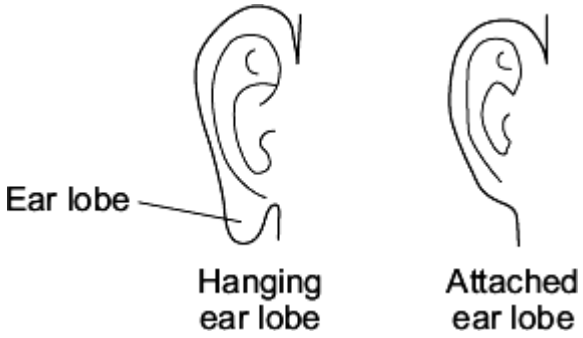
REPRODUCTION PART III

Q1.

People have different shaped ear lobes, either ‘hanging’ or ‘attached’.

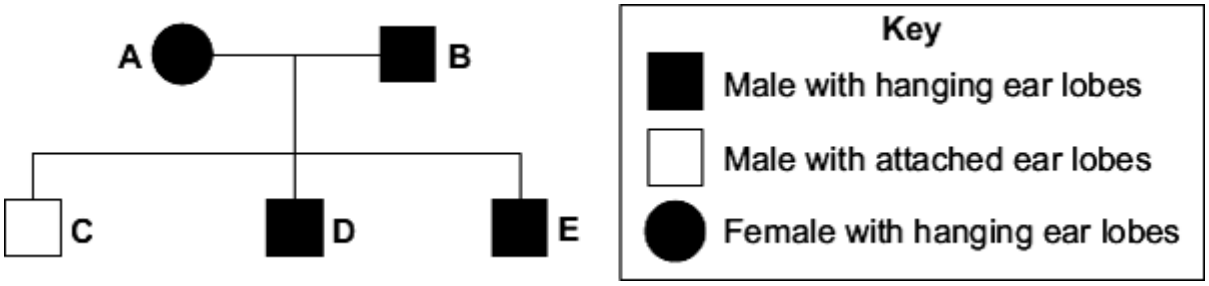
The diagrams show the two shapes of ear lobe.



A gene controls the shape of a person’s ear lobes.

The diagram shows a family tree.

Parents **A** and **B** both have hanging ear lobes.



(a) The key does **not** show the symbol for a female with attached ear lobes.

Draw the symbol for the key to show a female with attached ear lobes.

Use information in the family tree and the key.

Symbol = _____

(1)

(b) Look at the family tree.

What does the information in the family tree tell you about the allele for hanging ear lobes?

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

The allele for hanging ear lobes is

dominant.
weak.
recessive.

(1)

(c) (i) Parents **A** and **B** have three children, **C**, **D** and **E**.
All three children are boys.

What are the chances that the next child of parents **A** and **B** will be a girl?

Draw a ring around **one** answer.

no chance (0 %) **a half (50 %)** **certain (100 %)**

(1)

(ii) Which statement explains your answer to part (c)(i)?

Tick (✓) **one** box.

Some of **B**'s sperm cells have an X chromosome. ☐

Some of **A**'s egg cells have a Y chromosome ☐

All of **B**'s sperm cells have an X chromosome. ☐

(1)
(Total 4 marks)

Q2.

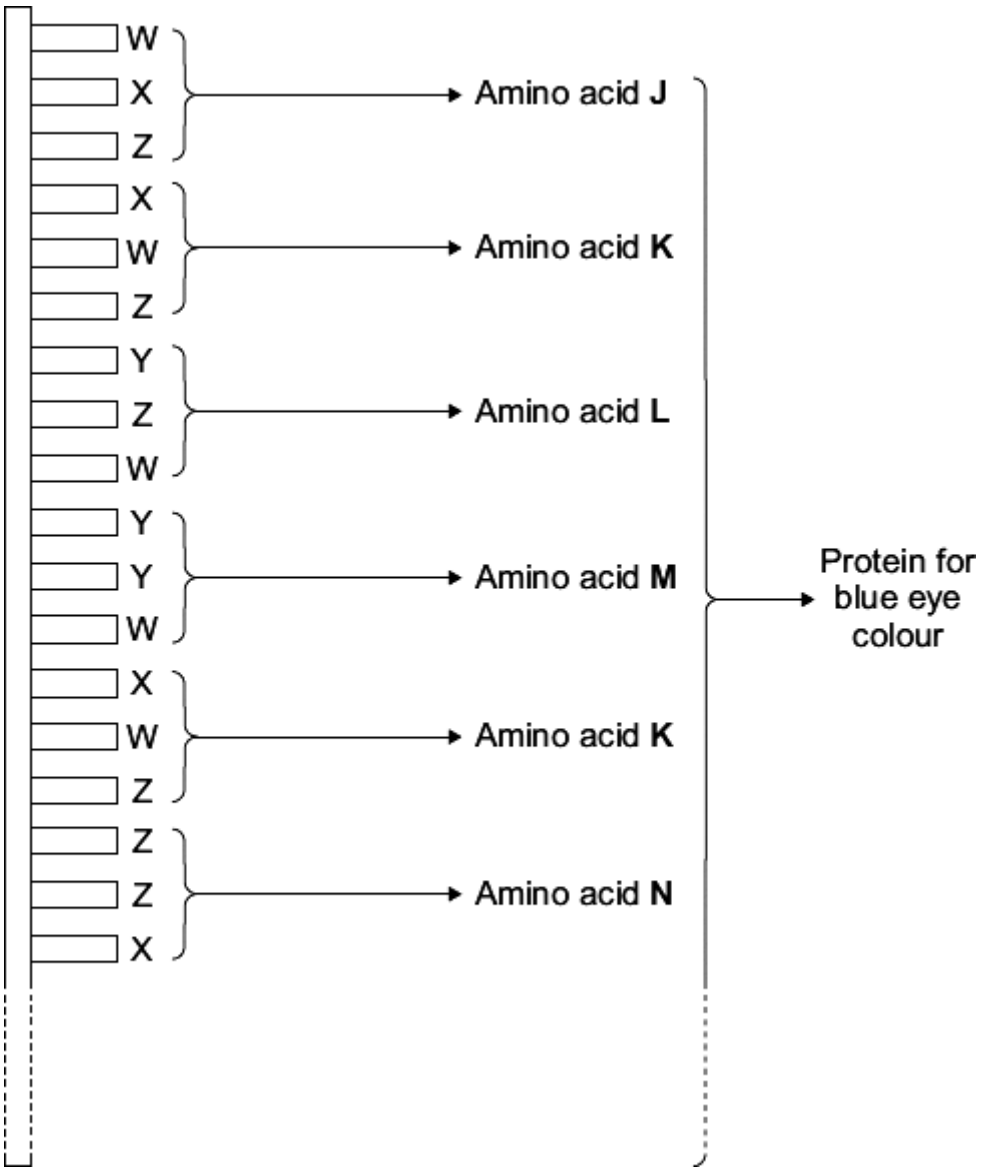
A molecule of DNA contains four different bases, **W**, **X**, **Y** and **Z**.

The four bases are arranged in a long chain.

The chain of bases controls the synthesis of a protein.

The diagram shows a small section of a DNA molecule.

This section is responsible for synthesising the protein for blue eye colour.



(a) What word is used to describe *a small section of a DNA molecule that controls the synthesis of a protein*'?

_____

(1)

(b) In the cell, where are proteins synthesised?

_____

(1)

(c) Describe how the protein for blue eye colour is synthesised.

To gain full marks you must use information from the diagram.

_____

_____

_____

_____

_____

_____

_____

(3)

(d) Mistakes sometimes occur when DNA molecules are copied during cell division.

Suppose that one of the **W** bases shown in the diagram was substituted by an **X** base.

(i) What would happen to the structure of the protein synthesised by this part of the DNA molecule?

_____

_____

(1)

(ii) What might be the effect of this change in structure of the protein?

_____

_____

(1)

(Total 7 marks)

Q3.

(a) Human body cells contain 46 chromosomes.

(i) How many chromosomes are there in a human sperm cell?

(1)

(ii) Name the part of the sperm cell that contains the chromosomes.

_____

(1)

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

(i) In human females, the sex chromosomes are

X and **X**.
X and **Y**.
Y and **Y**.

(1)

(ii) In human males, the sex chromosomes are

X and **X**.
X and **Y**.
Y and **Y**.

(1)

(c) A man might release 300 million sperm cells at a time.

How many of these sperm cells would contain an **X** chromosome?

_____

(1)

(Total 5 marks)

Q4.

Cystic fibrosis is an inherited disorder.

Mr and Mrs Brown do **not** have cystic fibrosis but they have a child with cystic fibrosis.

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

(i) The allele for cystic fibrosis is a

carrier allele.

dominant allele.

recessive allele.

(1)

(ii) Mr and Mrs Brown are both

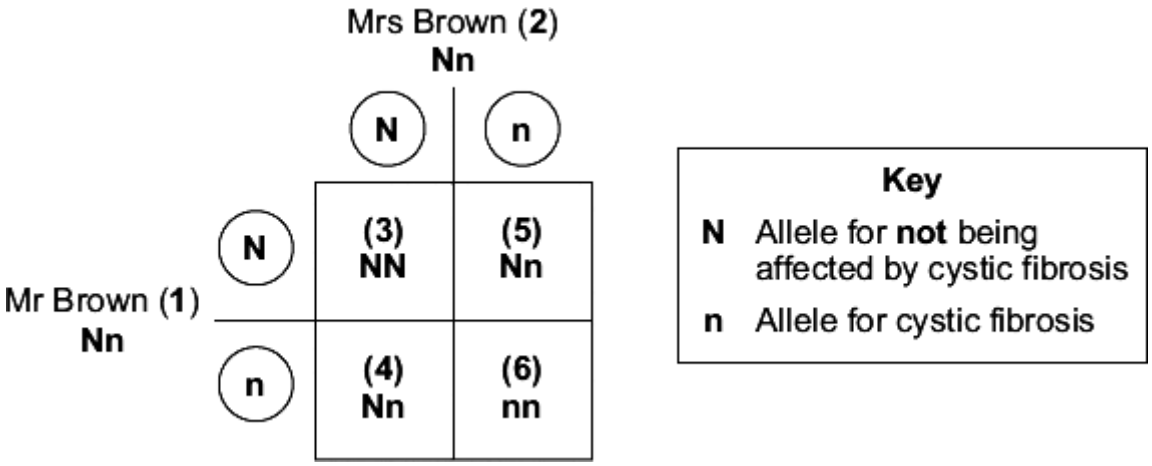
carriers.

immune.

infected.

(1)

(b) The diagram shows how the allele for cystic fibrosis can be inherited by Mr and Mrs Brown's children.



(i) Give the number of **one** person in the diagram who has cystic fibrosis. ☐

(1)

(ii) The chance that Mr and Mrs Brown's next child will have cystic fibrosis is

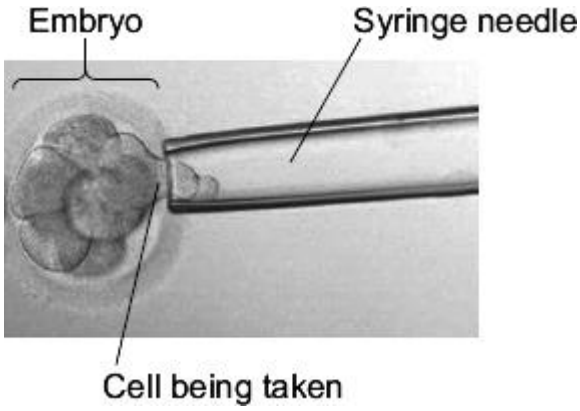
_____

(1)

(c) A genetic counsellor describes to Mr and Mrs Brown one way of screening embryos for cystic fibrosis.

- Some eggs are collected from Mrs Brown.
- The eggs are then fertilised in a dish.
- Several embryos may start to develop.

The photograph shows how doctors take one cell from each embryo when it is only 3 days old.



- The DNA in the cell from each embryo is tested for cystic fibrosis.
- Doctors select one embryo that is unaffected and place it in Mrs Brown's uterus.
- The embryo then develops into a baby.

Use the information to suggest **one** advantage and **one** disadvantage of screening embryos in this way.

Advantage _____

_____

Disadvantage _____

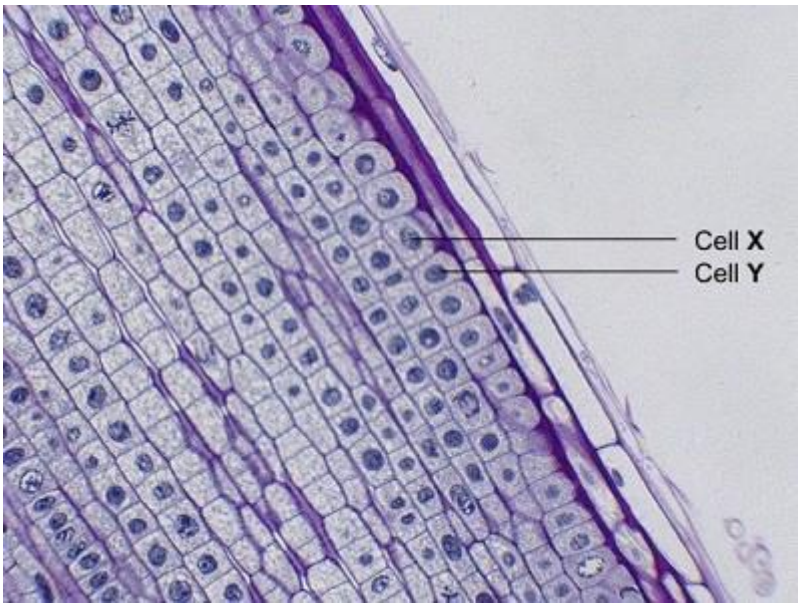
_____

(2)

(Total 6 marks)

Q5.

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)

Q6.

People with cystic fibrosis make large amounts of thick, sticky mucus in their lungs.
Cystic fibrosis is caused by the inheritance of recessive alleles.

(a) What do each of the following mean?

(i) Alleles

_____

_____

(1)

(ii) Recessive

_____

_____

(1)

(b) Mr and Mrs Brown have a child with cystic fibrosis. They hope to have another child. They want to know the probability that their next child will have cystic fibrosis. They visit a genetic counsellor who explains, "You are both heterozygous for cystic fibrosis. There is a 1 in 4 (25%) chance that your next child will have cystic fibrosis."

Use the following symbols in answering the questions.

N = allele for being unaffected by cystic fibrosis
n = allele for cystic fibrosis

(i) Mr and Mrs Brown both have the same genotype.

What is their genotype? _____

(1)

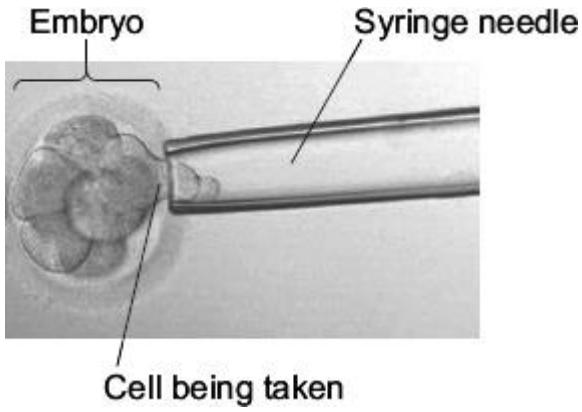
(ii) There is a 1 in 4 chance that Mr and Mrs Brown's next child will have cystic fibrosis.
Use a genetic diagram to explain why.

(3)

(c) Mr and Mrs Brown do **not** want to have another child with cystic fibrosis. The genetic counsellor explains two different methods for finding out whether an embryo has cystic fibrosis. The methods are:

- pre-implantation genetic diagnosis (**PGD**)
- chorionic villus sampling (**CVS**).

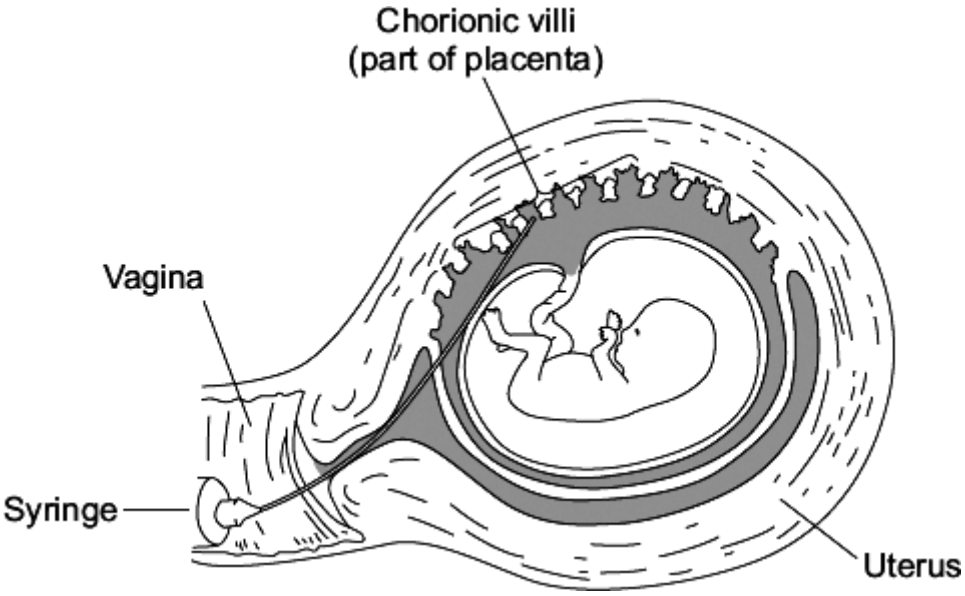
In **PGD**, eggs are fertilised in dishes and allowed to grow into embryos. A cell is taken from each embryo when the embryo is 3 days old. The photograph shows how the cell is taken.



Photograph:© Pascal Goetgheluck/
Science Photo Library

The DNA in the cell can then be tested. The possibility of a false positive result is about 1 in 6. An unaffected embryo can then be placed in the woman's uterus. The procedure costs about £6000.

CVS can only be done after 9 weeks of pregnancy. A tiny piece of the placenta is taken out using a tube attached to a syringe. This is grown in tissue culture for about 7 days. The diagram below shows how **CVS** is done.



The DNA in the cells can then be tested. About 2 in every 100 women have a miscarriage because of **CVS**. The possibility of a false positive result is about 1%. The procedure costs about £600. Following a positive result, the parents must then decide whether to terminate the pregnancy.

The genetic counsellor thinks that **PGD** is a better method than **CVS** for detecting cystic fibrosis in an embryo.

Evaluate this opinion.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

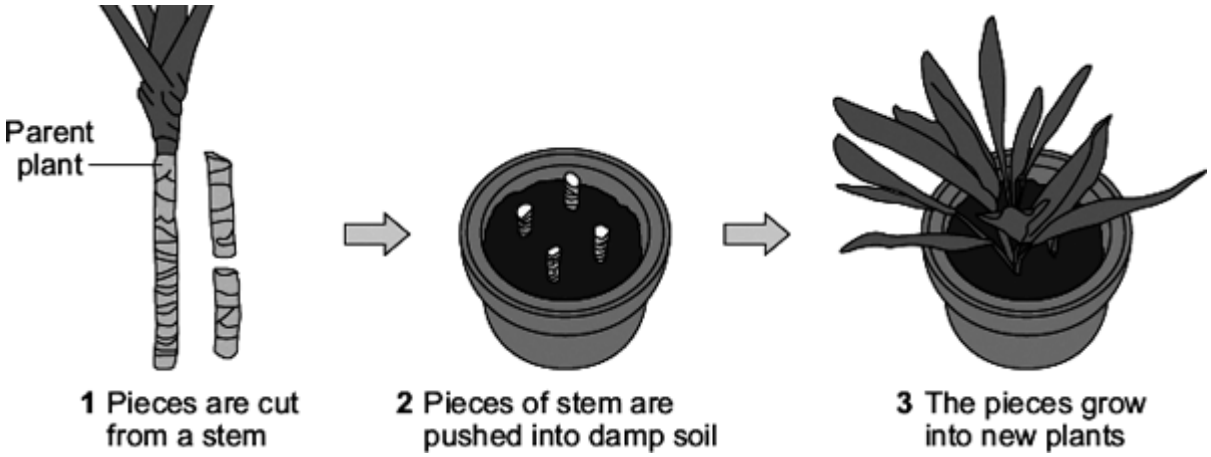
_____

(4)

(Total 10 marks)

Q7.

(a) The drawings show one way of producing new plants. The new plants are identical to the parent plant.



Use words from the box to complete the sentences.

asexual	**characteristics**	**clones**	**engineering**	**genes**	**sexual**

The colour and shape of the leaves are known as _____

The information for leaf colour is stored in parts of chromosomes

called _____

The new plants are known as _____

The new plants have been produced by _____ reproduction.

(4)

(b) (i) Name **one** other way of producing plants that are identical to their parents.

_____

(1)

(ii) Name **one** way of producing animals that are identical to each other.

_____

(1)

(Total 6 marks)

Q8.

A child saved apple seeds from an apple she ate. She planted the seeds in the garden. A few years later the apple trees she had grown produced apples.

(a) The apples from the new trees did **not** taste like the original apple.

Explain why.

_____

_____

_____

_____

_____

(2)

(b) (i) Apple trees can be reproduced so that the apples from the new trees will taste the same as the apples from the parent trees.

Give **one** method used to reproduce apple trees in this way.

_____

_____

(1)

(ii) Explain why the method you have suggested in part **(b)(i)** will produce apples that taste the same as the apples from the parent trees.

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q9.

The diagram shows a strawberry plant.

The parent plant grows side shoots.

New plants grow on the side shoots.

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)

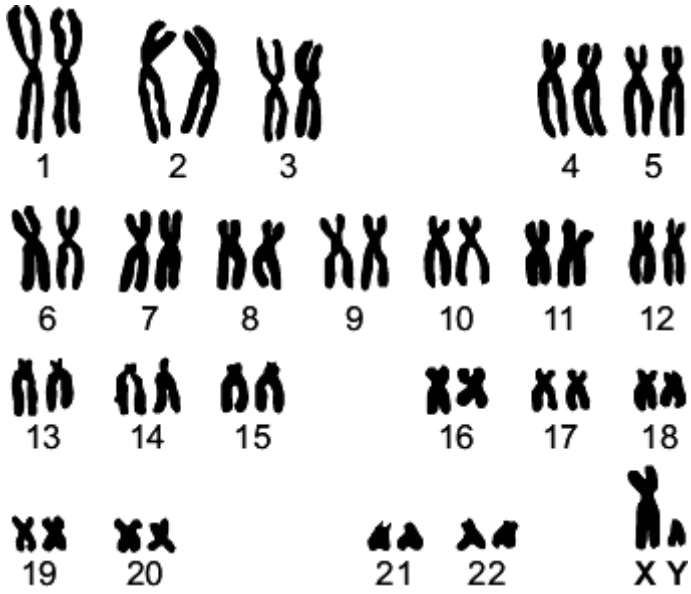
(Total 3 marks)

Q10.

When scientists look at dividing cells under a microscope, they can see strands that contain a chemical called DNA.

A photograph of these strands can be cut up and re-arranged.

The diagram shows an arrangement of the strands from a human cell.



(a) What name is given to the strands containing DNA shown in the diagram?

Draw a ring around **one** answer.

alleles **chromosomes** **genes**

(1)

(b) Look carefully at the diagram.

(i) The cell was taken from a man and not from a woman.

How can you tell?

_____

(1)

(ii) What evidence is there that the strands are from a body cell, and not from a gamete?

Tick (✓) **one** box.

The strands are arranged in order of size. ☐

The strands are in pairs. ☐

Gametes are made in the testes and ovaries. ☐

(1)

(iii) When a human cell is not dividing the strands containing DNA are **not** clearly visible.

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

In a human cell, the DNA is normally found in the

cell membrane.

cytoplasm.

nucleus.

(1)

(Total 4 marks)

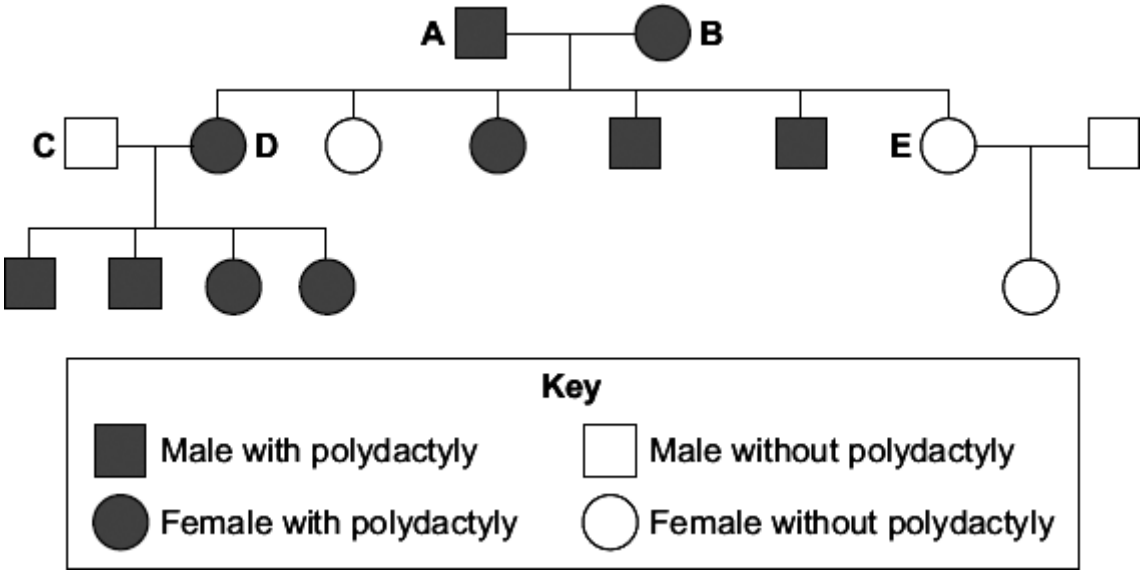
Q11.

Cats normally have four toes on each back paw.

The picture shows the back paw of a cat with an inherited condition called polydactyly.

By Onyxrain (Own work) [Public domain], via Wikimedia Commons

The family tree shows the inheritance of polydactyly in three generations of cats.



(a) What combination of alleles did the original parents, **A** and **B**, have?

Explain how you work out your answer.

You may use a genetic diagram in your answer.

Use the symbol **H** to represent the dominant allele.

Use the symbol **h** to represent the recessive allele.

_____

_____

_____

_____

_____

_____

A = _____ **B =** _____

(4)

(b) (i) Give **two** possible combinations of alleles for cat **D**.

1. _____ 2. _____

(1)

(ii) You cannot be sure which one of these two is the correct combination of alleles for cat **D**.

Why?

_____

_____

_____

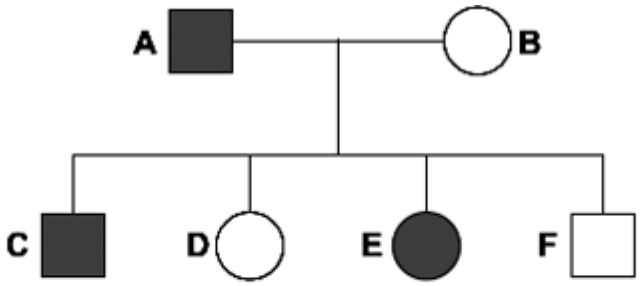
(1)

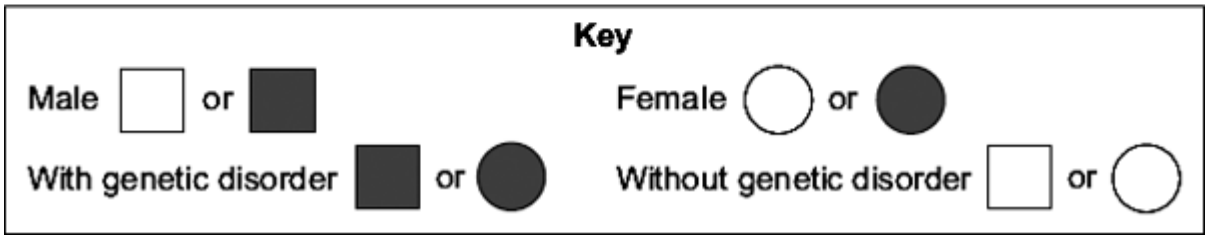
(Total 6 marks)

Q12.

The diagram shows the family tree of a pair of pigs, **A** and **B**.
Pigs **A** and **B** have four offspring, **C**, **D**, **E** and **F**.

Some of the pigs have a genetic disorder.





(a) Which pig, **A**, **B**, **C**, **D**, **E** or **F**, is:

(i) a male pig with the genetic disorder

(1)

(ii) a female pig without the genetic disorder? ☐

(1)

(b) Draw a ring around the correct answer to complete the sentences.

Pig **C** has the genetic disorder.

(i) Pig **C** inherited the genetic disorder from

pig **A**.

pig **B**.

pig **E**.

(1)

(ii) The gene for the genetic disorder was passed on in

an embryo.

an enzyme.

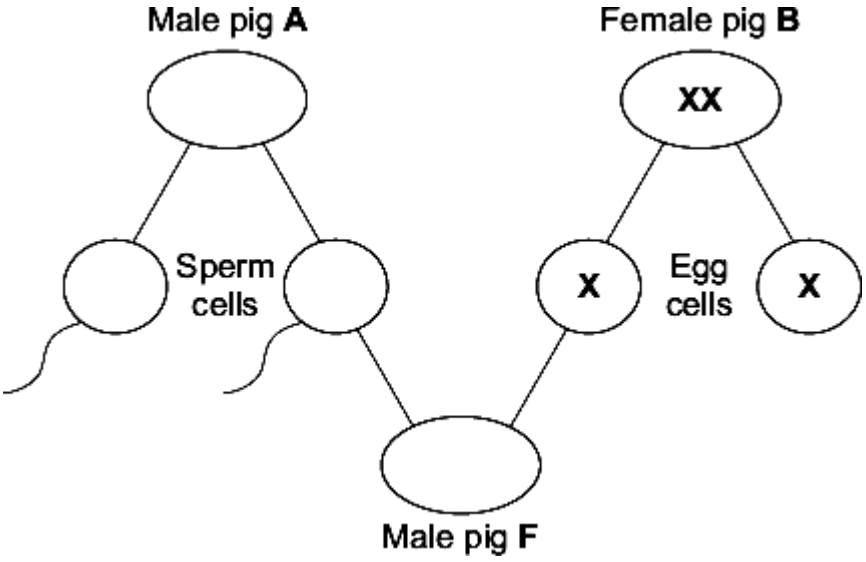
a gamete.

(1)

(c) Pig **F** is a male.

Complete the diagram to show how the sex of pig **F** depends on the inheritance of the sex chromosomes **X** and **Y**.

The sex chromosomes of pig **B** and the egg cells have been completed for you.



(3)

(Total 7 marks)

Q13.

A certain allele increases the chance of women developing one type of breast cancer.

A woman has this allele. She wants to be sure that she will not have daughters who also have the allele.

Doctors:

- collect several eggs from her ovaries
- fertilise the eggs with sperm, in dishes.

(a) The doctors expect half the embryos produced to be female.

Explain why.

_____

_____

_____

_____

(2)

(b) The embryos grow to around 100 cells.

Doctors:

- remove one cell from each embryo
- check the cell for the allele.

Complete the sentence.

This process is known as embryo _____ .

(1)

(c) One of the female embryos did not have the allele.
This female embryo was implanted into the woman's uterus.

Evaluate the advantages and disadvantages of the whole procedure.

Use information from all parts of this question and your own knowledge.

Remember to give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q14.

Cystic fibrosis and Huntington's disease are inherited disorders.

(a) Someone can be a carrier of cystic fibrosis.

Explain how.

You may include a genetic diagram in your answer.

_____

_____

_____

_____

(2)

(b) Why does only one parent need to have the Huntington's disease allele for a child to inherit Huntington's disease?

_____

_____

(1)

(Total 3 marks)

Q15.

Soay sheep live wild on an island off the north coast of Scotland. No people live on the island.

By Owen Jones = Jonesor [CC-BY-SA-2.5], via Wikimedia Commons

Over the last 25 years, the average height and mass of the wild Soay sheep have decreased.

The scientists think that climate change might have affected the size of the sheep.

(a) More Soay sheep are now able to survive winter than 25 years ago.

What change in the climate may have helped more Soay sheep to survive winters?

_____

_____

(1)

(b) Complete the sentences.

(i) Soay sheep show variation in size because of differences in their

_____

(1)

(ii) The change in the size of the Soay sheep over 25 years can be explained by Darwin's

theory of _____

(1)

(Total 3 marks)

Q16.

Organisms can be produced by asexual reproduction and by sexual reproduction.

(a) Give **two** differences between asexual reproduction and sexual reproduction.

1. _____

_____

2. _____

_____

(2)

(b) Adult cell cloning is a type of asexual reproduction.

Explain why.

_____

_____

_____

_____

(2)

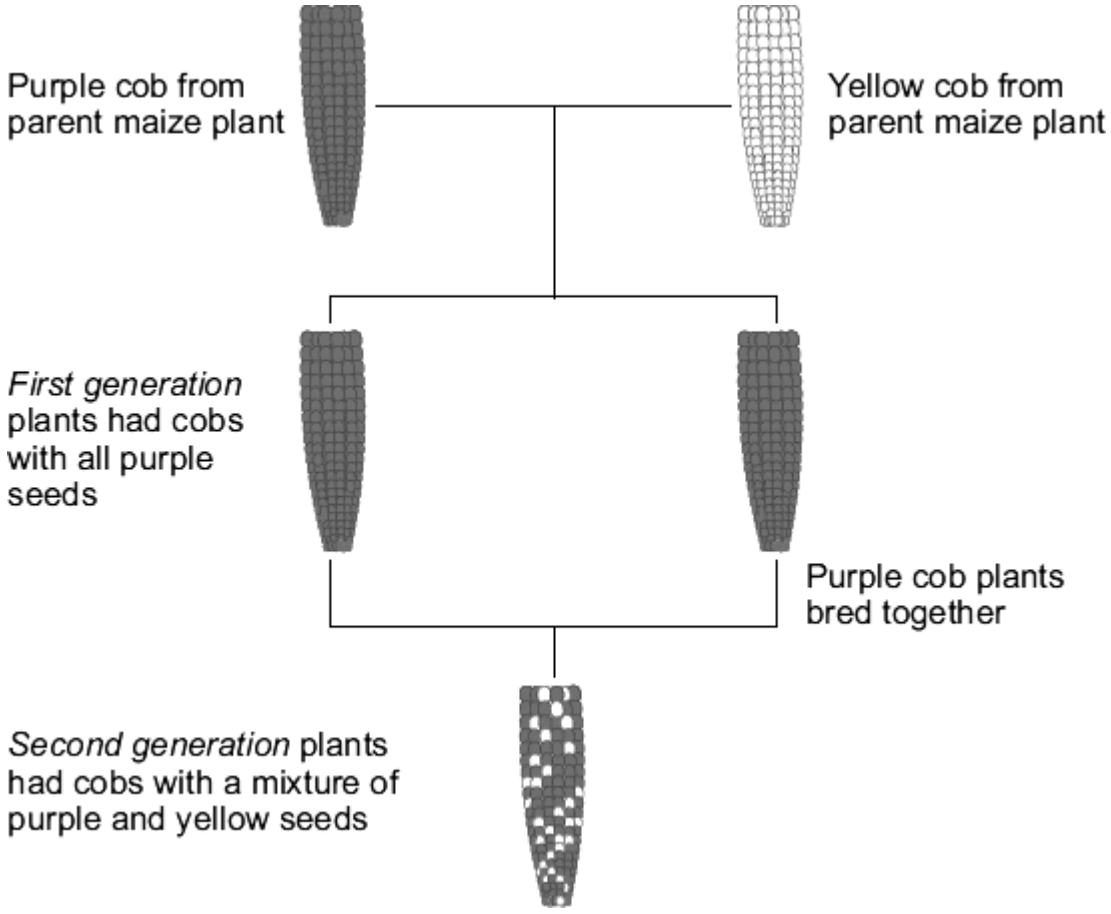
(Total 4 marks)

Q17.

Maize plants reproduce sexually to form maize cobs.
Each maize cob has many seeds.

The colour of the seeds is controlled by a gene.
The gene has two alleles, purple and yellow.

The diagram shows the cobs produced by breeding maize plants.



(a) Use words from the box to complete the sentences.

dominant	**environmental**	**recessive**

(i) The first generation plants show that the purple allele is

_____

(1)

(ii) The second generation plants show that the yellow allele is

_____

(1)

(b) The allele for purple can be represented by the letter **A**.
The allele for yellow can be represented by the letter **a**.

(i) What alleles does a yellow seed have?

Draw a ring around **one** answer.

AA **Aa** **aa**

(1)

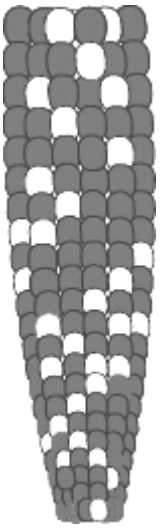
(ii) What alleles does a purple seed from a *first* generation plant have?

Draw a ring around **one** answer.

AA **Aa** **aa**

(1)

(c) The drawing shows a cob from one of the *second generation* plants.



A student counted 334 purple seeds and 110 yellow seeds on this maize cob.

What is the approximate ratio of purple seeds to yellow seeds on the cob?

Tick (✓) **one** box.

3 purple : 1 yellow ☐

1 purple : 3 yellow ☐

1 purple : 1 yellow ☐

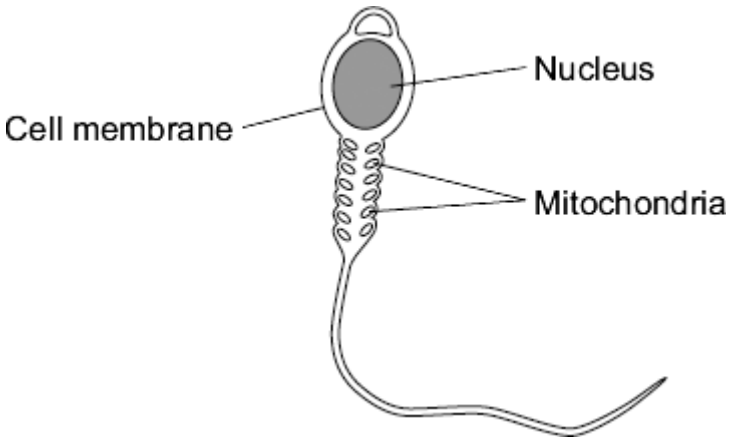
(1)

(Total 5 marks)

Q18.

Cells in the human body are specialised to carry out their particular function.

(a) The diagram shows a sperm cell.



The sperm cell is adapted for travelling to, then fertilising, an egg.

(i) How do the mitochondria help the sperm to carry out its function?

_____

_____

(1)

(ii) The nucleus of the sperm cell is different from the nucleus of body cells.

Give **one** way in which the nucleus is different.

_____

_____

(1)

(b) Stem cells from human embryos are used to treat some diseases in humans.

Explain why.

_____

_____

_____

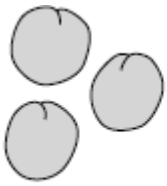
_____

(2)

(Total 4 marks)

Q19.

In the 1860s, Gregor Mendel studied inheritance in nearly 30 000 pea plants. Pea plants can produce either round seeds or wrinkled seeds.



Round pea seeds

Wrinkled pea seeds

(a) Mendel crossed plants that always produced round seeds with plants that always produced wrinkled seeds.

He found that all the seeds produced from the cross were round.

Use the symbol **A** to represent the dominant allele and **a** to represent the recessive allele.

Which alleles did the seeds from the cross have?

_____

(1)

(b) Mendel grew hundreds of plants from the seeds of the offspring.
He crossed these plants with each other.

(i) Mendel's crosses produced 5496 round pea seeds and 1832 wrinkled pea seeds.

Explain why Mendel's crosses gave him these results.

In your answer you should use:

- a genetic diagram
- the symbols **A** and **a**.

(3)

(ii) One of Mendel's crosses produced 19 round seeds and 16 wrinkled seeds.

These numbers do **not** match the expected ratio of round and wrinkled seeds.

Suggest why.

_____

_____

(1)

(c) The importance of Mendel's discovery was not recognised until many years after his death.

Give **one** reason why.

_____

_____

(1)

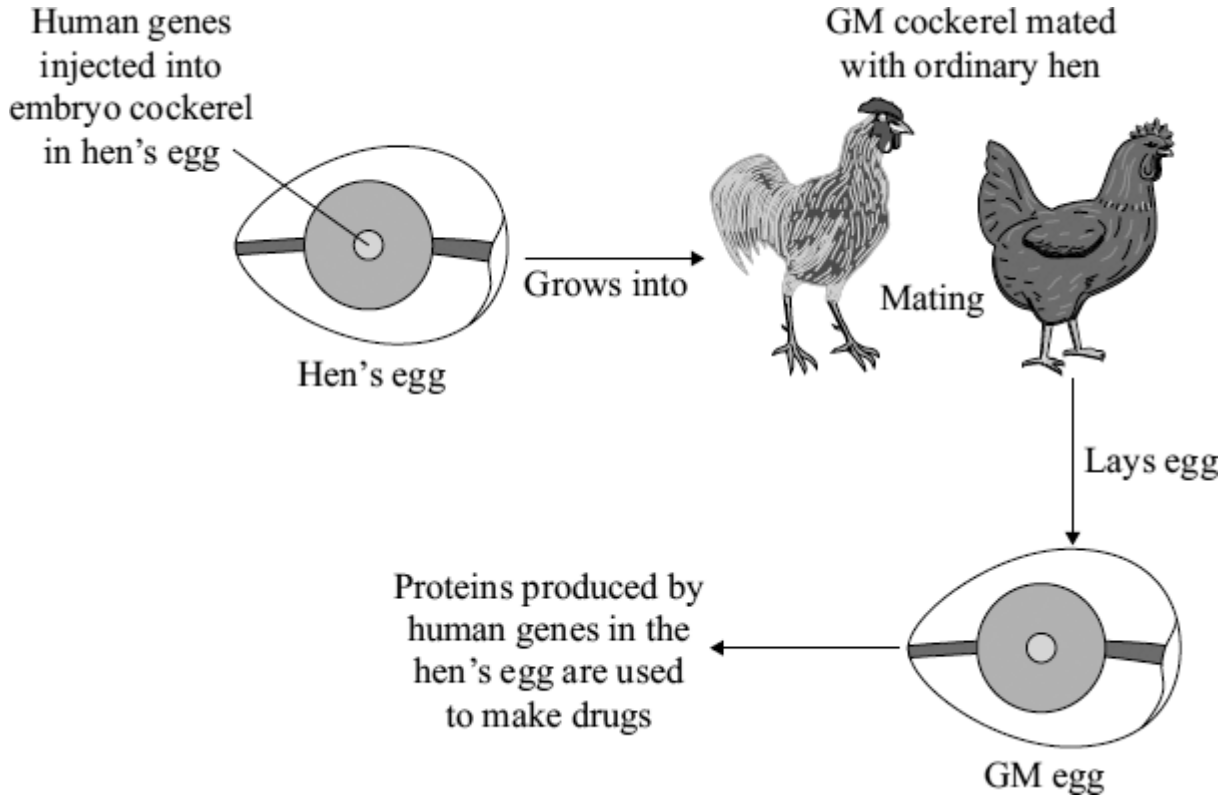
(Total 6 marks)

Q20.

Scientists have discovered how to produce genetically modified (GM) hens' eggs.

Some proteins produced in GM eggs can be used as drugs to treat humans.

The diagram shows how this is done.



(a) Which type of reproduction is involved when the cockerel mates with the hen?

Tick (✓) **one** box.

Asexual ☐

Cloning ☐

Sexual ☐

(1)

(b) From which part of a human are the genes cut?

Tick (✓) **one** box.

Chromosome ☐

Embryo ☐

Glands ☐

(1)

(c) Read the information about genetically modified animals.

- GM animals might escape and breed with wild animals.
- Genetic modification can produce fast-growing animals for food.
- Genetic modification can be used to clone animals in danger of extinction.
- Using GM animals can reduce the number of animals used in medical research.
- Animals have the right to be free from genetic modification.

Use **only** this information to answer these questions.

(i) Give **two** reasons why many people are in favour of genetically modified animals.

1. _____

2. _____

(2)

(ii) Give **two** reasons why many people are against genetically modified animals.

1. _____

2. _____

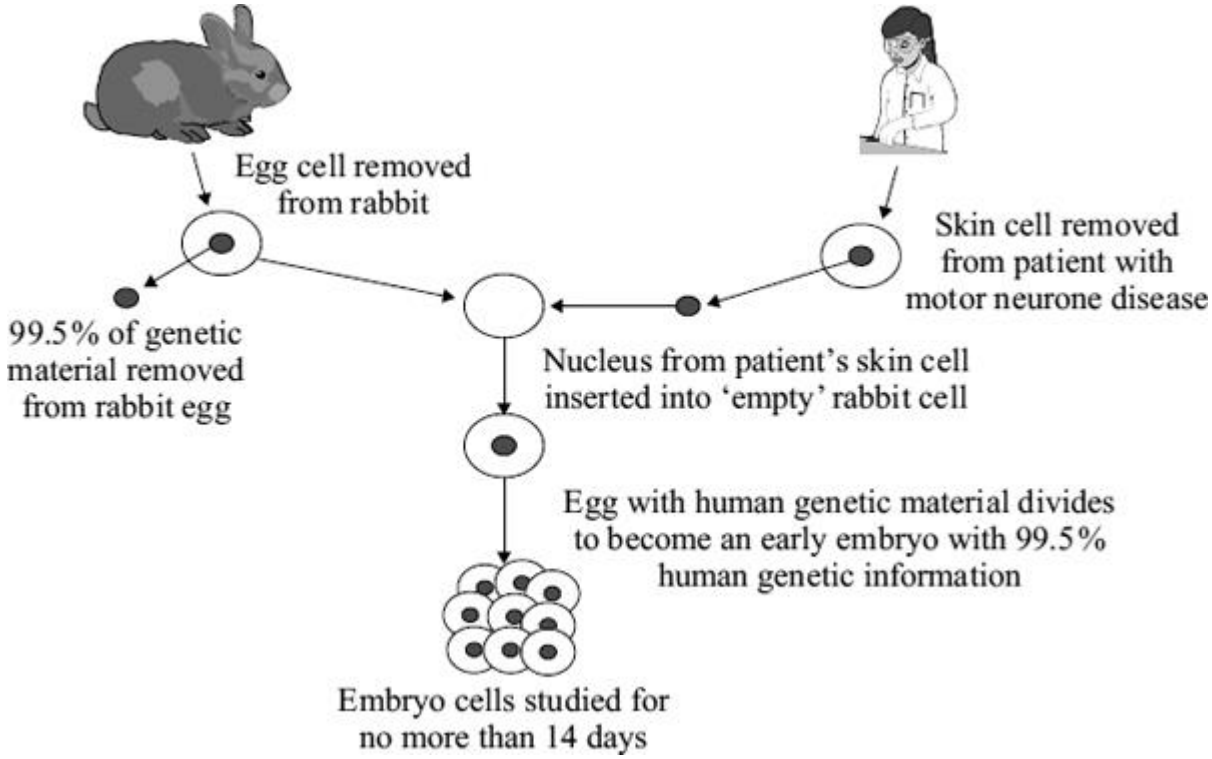
(2)

(Total 6 marks)

Q21.

Scientists in Korea have discovered a method of producing rabbit–human embryos.Rabbit–human embryos could provide cells for research into human diseases such as motor neurone disease. Rabbits produce large numbers of eggs. Rabbit–human embryos could overcome a shortage of human embryo cells for research.

The diagram shows how rabbit–human embryos are produced.



(a) Which structures in the nucleus contain 99.5% of a cell's genetic information?

_____

(1)

(b) Use the above information and your own knowledge and understanding to evaluate how the production of rabbit–human embryos may help research into human diseases.

Remember to give a conclusion as part of your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 5 marks)

Q22.

Humans reproduce sexually.

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

(a) (i) At fertilisation | chromosomes / genes / sex cells | join together.

(1)

(ii) At fertilisation a single cell forms, which has new pairs of | chromosomes. / nuclei. / sex cells. |

(1)

(b) Cystic fibrosis can be inherited by children whose parents do not have it.

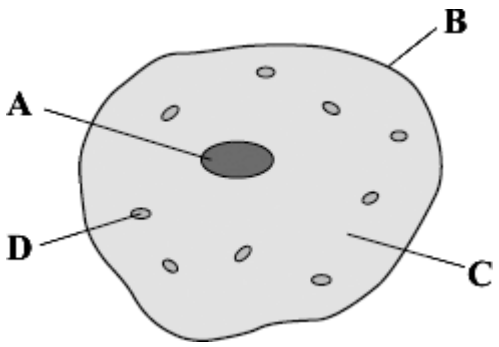
(i) A person who has cystic fibrosis has | two / three / four | copies of the cystic fibrosis allele.

(1)

(ii) The cystic fibrosis allele is | large. / recessive. / strong. |

(1)

(c) The diagram shows a human body cell.



Choose the correct answer from the box to complete each sentence.

cell membrane	**cell wall**	**cytoplasm**	**nucleus**

(i) The part of the cell labelled **B** is the _____

(1)

(ii) The part of the cell labelled **C** is the _____

(1)

(d) Which part of the cell, **A**, **B**, **C** or **D**:

(i) contains the allele for cystic fibrosis ☐

(1)

(ii) is affected by cystic fibrosis? ☐

(1)

(Total 8 marks)

Q23.

(a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discusses embryo screening.

Read the information which they received from the counsellor.

- Under an anaesthetic five eggs will be removed from Mrs Smith's ovary.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.

- A suitable embryo will be placed into Mrs. Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be killed.

(i) Suggest why it is helpful to take five eggs from the ovary, rather than just one.

_____

_____

(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion as part of your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q24.

We breed animals with the characteristics that we prefer.

(a) The photograph shows a rabbit with some of its babies.

Photograph supplied by iStockphoto/Thinkstock

Use words from the box to complete the sentences about inheritance in rabbits.

characteristic	chromosome	gene	gamete

(i) The colour of a rabbit's fur is known as a _____

(1)

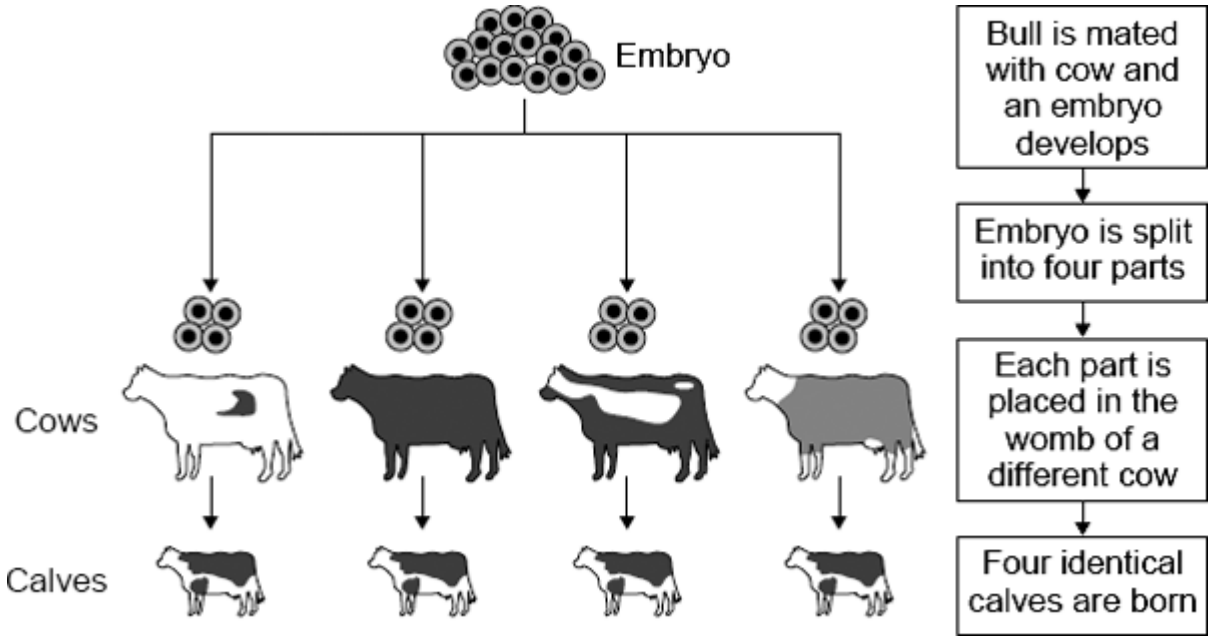
(ii) This colour is controlled by a _____

(1)

(iii) Each sex cell of a rabbit is known as a _____

(1)

(b) The diagram shows one way of producing calves.



Use words from the box to complete the sentences.

asexual	clones	cuttings	gametes	genetic	sexual

A bull was mated with a cow.

This is _____ reproduction.

The embryo produced was split into four parts.

The calves in the diagram have identical genetic information.

This is because the calves were produced by _____ reproduction.

The identical calves are known as _____

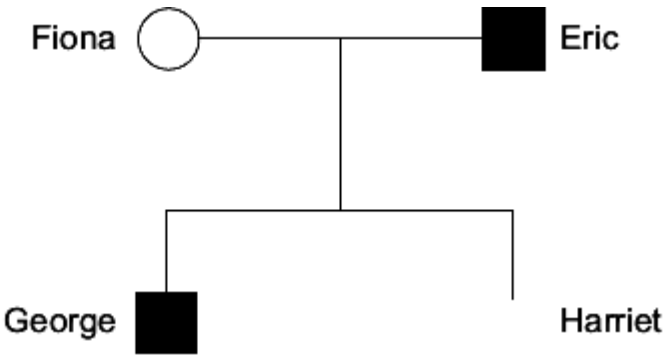
(3)

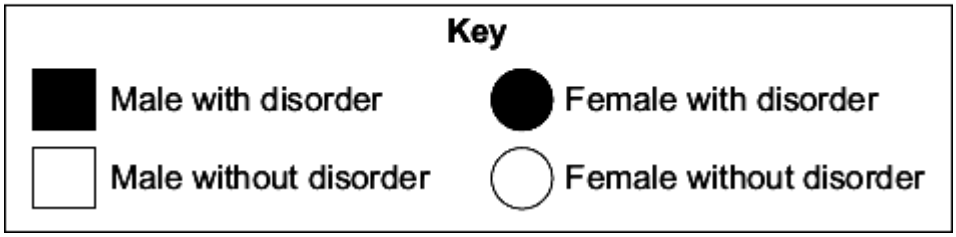
(Total 6 marks)

Q25.

The family tree shows the inheritance of a disorder caused by a dominant allele.

Fiona and Eric have two children George and Harriet.





(a) The son, George, has the disorder.

The daughter, Harriet, does **not** have the disorder.

(i) Use the key to draw the symbol for Harriet next to her name **on the family tree**.

(2)

(ii) The symbol **D** represents the dominant allele for the disorder.
The symbol **d** represents the recessive allele.

Fiona has the pair of alleles **dd**.

Write the correct pairs of alleles in the boxes.

Harriet has the pair of alleles ☐

A person with the disorder could have

the pair of alleles ☐ or the pair of alleles ☐

(3)

(b) Before Harriet was born, a doctor suggested that Fiona should have the embryo 'screened'.

(i) Give **one** reason why the doctor suggested screening.

Tick (✓) **one** box.

To check for the **D** allele ☐

To check the sex of the embryo ☐

To cure the disorder ☐

(1)

(ii) Why do some people believe that embryos should **not** be screened?

_____

_____

(1)

(Total 7 marks)

Q26.

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.

Suggest why.

_____

_____

(1)

(b) Chromosomes contain DNA molecules.

Describe the function of DNA.

_____

_____

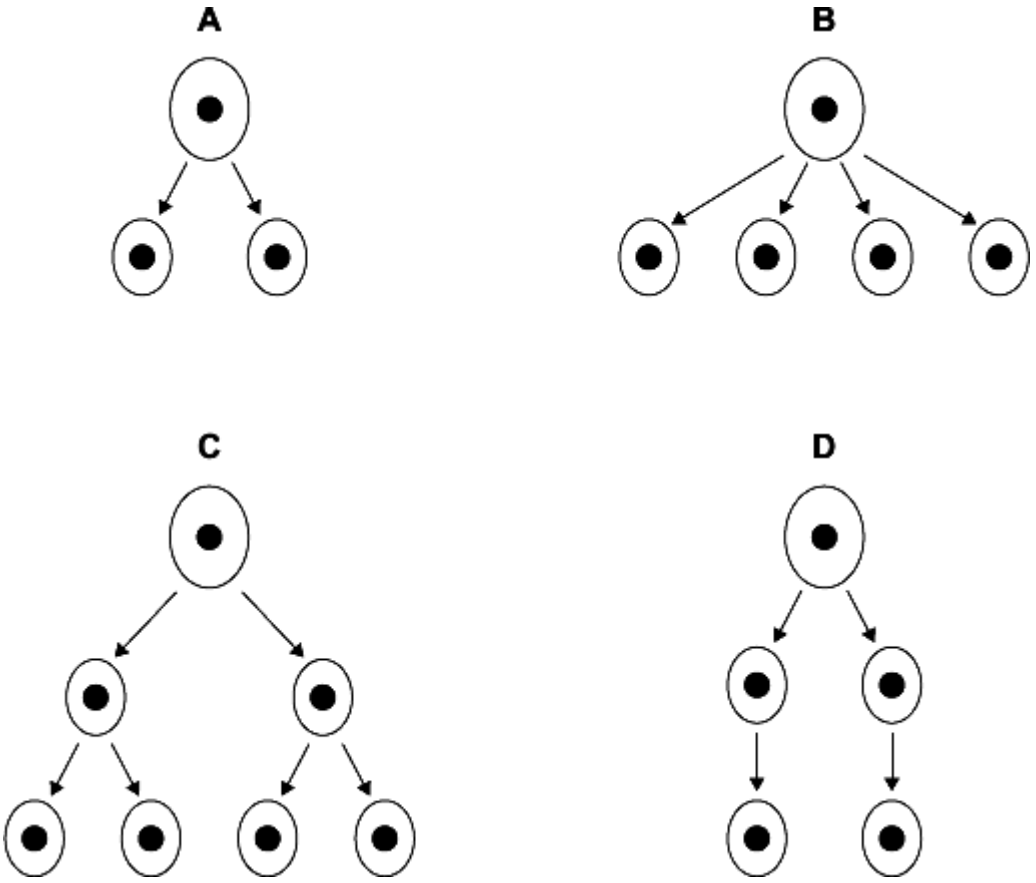
_____

_____

(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)

Q27.

The photographs show a zorse and its parents, a zebra and a horse.

Horse

Zebra

Zorse

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

The zorse was produced by

cloning
asexual reproduction
sexual reproduction

.

(1)

(b) Explain the appearance of the zorse.

Use **both** words from the box in your explanation.

gametes	**genes**

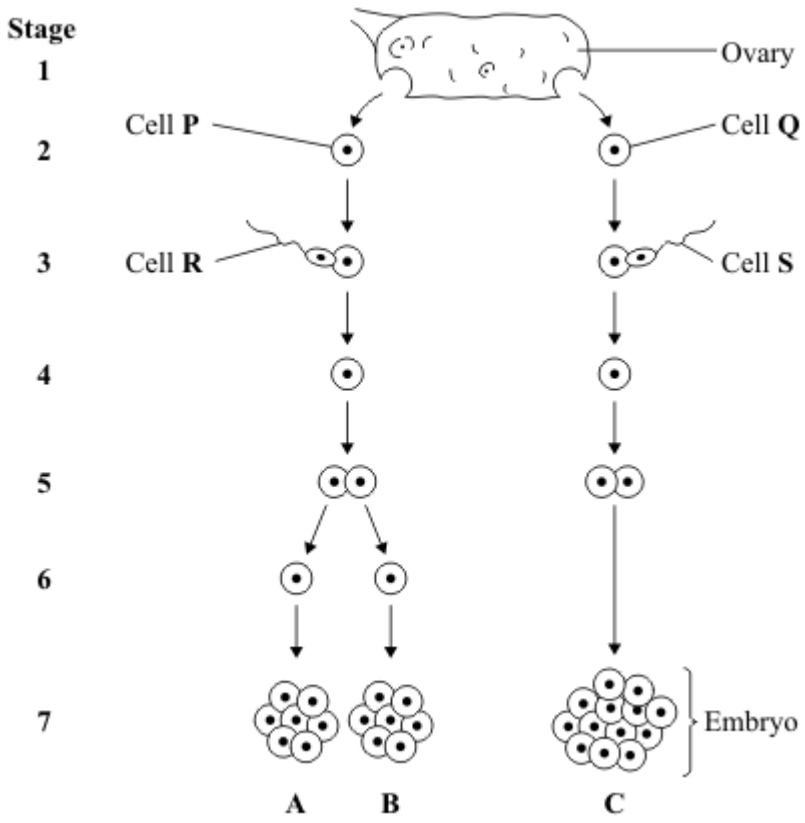
(3)

(Total 4 marks)

Q28.

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.

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.

_____

_____

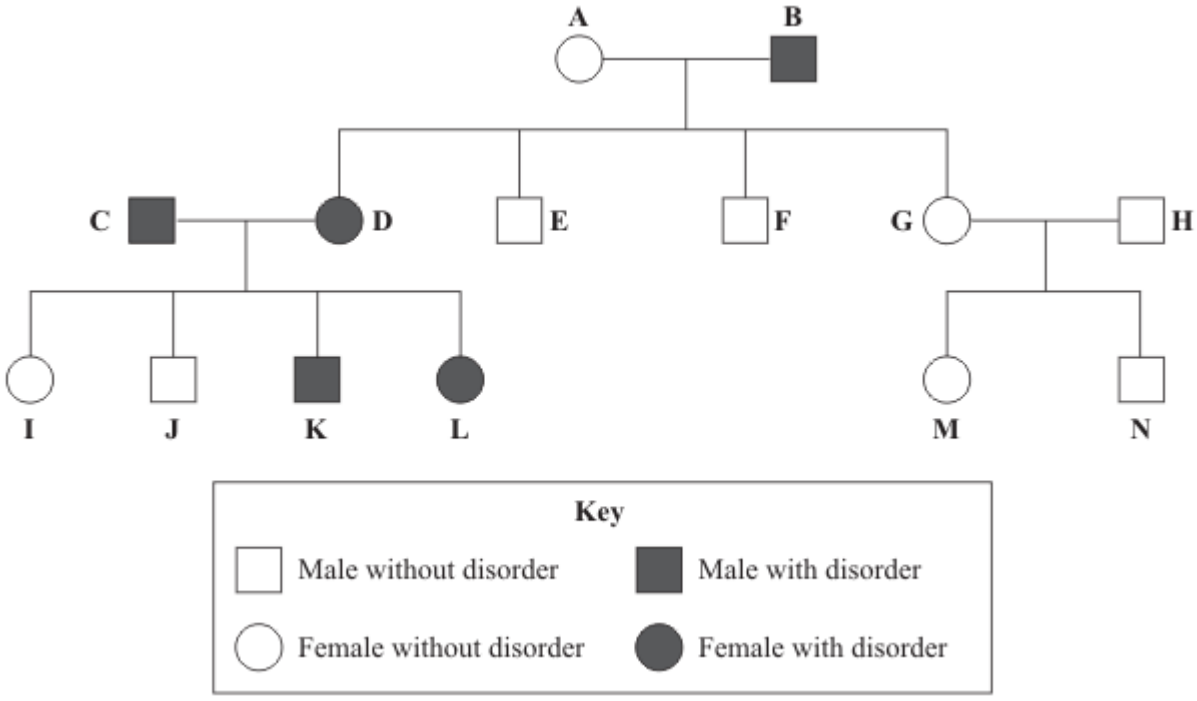
_____

(1)

(Total 9 marks)

Q29.

The diagram shows a family tree in which some individuals have an inherited disorder, which may cause serious long-term health problems.



(a) What proportion of the children of **A** and **B** have the disorder?

_____

(1)

(b) Explain the evidence from the diagram which shows that the allele for the disorder is dominant.

Use the appropriate letters to identify individuals in your answer.

You may use genetic diagrams in your explanation. There is space for you to draw a genetic diagram at the top of the facing page.

_____

_____

_____

_____

_____

_____

(3)

(c) (i) What is meant by 'embryo screening'?

_____

_____

(1)

(ii) A doctor suggests that couple **C** and **D** should have their embryos screened but that couple **G** and **H** do **not** need this procedure.

Explain the reasons for the doctor's suggestions.

_____

_____

_____

_____

_____

_____

_____

_____

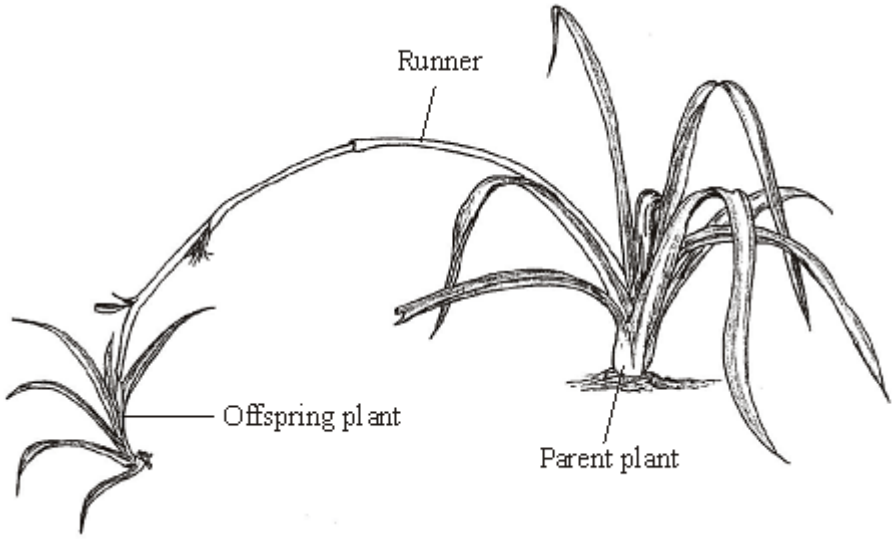
_____

(3)

(Total 8 marks)

Q30.

The diagram shows a spider plant during one type of reproduction.



Complete the sentences using words from the box.

asexual	**characteristics**	**chromosomes**	
gametes	**genes**	**mitosis**	**sexual**

(a) The colour and shape of the leaves of a spider plant are known as _____

(1)

(b) The shape of the leaves is controlled by _____

(1)

(c) The thread-like structures inside the nucleus of the cells are called _____

(1)

(d) The spider plant produces new cells in the runner by a process called _____

(1)

(e) This type of reproduction is called _____ reproduction.

(1)

(Total 5 marks)

Q31.

Cystic fibrosis is an inherited disorder that can seriously affect health.

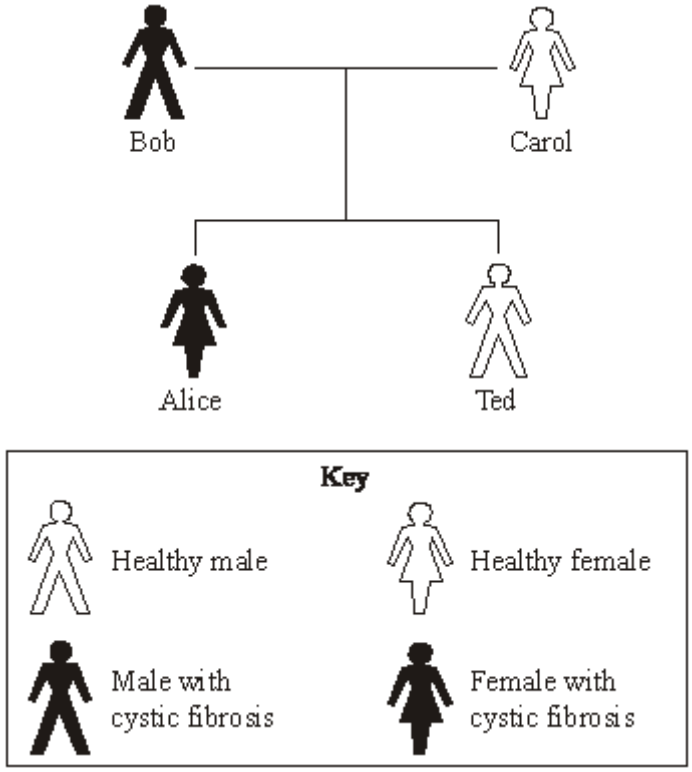
(a) Which **one** of these is affected by cystic fibrosis?

Draw a ring around your answer.

blood **cell membranes** **kidneys** **nervous system**

(1)

(b) The diagram shows the inheritance of cystic fibrosis in a family. The allele that produces cystic fibrosis is recessive.



(i) Explain why Alice inherited cystic fibrosis.

_____

_____

_____

_____

(2)

(ii) Explain why Ted did **not** inherit cystic fibrosis.

_____

_____

_____

_____

(2)

(c) Bob and Carol know that there is a risk that their next baby will have cystic fibrosis.

Embryos can be screened for the allele that produces cystic fibrosis.

Many people support the screening of embryos, but others do not.

(i) Suggest **one** reason why many people support the screening of embryos for the cystic fibrosis allele.

_____

_____

_____

(1)

(ii) Suggest **one** reason why many people are against the screening of embryos for the cystic fibrosis allele.

_____

_____

_____

(1)

(Total 7 marks)

Q32.

Chromosomes contain molecules of DNA. Genes are small sections of DNA.

(a) Each gene contains a code.

What does a cell use this code for?

_____

_____

_____

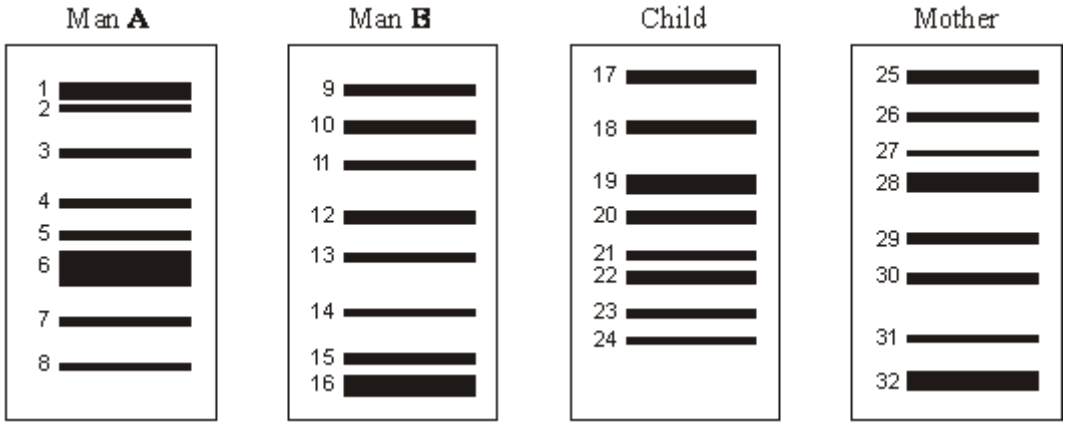
_____

(2)

(b) DNA fingerprints can be used to identify people. One example of the use of DNA fingerprints is to find out which man is the father of a child.

The diagram shows the DNA fingerprints of a child, the child's mother and two men who claim to be the child's father.

The numbers refer to the bars on the DNA fingerprints.



(i) Which man, **A** or **B**, is more likely to be the father of the child? ☐

Use the numbers on the DNA fingerprints to explain your choice.

In your answer you should refer to all four people.

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Only half the bars of the child's DNA fingerprint match the mother's DNA fingerprint.

Explain why.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q33.

Read the passage about IVF (in-vitro fertilisation) and embryo-splitting.

> "IVF is not as successful as we would like it," says scientist Michael Tucker. "On average, only one in five or one in six of all the embryos that we generate in the IVF lab will develop as far as full-term delivery as a baby."
>
> "There is a way to perhaps double those odds. A new, identical embryo is split off from the original embryo made in the IVF lab."
>
> "What we are really doing is creating an identical twin," says scientist Dr Hilton Kort.
>
> "And that's what happens in nature every day. Cloning is creating a replica of a person or an animal."

(a) Explain why the two embryos will develop into identical twins.

_____

_____

_____

_____

(2)

(b) Explain why the embryos are **not** clones of their parents.

_____

_____

_____

_____

(2)

(c) The scientists want to develop this technique, but are afraid to do so because public opinion might be against the technique.

Suggest an explanation for this.

_____

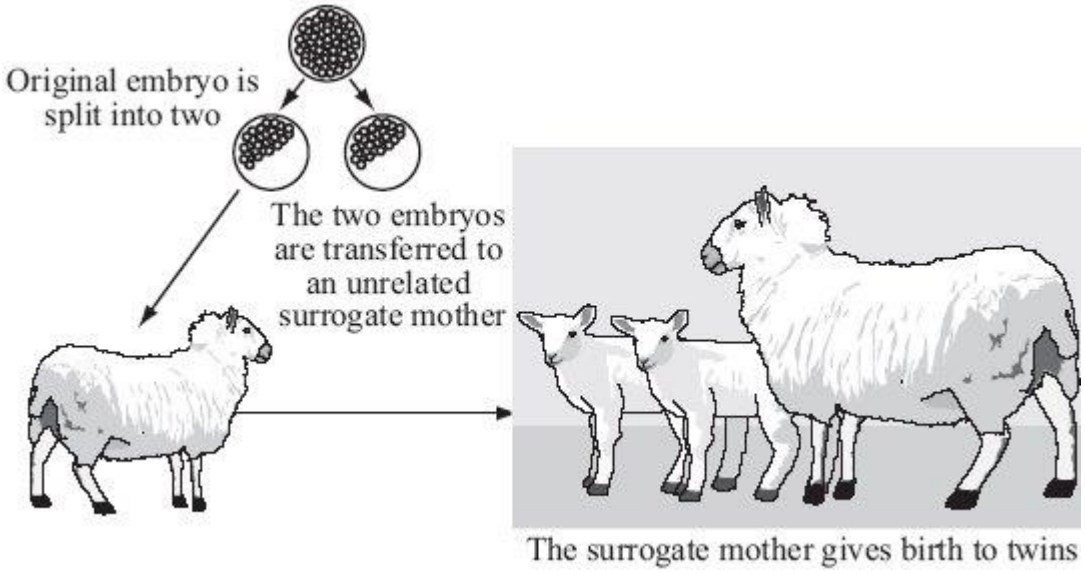
_____

(1)

(Total 5 marks)

Q34.

The diagram shows one way of cloning sheep.



Use words from the box to complete the sentences.

asexual	**clones**	**different**	**gametes**

identical	joining	sexual	splitting

The original embryo in the diagram developed following the _____ of an egg

and a sperm. This is called _____ reproduction. The twins in the diagram have

_____ genetic information. This is because the two embryos were produced by

_____ reproduction. Because of this they are known as _____

(Total 5 marks)

Q35.

Complete each sentence by choosing the correct terms from the box.

23	**46**	**ADH**	**DNA**	**XX**	**XY**	**YY**
dominant	**female**	**male**	**recessive**	**strong**	**weak**	

A gene is made up of a substance called _____ . Genes are found on chromosomes

and most human cells contain _____ pairs of chromosomes. In females the two

sex chromosomes are _____ but in males the two sex chromosomes are _____ .

Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a

Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a

genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a

genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a

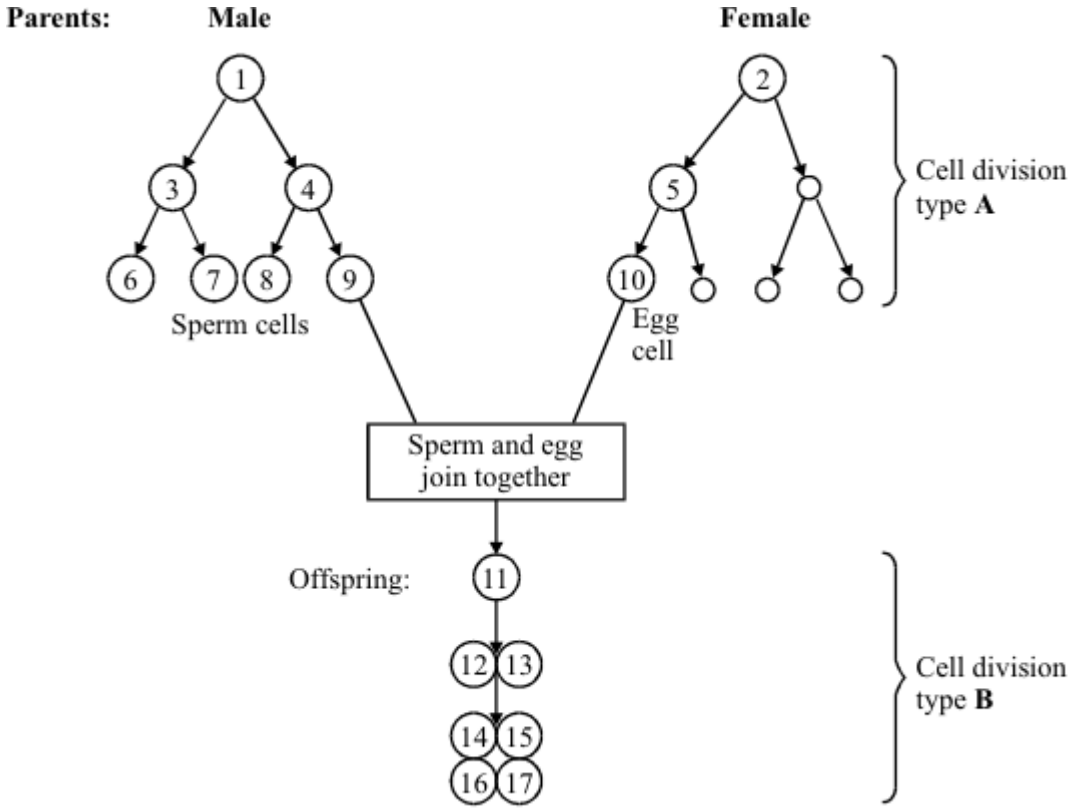
_____ allele. The two parents are healthy because they also have the

_____ allele.

(Total 6 marks)

Q36.

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)

Q37.

Diagram **1** shows the nucleus of a cell at the start of meiosis.

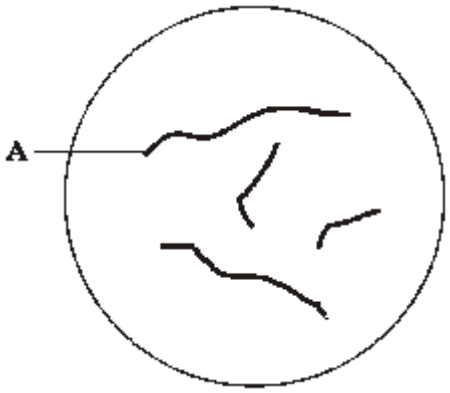


Diagram 1

(a) Name structure **A**. _____

(1)

(b) During meiosis, the nucleus shown in diagram **1** will divide twice to form four nuclei.

Complete diagram **2** to show the appearance of one of these nuclei.

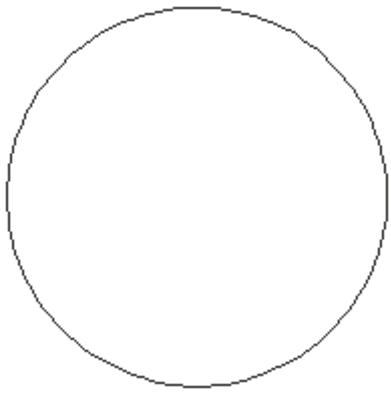
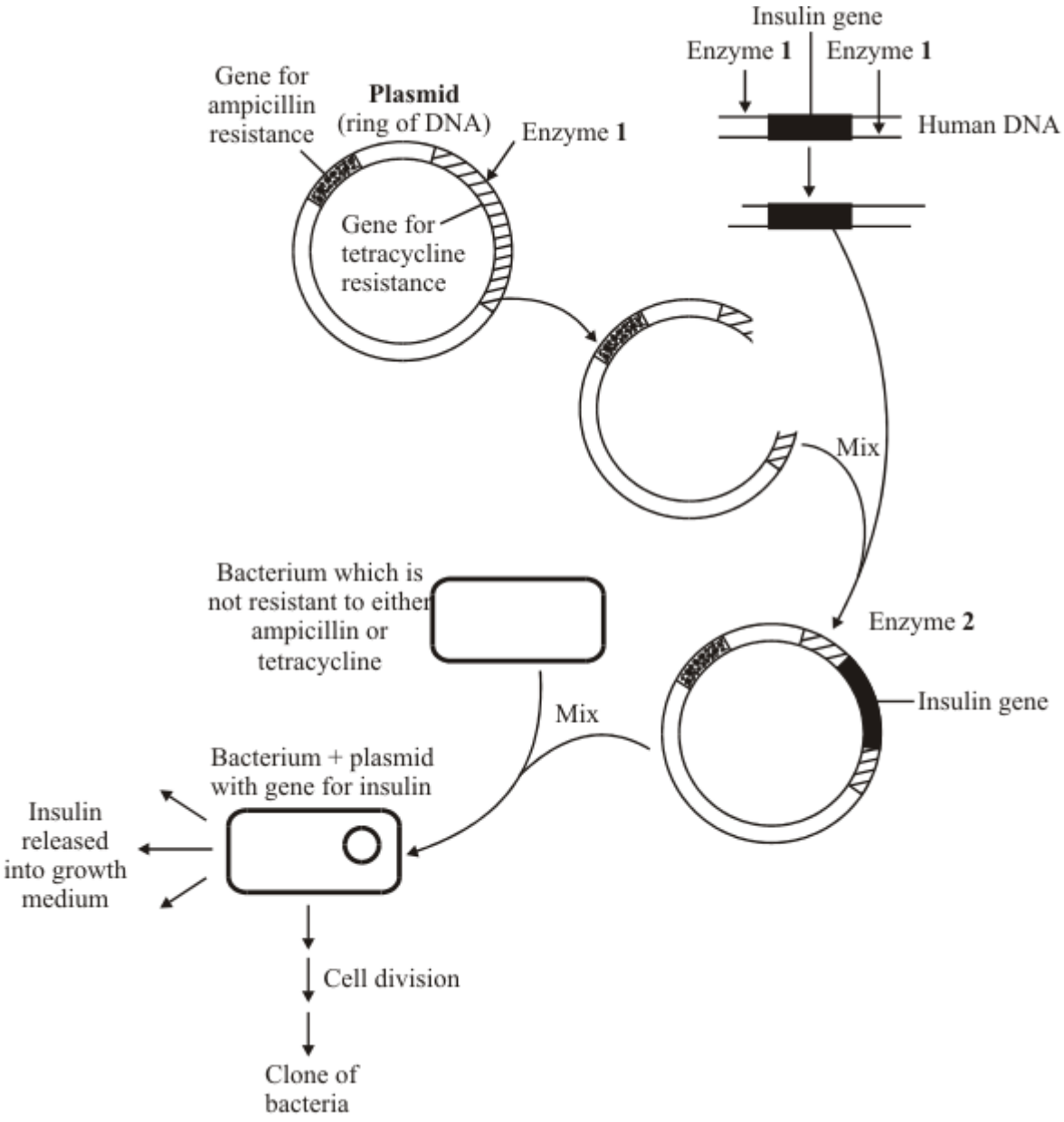


Diagram 2

(2)
(Total 3 marks)

Q38.

The diagram shows how genetic engineering can be used to produce human insulin from bacteria. Ampicillin and tetracycline are two types of antibiotic. Study the diagram carefully and answer the questions.



In experiments like these, some bacteria take up the plasmid (ring of DNA) containing the insulin gene. Other bacteria fail to take up a plasmid, or they take up an unmodified plasmid (a ring of DNA which has not been cut open and which does not contain the insulin gene).

(a) Complete the table by putting a tick (✓) in the correct boxes to show which bacteria would be able to multiply in the presence of ampicillin and which bacteria would be able to multiply in the presence of tetracycline.

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

(3)

(b) The bacterium with the plasmid containing the insulin gene multiplies by cell division to form a clone of bacteria.

Will **all** the bacteria in this clone be able to produce insulin? Explain your answer.

_____

_____

_____

_____

_____

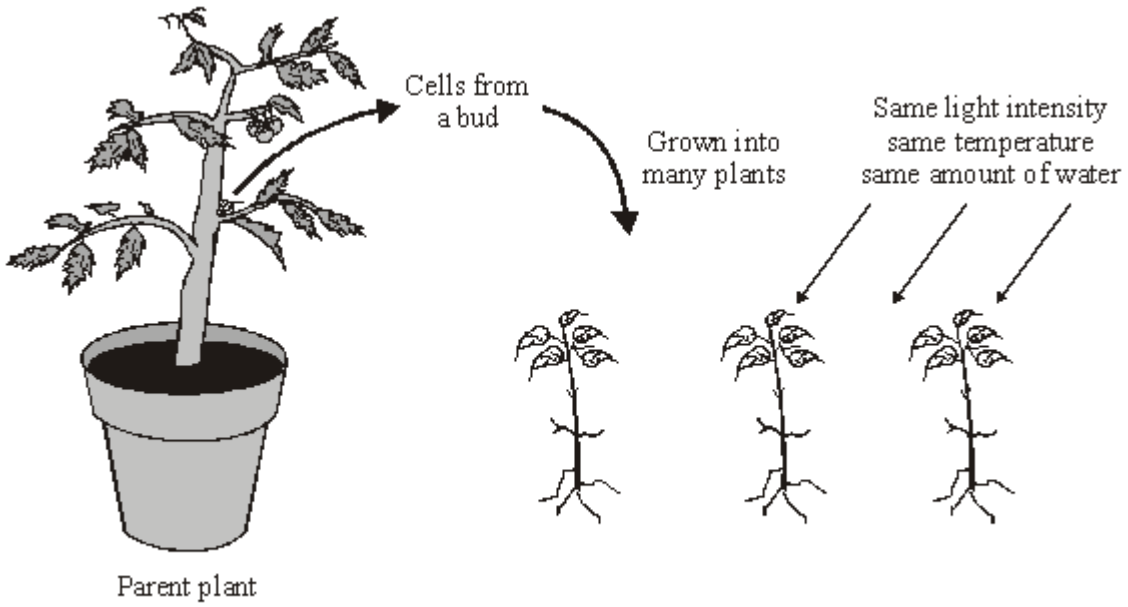
_____

(3)

(Total 6 marks)

Q39.

The diagram shows a method of producing a large number of plants which all look the same. Cells taken from the bud can be split into many groups. Each group of cells is then grown under the same conditions.



(i) What do scientists call organisms which are all produced from one parent and which all look the same?

Draw a ring around **one** answer.

clones **communities** **populations**

(1)

(ii) Give **two** reasons why plants produced by this method will all look the same.

1. _____

_____

2. _____

_____

(2)

(Total 3 marks)

Q40.

(a) Alleles are different forms of the same gene.

Why does a person usually inherit **two** alleles of each gene?

_____

(1)

(b) Some humans are albino (they have white hair and pale skin). This condition is caused by a recessive allele, **n**. The other allele, **N**, causes a coloured pigment to be made.

There are three possible combinations of these alleles:

NN **Nn** **nn**

(i) Which **one** of these combinations will an albino person have?

_____

(1)

(ii) Two non-albino parents can sometimes have an albino child.

Which **one** of the following combinations of alleles must these two parents have?

Tick (✓) the box next to the correct answer.

Tick **one** box only.

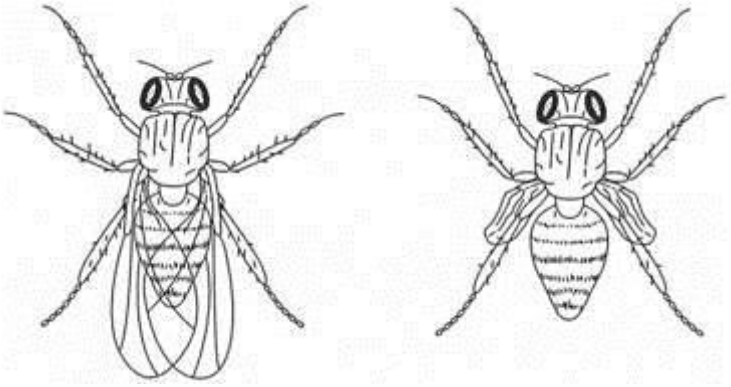
Parent 1	**Parent 2**	
NN	NN	☐
NN	Nn	☐
Nn	Nn	☐
nn	nn	☐

(1)

(Total 3 marks)

Q41.

The fruit fly, *Drosophila,* has either long wings or vestigial wings, as shown in the diagram.



Long-winged fly **Vestigial-winged fly**

The size of the wings is determined by a pair of alleles: **A** and **a**.
Long-winged flies have one of two possible genotypes: **AA** or **Aa**.
Vestigial-winged flies have only one genotype: **aa**.

(a) (i) What is the genotype of a heterozygous fly?

_____

(1)

(ii) Why can vestigial-winged flies only have the genotype **aa**?

_____

(1)

(b) A male and a female long-winged fly were crossed. They produced 96 offspring.
72 of the offspring had long wings and 24 had vestigial wings.
Use a genetic diagram to explain this.

(4)
(Total 6 marks)

Q42.

There are two types of reproduction, asexual and sexual. Use the words in the box to complete the sentences about reproduction.

You may use each word once or not at all.

asexual	eggs	gametes	fertilisation	inheritance
ovaries	sexual	sperms	testes	variation

The genetic information from the mother is carried in the _____

which are made in the _____ .

The genetic information from the father is carried in the _____

which are made in the _____ .

In _____ reproduction, offspring are produced that are genetically different from either parent.

This happens because genetic information from each parent is carried in the _____ and joined together during _____ to develop into a fetus.

In _____ reproduction, genetically identical offspring are produced because no mixing of genetic material takes place.

(Total 8 marks)

Q43.

(a) Complete the following passage

Chromosomes carry genetic information. Chromosomes are made up of _____ . Human body cells contain 46 chromosomes. There are twenty-two matching pairs but the final pair does not always match. It is these two that determine the gender, or sex, of the human. If you are a _____ the final pair of chromosomes matches. If you are a _____ the final pair of chromosomes does not match.

(2)

(b) Draw a labelled diagram to show that there is an equal chance of parents producing a baby boy or girl. Use the symbols **X** and **Y** for the chromosomes.

(4)

(Total 6 marks)

Q44.

(a) Mice with black fur can have the genotype **BB** or **Bb,** whilst mice with brown fur have the genotype **bb**.

(i) Use a genetic diagram to show what fur colours you would predict in the F1 offspring produced by two mice who are both **Bb**.

(3)

(ii) Why might your prediction of fur colour in the F1 generation **not** be proved right?

_____

_____

(1)

(b) Using the example in part (a) to help:

(i) describe the difference between dominant and recessive alleles;

_____

_____

_____

_____

(2)

(ii) describe the difference between alleles and genes;

_____

_____

_____

_____

(2)

(iii) describe the difference between homozygous and heterozygous chromosomes.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q45.

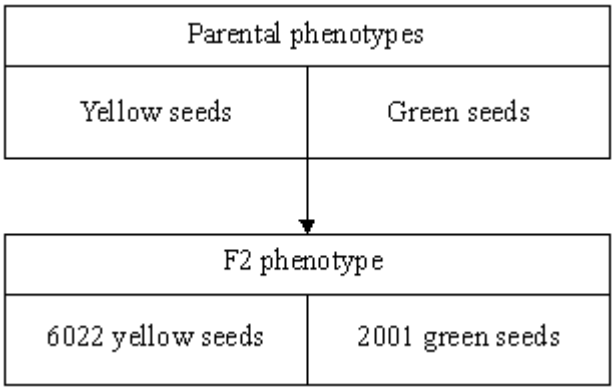
In the 1850s an Austrian monk, called Gregor Mendel, carried out a series of investigations on heredity.

(i) What plants did he use for his investigations?

_____

(1)

(ii) In his work he assumed that one gene controlled one characteristic. He started his investigations with pure breeding parents. Use a genetic diagram to show how he explained the following result.



(4)

(Total 5 marks)

Q46.

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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_____

_____

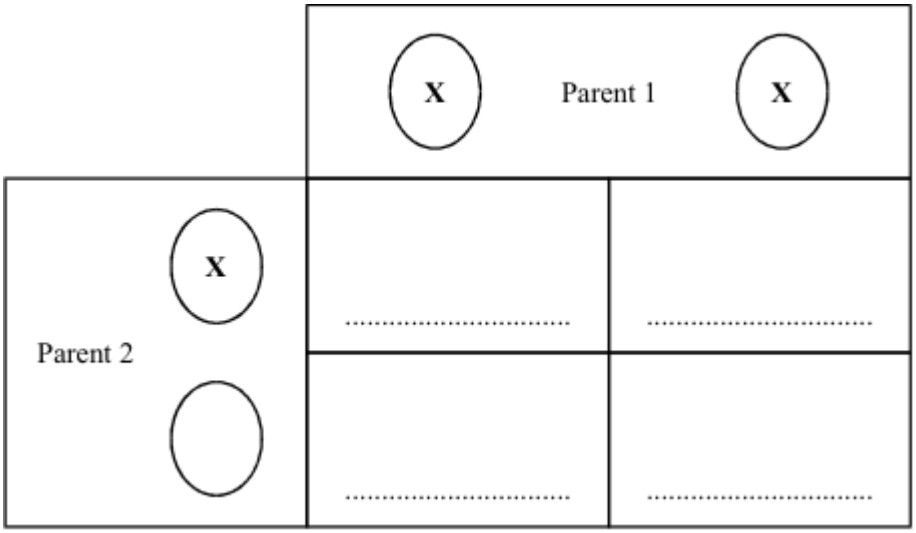
_____

_____

(Total 6 marks)

Q47.

The chromosomes for determining the gender or sex of a person are labelled **X** and **Y**.



(a) Complete the Punnett Square to show the genotype of parent 2 and of the four offspring.

(3)

(b) Which parent is the mother?

_____

(1)

(c) What are the chances of getting a baby boy?

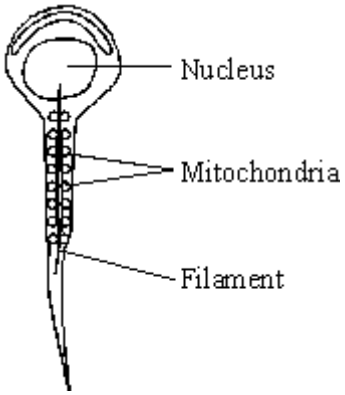
_____

(1)

(Total 5 marks)

Q48.

The diagram shows a human sperm. Inside the tail of the sperm is a filament mechanism that causes the side to side movement of the tail, which moves the sperm.



(a) Describe the function of the mitochondria and suggest a reason why they are arranged around the filament near the tail of the sperm.

_____

_____

_____

_____

(3)

(b) Explain the significance of the nucleus in determining the characteristics of the offspring.

_____

_____

_____

(2)

(Total 5 marks)

Q49.

These are all dogs. They are *in the same species.*

Type:	Great Dane	Yorkshire Terrier	Standard Dachshund
Weight:	54 kg	3.5 kg	9 kg
Height to shoulder:	57 cm	25 cm	20 cm

(a) What does it mean to be *in the same species?*

_____

_____

(2)

(b) Complete the following sentences.

- When dogs reproduce the _____ produces sperm in the

  _____ and the female produces eggs in the _____
- Sperm and eggs are also called _____
- During mating, the sperm and eggs fuse together. This is known as

  _____
- Once this has happened the _____ starts to develop in the uterus of the mother.

(6)

(c) Explain why puppies have some of the characteristics of both parents.

_____

_____

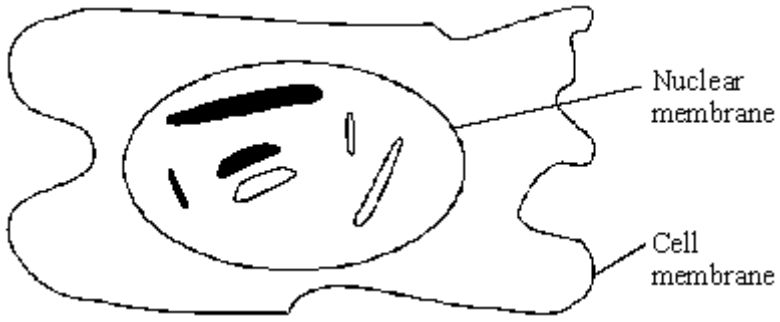
_____

(2)

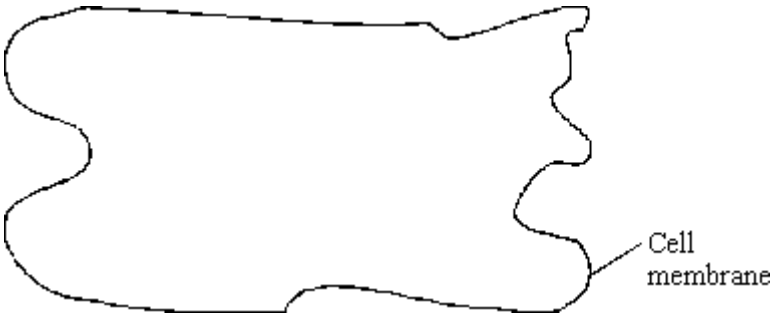
(Total 10 marks)

Q50.

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

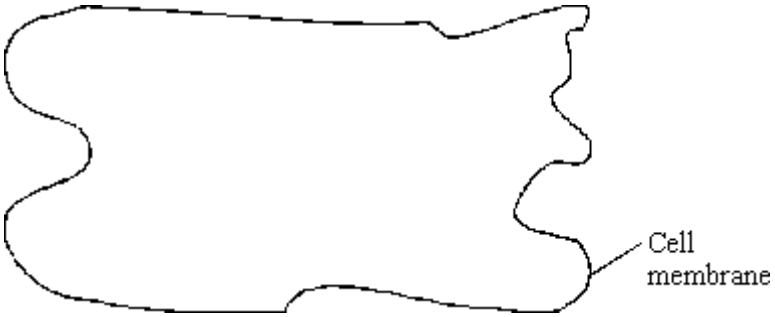


(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis.*



(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)

Q51.

In humans, the sex chromosomes **X** and **Y** determine whether the baby will be male or female (its gender).

(a) (i) Draw a genetic diagram to show how gender is inherited. The male has **XY** chromosomes and the female has **XX.**

(2)

(ii) What is the likelihood of obtaining a male child?

_____

(1)

(b) In the 16th century Henry VIII was the King of England. He blamed some of his wives for giving birth to daughters instead of sons. With our present day knowledge of genetics this mistake could not be made today. Explain why Henry VIII was wrong.

_____

_____

_____

(2)

(Total 5 marks)

Q52.

The passage below is an extract from an article in The Independent newspaper.

This Mouthwash could mean a lot to your Children

A SIMPLE TEST SCREENS WOULD-BE PARENTS FOR THE DEFECTIVE GENE THAT CAUSES CYSTIC FIBROSIS

It is not every week that a university professor tells you to spit in front of him. But Bob Williamson, professor of biochemistry and molecular genetics asked me to do just that.

In future, some people may choose their marriage partners on the basis of the contents of their spit.

The professor handed me a sample bottle containing sterile salt solution.

I rinsed my mouth out and spat back into the tube. Incredible though it may sound, the mouthwash now contained enough cells from the inner lining of my cheek for an assistant to dissect my DNA and check whether I carry any of the mutations responsible for cystic fibrosis.

Professor Williamson's team can locate genetic markers, distinctive segments of DNA, that are inherited along with the mutant genes in people affected with cistic fibrosis.

About 16 000 people who bought *The Independent* this morning unwittingly carry a cystic fibrosis gene. The statistics indicate that 23 of the staff of this newspaper are unknowing carriers. Carriers are normal healthy individuals who do not have the disease.

(a) Describe, as fully as you can, where genes are located inside cheek cells.

(2)

(b) The gene for cystic fibrosis has two forms called alleles. Only the recessive allele causes cystic fibrosis.

Explain how two healthy carriers of the cystic fibrosis allele could produce a child with the disease. Use the symbol **A** for the normal allele of the gene and **a** for the allele which produces the disease. You may use a diagram if you wish.

(4)

(d) In the test used to identify the 'genetic markers', DNA is extracted from the cheek cells. The DNA molecules are then made to produce hundreds of millions of copies of themselves.

(i) Explain, as fully as you can, how the structure of DNA molecules allows them to replicate themselves.

(6)

(ii) Explain how DNA controls the structure of proteins.

_____

_____

(3)

(Total 15 marks)

Q53.

The following passage is adapted from an article by Martin Kelly in The Independent newspaper.

Thanks to the test tube banana

Specially bred resistant varieties may

save African crops from disease

A banana is a fruit, but it has no seeds. And if there are no seeds how do the plants reproduce? At one level the answer is easy; centuries of selective breeding have resulted in varieties with plenty of tasty flesh but few bitter inedible seeds, and propagation is carried out by means of root corms.

Most bananas we eat are thus actually 'clones' of a few successful plants, as is also the case with the potato. Banana clones are genetically identical to their parents, so growers can be completely sure their fruits will be big and tasty.

Genetic variability of these cloned plants is extremely low. Resistance to new diseases, therefore, is almost nil; witness the spread of potato blight through Ireland in the 1840s.

The issue goes well beyond our high streets and supermarkets. The banana has a larger relative called a plantain, which is starchy rather than sweet and is a staple food of more than 60 million Africans. Bananas and plantains are being ravaged by a new fungal disease called Black Sigatoka. The commercial planters that produce the bananas we buy in supermarkets have little problem here; they can afford to buy chemicals to spray their crops. African subsistence farmers, forced to rely on 'organic' methods can only sit by and watch their plants die.

Several governments have turned to the International Institute for Tropical Agriculture (IATA) for help. IATA is in Africa, but is not of Africa. It is internationally funded with levels of staffing and equipment that enable advanced bio-technological techniques to be used. However, even with genetic engineering, to breed resistant varieties is a long-term project and Black Sigatoka is not going to wait. IATA scientists have had to divide their energies between two approaches: an interim solution and the development of resistant varieties.

The interim solution was easily found in a group of 'cooking bananas' which were resistant to Black Sigatoka disease and which could, to some extent, be substituted for plantain in the diet. These, however, were only found in localised areas and the first problem facing IATA was to obtain enough plants from the few available plants of resistant

varieties to supply the needs of the affected farmers.

(a) Explain how selective breeding may have been used to produce bananas with tasty flesh.

(2)

(b) Explain, as fully as you can, why "Genetic variability of these cloned plants is extremely low" compared with natural populations.

(4)

(c) Explain, as fully as you can, how IATA scientists might be able to "obtain enough plants from the few available plants of resistant varieties to supply the needs of affected farmers".

(3)

(d) Explain, as fully as you can, how IATA scientists may use genetic engineering to produce varieties of banana resistant to Black Sigatoka disease.

(4)

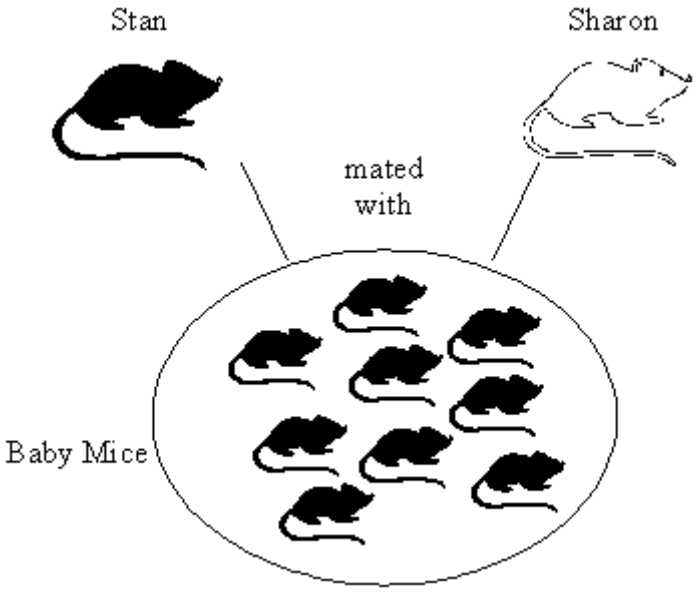
(Total 13 marks)

Q54.

A student's hobby was breeding pet mice. Three of the pet mice were called Stan, Tom and Sharon. Stan and Tom had black fur. Sharon had white fur.

The colour of the fur is controlled by a single gene which has two alleles B and b.

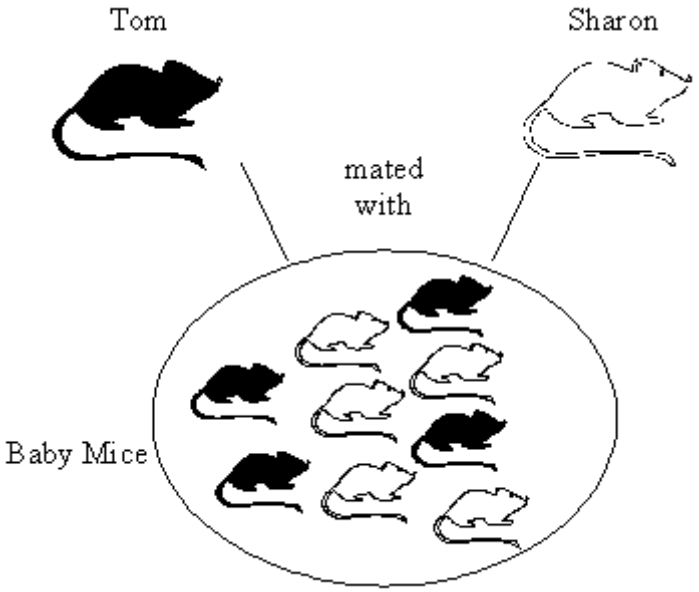
(a) The student first crossed Stan with Sharon. The results are shown on the diagram.



Explain why the baby mice produced by crossing Stan and Sharon all had black fur. You may use a genetic diagram if you wish.

(3)

(b) The student then crossed Tom with Sharon. The results are shown on the diagram.



When Tom was crossed with Sharon, some of the baby mice had black fur and

some white.

Explain why. You may use a genetic diagram if you wish.

(3)
(Total 6 marks)

Q55.

Wild turkeys have black feathers. Until about 30 years ago turkeys reared for meat also had black feathers like this.

However, a recessive gene which produced entirely white feathers appeared, and turkey farmers changed to breeding white-feathered birds.

Supermarkets preferred white-feathered birds, because small pieces of feather left in the skin after plucking were not visible as dark patches. Customers wanted unblemished oven-ready birds. Now, however, there is a demand again for birds with black feathers which can be marketed as 'traditional' farm-produced turkeys.

(a) Feather colour is controlled by one pair of genes.

(i) Suggest suitable symbols for **each** of the two alleles of this pair of genes.

Black feathers _____ White feathers _____

(1)

(ii) What alleles for feather colour would a white turkey have? _____

(1)

(b) Explain carefully why 'traditional' black-feathered turkeys could not be bred from a flock of white-feathered birds.

_____

_____

_____

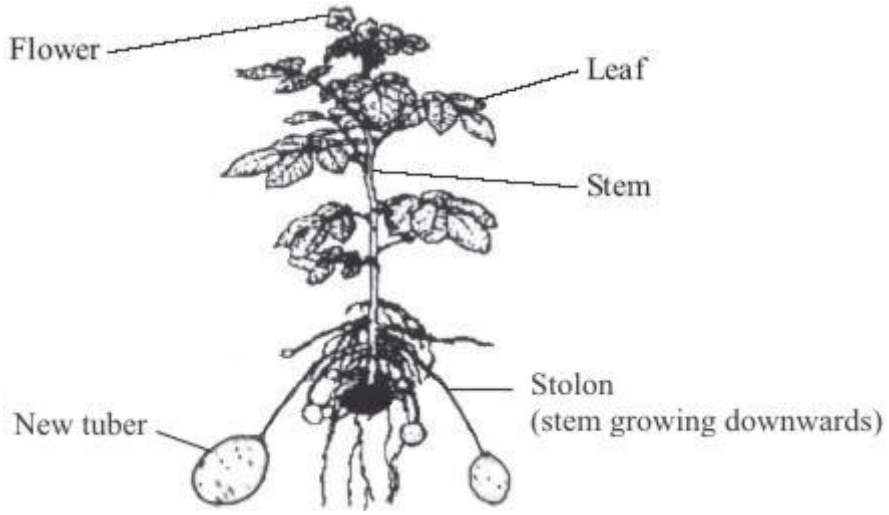
_____

(2)

(Total 4 marks)

Q56.

The drawing shows a potato plant producing new tubers (potatoes). Buds on the stem of the parent plant produce stolons. The new tubers are formed at the ends of the stolons (stems that grow downwards).



(a) Explain why the new tubers are genetically identical to each other.

_____

_____

_____

_____

(2)

(b) Some of the tubers are used to produce potato plants. These new potato plants will not all grow to the same height.

Give **one** reason why.

_____

_____

(1)

(Total 3 marks)

Q57.

Read the extract.

Super-bug may hit the price of coffee

The coffee bean borer, a pest of the coffee crop, can be controlled by the pesticide endosulphan However, strains of the insect that are up to 100 times more resistant to the pesticide have emerged on the South Pacific island of New Caledonia.

For full resistance to be passed on to an offspring two copies of the new resistance allele should be inherited, one from each parent. There is much inbreeding with brother-sister matings happening in every generation, so it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele.

If this resistance spreads from New Caledonia, it will mean the loss of a major control method. This will present a serious threat to the international coffee industry.

(a) Suggest how the allele for resistance to endosulfan may have arisen.

_____

_____

(1)

(b) (i) How would you expect the proportion of normal coffee bean borers on New Caledonia to change over the next few years?

_____

(ii) Explain why this change will take place.

_____

_____

_____

_____

_____

_____

(3)

(c) Explain why “it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele.” (lines 6-8)

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q58.

Most people have a gene which produces a protein called CFTR that enables the cells lining the lungs to work efficiently. In people suffering from cystic fibrosis this gene is faulty; it produces a protein which lacks just one of the 1480 amino acids found in CFTR.

(i) Name the molecule which carries the genetic information for producing proteins such as CFTR.

_____

(1)

(ii) Explain how this molecule is responsible for the structure of proteins such as CFTR.

_____

_____

_____

_____

_____

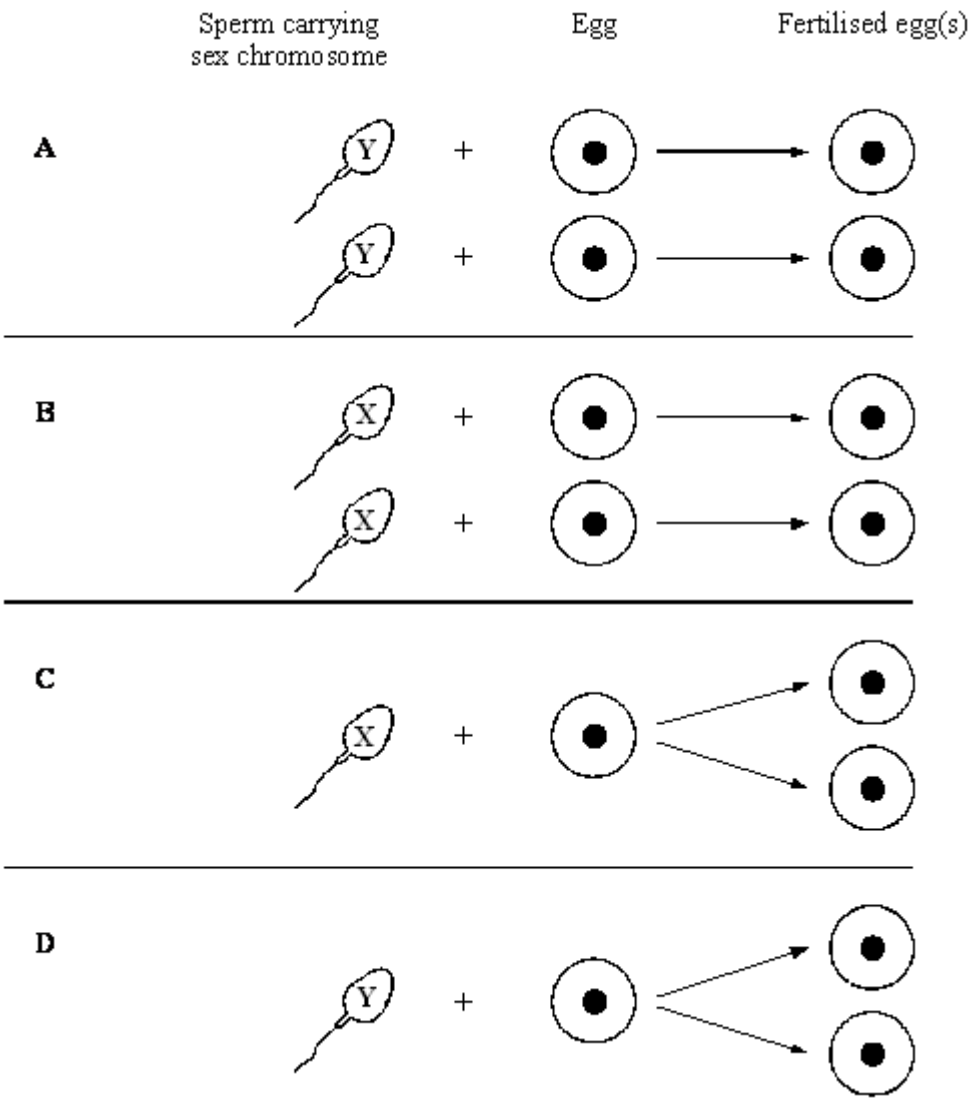
_____

(3)

(Total 4 marks)

Q59.

The diagrams show four ways in which human twins may be formed.



Which diagram, **A**, **B**, **C** or **D**, shows the process which will produce genetically identical twin boys?

_____

Explain the reason for your choice.

_____

_____

_____

_____

_____

_____

(Total 3 marks)