

Cell Division

These practice questions can be used by students and teachers and is suitable for GCSE AQA Biology topic Questions 8641

Level: GCSE AQA Biology 8641

Subject: Biology

Exam board: GCSE AQA

Topic: Cell Division

Q1.

This question is about the cell cycle.

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

Where are chromosomes found?

Tick **one** box.

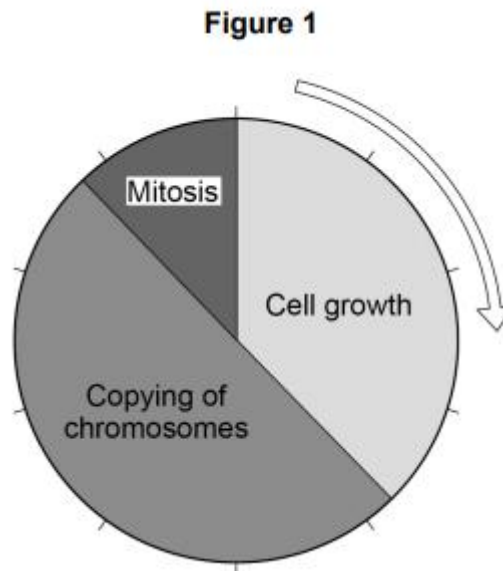
- | | |
|-----------|--------------------------|
| Cytoplasm | <input type="checkbox"/> |
| Nucleus | <input type="checkbox"/> |
| Ribosomes | <input type="checkbox"/> |
| Vacuole | <input type="checkbox"/> |

(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 | <input type="checkbox"/> |
|-------------|--------------------------|

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)

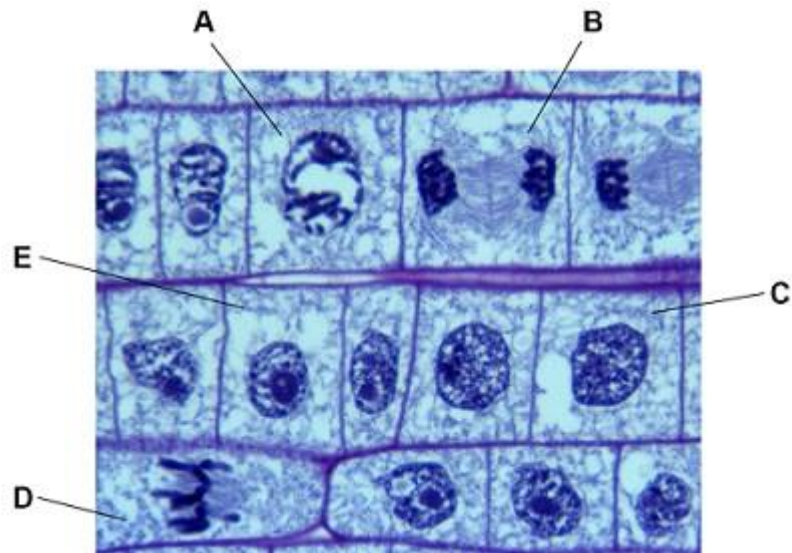
- (e) The cell cycle in **Figure 1** takes two hours in total.
The cell growth stage takes 45 minutes.

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)

Q2.

Plants are made up of cells, tissues and organs.

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

Level of organisation

Plant part

Organ

Leaf

Root hair

Spongy mesophyll

Tissue

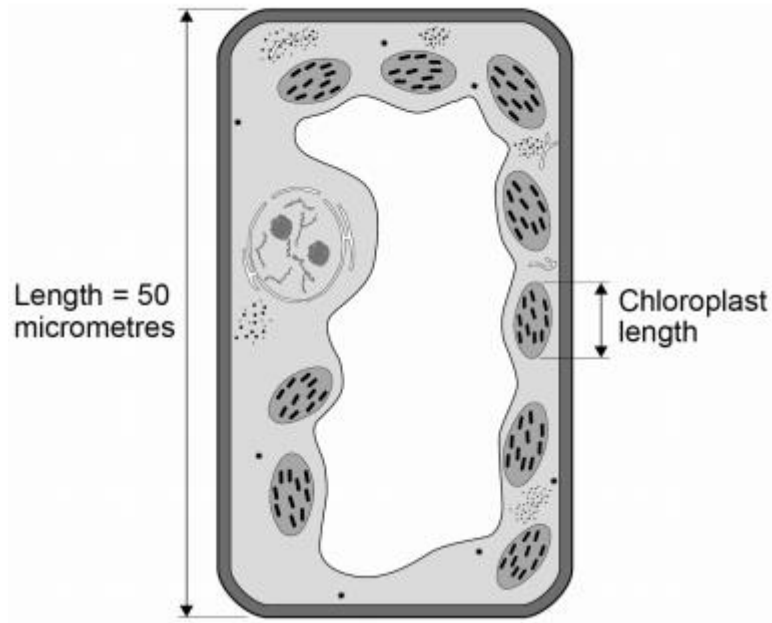
Vacuole

Xylem

(2)

Figure 1 shows a plant cell drawn to scale.

Figure 1



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

Tick **one** box.

- Epidermis
- Palisade mesophyll
- Phloem
- Xylem

(1)

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

Length = _____ micrometres

(2)

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

Give **one** reason why.

(1)

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

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

Tick **one** box.

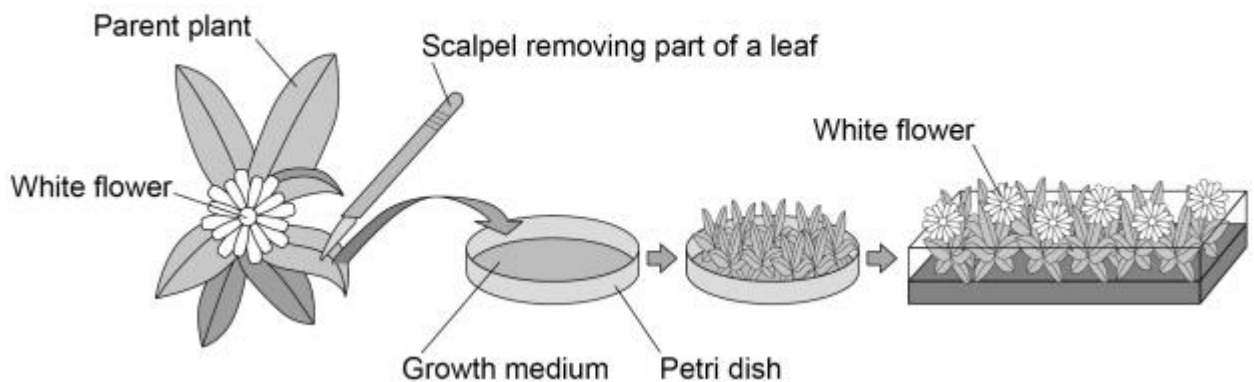
- Differentiation
- Metabolism
- Transpiration
- Transport

(1)

Scientists can clone plants using tissue culture.

Figure 2 shows the process of tissue culture.

Figure 2



(f) Why might scientists want to clone plants?

Tick **one** box.

- To create new species of plants.
- To introduce variation into plants.

To protect endangered plants from extinction.

To reduce disease resistance in plants.

(1)

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

Tick **one** box.

No special equipment is needed.

Plants can be produced quickly.

The flowers are all different colours.

The offspring are all genetically different.

(1)

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

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

(1)

(Total 10 marks)

Q3.

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)

Q4.

Rose black spot is a disease of roses.

(a) What type of microorganism causes rose black spot?

Tick **one** box.

- A bacterium
- A fungus
- A protist
- A virus

(1)

(b) Explain how different **types of organism** defend themselves against microorganisms.

(6)

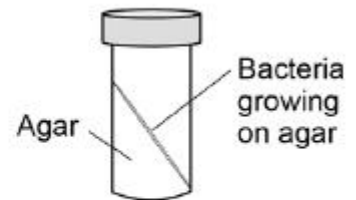
(c) A student tried to grow some bacteria in the laboratory.
The diagram shows some of the apparatus used.



Inoculating loop



**Petri dish
containing agar**



**Bottle containing
the bacteria**

This is the method used.

1. Remove the lid of the Petri dish.
2. Remove the lid of the bottle containing the bacteria.
3. Use the inoculating loop to remove some of the bacteria from the bottle.

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4. Spread the bacteria over the agar using the inoculating loop.
5. Put the lid back on the Petri dish.
6. Put the Petri dish into an incubator at 25 °C for 24 hours.

Steps 1–5 could cause the sample of the bacteria on the petri dish to be contaminated.

Give **three** improvements to the method to prevent contamination.

1. _____

2. _____

3. _____

(3)

- (d) Why did the student grow the bacteria at 25 °C rather than at 40 °C?

Tick **one** box.

So the bacteria grew more quickly

So the bacteria grew more slowly

To prevent the growth of a harmful pathogen

To save money

(1)

(Total 11 marks)

Q5.

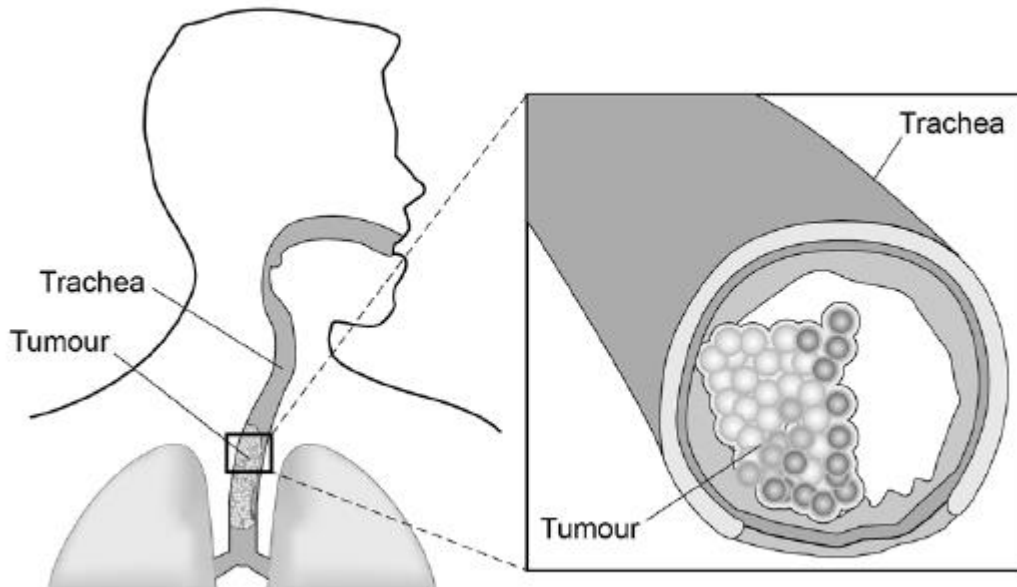
Stem cells can be used to treat some diseases.

- (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.

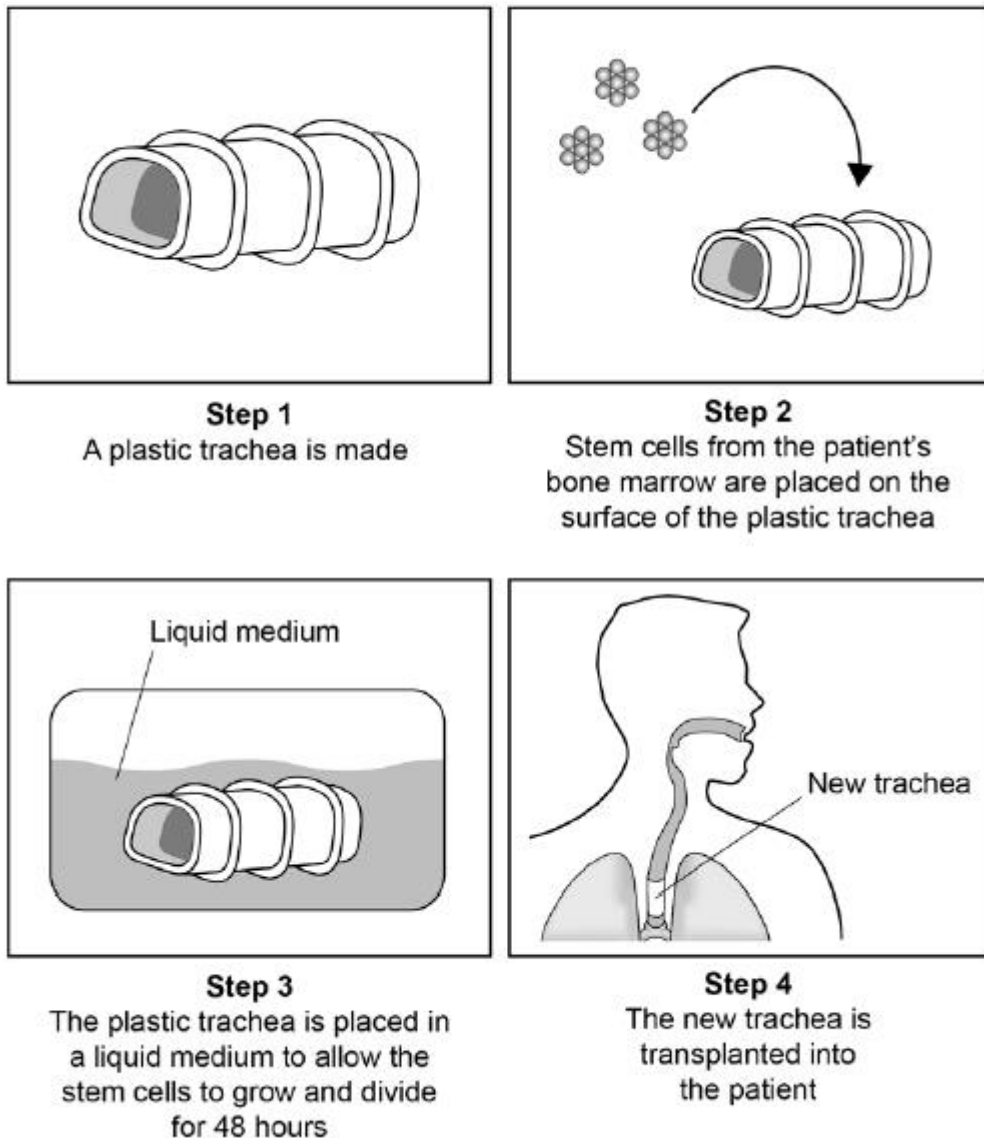
(1)

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.

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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.

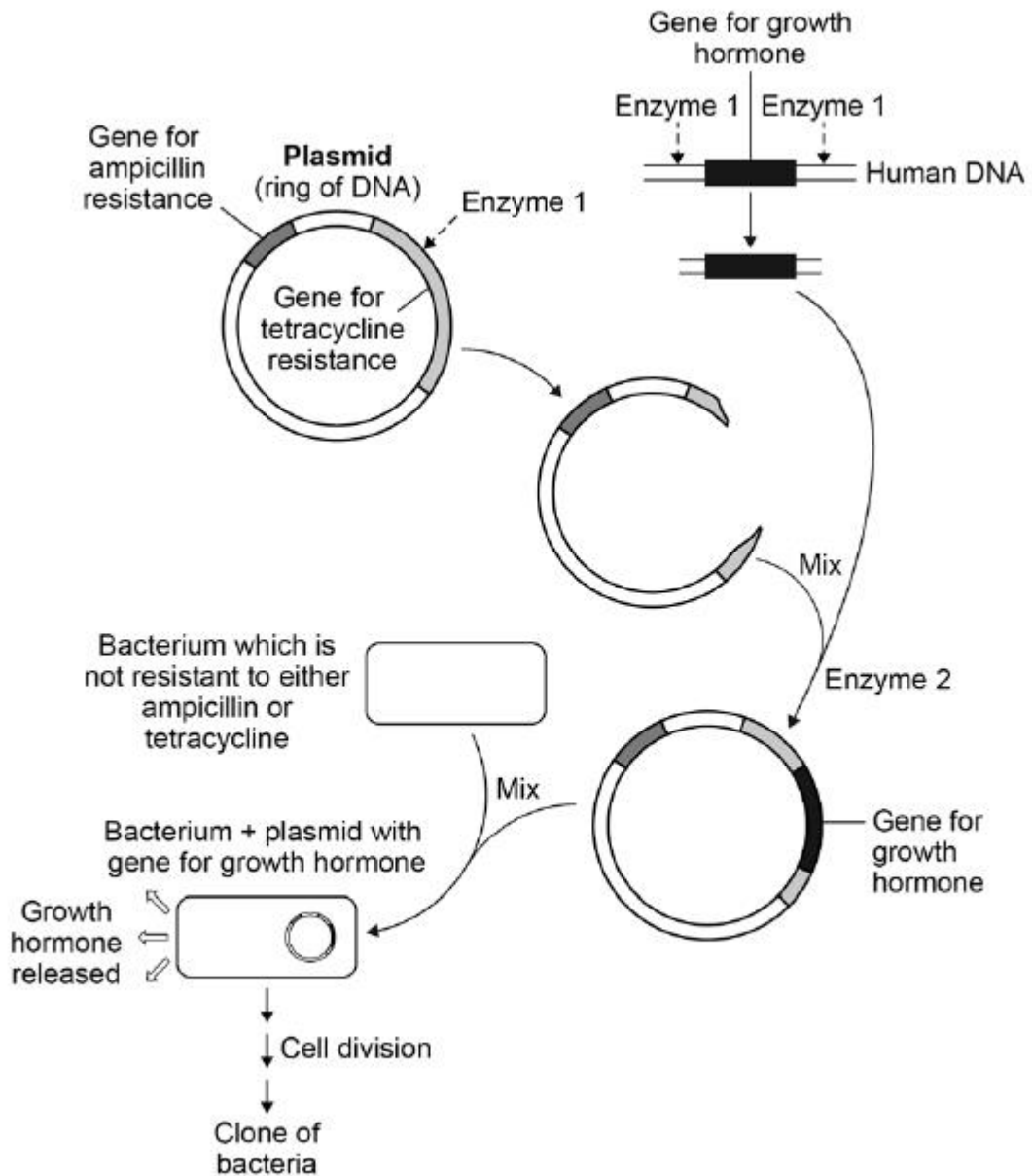
Give a conclusion to your answer.

(6)

(Total 16 marks)

Q6.

The diagram shows how scientists can use genetic engineering to produce human growth hormone.



- (a) Human growth hormone is made by the pituitary gland.

The human DNA containing the gene for growth hormone can be taken from a white blood cell.

Give the reason why the gene does **not** have to be taken from cells in the pituitary gland.

(1)

The figure above shows that the plasmid contains two genes for antibiotic resistance:

- a gene for resistance to the antibiotic ampicillin
- a gene for resistance to the antibiotic tetracycline.

- (b) Explain how the structure of **Enzyme 1** allows it to cut the gene for tetracycline
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resistance, but **not** the gene for ampicillin resistance.

(3)

- (c) In the final step of the diagram above, very few bacteria take up a plasmid containing the gene for growth hormone.

Some bacteria take up an unmodified plasmid.

Most bacteria do **not** take up a plasmid.

Complete the table below.

- Put a tick in the box if the bacterium **can** multiply in the presence of the given antibiotic.
- Put a cross in the box if the bacterium **cannot** multiply in the presence of the given antibiotic.

	Bacterium can multiply in the presence of	
	Ampicillin	Tetracycline
Bacterium + plasmid with growth hormone gene		
Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

- (d) The figure above shows that the bacterium containing the gene for human growth hormone multiplies by cell division.

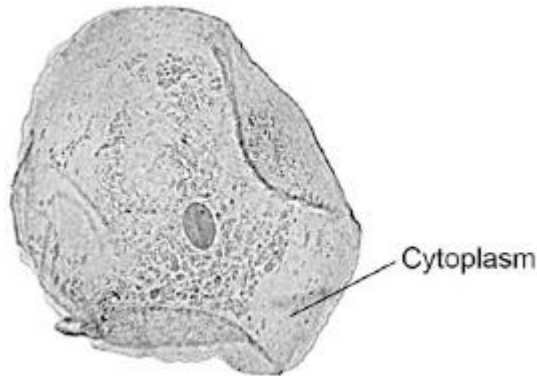
This produces a clone of bacteria.

Explain why **all** the bacteria in this clone are able to produce growth hormone.

Q7.

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

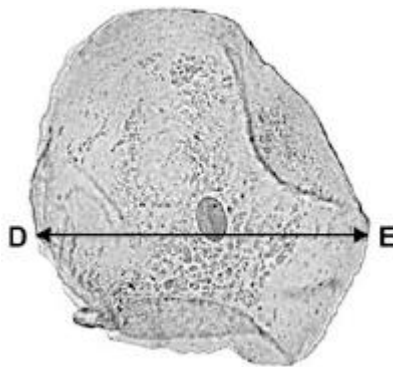
Higher magnification

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 (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:

$$\text{real size} = \frac{\text{image size}}{\text{magnification}} \quad \text{_____ mm}$$

Convert mm to μm _____ μm

(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 μm

0.2 μm



2.0 μm

20.0 μm

(1)
(Total 9 marks)

Q8.

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.

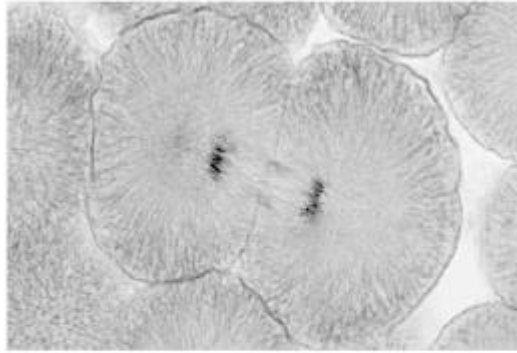
(1)

- (b) Scientists produced a single plant that contained a TMV-resistant gene.

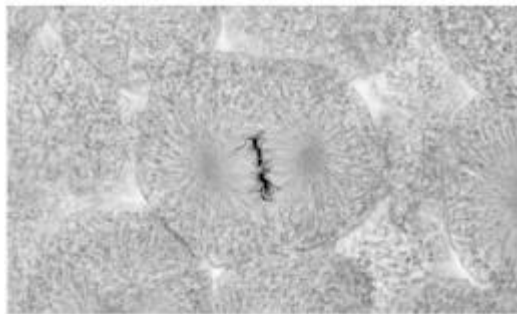
Suggest how scientists can use this plant to produce **many** plants with the TMV-resistant gene.

(1)

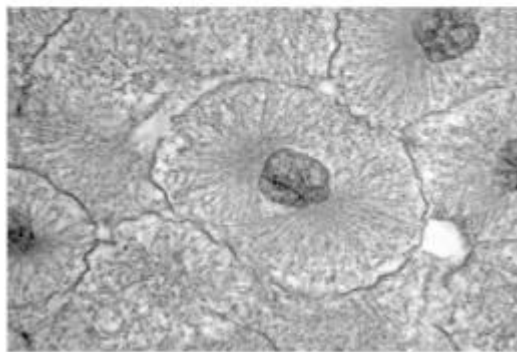
A



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.

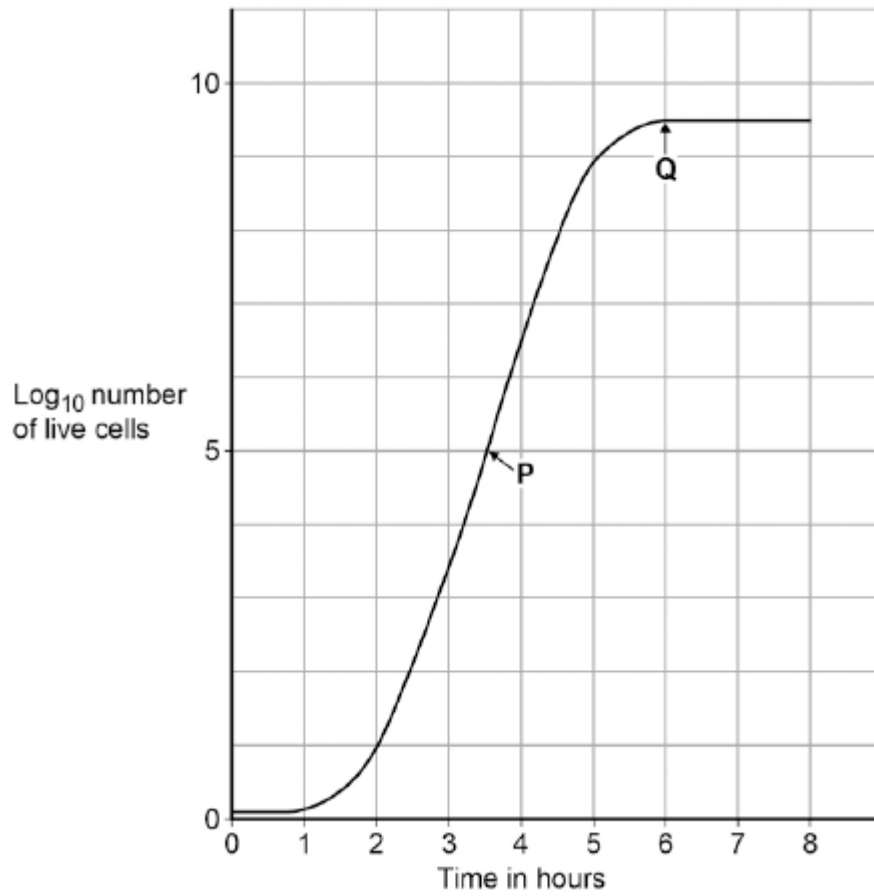
Time in **Stage 2** = _____ minutes

(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)

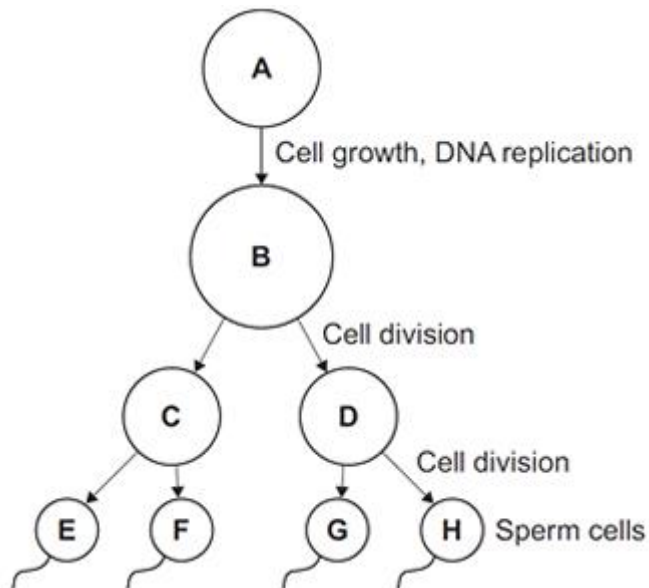
(f) Suggest why the number of cells levels out at **Q**.

_____ (2)

(Total 11 marks)

Q10.

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?

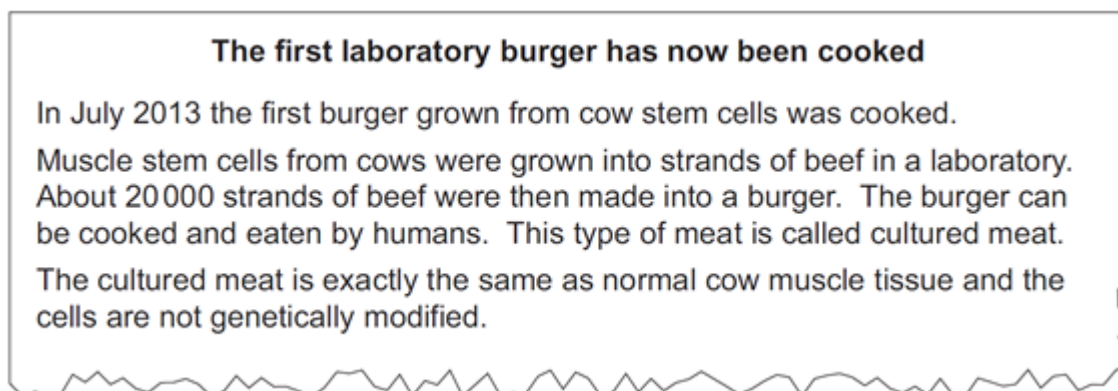
(1)

(Total 10 marks)

Q11.

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

Figure 1



- (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
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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.

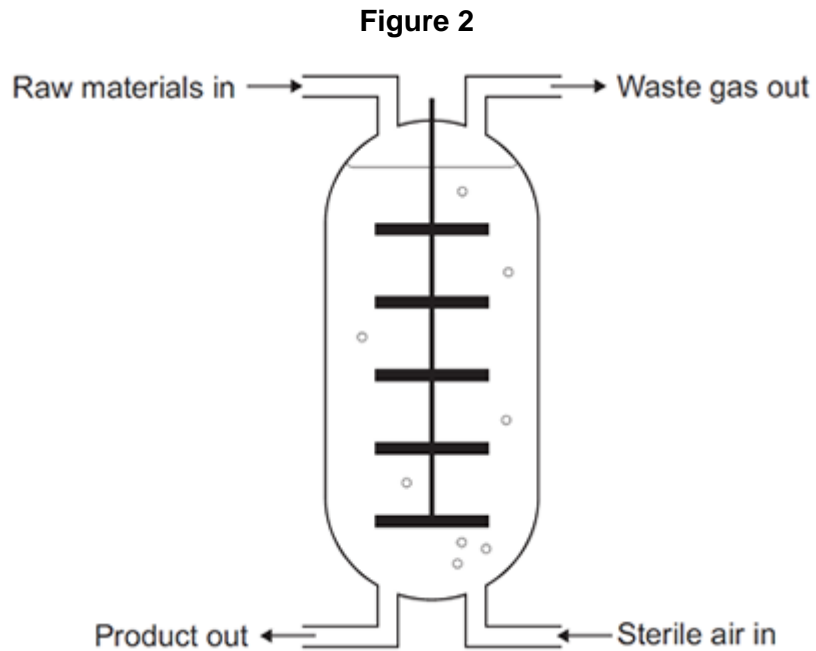
1. _____

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)

Q12.

- (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.

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

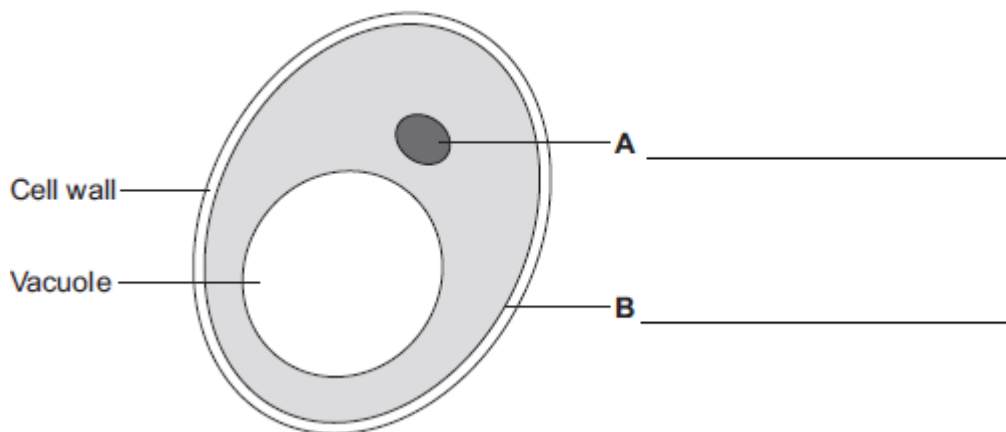
(1)

(Total 6 marks)

Q13.

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.

embryos	hair	nerve cells
----------------	-------------	--------------------

Human stem cells may come from

(1)

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

cystic fibrosis

paralysis

polydactyly

Human stem cells can be used to treat

(1)

(Total 5 marks)

Q14.

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.

chromosome

gene

nucleus

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

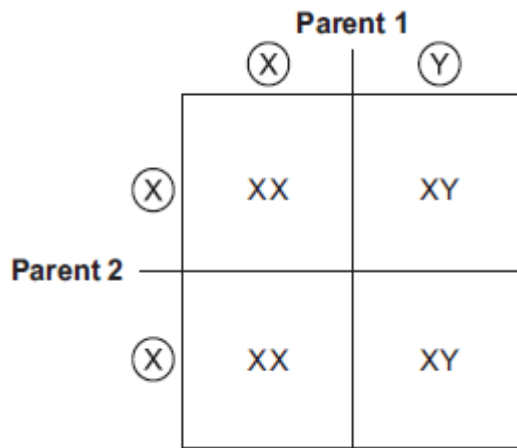
carbohydrate.

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)

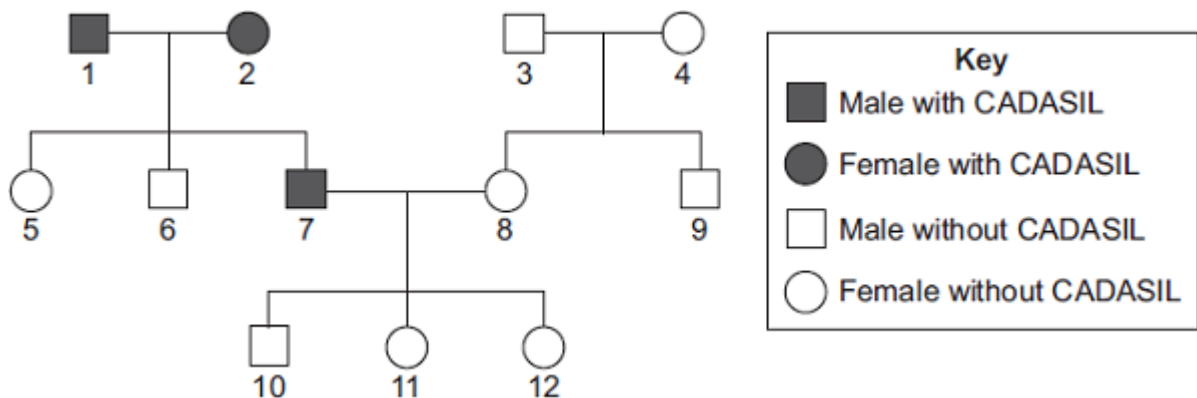
(Total 7 marks)

Q15.

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)

Q16.

- (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)

Q17.

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

Species A



Species B



Images: © iStock/Thinkstock

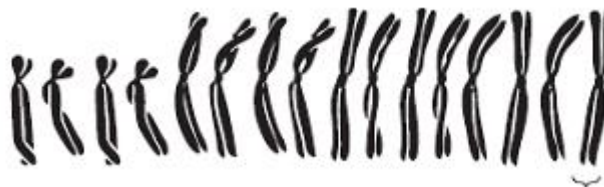
The drawings show chromosomes from one cell in the root of each plant during cell division.

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)

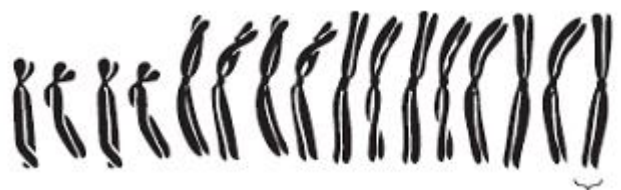
(ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

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)

Q18.

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.

Stem cells from human embryos	Stem cells from adult bone marrow
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.

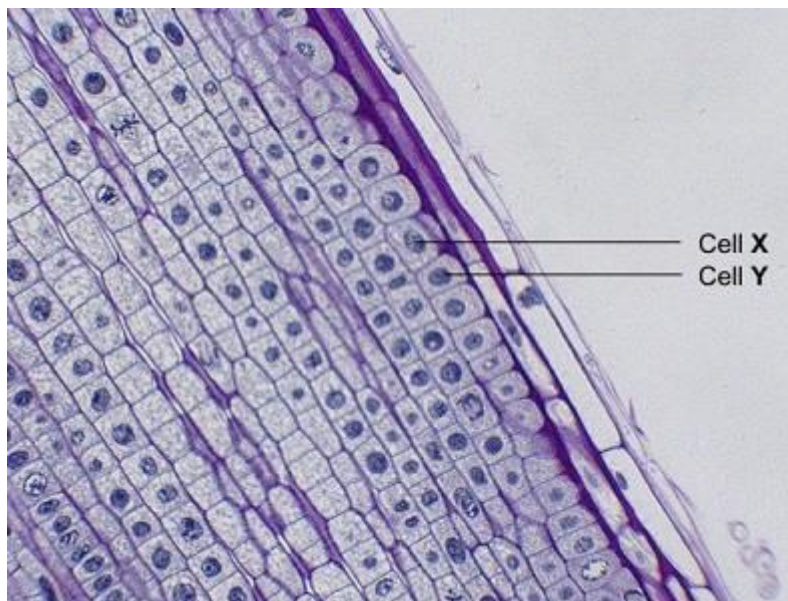
Use **only** the information above to answer these questions.

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

1. _____
2. _____

Q20.

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)

Q21.

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.

asexual	differentiation	embryos	fertilisation
gametes	genes	mitosis	sexual

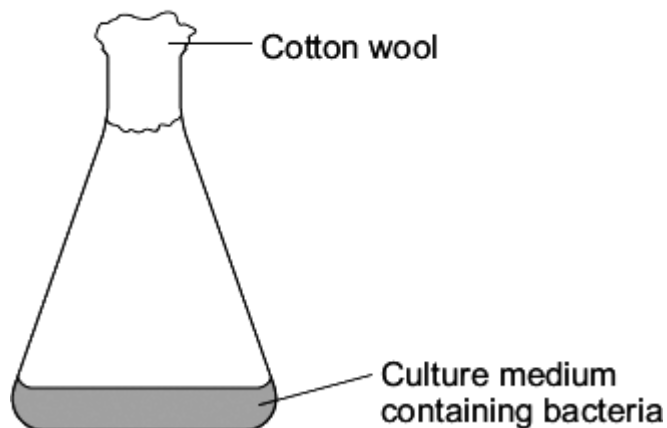
- (a) The new plant is produced by _____ reproduction. (1)
- (b) In this type of reproduction, body cells divide by _____. (1)
- (c) The new plant has the same _____ as the parent plant. (1)
- (Total 3 marks)**

Q22.

Some students grew one species of bacterium in a flask.

Diagram 1 shows the flask.

Diagram 1



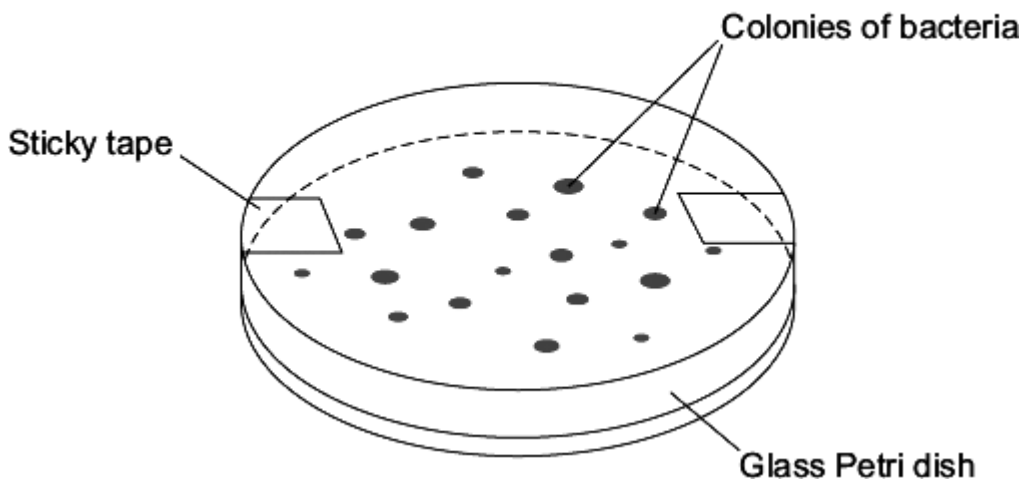
The students wanted to find the number of bacteria in 1 cm^3 of the culture medium.

The students:

- diluted 1 cm^3 of the culture medium from the flask with 999 cm^3 of water
- added 1 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.

Diagram 2



- (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^3 of the undiluted culture.

Number of colonies of bacteria in the Petri dish = _____

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These colonies were formed from 1 cm³ of the culture diluted × 1000.

Therefore, number of bacteria in 1 cm³ 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)

Q23.

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

Animals		Plants	
Species	Number of chromosomes in each body cell	Species	Number of chromosomes in each body cell
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.

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Suggest why.

(1)

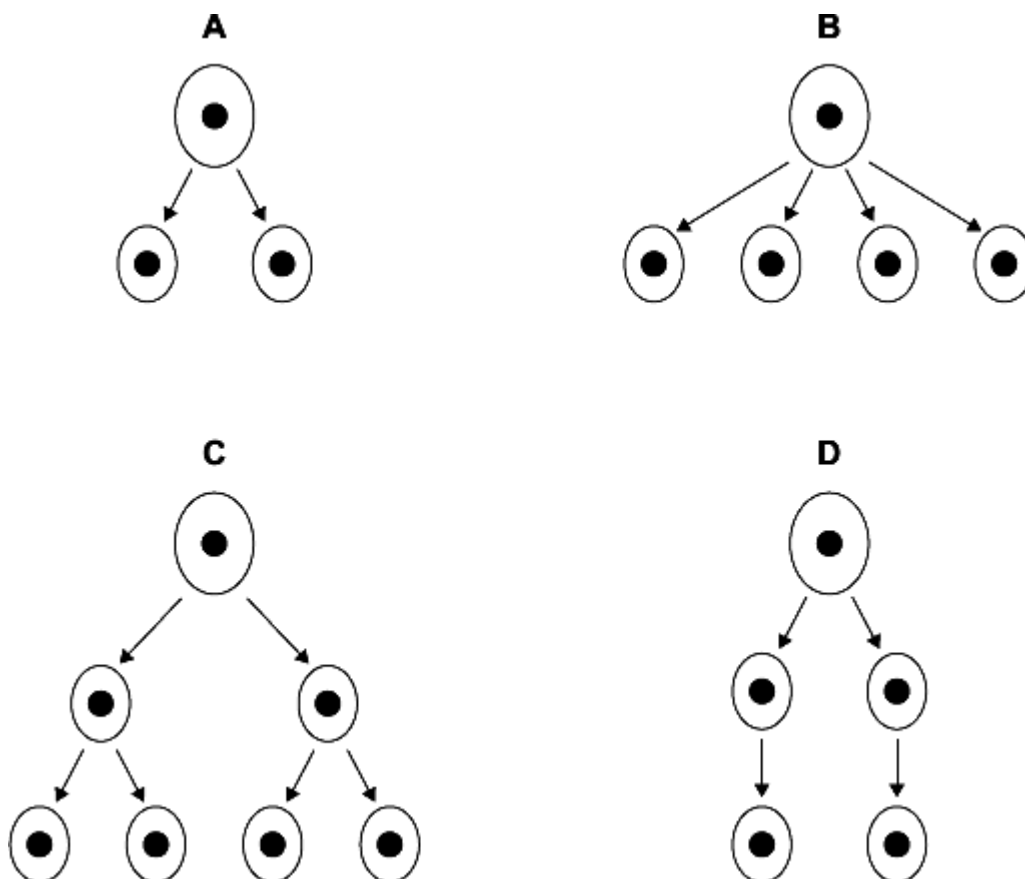
(b) Chromosomes contain DNA molecules.

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)

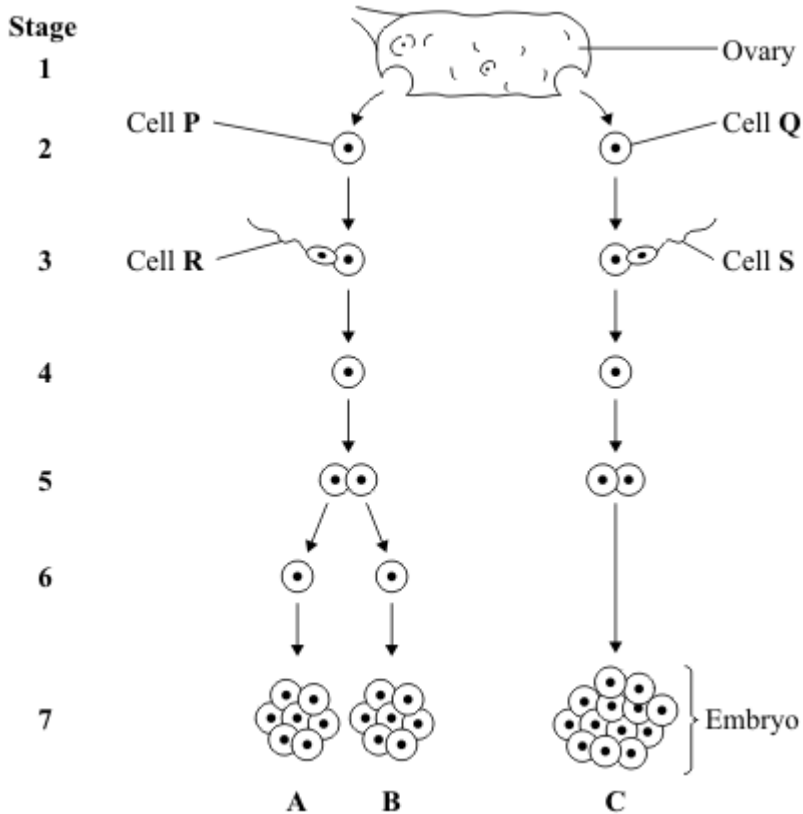
Q24.

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.

egg	genes	sperm
------------	--------------	--------------

(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.

Ileles

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.

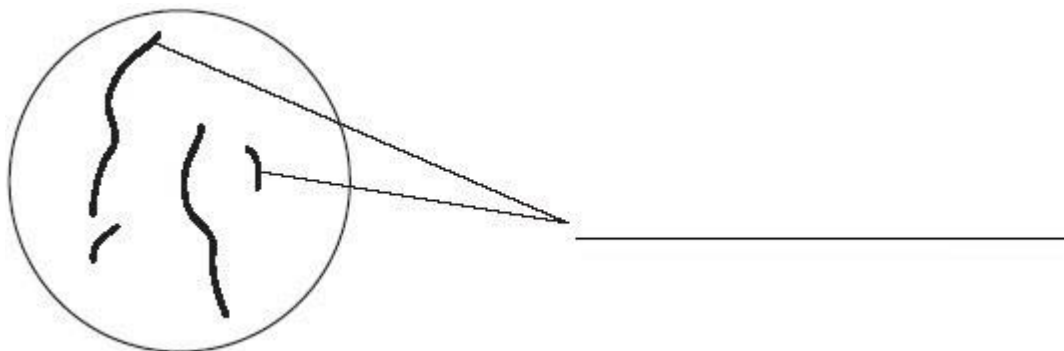
(1)

(Total 9 marks)

Q25.

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

Diagram 1



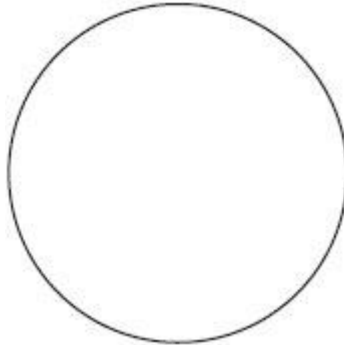
(a) Use a word from the box to label **Diagram 1**.

alleles	chromosomes	gametes
----------------	--------------------	----------------

(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.

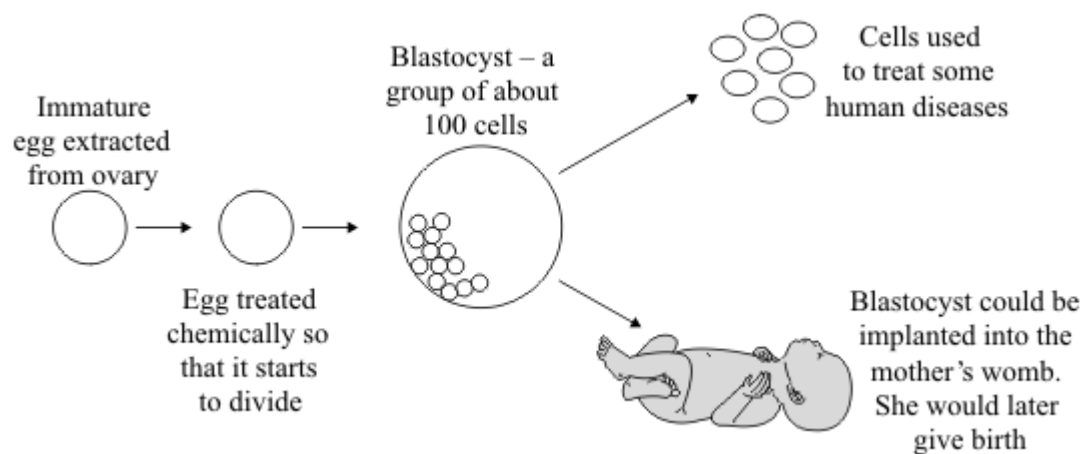
1. _____

2. _____

(2)
(Total 6 marks)

Q26.

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.

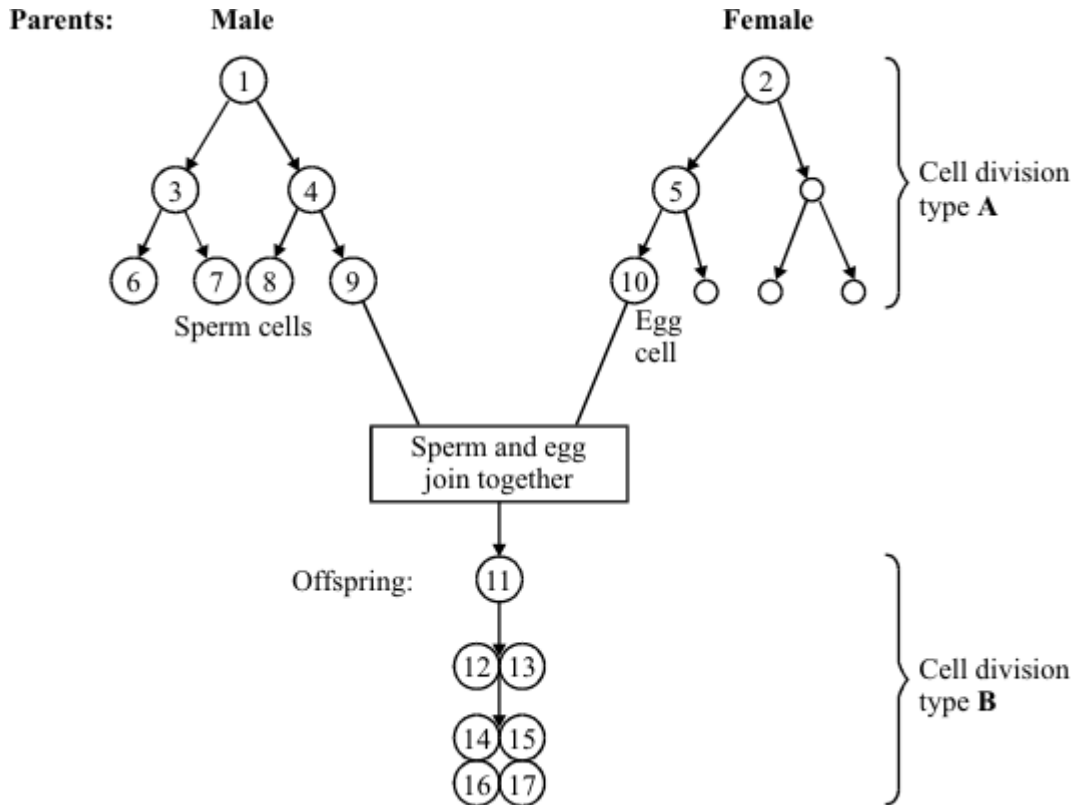
Using information from the diagram, suggest an explanation for this.

(Total 4 marks)

Q27.

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)

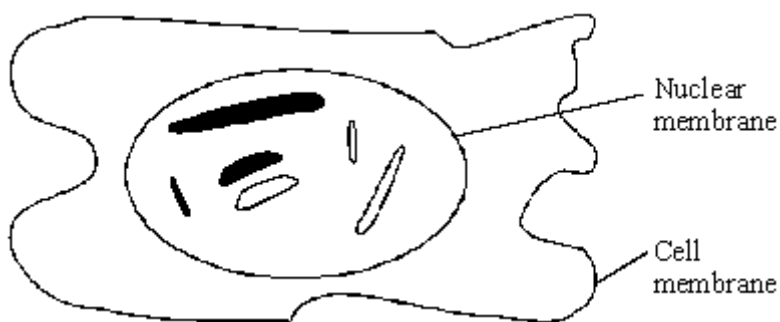
Q28.

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.

(Total 6 marks)

Q29.

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

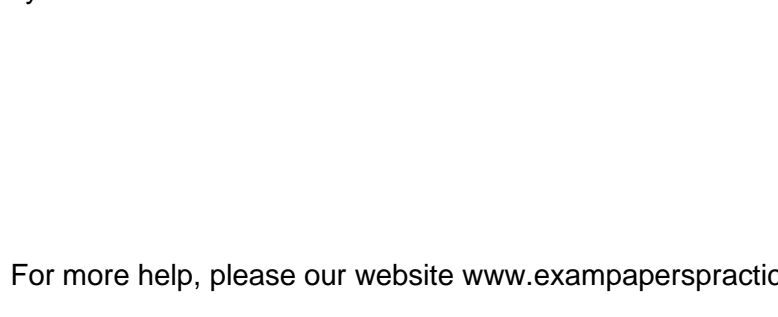


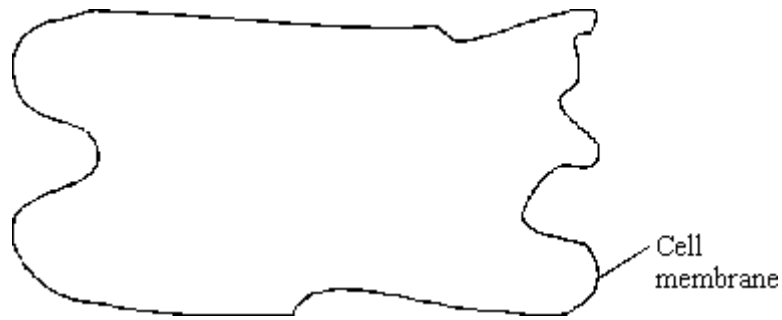
(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis*.



(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)

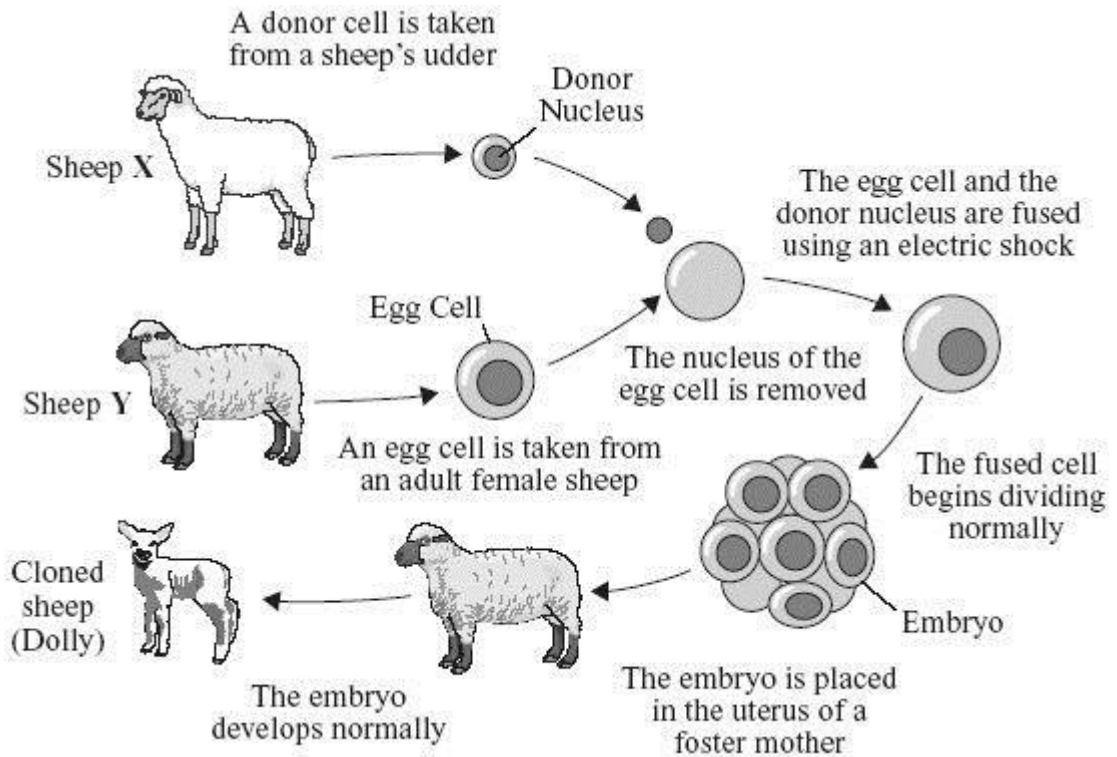
- (iii) What are the chances of a baby being a carrier if both parents are heterozygous?

(1)

(Total 10 marks)

Q30.

The diagram shows how Dolly the sheep was cloned.

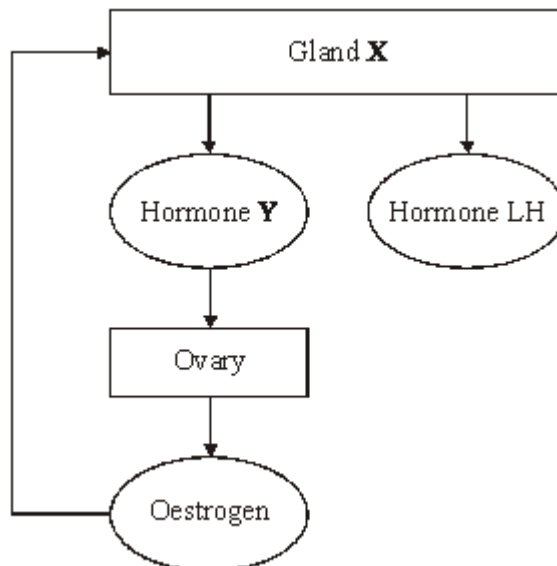


(a) Name the type of cell division that occurs:

- (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. _____

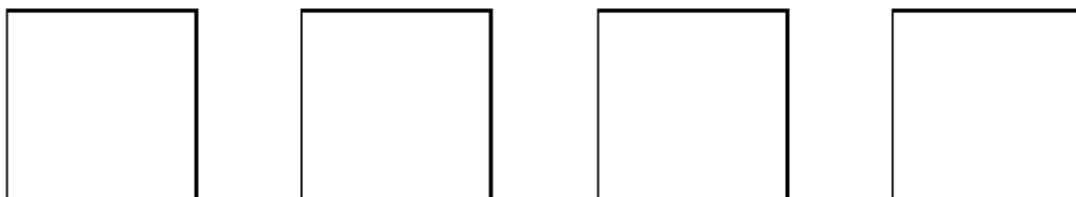
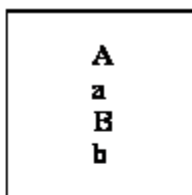
2. _____

(2)
(Total 6 marks)

Q31.

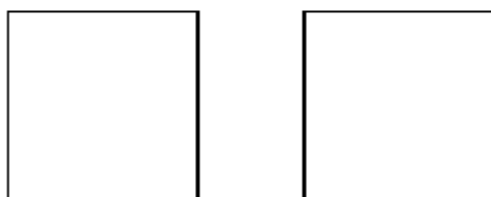
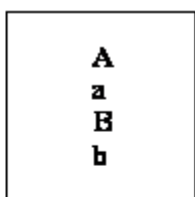
In the cell shown in the diagram as a box, one chromosome pair has alleles **Aa**. The other chromosome pair has alleles **Bb**. The cell undergoes meiosis.

(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:

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(i) a normal human cell;

_____ (1)

(ii) a human gamete;

_____ (1)

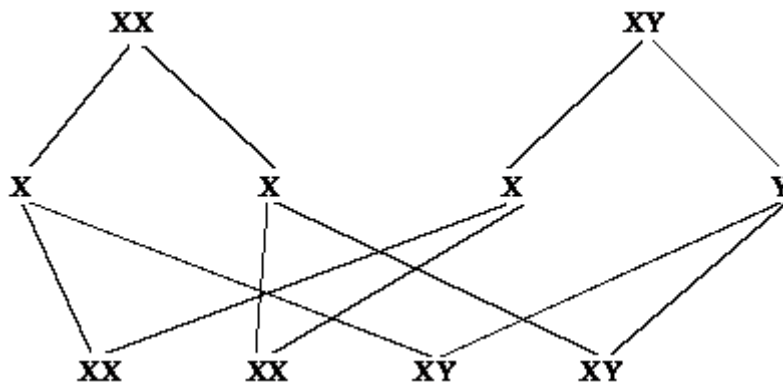
(iii) the daughter cell from mitosis of a human cell.

_____ (1)

(Total 7 marks)

Q32.

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)

Q33.

- (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)

Mark schemes

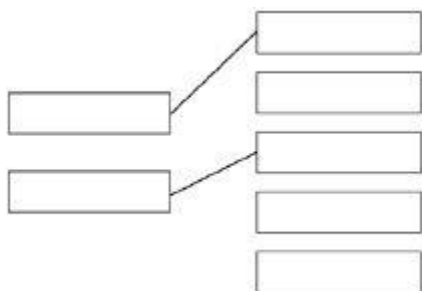
Q1.

- | | | |
|-----|-------------------------------------------------|---|
| (a) | nucleus | 1 |
| (b) | gene(s)
<i>allow allele(s)</i> | 1 |
| (c) | copying of chromosomes | 1 |
| (d) | mitochondria | 1 |
| (e) | 60 – 45
or
120 – 105 | 1 |
| | 15 (minutes) | 1 |
| | <i>an answer of 15 (minutes) scores 2 marks</i> | |
| (f) | C | 1 |
| (g) | 8 | 1 |
| (h) | to repair tissues | 1 |

[9]

Q2.

(a)



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

- | | | |
|-----|--------------------|---|
| (b) | palisade mesophyll | 1 |
|-----|--------------------|---|

- (c) $\frac{50}{8}$ 1
- 6 / 6.25 / 6.3 (micrometres) 1
- an answer of 6 / 6.25 / 6.3 scores 2 marks*
- (d) they have no chloroplasts / chlorophyll 1
allow they are underground
allow they don't get (access to) light
allow (because) photosynthesis needs light
allow they can't absorb light
ignore 'sun'
ignore 'it is dark'
- (e) differentiation 1
- (f) to protect endangered plants from extinction 1
- (g) plants can be produced quickly 1
- (h) any **one** from: 1
- glucose / sugars / starch
 - amino acids / protein
 - hormones
allow named hormones e.g. auxin
 - ions / minerals
allow magnesium / nitrate
 - vitamins
allow named vitamins e.g. vitamin B
 - water
allow H₂O / H2O
ignore oxygen / carbon dioxide / agar / nutrients / fertiliser

[10]

Q3.

(a)

	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			✓

3 correct = 2 marks

2 correct = 1 mark

0 or 1 correct = 0 marks

2

(b) any **two** from:

ignore references to one parent only

- many offspring produced
- takes less time
allow asexual is faster
- (more) energy efficient
- genetically identical offspring
allow offspring are clones
- successful traits propagated / maintained / passed on (due to offspring being genetically identical)
- no transfer of gametes or seed dispersal
allow no vulnerable embryo stage
allow no need for animals
- not wasteful of flowers / pollen / seeds
- colonisation of local area
must imply local area

2

(c) genetic variation (in offspring)

1

(so) better adapted survive

allow reference to natural selection or survival of the fittest

1

(and) colonise new areas by seed dispersal

or

can escape adverse event in original area (by living in new area)

must imply new area

1

many offspring **so** higher probability some will survive

1



allow bluebell example described (**max 3** if not bluebell)

[8]

Q4.

(a) a fungus

1

(b) **Level 3 (5-6 marks):**

Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

Level 2 (3-4 marks):

Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1 (1-2 marks):

Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

Level 0

No relevant content

Indicative content

	defence	description of defence
animals	skin	sebum / oils to kill microbes dead layer difficult to penetrate
	nose	hairs keep out dust and microbes
	trachea / bronchi	mucus traps microbes cilia moves mucus
	stomach	(hydrochloric) acid kills bacteria
	white blood cells	produces antibodies produces antitoxins engulf microbes / phagocytosis
plants	cell wall	tough / difficult to penetrate
	waxy cuticle	tough / difficult to penetrate
	dead cells / bark	fall off, taking pathogens with them
	production of antibacterial chemicals	kill bacteria



fungi	antibiotic production	kill bacteria
--------------	-----------------------	---------------

6

- (c) any **three** from:
- sterilise agar (before use)
 - sterilise (Petri) dish before use
 - disinfect bench (before use)
 - pass inoculating loop (through flame)
 - secure lid with (adhesive) tape
 - minimise exposure of agar / culture to air / lift and replace lid as quickly as possible

allow:

- *dip loop into ethanol (after flaming)*
 - *keep the lid on the plate for as long as possible*
- or**
- minimise exposure of agar to air*
- or**
- *only tilt the lid off (rather than remove it)*
 - *flame the neck of the bottle*

3

- (d) to prevent the growth of a harmful pathogen

1

[11]

Q5.

- (a) an undifferentiated / unspecialised cell

1

that can differentiate / become / change into (many) other cell types

1

- (b) (malignant tumours) invade / spread to other tissues via the blood (benign don't)
- or**
- (malignant tumours) form secondary tumours in other organs

ignore cancer unqualified

allow converse

allow metastasises

1

- (c) mitosis

correct spelling only

1

- (d) glucose

answers in any order

ignore sugar

1

protein / amino acids

1

- (e) no need to wait for a donor
or
 can be done immediately 1

(so) no risk of rejection
or
 no need for immunosuppressant drugs
if no other marks awarded, allow for 1 mark idea of ethics surrounding the use of tissue from another / dead person 1

- (f) stent opens up the trachea 1

allowing air to flow through
or
 allowing patient to breathe 1

- (g) **Level 3 (5-6 marks):**
 A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

Level 2 (3-4 marks):
 Some logically linked reasons are given. There may also be a simple judgement.

Level 1 (1-2 marks):
 Relevant points are made. They are not logically linked.

Level 0
 No relevant content

Indicative content

embryos advantages

- can create many embryos in a lab
- painless technique
- can treat many diseases / stem cells are pluripotent / can become any type of cell (whereas bone marrow can treat a limited number)

embryos disadvantages

- *harm / death to embryo*
- *embryo rights / embryo cannot consent*
- *unreliable technique / may not work*

bone marrow advantages

- no ethical issues / patient can give permission
- can treat **some** diseases
- procedure is (relatively) safe / doesn't kill donor
- tried and tested / reliable technique
- patients recover quickly from procedure

bone marrow disadvantages

- *risk of infection from procedure*
- *can only treat a few diseases*
- *procedure can be painful*

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both procedures advantage

can treat the disease / problem

both procedures disadvantages

- risk of transfer of viral infection
- some stem cells can grow out of control / become cancerous

[16]

Q6.

- (a) white blood cells have the same DNA / genes / chromosomes
or
 have the gene for GH

allow have all the genes

allow all body cells (except RBCs) have all of the genes

1

- (b) enzyme has specifically-shaped active site

1

the 2 antibiotic resistance genes have different (sequence of) bases

1

only Tetracycline-resistance gene fits (active site of) enzyme

or

only Tetracycline-resistance gene is complementary to (active site of) enzyme

1

- (c)

Ampicillin	Tetracycline
✓	✗
✗	✗
✓	✓

1 mark for each correct row

if no other mark, allow 1 mark for one correct column

1

1

1

- (d) clone produced by asexual reproduction
allow by 'mitosis'

1

all DNA / all genes are copied

allow GH gene copied

allow plasmid copied

1

every cell receives a copy

or

receives every gene
or
 receives GH gene
or
 receives plasmid
or
 genetically-identical cells

1

[10]

Q7.

(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]

Q8.

(a) to kill virus
or
 to prevent virus spreading

1

(b) take (stem) cells from meristem
or
 tissue culture

allow take cuttings

1

- (c) use Benedict's solution 1
- glucoses turns solution blue to orange 1

- (d) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points that explain why plants with TMV have stunted growth.

Level 1 (1–2 marks):

Simple statements are made, but not precisely. The logic is unclear.

0 marks:

No relevant content.

Indicative content

- less photosynthesis because of lack of chlorophyll
- therefore less glucose made
so
- less energy released for growth
- because glucose is needed for respiration
and / or
- therefore less amino acids / proteins / cellulose for growth
- because glucose is needed for making amino acids / proteins / cellulose

4

[8]

Q9.

- (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) $(4 / 36) \times 16 \times 60$ 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]

Q10.

- (a) testis / testes
allow testicle(s) 1
- (b) (i) **B** = 13.2
C = 6.6
E = 3.3
all 3 correct = 2 marks
2 or 1 correct = 1 mark
*If no marks awarded allow ecf for **C** **and** **E** based on answer to **B***
ie $C = \frac{1}{2} B$ and $E = \frac{1}{2} C$ for one mark 2
- (ii) 6.6
*allow twice answer for cell **E** in part bi* 1
- (iii) mitosis
correct spelling only 1
- (c) (i) any **two** from:
 - cells that are able to divide
 - undifferentiated cells / not specialised
 - can become other types of cells / tissues **or** become specialised /differentiated*allow pluripotent* 2
- (ii) 4-day embryo is a (potential) human life
or
 destroying/damaging (potential) human life
allow cord would have been discarded anyway
ignore reference to miscarriage
allow cannot give consent

For more help, please our website www.exampaperspractice.co.uk

- 1
- (iii) perfect tissue match **or** hard to find suitable donors
allow same/matching antigens
allow no danger of rejection
allow no need to take immunosuppressant drugs (for life)
*ignore genetically identical **or** same DNA*
- 1
- (iv) stem cells have same faulty gene / allele / DNA / chromosomes
allow genetically identical
ignore cells have the same genetic disorder
- 1

[10]

Q11.

- (a) (i) fewer cows
- 1
- any **one** from:
- less methane
*do **not** allow CH⁴*
 - less CO₂ in the atmosphere because of less deforestation **or** less plants consumed.
*allow less CO₂ released into the atmosphere because less fuel used e.g. to heat cowsheds **or** to transport meat*
*do **not** allow CO²*
- 1
- (ii) any **two** from:
- could be mass produced to feed an increasing population
 - disease free meat
 - no / low fat
 - no harm to animals or less intensive farming
allow (may be) suitable for vegetarians
 - antibiotic free meat
 - more land available for farming crops
allow no energy loss along a food chain
- 2
- (b) fungus / Fusarium
- 1
- with glucose (syrup)
- 1
- in aerobic conditions **or** in presence of oxygen
ignore air
- 1
- mycoprotein is harvested / purified
allow ammonia added (as source of nitrogen)

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ignore stirring / mixing and temperature

1

[8]

Q12.

(a)

	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	✓		

*if more than one tick per row then no mark
ignore first row*

1
1
1
1

(b) (i) (adult) bone marrow

accept (umbilical) cord blood, skin, amniotic fluid / membrane

1

(ii) cells will not be rejected by the patient's body (if they have been produced by therapeutic cloning)

allow easier to obtain linked to embryo stem cells

or

(embryo stem cells) can develop into many different types of cells

allow doesn't need an operation linked to bone marrow

or

(embryo stem cells) not yet differentiated / specialised or undifferentiated

accept embryo cells are pluripotent

1

Q13.

- (a) **A** = nucleus
allow phonetic spelling 1
- B** = (cell) membrane 1
- (b) for repair / growth **or** to replace cells
ignore new cells / skin 1
- (c) (i) embryos 1
- (ii) paralysis 1

[5]

Q14.

- (a) (i) fertilisation 1
- (ii) in sequence:
accept 1 next to gene, 2 next to chromosome and 3 next to nucleus in box
- 1 gene
2 chromosome
3 nucleus
*allow 1 mark for smallest **or** largest in correct position* 2
- (iii) DNA 1
- (b) (i) On diagram:
tick drawn next to **X** and / or **Y** from Parent 1
tick(s) must be totally outside grid squares
allow ticks around "parent"
extra ticks elsewhere cancel 1
- (ii) 0.5 / ½ / 50% / 1:1 / 50:50 / 1 in 2
allow 2/4 / 2 in 4 / 2 out of 4 / 'even(s)' / 'fifty – fifty'
*do **not** allow 1:2 or '50 / 50' or '50 – 50'* 1

2 (out of 4) boxes are **XX**

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or

half of the sperm contain an **X**-chromosome

allow XY is male and 2 (out of 4) boxes are XY

1

[7]

Q15.

- (a) (i) allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous
if present other allele not expressed

1

- (ii) 2 affected parents have unaffected child **or** 1 **and** 2 → **5 / 6**

or if recessive all of **1** and **2**'s children would have CADASIL

1

- (iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL

1

- (b) genetic diagram including:

accept alternative symbols, if defined

1

correct gametes:

D and **d**

and d (and **d**)

ignore 7 / 8 or male / female

1

derivation of offspring genotypes:

Dd Dd dd dd

*allow just **Dd dd** if ½-diagram*

allow ecf if correct for student's gametes

1

identification of **Dd** as CADASIL

or dd as unaffected

allow ecf if correct for student's gametes

1

correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1

1

- (c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised

1

can form blood vessel cells / brain cells

or

For more help, please our website www.exampaperspractice.co.uk

stem cells can divide

1

- (ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin

more ethical qualified

ignore religion unqualified

or

if from a relative then less chance of rejection **or** if from self then no chance of rejection

or

skin cells more accessible

1

[10]

Q16.

- (a) (i)

Feature	Mitosis only	Meiosis only
Produces new cells during growth and repair	✓	
Produces gametes (sex cells)		✓
Produces genetically identical cells	✓	

All 3 correct = **2** marks

2 correct = **1** mark

0 or 1 correct = **0** marks

2

- (ii) (a man) testis / testes
accept testicle(s)

1

(a woman) ovary / ovaries

*do **not** accept 'ova' / ovule*

1

- (b) (i) XY / YX
or
X and Y

1

- (ii) XX
or
X and X or 2 X's
accept X

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1

- (c) $\frac{1}{2}$ / 0.5 / 50% / 1:1 / 1 in 2
do not accept 1:2 / 50/50
allow 50:50
allow 2 in 4

1

[7]

Q17.

- (a) (i) DNA replication / copies of genetic material were made
'it' = a chromosome
allow chromosomes replicate / duplicate / are copied
ignore chromosomes divide / split / double

1

- (ii) one copy of each (chromosome / chromatid / strand) to each offspring cell
ignore ref. to gametes and fertilisation

1

each offspring cell receives a complete set of / the same genetic material

allow 'so offspring (cells) are identical'

1

- (b) (i) meiosis
allow mieosis as the only alternative spelling

1

- (ii) Species A = 4 **and** Species B = 8

1

- (iii) sum of A + B from (b)(ii) e.g. 12

1

- (c) (i) similarities between chromosomes
or
 similarities between flowers described
e.g. shape of petals / pattern on petals / colour / stamens

1

can breed / can sexually reproduce

allow can reproduce with each other / they can produce offspring

1

- (ii) any **two** from:

- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes



- some chromosomes unable to pair (in meiosis)
- (viable) gametes not formed / some gametes with extra / too many genes / chromosomes

or

some gametes with missing genes / chromosomes

2

[10]

Q18.

- (a) *comparisons are **not** required but should be credited
accept a clear indication of the statement even if incomplete*

can develop into most other types of cell

1

each cell divides every 30 minutes

1

low chance of rejection by the patient's immune system

1

- (b) any **three** from:

- cheaper / only costs £1000
*this **must** be comparative
ignore costs £1000*
- can collect many (stem) cells
- adults give permission for their own bone marrow to be collected
comparisons are not required but should be credited
- safe

3

[6]

Q19.

Marks should **not** be awarded for simply copying the information provided
A mark may be awarded for a comparison between treatments if the answer only involves copied information

any **four** from:

*For all 4 marks to be awarded, there must be at least 1 pro
and 1 con*

embryo stem cells – examples of

pros

- can treat a wide variety / lots of diseases / problems

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- many available / plentiful
- using them better than wasting them
- painless

cons

- (possible) harm / death to embryo
- (relatively) untested / unreliable / may not work
allow long term effects not known
or *may be more risky*
- embryo can't be 'asked' / 'embryo rights' idea

adult bone marrow stem cells – examples of

pros

- no ethical issues (in collection) **or** permission given
- quick recovery
- (relatively) safe
allow does not kill (donor) / low risk
- well tried / tested / know they work

cons

- operation hazards eg infection
- few types of cell / tissue produced **or** few diseases / problems treated
- painful so may deter donors

4

Conclusion to evaluation:

A reasoned conclusion from the evidence

1

[5]

Q20.

- (a) (i) mitosis

correct spelling only

1

- (ii) replicates / doubles / is copied / duplicates

accept cloned

ignore multiplied / reproduced

1



- (b) fertilisation occurs / fusion (of gametes)
accept converse for asexual, eg none in asexual / just division in asexual

1

so leading to mixing of genetic information / genes / DNA / chromosomes
genes / DNA / chromosomes / genetic information comes from 1 parent in asexual
ignore characteristics

1

one copy (of each allele / gene / chromosome) from each parent
or
gametes produced by meiosis
or
meiosis causes variation
meiosis must be spelt correctly

1

[5]

Q21.

- (a) asexual

1

- (b) mitosis

1

- (c) genes

1

[3]

Q22.

- (a) cell division / bacterium divides / multiplies / reproduces
allow asexual / mitosis
ignore growth

1

- (b) 18

1

18 000 / 18×10^3 / 1.8×10^4
*do **not** accept 1.8 / 1.8^{04} / 1.8^4*
allow ecf from wrong count

1

- (c) to kill / destroy other microorganisms / named type
or to prevent contamination
ignore germs / viruses

1

to prevent other microorganisms affecting the results
or other microorganisms would be counted
allow to give accurate / reliable results

1

- (d) prevent growth of pathogens / disease-causing microorganisms / dangerous microorganisms

*do **not** accept microorganisms become pathogenic*
ignore germs / viruses
ignore general safety / biohazards / harmful products produced by bacteria

1

- (e) to improve the reliability of the investigation / check for anomalies

*do **not** accept accuracy / precision / fairness / validity*
ignore averages / repeatability / reproducibility

1

[7]

Q23.

- (a) any **one** from

- chromosomes in pairs
- inherited one of each pair from each parent
- one of each pair in egg **and** one of each pair in sperm
- so sex cells / gametes can have half the number
allow need to pair during cell division / meiosis

1

- (b) any **two** from:

- code
- combination / sequence of amino acids
- forming specific / particular proteins / examples
*If **no other mark** gained allow reference to controlling characteristics / appearance for **1** mark*

2

- (c) (i) C

1

- (ii) 30

1

- (d) (i) for growth / repair / replacement / asexual reproduction

*do **not** accept incorrect qualification, eg growth of cells **or** repair of cells*

they equals cells therefore do not accept they grow etc

1

(ii) 44 **or** 22 pairs

1

[7]

Q24.

(a) 2 and 3

1

(b) cell **P** has an X chromosome; cell **R** has a Y chromosome

1

(c) any **two** from:

- (formed from) different egg / 2 eggs
- (formed from) different sperm / 2 sperm
- have different genes / alleles / chromosomes / DNA
allow genetics

2

(d) (i) stem cells

1

(ii) the cells divide

1

the cells differentiate

1

(iii) (medical) research / named eg growing organs
or

medical / patient treatment

allow (embryo) cloning

*do **not** allow designer babies / more babies*

1

(iv) any **one** from:

- ethical / moral / religious objections
ignore cruel / not natural / playing God
- potential harm to embryo
allow deformed
ignore harm to mother

1

[9]

Q25.

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- (a) chromosomes 1
- (b) diagram showing four separate chromosomes two long and two short (as in diagram 1)
*allow each chromosome shown as two joined chromatids do **not** allow if chromosomes touching each other* 1
- (c) (i) any **two** from:
- can grow into any type of tissue / named tissue
 - used in medical research
 - used to treat human diseases
 - large numbers can be grown
- 2
- (ii) any **two** from:
- expensive
 - grow out of control / ref cancers
 - may be rejected
 - need for drugs (for rest of life)
- 2
- [6]**

Q26.

any **four** from:

- cells used to treat diseases do not go on to produce a baby
- produces identical cells for research
- cells would not be rejected
- allow cells can form different types of cells
- (immature) egg contains only genetic information / DNA / genes / chromosomes from mother **or** there is only one parent
- asexual / no mixing of genetic material / no sperm involved / no fertilisation **or** chemical causes development
- baby is a clone
- reference to ethical / moral / religious issues

allow ethically wrong

NB cloning is illegal gains 2 marks

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ignore unnatural

- risk of damage to the baby
in correct context

[4]

Q27.

- (a) A = meiosis

accept 'mieosis'
*do **not** accept 'miosis'*

1

B = mitosis

*do **not** accept 'meitosis' etc*

1

- (b) fertilisation allow conception

1

- (c) (i) 23

1

- (ii) 46

1

[5]

Q28.

one mark for each of the following comparisons to a maximum of **6**

*candidates **must** make a clear comparison*

meiosis

mitosis

sexual

asexual

gametes

growth

ovary **or** testes
or gonads

all other cells

half number
of chromosomes

same number
of chromosomes

haploid **or**
23 chromosomes

diploid **or**
46 chromosomes

reassortment **or**
variation possible
or not identical

no reassortment
or no variation
or identical

4 cells produced

2 cells produced

2 divisions

1 division

[6]

Q29.

- (a) (i) *if two nuclei drawn then maximum two marks* 1
- 6 chromosomes 1
- same 3 homologous pairs 1
- nuclear membrane drawn 1
- (ii) 3 chromosomes 1
- 1 from each homologous pair 1

- (b) (i) *parent line must be separate*
- heterozygous parents Tt x Tt
maximum of 2 marks if parental genotype is wrong
- gametes correct T t T t 1
- genotypes TT Tt Tt tt 1
- (ii) correct analysis of chance i.e. 1 in 4
or 25% 1
- (iii) 50% **or** 1 in 2 1

[10]

Q30.

- (a) (i) meiosis 1
- (ii) mitosis 1
- (c) (i) **X** pituitary 1

Y FSH

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- (ii) stimulates LH production 1
- inhibits FSH production / production of Y 1

[6]

Q31.

- (a) **A A a a**
Aa allele correctly separated 1

- B b B b**
*Bb allele arranged to form four different pairings
 all four pairings must be correct for the second mark* 1

- (b) **A A**
the two cells the same as the parent cell

- a a**
B B
b b
1 mark for each cell 2

- (c) (i) 46
accept 23 pairs 1

- (ii) 23
accept half if c(i) 1

- (iii) 46
accept save as c(i) 1

[7]

Q32.

- (a) circles round right hand **X** and **Y** gametes
put two ticks or crosses by the circles 2

- (b) 50:50 or 1:1 or 50% or 0.5 or ½ equal or evens
credit even



do not accept 2:1 **or** 50 / 50

- (c) (i) 23 1
- (ii) 23 1
- credit the same as the one above to be marked consequential* 1
- (d) DNA 1
- do not accept nucleic acid* 1
- (e) same 1

[7]

Q33.

- (a) 23 1
- (b) chromosome nucleus gene cell 1
 2 3 1 4
- (c) (i) any **one** from 1
 (cells which are bigger) take up more space
 (cells) have to get bigger **or** mature to divide
- (ii) chromosomes duplicate **or** 1
 make exact copies of self
 accept forms pairs of chromatids
- nuclei divide 1
 *accept chromatids **or***
 chromosomes separate
- identical (daughter) cells formed 1
 accept for example, skin cells make
 *more skin cells **or** cells are clones*
- (d) any **two** from 1
 Differentiation mark
 babies need **or** are made of different types of cells **or** cells that have
 different functions



*accept different cells are needed
for different organs*

Division or specialisation mark

as fertilised egg starts to divide each cell specialises to form a part of the body

*accept specialised cells make
different parts of the body*

Growth mark

specialised cells undergo mitosis to grow further cells

*accept cells divide **or** reproduce
to form identical cells*