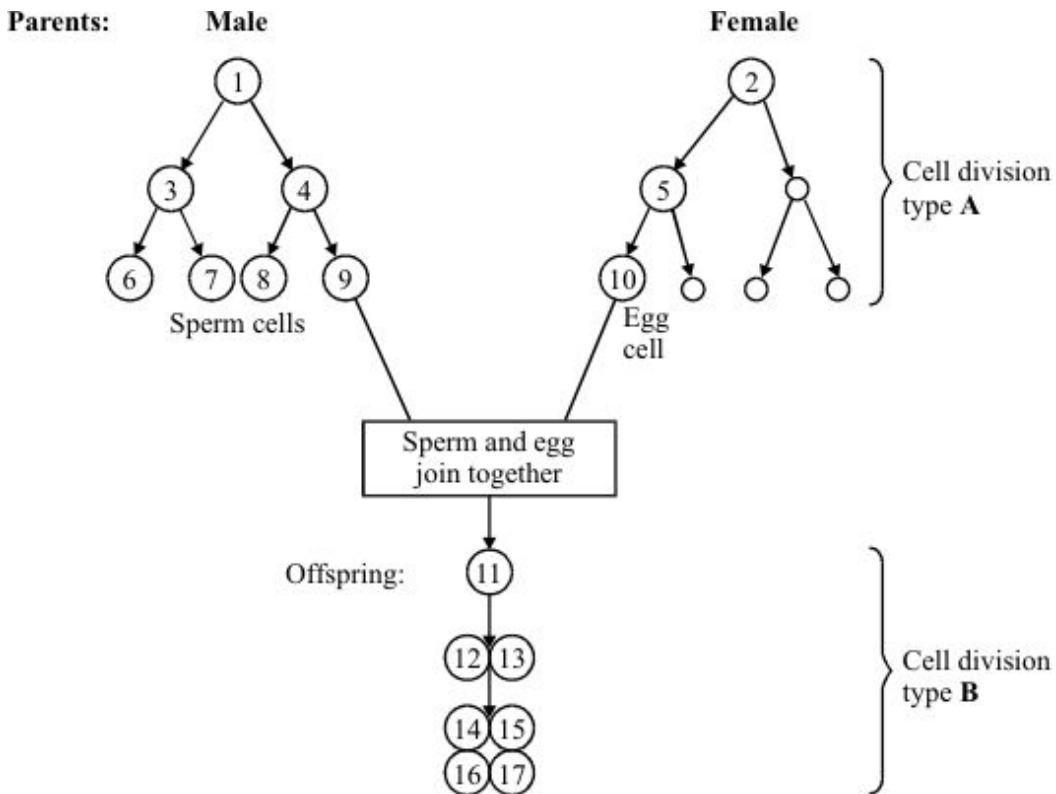
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(Total 4 marks)

19

The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.





(a) Name the two types of cell division, **A** and **B**, shown in the diagram.

Type **A** .....

Type **B** .....

(2)

(b) Name the process in which an egg and sperm join together.

.....

(1)

(c) Cell **1** contains 46 chromosomes. How many chromosomes will there be in:

(i) cell **10**; .....

(1)

(ii) cell **14**? .....

(1)

**(Total 5 marks)**

**20**

Meiosis and mitosis are different types of division in human cells. Compare the two processes by referring to where each takes place and the kind of products that are made.

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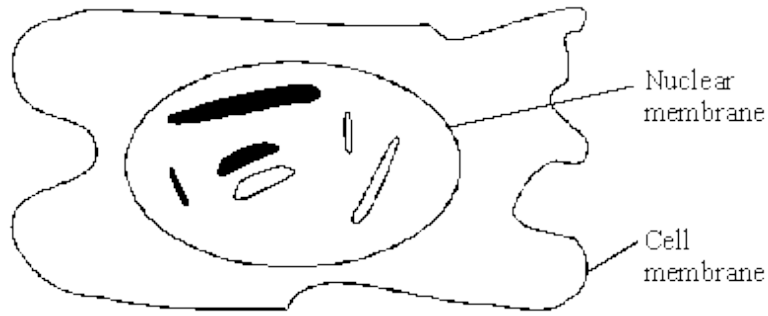
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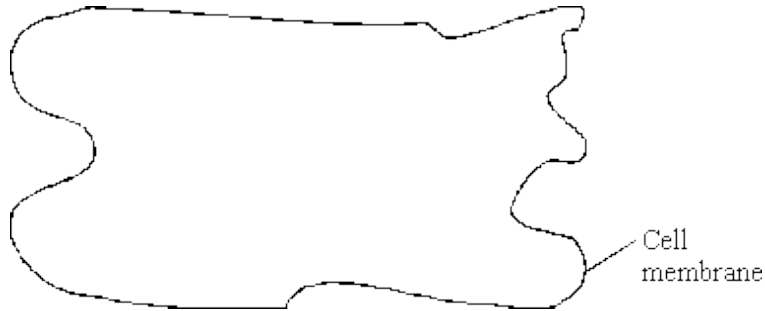
**(Total 6 marks)**

21

(a) The diagram shows a normal body cell which has six chromosomes.

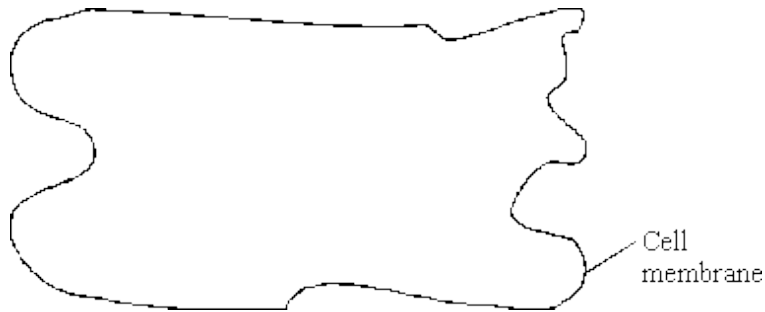


(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis*.



(3)

(ii) Complete the diagram below to show **one** cell produced from the original cell by *meiosis*.



(2)

- (b) Thalassaemia is a blood disease. It is determined by a single recessive allele. A person with one recessive allele does **not** get the disease but does act as a carrier. People with this pair of recessive alleles can become ill.
- (i) Draw a genetic diagram to show the inheritance of this disease if both parents are heterozygous.

[Use the symbols T = dominant allele and t = recessive allele]

(3)

- (ii) What are the chances of a baby inheriting the disease?

.....

(1)

- (iii) What are the chances of a baby being a carrier if both parents are heterozygous?

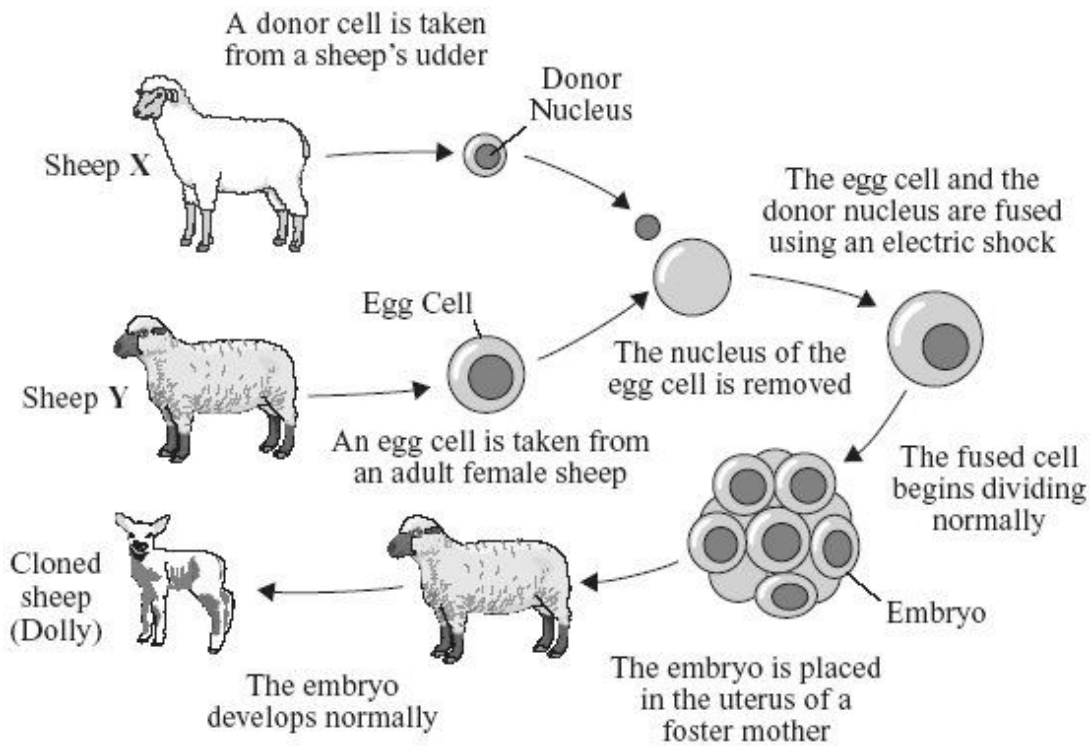
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(1)

**(Total 10 marks)**

22

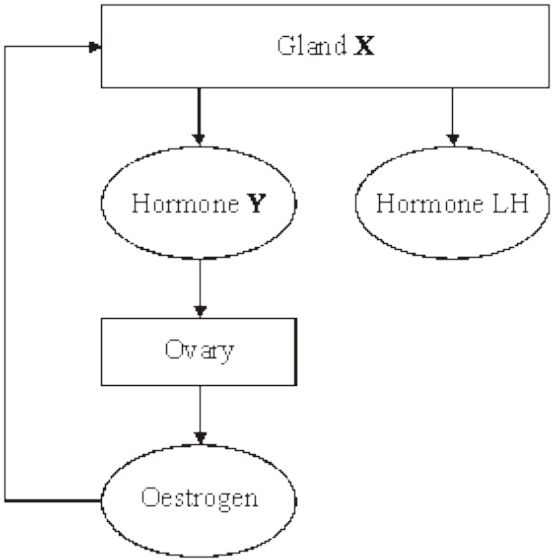
The diagram shows how Dolly the sheep was cloned.



- (a) Name the type of cell division that occurs:
  - (i) as the egg cell is produced; .....
  - (ii) as the fused cell begins to divide normally. ....

(2)

(c) The diagram below shows the relationships between the glands and hormones that control the menstrual cycle of a woman.



- (i) Name:  
gland **X**; .....  
hormone **Y**. .....

(2)

- (ii) Give **two** effects of the hormone oestrogen on gland **X**.

- 1 .....  
.....  
2 .....  
.....

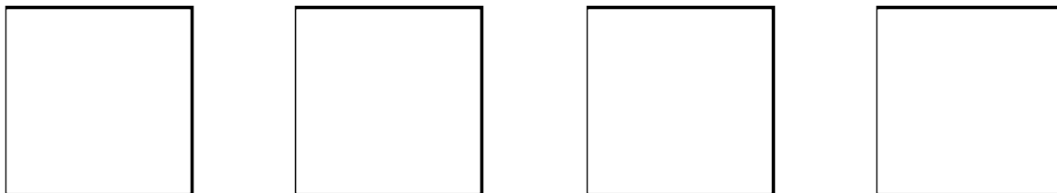
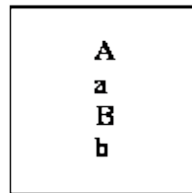
(2)

(Total 6 marks)

23

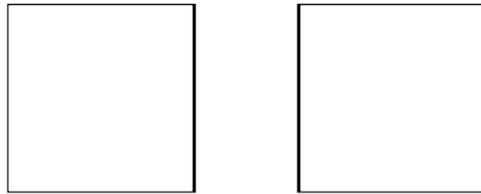
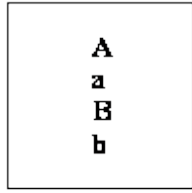
In the cell shown in the diagram as a box, one chromosome pair has alleles **Aa**. The other chromosome pair has alleles **Bb**. The cell undergoes meiosis.

- (a) Complete the diagram of the four gametes to show the independent assortment, or reassortment, of genetic material during meiosis.



(2)

- (b) If the cell undergoes mitosis instead of meiosis, draw the two daughter cells which result to show the chromosomes in each.



(2)

- (c) State the number of chromosomes in:

- (i) a normal human cell;

.....

(1)

- (ii) a human gamete;

.....

(1)

- (iii) the daughter cell from mitosis of a human cell.

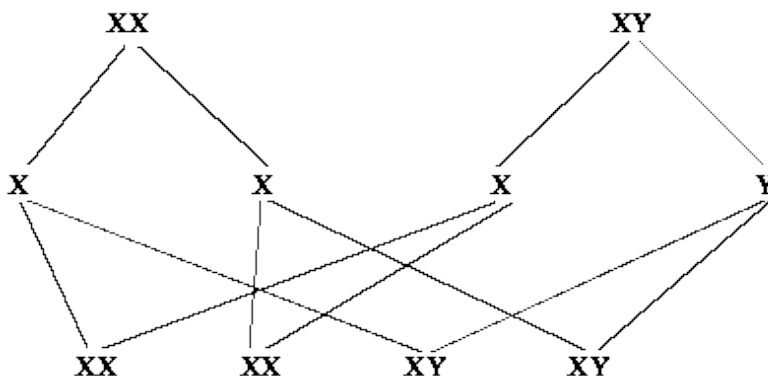
.....

(1)

(Total 7 marks)

24

The genetic diagram shows how the chromosomes divide and combine in human reproduction.



(a) Draw circles around the symbols for the **two** male gametes.

(2)

(b) State the chance of a child being a girl.

.....

(1)

(c) (i) How many pairs of chromosomes are there in a human body cell?

.....

(1)

(ii) How many chromosomes are there in a human egg cell?

.....

(1)

(d) Chromosomes contain genes. From what substance are genes made?

.....

(1)

(e) In the process of mitosis, how do the number of chromosomes in the daughter cells compare to that in the original cell?

.....

(1)

**(Total 7 marks)**

**25**

(a) How many pairs of chromosomes are there in a body cell of a human baby?

.....

(1)

(b) Place the following in order of size, **starting with the smallest**, by writing numbers **1 – 4** in the boxes underneath the words.

chromosome

nucleus

gene

cell

(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

.....

(1)

(ii) The process of cell division by mitosis

.....

.....

.....

.....

.....

.....

**(3)**

(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

.....

.....

**(2)**

**(Total 8 marks)**