Reproduction

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: Reproduction

Q1.

This question is about the cell cycle.

(a) Chromosomes are copied during the cell cycle.

Where are chromosomes found?

Tick **one** box.

Cytoplasm	☐
Nucleus	☐
Ribosomes	☐
Vacuole	☐

(1)

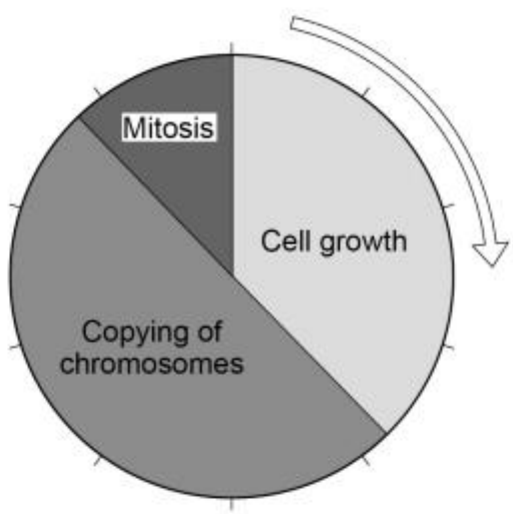
(b) What is the name of a section of a chromosome that controls a characteristic?

____

(1)

Figure 1 shows information about the cell cycle.

Figure 1



(c) Which stage of the cell cycle in **Figure 1** takes the most time?

Tick **one** box.

Cell growth ☐

Copying of chromosomes ☐

Mitosis ☐

(1)

(d) During mitosis cells need extra energy.
Which cell structures provide most of this energy?

Tick **one** box.

Chromosomes ☐

Cytoplasm ☐

Mitochondria ☐

Ribosomes ☐

(1)

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

Calculate the time taken for mitosis.

____

____

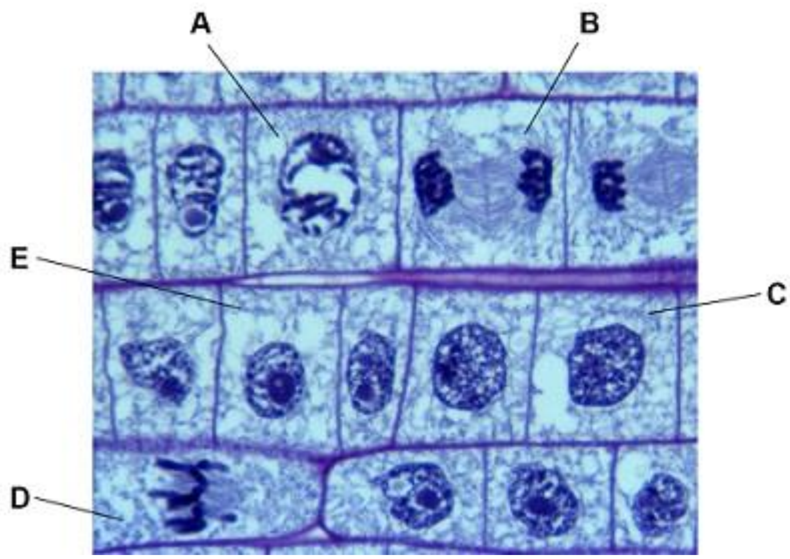
____

____

Time = ____________________ minutes

(2)

Figure 2 shows some cells in different stages of the cell cycle.



(f) Which cell is **not** dividing by mitosis

Tick **one** box.

A	☐	B	☐	C	☐	D	☐

(1)

(g) Cell **E** in **Figure 2** contains 8 chromosomes.
Cell **E** divides by mitosis.

How many chromosomes will each new cell contain?

Tick **one** box.

2 ☐

4 ☐

8 ☐

16 ☐

(1)

(h) Why is mitosis important in living organisms?

Tick **one** box.

To produce gametes ☐

To produce variation ☐

To release energy ☐

To repair tissues ☐

(1)
(Total 9 marks)

Q2.

Earthworms are small animals that live in soil. Earthworms have no specialised gas exchange system and absorb oxygen through their skin.

(a) What is the name of the process in which oxygen enters the skin cells?

Tick **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Respiration ☐

(1)

The table below shows information about four skin cells of an earthworm.

Cell	**Percentage of oxygen**	
	Outside cell	**Inside cell**

A	9	8
B	12	8
C	12	10
D	8	12

(b) Which cell has the smallest difference in percentage of oxygen between the outside and the inside of the cell?

Tick **one** box.

A		B		C		D	

(1)

(c) Which cell will oxygen move **into** the fastest?

Tick **one** box.

A		B		C		D	

(1)

(d) Earthworms have a large surface area to volume ratio.

Suggest why a large surface area to volume ratio is an advantage to an earthworm.

____

____

(1)

(e) The earthworm uses enzymes to digest dead plants.

Many plants contain fats or oils.

Which type of enzyme would digest fats?

____

____

(1)

(f) Earthworms move through the soil.

This movement brings air into the soil.

Dead plants decay faster in soil containing earthworms compared with soil containing **no** earthworms.

Explain why.

____

____

____

____

____

____

(3)

(g) When earthworms reproduce, a sperm cell from one earthworm fuses with an egg cell from a different earthworm.

Name the process when an egg cell and a sperm cell fuse.

____

(1)

(h) Some types of worm reproduce by a process called fragmentation.

In fragmentation, the worm separates into two or more parts. Each part grows into a new worm.

What type of reproduction is fragmentation?

____

(1)

(Total 10 marks)

Q3.

In the mid-19th century, a scientist studied inheritance in pea plants.

The scientist's work was the beginning of our modern understanding of genetics.

(a) What is the name of this scientist?

Tick **one** box.

Alfred Russel Wallace ☐

Charles Darwin ☐

Gregor Mendel ☐

Jean-Baptiste Lamarck ☐

(1)

(b) In the mid-20th century, other scientists identified the chemical substance that makes up genetic material.

What is the name of the chemical substance that makes up genetic material?

Tick **one** box.

Carbohydrate ☐

DNA ☐

Lipid ☐

Protein ☐

(1)

(c) A gene often has two alleles.

One allele is dominant and the other allele is recessive.

When is a recessive allele expressed as a characteristic?

Tick **one** box.

When the dominant allele is not present	☐
When the recessive allele is inherited from the female parent	☐
When the recessive allele is inherited from the male parent	☐
When the recessive allele is present on only one of the chromosomes	☐

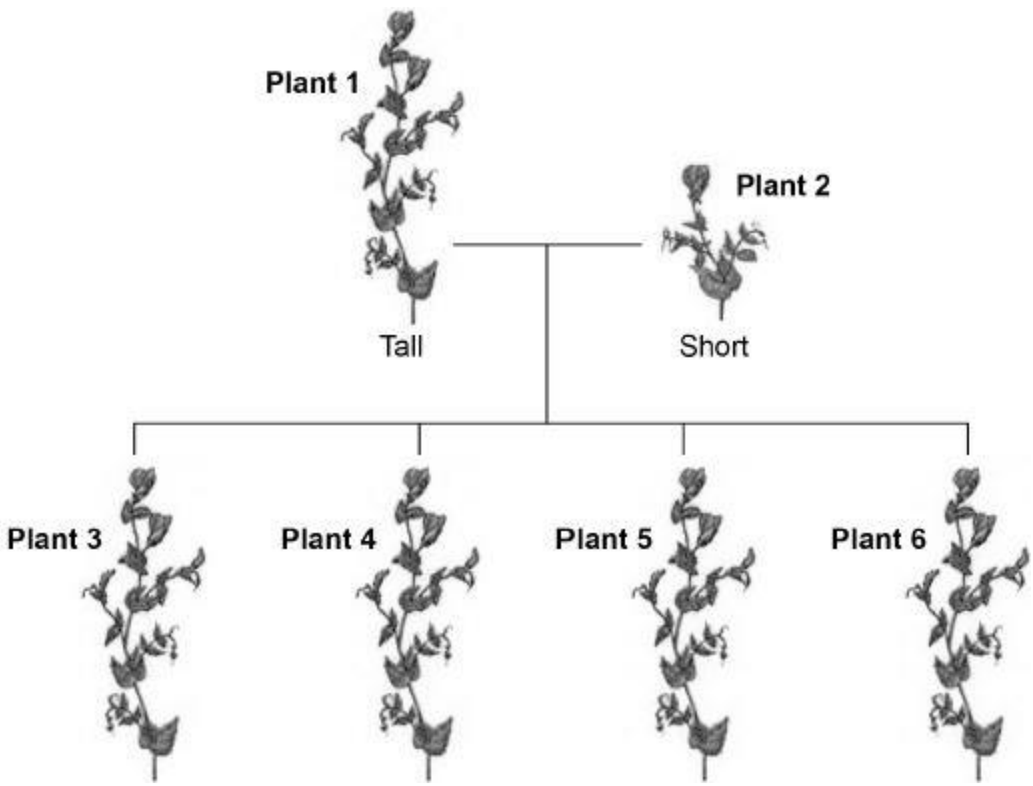
(1)

A scientist investigated the inheritance of height in pea plants.

The scientist crossed tall pea plants with short pea plants.

Figure 1 shows the scientist's results.

Figure 1



All tall offspring

In questions **(d)** and **(e)**, use the following symbols to represent alleles:

T = the dominant allele for tall.
t = the recessive allele for short.

(d) In **Figure 1**, the genotype of plant **1** is **TT**.

Give the genotype of plant **2**.

____

(1)

(e) The scientist crossed plant **3** with plant **4**.

Complete **Figure 2** to show the offspring produced from this cross.

Figure 2

		Male gametes	
		T	t
Female gametes	T	TT	
	t		

(2)

(f) Draw a circle around **one** of the homozygous offspring in **Figure 2**.

(1)

(g) What is the ratio of tall plants : short plants in the offspring in **Figure 2**?

Ratio of tall plants : short plants = _______________ : _______________

(1)
(Total 8 marks)

Q4.

Cell division is needed for growth and for reproduction.

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

Complete the table.

Tick **one** box for each statement.

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

(2)

Bluebell plants grow in woodlands in the UK.

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

(b) One advantage of asexual reproduction for bluebells is that only **one** parent is needed.

Suggest **two** other advantages of asexual reproduction for bluebells.

1. ____

____

2. ____

____

(2)

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

____

____

(4)
(Total 8 marks)

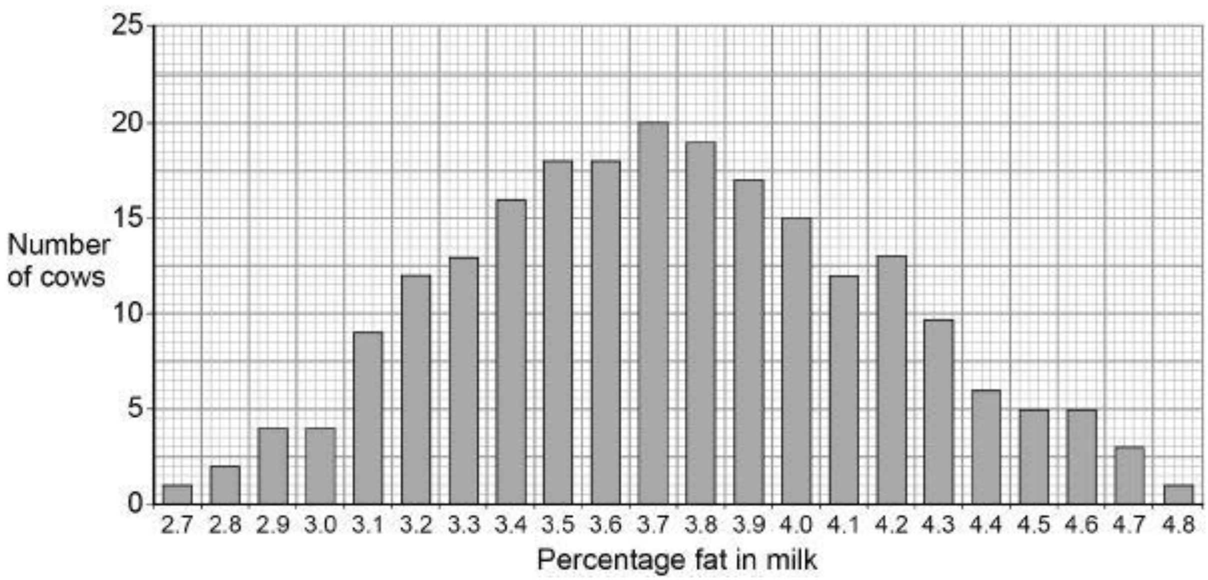
Q5.

Scientists want to breed cows that produce milk with a low concentration of fat.

Figure 1 shows information about the milk in one group of cows.

The cows were all the same type.

Figure 1



(a) In **Figure 1** the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

Mean percentage = ________________

(1)

(b) A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

Tick **one** box.

2		3		22		46	

(1)

(c) Give the evidence from **Figure 1** which shows the percentage of fat in the milk is controlled by several genes.

____

____

(1)

(d) One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

____

____

____

____

____

____

(3)

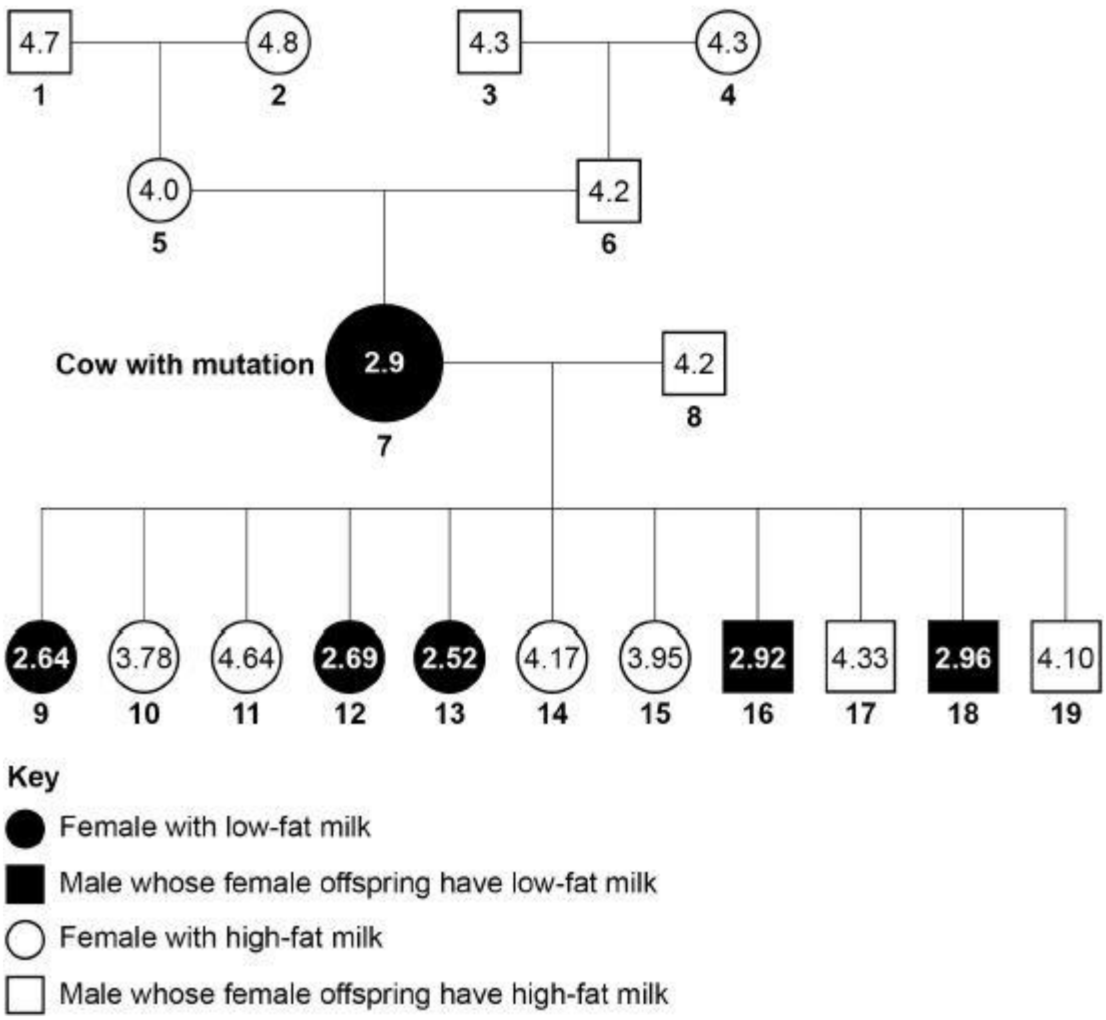
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

Figure 2 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

Figure 2



(e) Animal **8** is homozygous.

The mutation in animal **7** produced a dominant allele for making low-fat milk.

Give evidence from **Figure 2** that animal **7** is heterozygous.

____

____

(1)

(f) Animals **7** and **8** produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals **7** and **8** to mate naturally.

(1)

(g) Draw a Punnett square diagram to show a cross between animals **7** and **8**.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

(4)

(h) The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in **Figure 2**.

Describe how the scientists would do this.

____

____

____

____

____

(4)
(Total 16 marks)

Q6.

Chromosomes carry genetic information.

Chromosomes are found in nearly all human cells.

(a) How many chromosomes are there in most human body cells?

Tick **one** box.

23 ☐

24 ☐

46 ☐

48 ☐

(1)

(b) How many chromosomes are there in a human gamete cell?

____

(1)

(c) Complete the sentences.

Choose the answers from the box.

sexual reproduction	binary fission	egg	fertilisation	meiosis
mitosis	ovary	sperm	testis	uterus

The female gamete is called the ____________________________.

The male gamete is called the ____________________________.

The female gamete is produced in the ____________________________.

Gametes are produced by a type of cell division

called ____________________________ .

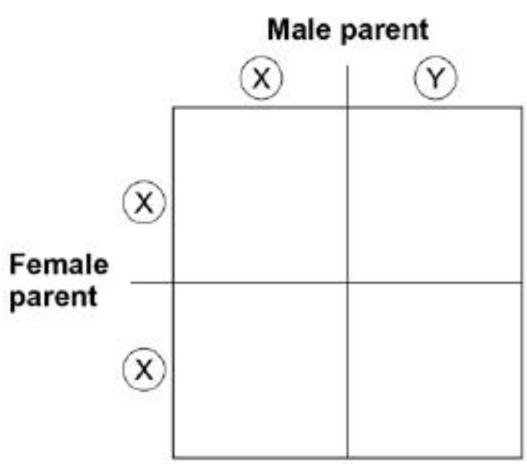
Male and female gametes join together in a process

called ____________________________ .

(5)

In humans, the sex chromosomes are called **X** and **Y**.

The diagram shows the inheritance of sex chromosomes.



(d) Complete the diagram above to show the sex chromosomes inherited by the offspring.

(2)

(e) What is the chance that a child produced by these parents will be female?

Tick **one** box.

1 in 2 ☐

1 in 3 ☐

1 in 4 ☐

3 in 4 ☐

(1)

(f) The parents shown in the diagram above have five children.

Give **two** reasons why these children all look different from each other.

1. ____

____

2. ____

____

(2)
(Total 12 marks)

Q7.

In humans, chromosome **X** and chromosome **Y** are the sex chromosomes.

(a) Most cells in the human body contain two sex chromosomes.

Which type of cell does **not** have two sex chromosomes?

Tick **one** box.

Liver cell ☐

Muscle cell ☐

Nerve cell	☐
Red blood cell	☐

(1)

(b) Apart from the sex chromosomes, how many **other** chromosomes are there in most human body cells?

Tick **one** box.

21 ☐ 23 ☐ 44 ☐ 46 ☐

(1)

Stickler syndrome is an inherited disorder that causes damage to the eye.

One of the symptoms of Stickler syndrome is that black spaces can appear in the visual image.

(c) Which part of the eye is affected by Stickler syndrome?

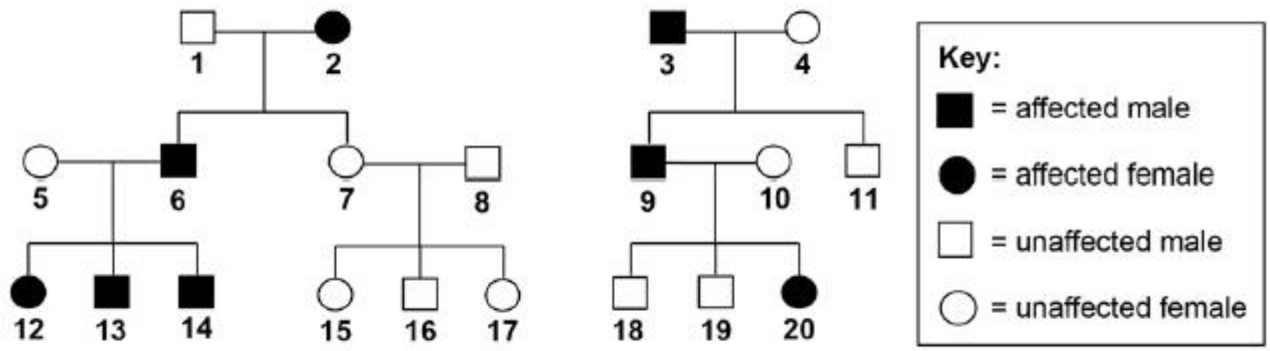
Tick **one** box.

Ciliary muscles	☐
Iris	☐
Retina	☐
Suspensory ligaments	☐

(1)

Stickler syndrome is caused by the inheritance of a dominant allele.

The diagram shows the inheritance of Stickler syndrome in two families.



Use the following symbols in your answers to (d) and (e):

A = the dominant allele for Stickler syndrome

a = the recessive allele for unaffected vision.

(d) Explain why none of the children of persons **7** and **8** have Stickler syndrome.

____

____

____

____

(2)

(e) Person **12** marries person **18**.

Use a Punnett square diagram to find the probability that their first child will be a female with Stickler syndrome.

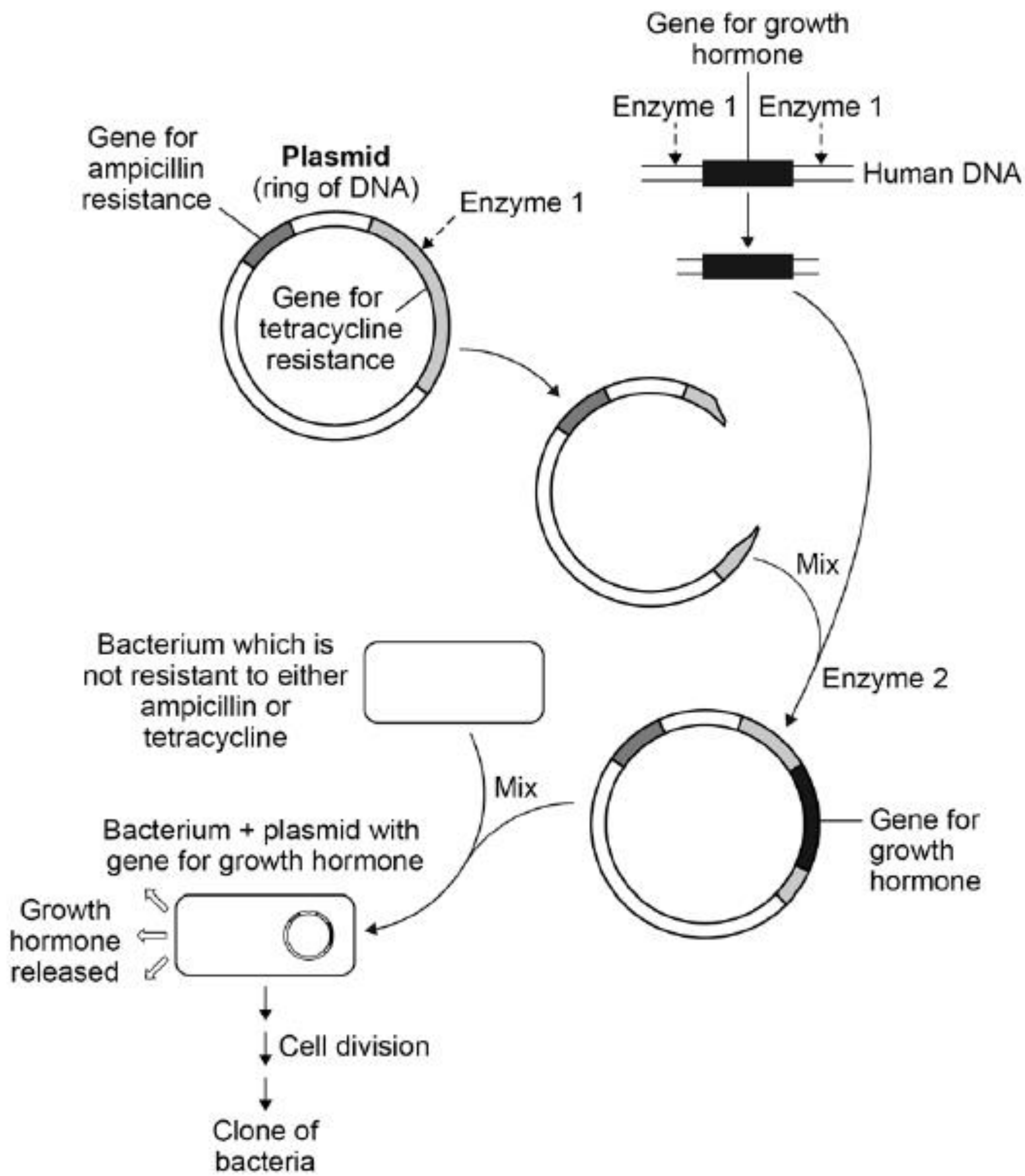
Probability of a female child with Stickler syndrome = ________________________

(4)

(Total 9 marks)

Q8.

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 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.

____

____

____

____

____

____

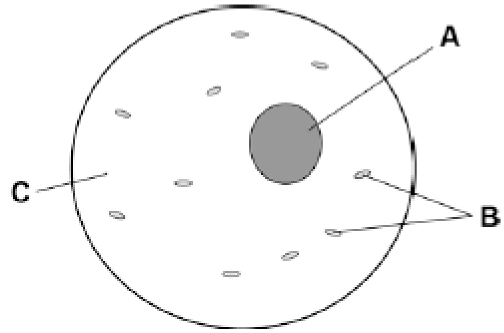
(3)

(Total 10 marks)

Q9.

Figure 1 shows a human body cell.

Figure 1



(a) Which part in **Figure 1** contains chromosomes?

Tick **one** box.

A ☐ **B** ☐ **C** ☐

(1)

(b) Humans have pairs of chromosomes in their body cells.

Draw **one** line from each type of cell to the number of chromosomes it contains.

Type of cell	**Number of Chromosomes**
	10
Human body cell	23
	46
Sperm cell	60
	92

(2)

(c) Humans have two different sex chromosomes, **X** and **Y**.

Figure 2 shows the inheritance of sex in humans.

Figure 2

		Mother	
		X	X
Father	X	XX	XX
	Y	XY	XY

Circle a part of **Figure 2** that shows an egg cell.

(1)

(d) Give the genotype of male offspring.

____

(1)

(e) A man and a woman have two sons. The woman is pregnant with a third child.

What is the chance that this child will also be a boy?

Tick **one** box.

0%	☐
25%	☐
50%	☐
100%	☐

(1)
(Total 6 marks)

Q10.

Our understanding of genetics and inheritance has improved due to the work of many scientists.

(a) Draw **one** line from each scientist to the description of their significant work.

Scientist	Description of significant work
Charles Darwin	Carried out breeding experiments on pea plants.
Alfred Russel Wallance	Wrote 'On the origin of species'.
Gregor Mendel	Worked on plant defence systems.

Worked on warning colouration in animals.

(3)

(b) In the mid-20th century the structure of DNA was discovered.

What is a section of DNA which codes for one specific protein called?

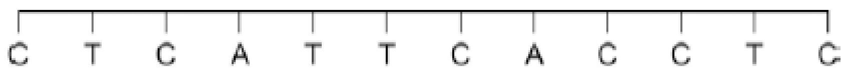
____

(1)

(c) **Figure 1** shows one strand of DNA.

The strand has a sequence of bases (A, C, G and T).

Figure 1



How many amino acids does the strand of DNA in **Figure 1** code for?

Tick **one** box.

2 ☐

3 ☐

4 ☐

6 ☐

(1)

(d) Mutations of DNA cause some inherited disorders.

One inherited disorder is cystic fibrosis (CF).

A recessive allele causes CF.

Complete the genetic diagram in **Figure 2**.

- Identify any children with CF.
- Give the probability of any children having CF.

Each parent does not have CF.

The following symbols have been used:

D = dominant allele for **not** having CF

d = recessive allele for having CF

Figure 2

		Mother	
		D	d
Father	D	DD	
	d		

Probability of a child with CF = ______________________

(3)

(e) What is the genotype of the mother shown in **Figure 2**?

Tick **one** box.

Heterozygous ☐

Homozygous dominant ☐

Homozygous recessive ☐

(1)
(Total 9 marks)

Q11.

Figure 1 shows an image of a small section of DNA.

Figure 2 shows the structure of a small section of DNA.

Figure 1 **Figure 2**

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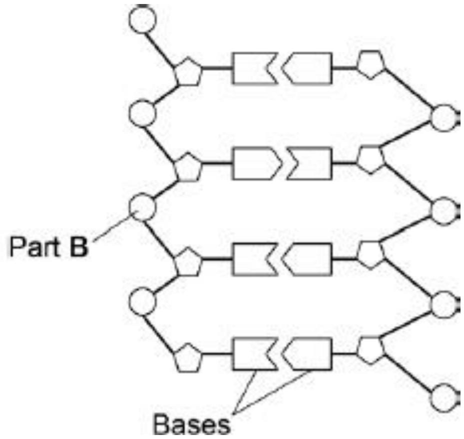


(a) What is Part **B**?

____

____

(1)

(b) In **Figure 1** the structure of DNA shows four different bases.

There are four different bases and they always pair up in the same pairs.

Which bases pair up together?

____

(1)

(c) Syndrome H is an inherited condition.

People with syndrome H do **not** produce the enzyme IDUA.

Figure 3 shows part of the gene coding for the enzyme IDUA.

Figure 3

C T C A T T C A G C T C — Strand **J** from a person **without** syndrome H

C T C A T T T A G C T C — Strand **K** from a person **with** syndrome H

Strand **K** shows a mutation in the DNA which has caused syndrome H.

The enzyme IDUA helps to break down a carbohydrate in the human body.

The enzyme IDUA produced from Strand **K** will not work.

Explain how the mutation could cause the enzyme **not** to work.

____

____

____

____

____

____

____

____

____

____

(5)

(d) A recessive allele causes syndrome H.

A heterozygous woman and a homozygous recessive man want to have a child.

Draw a Punnett square diagram to determine the probability of the child having syndrome H.

Identify any children with syndrome H.

Use the following symbols:

A = dominant allele

a = recessive allele

Probability = ____________________ %

(5)

(Total 12 marks)

Q12.

In humans, hair colour is an inherited characteristic.

Red hair is caused by a recessive allele.

(a) When does a recessive allele control the development of a characteristic?

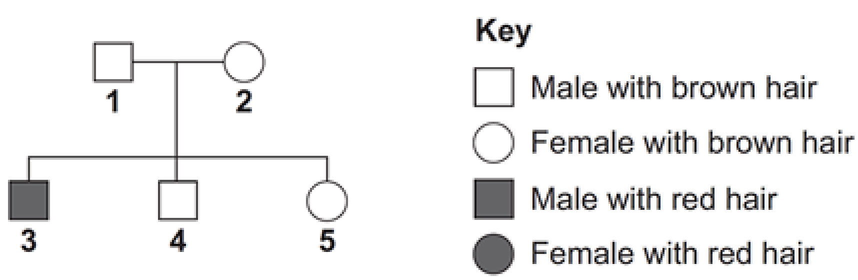
Tick (✓) **one** box.

When the allele is present on only one of the chromosomes.	☐
When the dominant allele is not present.	☐
When the allele is inherited from the female parent.	☐

(1)

(b) **Figure 1** shows the inheritance of hair colour in one family.

Figure 1



(i) Brown hair is caused by a dominant allele, **B**.

Red hair is caused by the recessive allele, **b**.

What combination of alleles does person **1** have?

Tick (✓) **one** box.

BB	☐

Bb ☐

bb ☐

(1)

(ii) Person **3** married a woman with brown hair.

Figure 2 shows how hair colour could be inherited by their children.

Figure 2

Woman
Brown hair

Person 3
Red hair

	B	b
b	Bb	
b		

Complete **Figure 2** to show the combination of alleles that the children would inherit.
One has been done for you.

(2)

(iii) What is the probability that one of the children would have red hair?

Tick (✓) **one** box.

1 in 2 ☐

1 in 3 ☐

1 in 4 ☐

(1)
(Total 5 marks)

Q13.

(a) Which organ of the human body produces egg cells?

Draw a ring around the correct answer.

liver **ovary** **testis**

(1)

(b) An egg joins with a sperm and develops into an embryo.

How many chromosomes are there in each cell of a human embryo?

Draw a ring around the correct answer.

23 **46** **48**

(1)

(c) Some women find it difficult to have a baby. A doctor may suggest that these women should use In Vitro Fertilisation (IVF) to help them have a baby.

Table 1 shows how successful IVF was for women of different ages at one clinic.

Table 1

Age of women in years	**Percentage of women who had a baby**
<35	35
35–37	31
38–39	25
40–42	32
43–44	7
>44	0

(i) A student thought that the result for women aged 40–42 was anomalous.

Suggest why the student thought this result was anomalous.

____

____

(1)

(ii) Describe the general trend in the results in **Table 1**.

You should ignore the anomalous result.

____

____

(1)

(d) Some babies are born with a faulty chromosome.

Scientists investigated whether the chance of having a baby with a faulty chromosome is also related to the age of the woman.

Table 2 shows the scientists' results.

Table 2

Age of women in years	**Number of women per 1000 who had a baby with a faulty chromosome**
25	2.0
30	2.6
35	6.1
40	19.6
45	66.0

(i) A 45-year-old woman is more likely than a 25-year-old woman to have a baby with a faulty chromosome.

How many times more likely?

____

____

Answer = ______________________ times

(2)

(ii) Suggest **two** reasons why many fertility clinics will **not** accept women over 40 years of age for IVF treatment.

Use information from **Table 1** and **Table 2** in your answer.

1.

___

___

2.

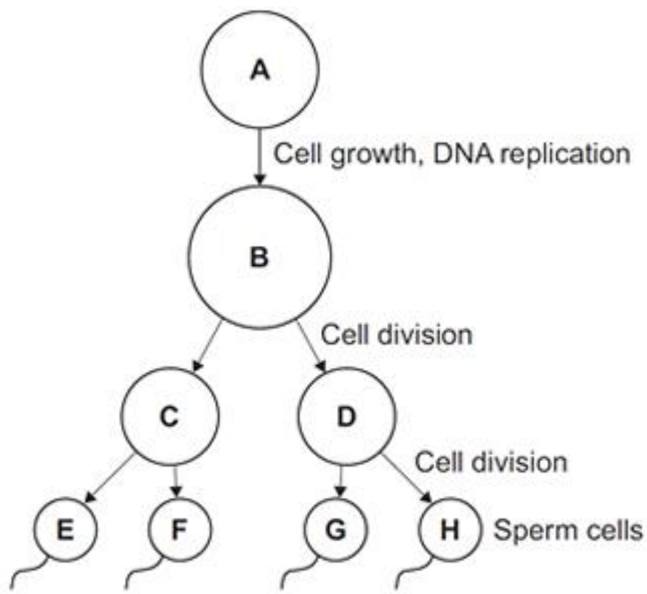
___

___

(2)
(Total 8 marks)

Q14.

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)

Q15.

Polydactyly is an inherited condition caused by a dominant allele.

(a) The figure below shows the hand of a man with polydactyly. The man has an extra finger on each hand.

The man's mother also has polydactyly but his father does not.

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(i) The man is **heterozygous** for polydactyly.

Explain how the information given above shows that the man is **heterozygous** for polydactyly.

____

____

____

____

____

____

(3)

(ii) The man marries a woman who does **not** have polydactyly.

What is the probability that their first child will have polydactyly?

____

(1)

(b) The man has red hair. His sister has brown hair.

Both of their parents have brown hair.

Brown hair is caused by the dominant allele, **B**.

Red hair is caused by a recessive allele, **b**.

Complete the genetic diagram below to show how the man's parents were able to have some children with red hair and some with brown hair.

	Father		**Mother**	
Parental phenotypes	______________		______________	
Parental Genotypes	______________		______________	
Gametes	________	________	________	________

Offspring genotypes: ____

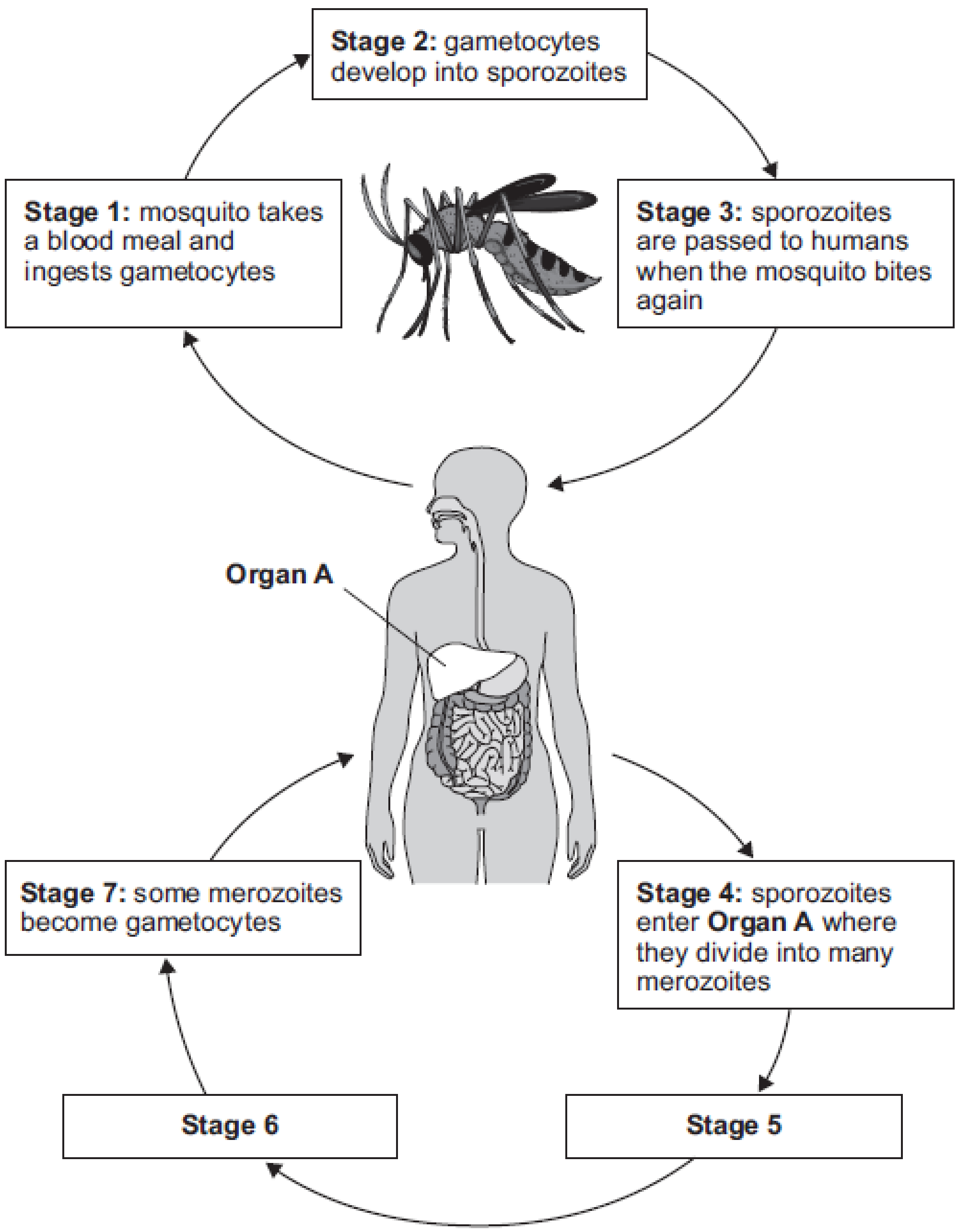
Offspring phenotypes: ____

(5)
(Total 9 marks)

Q16.

Figure 1 shows the stages in the transmission of the malaria parasite by mosquitoes to humans.

Figure 1



(a) Where in the mosquito does **Stage 2** happen?

Draw a ring around the correct answer.

brain **salivary glands** **stomach**

(1)

(b) What is **Organ A** in the human?

Draw a ring around the correct answer.

liver **pancreas** **small intestine**

(1)

(c) What happens in the human at **Stages 5** and **6**?

___

___

___

___

___

___

___

___

___

___

(4)

(d) Sickle-cell anaemia is an inherited disease caused by a mutation in the haemoglobin gene.

(i) Genes are small pieces of DNA. The DNA in a gene consists of a sequence of bases.

Figure 2 shows part of the base sequence in the DNA of a normal haemoglobin gene and the same section in the sickle-cell gene. **A**, **C**, **G** and **T** represent the different bases.

Figure 2

Normal gene	**GGACTCCTC**
Sickle-cell gene	**GGACACCTC**

Describe how the mutation causes a change in the shape of the haemoglobin protein molecule.

(4)

(ii) Sickle-cell anaemia is caused by a recessive allele, **a**. The normal haemoglobin allele is dominant, **A**.

Use a genetic diagram to find the probability that two heterozygous parents will produce a child who is homozygous for sickle-cell anaemia.

Probability = ________________

(4)

(iii) What is the benefit of the heterozygous genotype in areas where malaria is common?

____

____

(1)

(Total 15 marks)

Q17.

(a) A healthy diet should be balanced.

What is meant by a balanced diet?

____

____

____

____

(2)

(b) Cholesterol has important functions in the body.
Some cholesterol is produced by the liver.
Cholesterol is needed in the body to make the hormone oestrogen.

(i) Name the organ in the body which produces oestrogen.

____

(1)

(ii) What effect does oestrogen have on the female reproductive cycle?

____

____

(1)

(iii) Oestrogen is a naturally occurring steroid hormone.

Give **one** artificial use of a steroid hormone in the body.

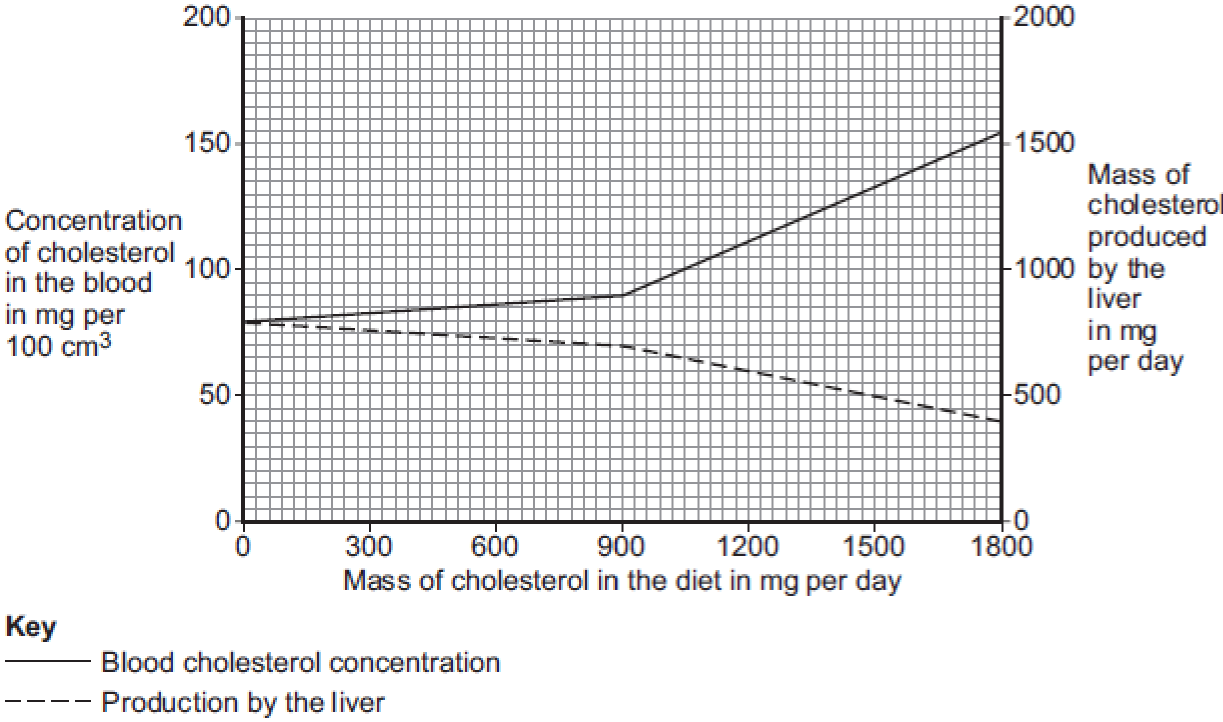
____

____

(1)

(c) The graph below shows the effect of the mass of cholesterol in the diet on:

- the concentration of cholesterol in the blood
- the mass of cholesterol produced by the liver.



Describe the effect of increasing the mass of cholesterol in the diet on the mass of cholesterol produced by the liver.

To gain full marks you should include data from the graph in your answer.

____

____

____

____

____

____

(2)

(d) Large amounts of cholesterol in the diet switch off the production of an enzyme called reductase, in the liver.

An increase of the enzyme reductase increases the production of cholesterol by the liver.

(i) Which part of a liver cell is responsible for controlling the production of reductase?

____

____

(1)

(ii) High blood cholesterol concentrations increase the likelihood of heart and circulatory diseases.

Doctors can prescribe statins to control the concentration of cholesterol in the blood.

Suggest how statins work.

____

____

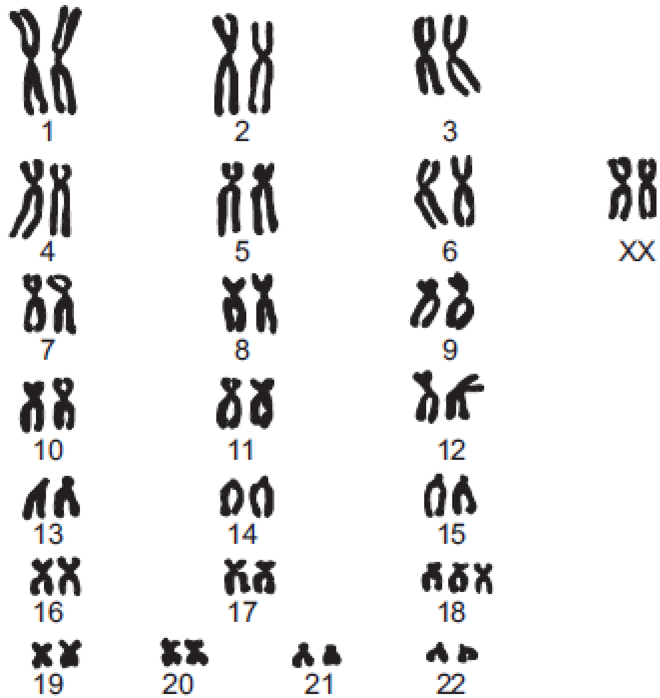
(1)
(Total 9 marks)

Q18.

Genetic disorder **E** is a condition caused by a change in the chromosomes.

(a) / **Figure 1** shows the chromosomes from one cell of a person with genetic disorder **E**.

Figure 1



(i) How do you know this person is female?

Use information from **Figure 1**.

____

____

(1)

(ii) Describe how the chromosomes shown in **Figure 1** are different from the chromosomes from a person who does not have genetic disorder **E**.

____

____

____

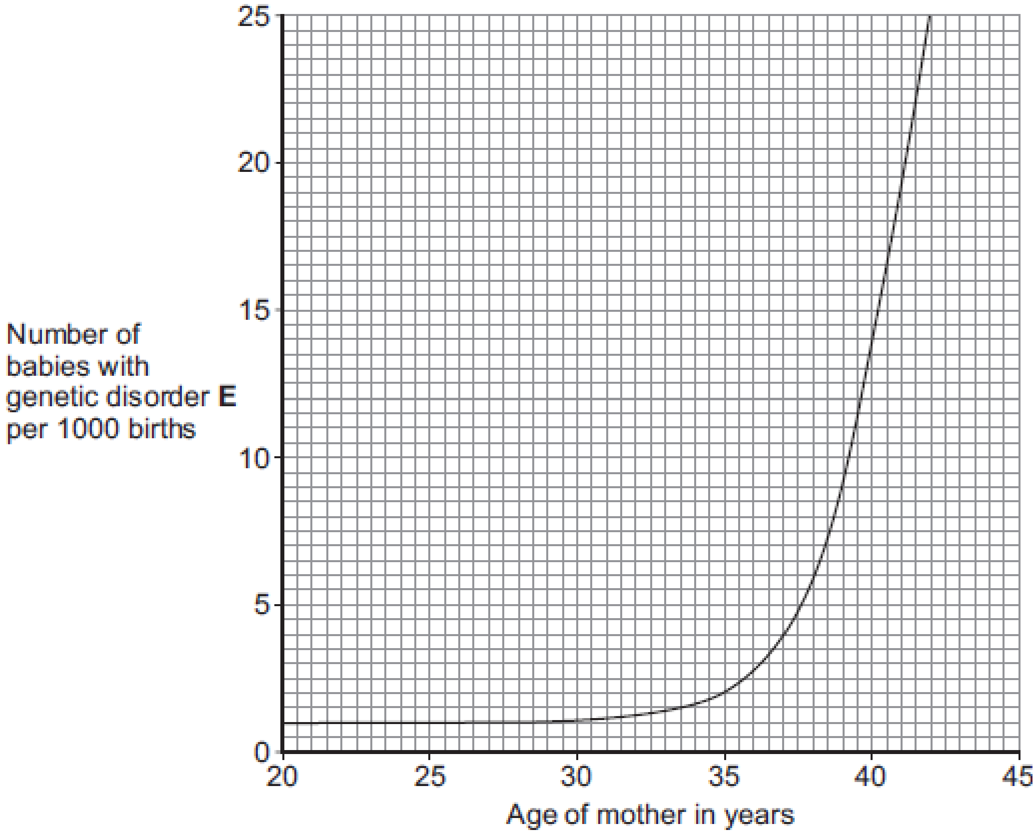
____

(2)

(b) As a woman gets older, the chance of her having a baby with genetic disorder **E** increases.

Figure 2 shows this.

Figure 2



(i) The chance of a 35-year-old woman having a baby with genetic disorder **E** is 2 per 1000 births.

What is the chance of a 40-year-old woman having a baby with genetic disorder **E**?

______________ per 1000 births

(1)

(ii) A 40-year-old woman is more likely than a 35-year-old woman to have a baby with genetic disorder **E**.

How many times more likely?

______________________ times

(1)

(c) A 41-year-old woman wants to have a baby. A 41-year-old woman has an increased chance of having a baby with genetic disorder **E**.

Doctors can screen embryos for genetic disorder **E**.

The table gives some information about two methods of embryo screening.

Method 1	Method 2
1. The woman is given hormones to cause the release of a few eggs. The eggs are taken from her body in a minor operation. The eggs are fertilised in a glass dish.	1. The woman gets pregnant in the normal way.
2. One cell is taken from each embryo when the embryo is 3 days old.	2. Cells are taken when the embryo is 10 weeks old.
3. Cells are screened for genetic disorder **E**.	3. Cells are screened for genetic disorder **E**.
4. An unaffected embryo is placed in the woman's uterus. Embryos that are not used are destroyed or used in medical research.	4. An unaffected fetus is allowed to develop. If the fetus has genetic disorder **E**, the woman can choose to have an abortion.
5. This method costs about £6000.	5. This method costs about £600.

Use information from the table to give **two** advantages and **one** disadvantage of **Method 1** compared with **Method 2** for detecting genetic disorder **E**.

Advantages of **Method 1**:

1.

____

____

2.

____

____

Disadvantage of **Method 1**:

____

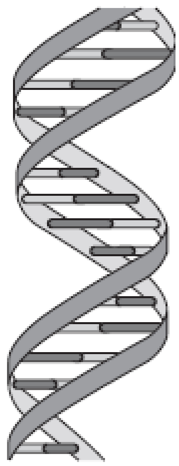
(3)
(Total 8 marks)

Q19.

DNA is the genetic material of human cells.

Figure 1 shows the structure of part of a DNA molecule.

Figure 1



(a) (i) Describe where DNA is found in a human cell.

(2)

(ii) When a cell divides by mitosis the new cells are genetically identical.

What causes the cells to be genetically identical?

(1)

(b) Many genes have different forms called alleles.

(i) A person has polydactyly (extra fingers or toes). Polydactyly is caused by a dominant allele.
What is the smallest number of copies of the dominant allele for polydactyly that could be found in a body cell of this person?

____

(1)

(ii) Another person has cystic fibrosis. Cystic fibrosis (CF) is caused by a recessive allele.
How many copies of the recessive CF allele are there in a body cell of this person?

____

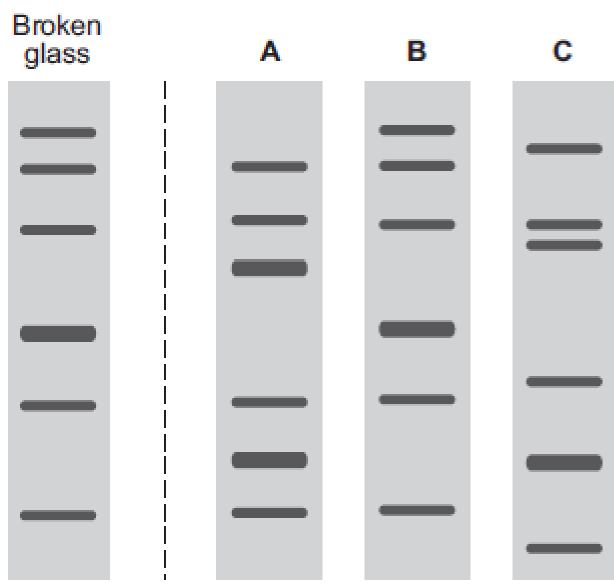
(1)

(c) A burglar broke into a house. The burglar cut his hand on some broken glass. Scientists extracted DNA from the blood on the broken glass.

The scientists analysed the DNA from the glass and DNA from three suspects, **A**, **B** and **C**. The scientists used a method called DNA fingerprinting.

Figure 2 shows the scientists' results.

Figure 2



Which suspect, **A**, **B** or **C**, is most likely to have been the burglar?

Tick (✓) **one** box.

A ☐

B ☐

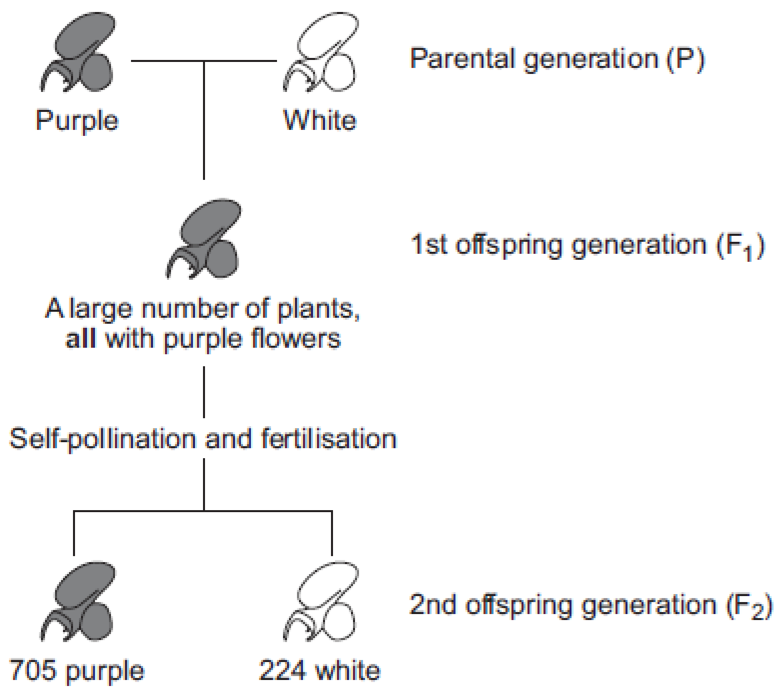
C ☐

(1)
(Total 6 marks)

Q20.

In 1866, Gregor Mendel published the results of his investigations into inheritance in garden pea plants.

The diagram below shows the results Mendel obtained in one investigation with purple-flowered and white-flowered pea plants.



(a) (i) Calculate the ratio of purple-flowered plants to white-flowered plants in the F_2 generation.

Ratio of purple : white = ______________________

(1)

(ii) There was a total of 929 plants in the F_2 generation.

Mendel thought that the production of a large number of offspring plants improved the investigation.

Explain why.

____

____

____

____

(2)

(b) (i) Some of the plants in the diagram are homozygous for flower colour and some are heterozygous.

Complete the table to show whether each of the plants is homozygous or heterozygous. For each plant, tick (✓) **one** box.

	Homozygous	**Heterozygous**
Purple-flowered plant in the P generation		
White-flowered plant in the P generation		
Purple-flowered plant in the F_1 generation		

(2)

(ii) Draw a genetic diagram to show how self-pollination of the F_1 purple-flowered plants produced mainly purple-flowered offspring in the F_2 generation together with some white-flowered offspring.

Use the following symbols:

N = allele for purple flower colour
n = allele for white flower colour

(3)

(c) When Mendel published his work on genetics, other scientists at the time did not realise how important it was.

Suggest **two** reasons why.

1.

2.

(2)

(Total 10 marks)

Q21.

Some genetic disorders are caused by alleles inherited from the parents.

(a) What are **alleles**?

(1)

(b) Describe how embryos can be screened for the alleles that cause genetic disorders.

(4)

(c) Polydactyly is a genetic disorder that leads to extra fingers or toes.

Polydactyly is caused by a dominant allele, **D**.

The photograph shows the hand of a person with polydactyly.

© Adem Demir/Hemera.

A man has polydactyly. His wife does not have polydactyly.

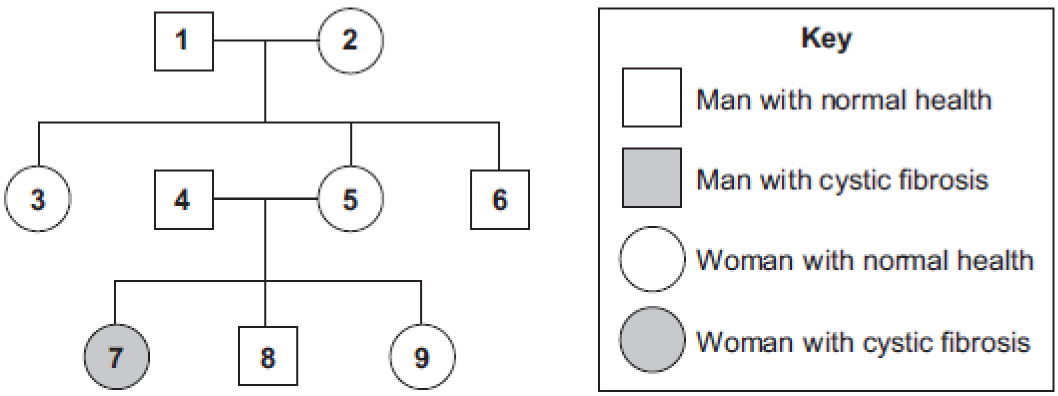
This couple's children have a 50% chance of having polydactyly.

Draw a genetic diagram to explain why.

(3)

(d) Cystic fibrosis is another genetic disorder. It is caused by a recessive allele.

The diagram shows the inheritance of cystic fibrosis in one family.



Woman **5** is pregnant with her fourth child.

What is the probability that this child will have cystic fibrosis?

Draw a genetic diagram to explain your answer.

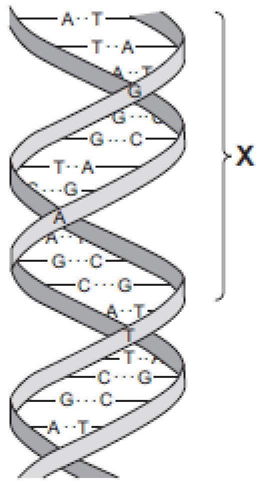
Use the following symbols.

N = allele for normal health
n = allele for cystic fibrosis

(4)
(Total 12 marks)

Q22.

The diagram shows part of a DNA molecule.



(a) (i) In which part of an animal cell is DNA found?

____

(1)

(ii) Complete the following sentence.

The letters **A**, **C**, **G** and **T** in the diagram represent four different compounds

called ____________________________ .

(1)

(iii) One strand of the DNA, in the section labelled **X**, contains the following sequence of these compounds:

T A T G G G T C T T C G

How many amino acids would this section of the DNA code for? ☐

(1)

(iv) The section of DNA described in part **(a) (iii)** is a small part of a gene.

The sequence of compounds **A**, **C**, **G** and **T** in the gene is important.

Explain why.

____

____

____

____

(2)

(b) *Read the following information about genetic engineering.*

The caterpillar of the European Corn Borer moth feeds on the fruits of maize (sweet corn). There is a chemical called Bt-toxin which is poisonous to the corn borer caterpillar but not to humans.

Scientists carried out the following steps.

1. The Scientists made a bacterial plasmid to which they added two genes:
   - **Bt** gene, which coded for production of the Bt-toxin
   - **kan**^{r} gene, which coded for resistance to an antibiotic called kanamycin.

2. They used this plasmid to produce genetically modified bacteria which could invade plant cells.

3. They mixed these genetically modified bacteria with pieces cut from maize leaves.

4. They placed the pieces of maize leaf on agar jelly in a Petri dish. The agar jelly contained the antibiotic, kanamycin. The kanamycin killed most of the pieces of maize leaf, but a few survived.

5. They took some cells from the surviving pieces of maize leaf and grew them in tissue culture.

The result was maize plants that now contained the **Bt** gene, as well as the **kan**^{r} gene, in all of their cells.

(i) What is a **plasmid** (Step 1)?

____

(2)

(ii) Why did the scientists add **kanamycin** to the agar jelly (Step 4)?

(2)

(iii) The scientists grew each Bt-maize plant from a single cell which contained the **Bt** gene.

Explain why **all** the cells in the Bt-maize plant contained the **Bt** gene.

(2)

(iv) Kanamycin is an antibiotic.

Some scientists are concerned that the gene for kanamycin resistance has been put into maize.

Suggest why.

(2)

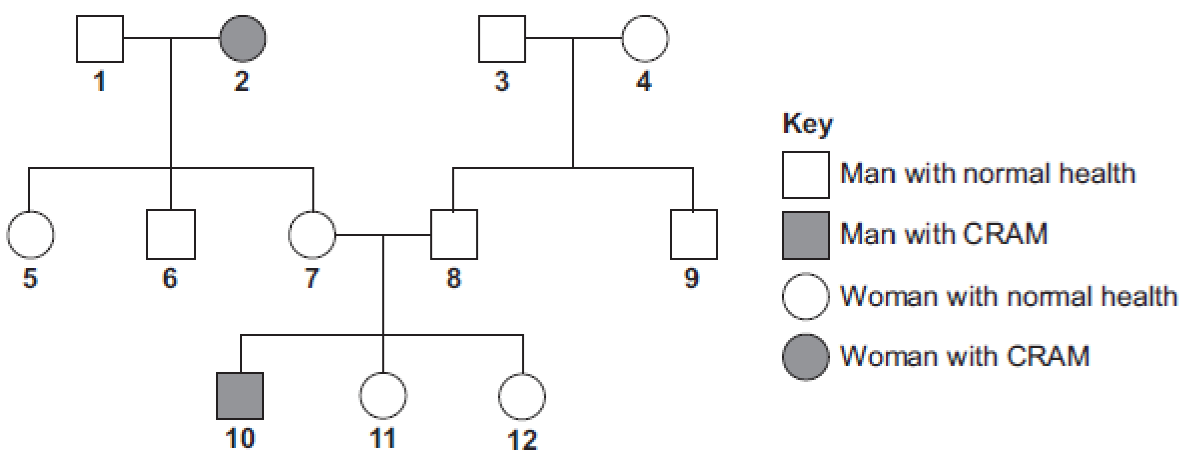
(Total 13 marks)

Q23.

CRAM is an inherited condition which causes muscle breakdown.

The breakdown products enter the urine, making it dark-coloured.

The diagram below shows the inheritance of CRAM in one family.



CRAM is caused by a recessive allele, **n**.

The allele for normal health is **N**.

(a) (i) What is an **allele**?

____

(1)

(ii) What does **recessive** mean?

____

____

(1)

(iii) Give evidence from the diagram that CRAM is caused by a **recessive** allele.

____

____

(1)

(b) (i) Person **2** is homozygous for CRAM.

What does **homozygous** mean?

____

____

(1)

(ii) None of person **2**'s children have CRAM.

Explain why.

____

____

____

(2)

(c) Persons **7** and **8** want to have another child.

(i) What is the probability that this child will have CRAM?

Draw a genetic diagram to explain your answer.

Probability = ______________________________

(4)

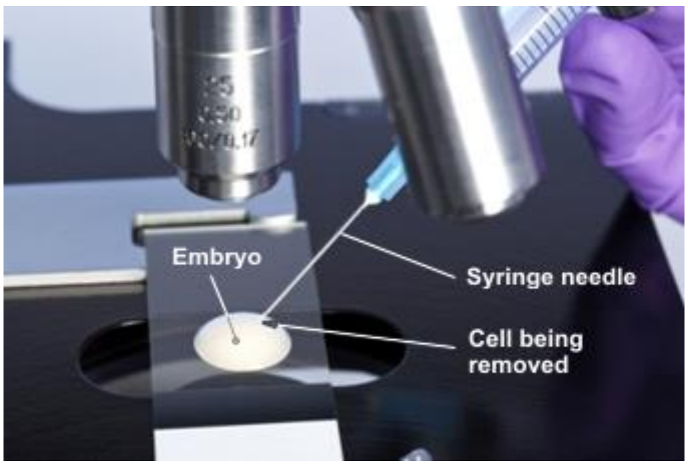
(ii) To avoid having another child with CRAM, persons **7** and **8** may decide to use embryo screening.

Two ways of doing this are:

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

PGD involves IVF (in vitro fertilisation) of a few eggs, then taking a cell from each embryo when it is 3 days old.

The image below shows how the cell is removed.



The DNA in the cell can then be tested. An unaffected embryo can be implanted in the woman's uterus. The possibility of a false positive result is around 1 in 6. The procedure costs about £6000. Affected embryos would be discarded. Extra unaffected embryos might be frozen and kept for later implantation. Alternatively, the extra embryos might be used in scientific research.

CVS involves taking a sample of blood from the placenta a few weeks into pregnancy. DNA from white blood cells can then be tested.
If an affected embryo is detected, the parents then have to decide whether to terminate the pregnancy or allow it to continue.

CVS has a 1 percent chance of giving an incorrect result and a 0.9 percent chance of causing a miscarriage. CVS costs about £600.

Evaluate the benefits of these two methods of embryo screening.

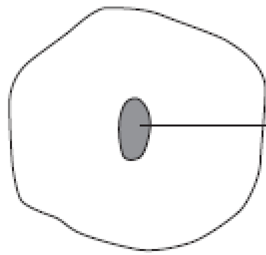
You should include a conclusion to your evaluation.

(5)

(Total 15 marks)

Q24.

The diagram below shows a cell.



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

(i) In the nucleus of a cell, genes are part of

chromosomes.
membranes.
receptors.

(1)

(ii) Different genes control different

characteristics
gametes
nuclei

of an organism.

(1)

(iii) Studying the similarities and differences between organisms allows us to

classify
clone
grow

the organisms.

(1)

(b) Complete the following sentence.

Living things can be grouped into animals, microorganisms and ____________
.

(1)

(Total 4 marks)

Q25.

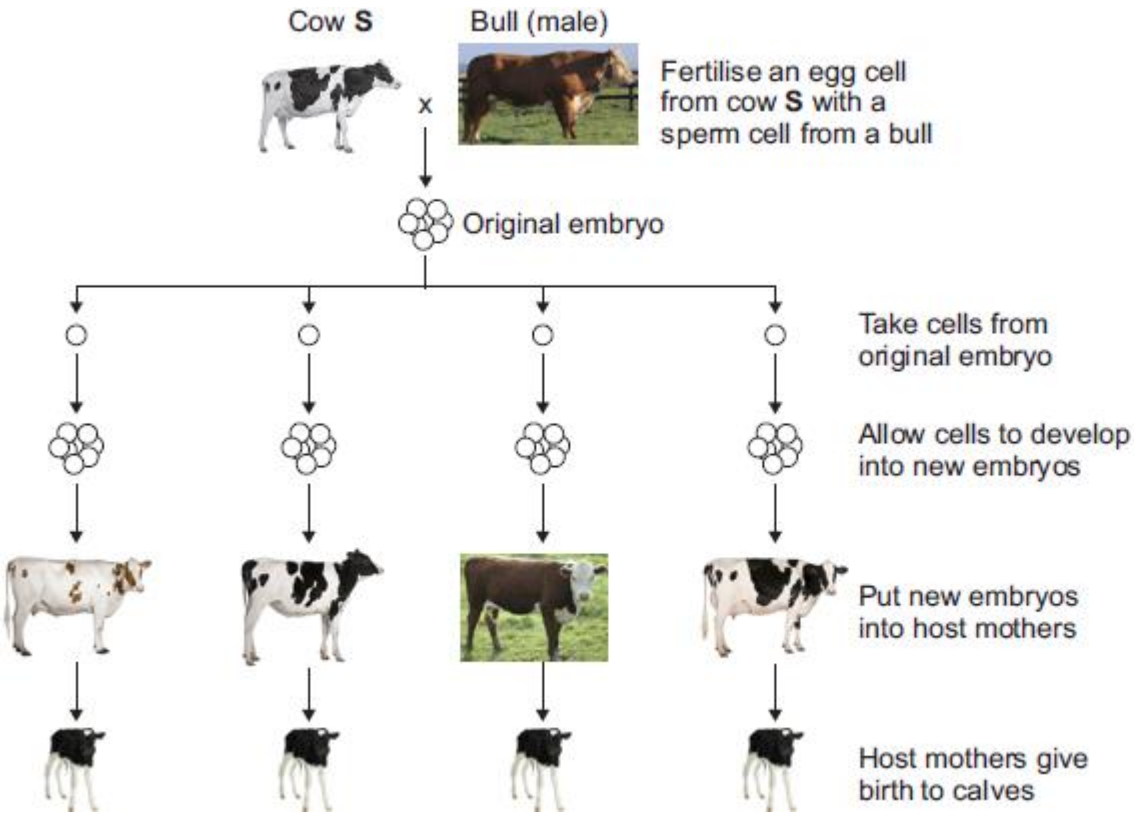
Most cows produce milk with a fat content of 3.4%.

Cow **S** produces milk with a fat content of 1.2%.

Only cow **S** has the gene to produce this low-fat milk.

(a) A farmer plans to develop more cows like cow **S**.

The diagram below shows how the farmer plans to do this.



(i) An egg cell from cow **S** is fertilised by a sperm cell from a bull. This is part of sexual reproduction.

What is the scientific name for sex cells such as egg cells and sperm cells?

____

(1)

(ii) After fertilisation, cells are taken from the original embryo.

These cells develop into new embryos.

Which part of the host mother's body should each new embryo be put into?

____

(1)

(b) (i) The calves born to all of the host mothers are genetically identical to each other.

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

The calves are genetically identical to each other because

they	are formed from the same original embryo. have the same host mother. have the same two parents.

(1)

(ii) What term is used to describe the method of producing calves shown in the diagram in part (a)?

Tick (✓) **one** box.

Adult cell cloning ☐

Embryo transplantation ☐

Genetic modification ☐

(iii) Why are the calves born to the host mothers **not** genetically identical to cow **S**?

____

____

(1)
(Total 5 marks)

Q26.

Read the information.

> Insects can be both useful and harmful to crop plants.
> Insects such as bees pollinate the flowers of some crop plants. Pollination is needed for successful sexual reproduction of crop plants.
> Some insects eat crops and other insects eat the insects that eat crops.

Corn borers are insects that eat maize plants.
A toxin produced by the bacterium *Bacillus thuringiensis* kills insects.
Scientists grow *Bacillus thuringiensis* in large containers. The toxin is collected from the containers and is sprayed over maize crops to kill corn borers.

A company has developed genetically modified (GM) maize plants. GM maize plants contain a gene from *Bacillus thuringiensis*. This gene changes the GM maize plants so that they produce the toxin.

(a) Describe how scientists can transfer the gene from *Bacillus thuringiensis* to maize plants.

___

___

___

___

___

___

___

(3)

(b) Would you advise farmers to grow GM maize plants?

Justify your answer by giving advantages and disadvantages of growing GM maize plants.

Use the information from the box and your own knowledge to help you.

___

___

___

(4)
(Total 7 marks)

Q27.

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)

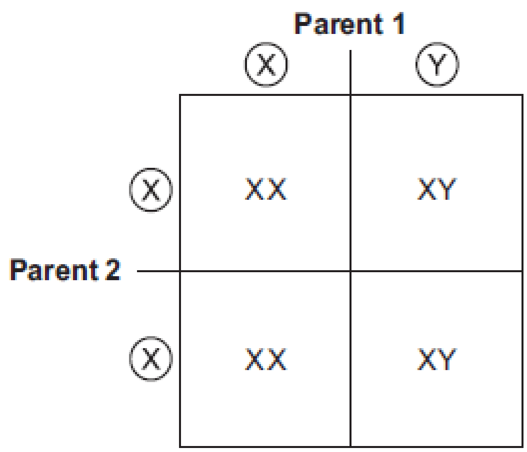
(iii) The egg and the sperm contain genetic material.

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)

Q28.

Phenylketonuria (PKU) is an inherited condition. PKU makes people ill.

(a) PKU is caused by a recessive allele.

(i) What is an allele?

____

____

(1)

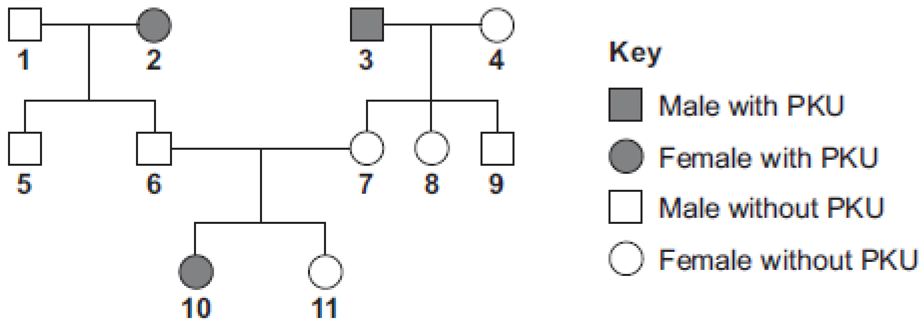
(ii) What is meant by recessive?

____

____

(1)

(b) The diagram below shows the inheritance of PKU in one family.



(i) Give **one** piece of evidence from the diagram that PKU is caused by a recessive allele.

____

____

(1)

(ii) Persons **6** and **7** are planning to have another child.
Use a genetic diagram to find the probability that the new child will have PKU.

Use the following symbols in your answer:

N = the dominant allele for **not** having PKU

n = the recessive allele for PKU.

Probability = ____________________________

(4)

(c) Persons **6** and **7** wish to avoid having another child with PKU.

A genetic counsellor advises that they could produce several embryos by IVF treatment.

(i) During IVF treatment, each fertilised egg cell forms an embryo by cell division.

Name this type of cell division.

____

(1)

(ii) An embryo screening technique could be used to find the genotype of each embryo.

An unaffected embryo could then be placed in person **7**'s uterus.

The screening technique is carried out on a cell from an embryo after just three cell divisions of the fertilised egg.

How many cells will there be in an embryo after the fertilised egg has divided three times? ☐

(1)

(iii) During embryo screening, a technician tests the genetic material of the embryo to find out which alleles are present.

The genetic material is made up of large molecules of a chemical substance.

Name this chemical substance.

____

______

(1)

(d) Some people have ethical objections to embryo screening.

(i) Give **one** ethical objection to embryo screening.

____

______

(1)

(ii) Give **one** reason in favour of embryo screening.

____

______

(1)

(Total 12 marks)

Q29.

When humans reproduce, chromosomes and genes are passed on to the next generation.

In each of the following questions, draw a ring around the correct answer to complete the sentence.

(a) A gene is a small section of

cellulose.
DNA.
protein.

(1)

(b) The sex chromosomes in the human male are

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

(1)

(c) (i) Most human body cells contain

23 chromosomes.
46 chromosomes.
92 chromosomes.

(1)

(ii) The number of chromosomes in a human gamete (sex cell)

is	the same number as half the number twice the number	in body cells.

(1)

(d)	Gametes are produced by	fertilisation. meiosis. mitosis.

(1)
(Total 5 marks)

Q30.

In each question, draw a ring around the correct answer to complete the sentence.

(a) Our understanding of how genes are inherited is mostly because of

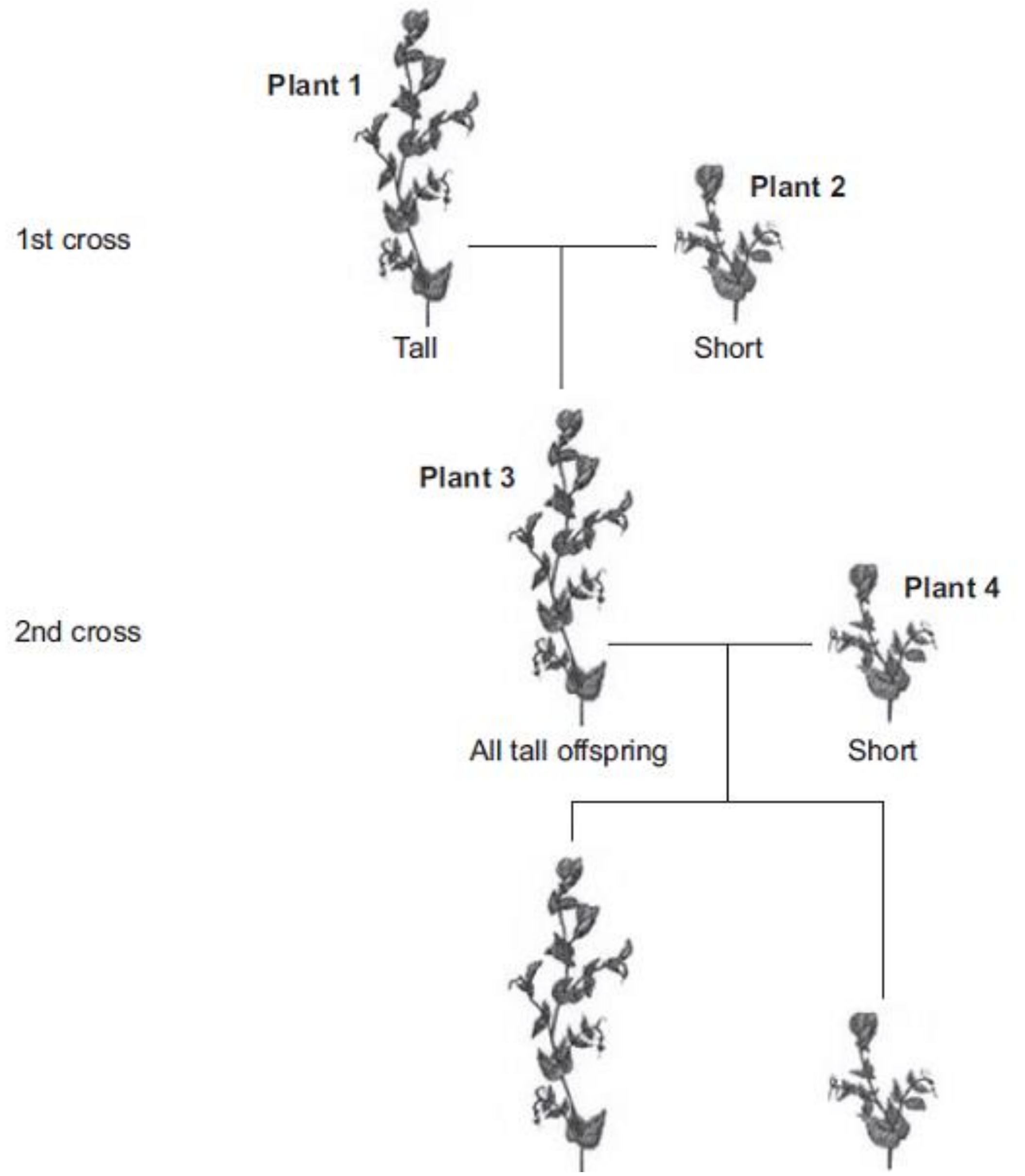
the work of	Darwin. Lamarck. Mendel.

(1)

(b) A scientist investigated inheritance in pea plants.

The scientist crossed tall pea plants with short pea plants. **Diagram 1** shows the results.

Diagram 1



Some tall offspring   Some short offspring

In the rest of this question, the following symbols are used to represent alleles.

T = allele for tall
t = allele for short

(i) The 1st cross in **Diagram 1** produced 120 offspring. All of these offspring were tall.

This shows that **plant 1** contained the alleles

TT.
Tt.

tt.

(1)

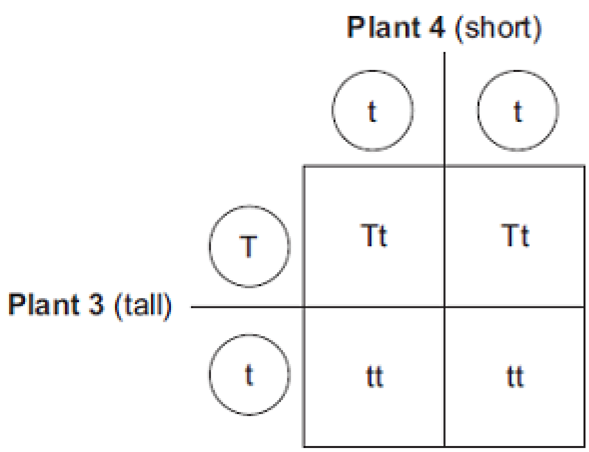
(ii) **Plant 3** is tall because of

a dominant allele.
the environment.
a recessive allele.

(1)

(c) **Diagram 2** gives more information about the cross between **plant 3** and **plant 4**.

Diagram 2



This cross produced some tall offspring and some short offspring.

The ratio of tall to short offspring in **Diagram 2** is

1:1.
2:1.
3:1.

(1)

(d) Two short plants were crossed. This cross produced 100 offspring.

The expected offspring would be

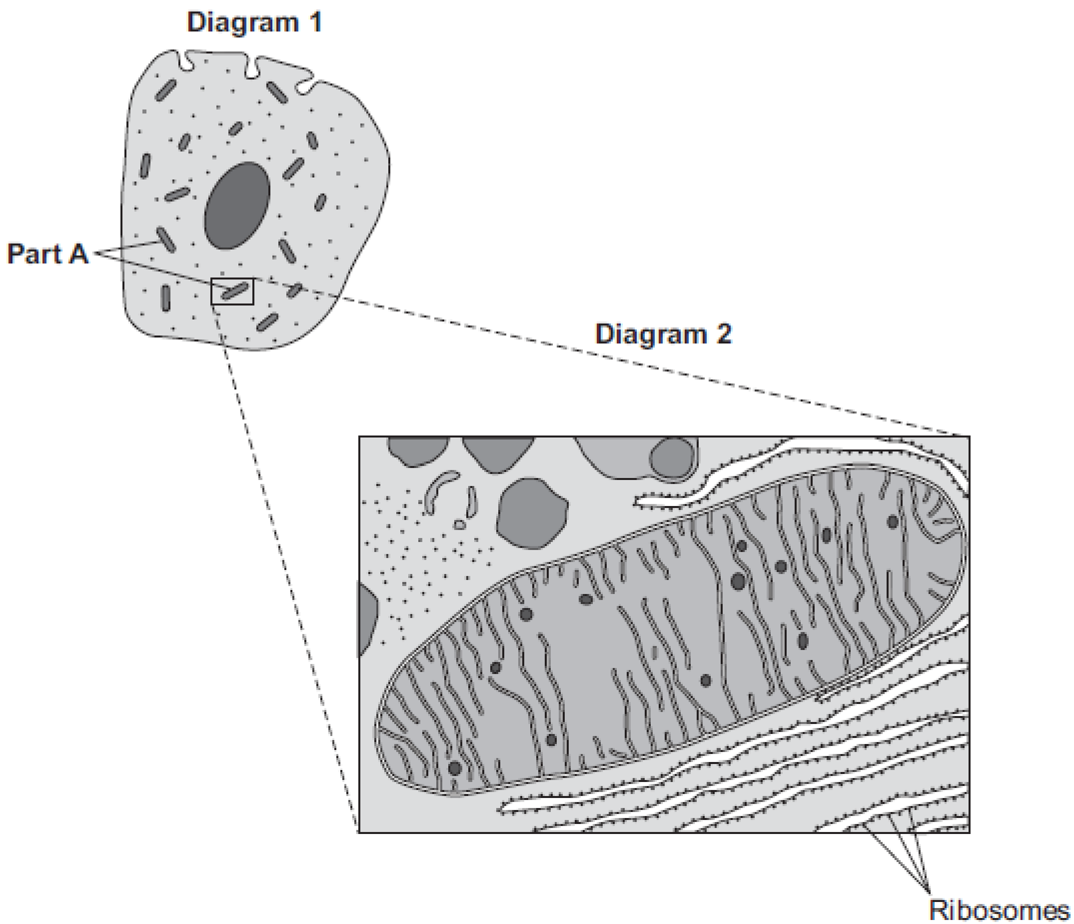
100 short plants.
50 tall plants and 50 short plants.
75 tall plants and 25 short plants.

(1)
(Total 5 marks)

Q31.

Diagram 1 shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

(a) (i) Name part **A**.

____

(1)

(ii) Complete the equation for aerobic respiration.

glucose + oxygen $\longrightarrow$ ____________ + ____________ (+ energy)

(2)

(iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

(3)

(b) The pancreas cell makes enzymes.

Enzymes are proteins.

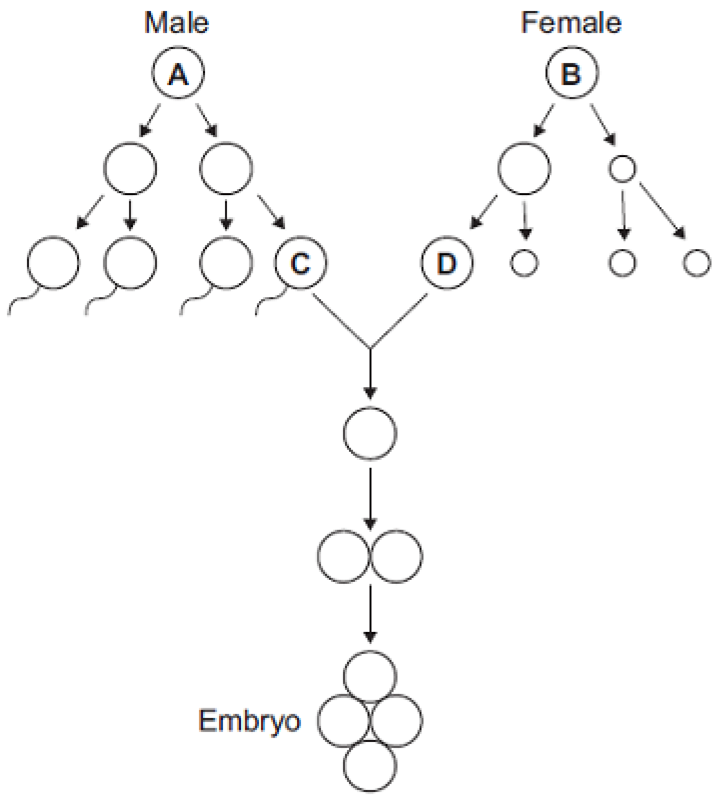
Describe how the ribosomes and part **A** help the cell to make enzymes.

____

(3)
(Total 9 marks)

Q32.

The diagram shows some of the cell divisions that occur during human reproduction.



(a) (i) Name the type of cell division that produces cell **D** from cell **B**.

____

(1)

(ii) Which organ in the male body produces cell **C** from cell **A**?

____

(1)

(b) (i) Cells **A** and **B** each contain 46 chromosomes.

How many chromosomes would there be in the nucleus of cell

C?

(1)

(ii) Why is it important that cell **C** has this number of chromosomes?

____

____

____

____

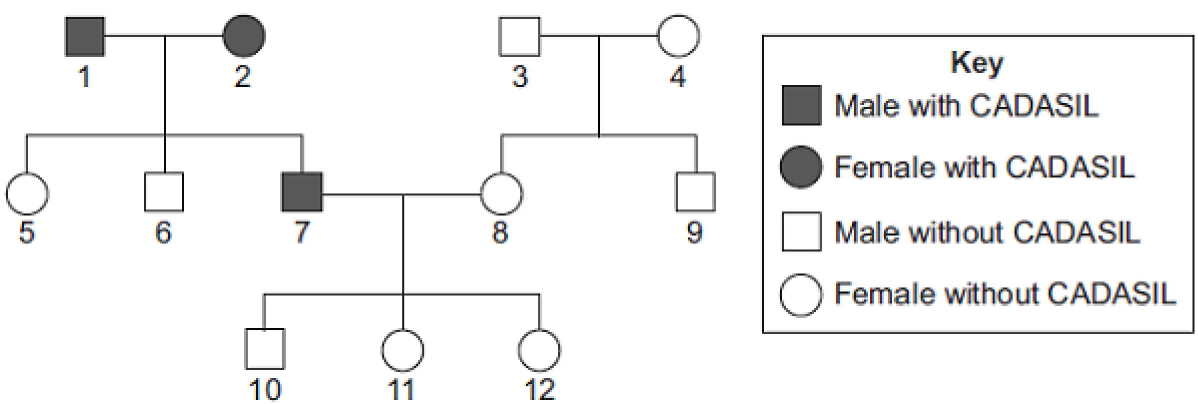
(2)
(Total 5 marks)

Q33.

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.

____

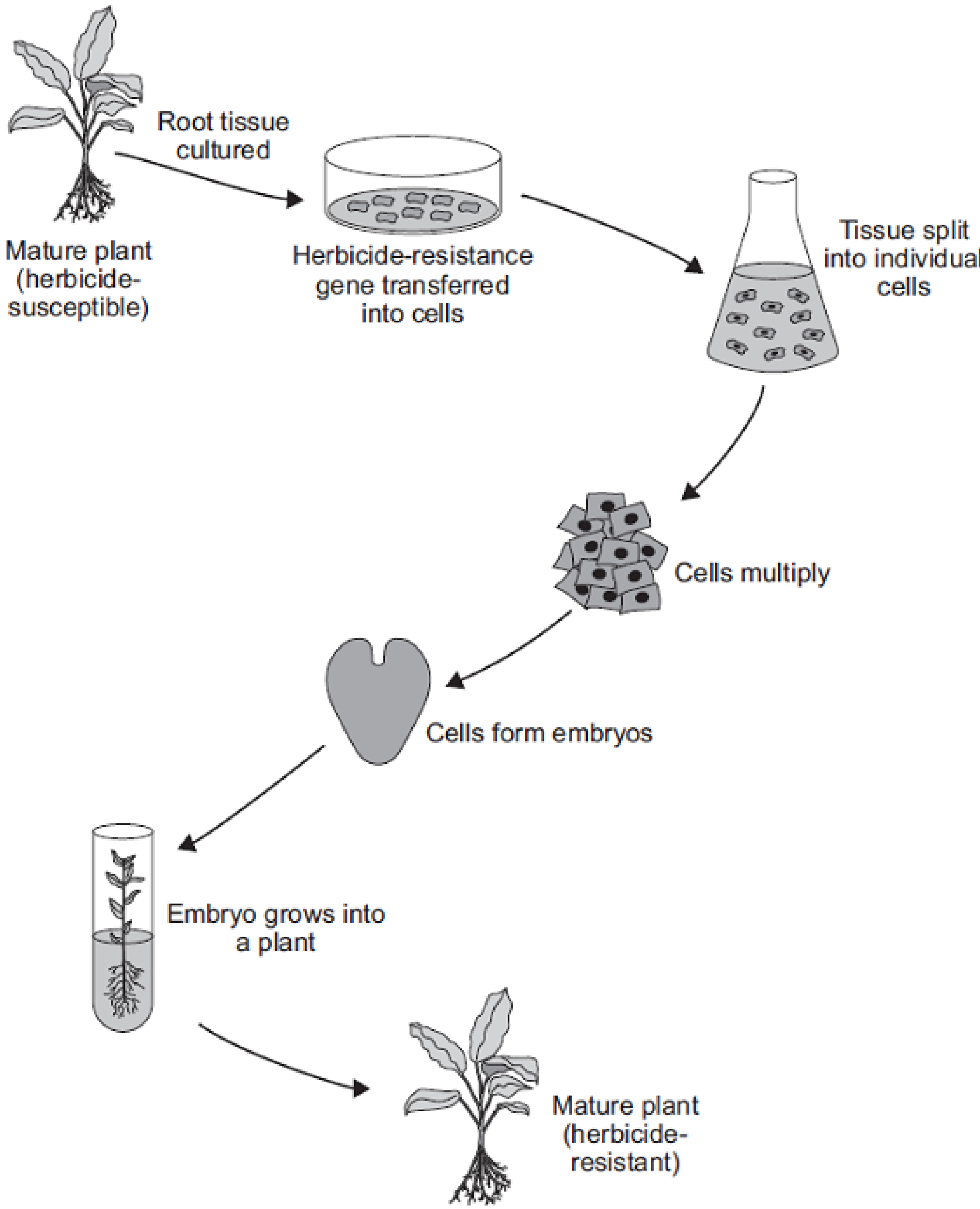
____

(1)

(Total 10 marks)

Q34.

The diagram shows one method of producing herbicide-resistant crop plants.



(a) The herbicide-resistance gene is cut out of a chromosome of a herbicide-resistant plant.

How is the herbicide-resistance gene cut out of the chromosome?

____

____

______

(1)

(b) Apart from having the herbicide-resistance gene, the herbicide-resistant plants are identical to the herbicide-susceptible plants.

Explain why.

______

______

______

______

(2)

(c) Suggest **one** advantage to a farmer of growing herbicide-resistant crops.

______

______

(1)

(d) Many people are opposed to the growing of herbicide-resistant crops produced in this way.

Suggest **one** reason why.

______

______

(1)

(Total 5 marks)

Q35.

Humans reproduce sexually.

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

chromosomes

(i) At fertilisation

genes
gametes

join together.

(1)

(ii) At fertilisation a single cell forms. The cell has new pairs of

chromosomes.
nuclei.
gametes.

(1)

(b) A child inherits cystic fibrosis. The child's parents do **not** have cystic fibrosis.

(i) What does this information tell us about the cystic fibrosis allele?

Tick (✓) **one** box.

The allele is dominant. ☐

The allele is recessive. ☐

The allele is strong. ☐

(1)

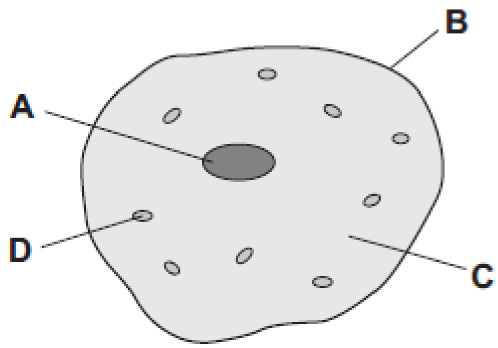
(ii) How many copies of the cystic fibrosis allele does the child have?

Draw a ring around your answer.

one **two** **four**

(1)

(c) The diagram shows a human body cell.



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 6 marks)

Mark schemes

Q1.

(a) nucleus
1

(b) gene(s)

allow allele(s)
1

(c) copying of chromosomes
1

(d) mitochondria
1

(e) 60 − 45
or
120 − 105
1

15 (minutes)
1

an answer of 15 (minutes) scores ***2*** *marks*

(f) C
1

(g) 8
1

(h) to repair tissues
1

[9]

Q2.

(a) diffusion
1

(b) A
1

(c) B
1

(d) (earthworm) can absorb more oxygen (in a given time)
or
increases / more gas exchange

allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food
1

(e) lipase
1

(f) more oxygen (in soil with earthworms)

allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q3.

(a) Gregor Mendel

1

(b) DNA

1

(c) when the dominant allele is not present

1

(d) tt

allow homozygous recessive

1

(e)

	T	t
T	TT	Tt
t	Tt	tt

*all 3 correct = **2** marks*
*2 correct = **1** mark*
*0 or 1 correct = **0** marks*

allow tT for Tt

2

(f) circle drawn around either TT or tt on Figure 2

allow circles drawn round both

1

(g) correct ratio from part **(e)** e.g. 3 : 1

allow multiples of stated ratio
allow 3 : 1 if no answer to part ***(e)***

1

[8]

Q4.

(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]

Q5.

(a) 3.7 1

(b) 2 1

(c) (different combinations of alleles cause) many / 22 values

allow continuous variation

or
in-between values
or
large range of values
or
there are not only two values

*allow there are not only 3 values if 3 is given in part **(b)*** 1

(d) different protein made

allow change in shape (of enzyme) or change in 3-D structure
ignore denature 1

active site changed 1

so substrate does not fit / bind

allow description of substrate
allow cannot form E-S complex
ignore lock and key description 1

(e) produces (some) offspring with high-fat milk
or
not all offspring have low-fat milk

ignore reference to alleles

1

(f) takes less time (to obtain results)
or
more offspring at the same time

*allow other sensible suggestion − e.g. allows screening **or** allow cow 7 to continue to produce eggs **or** avoid injury to cow 7 during mating or giving birth*

1

(g) male gametes correct: d (and d)

1

female gametes correct: D and d

1

*allow **1** mark if gametes are correct but gender not identified*

correct derivation of offspring genotypes from given gametes

*allow 2 × 2 **or** 2 × 1 derivation*

1

Dd identified as low-fat **and** dd identified as high-fat in offspring

if DD offspring are produced, must also identify as low-fat

1

(h) find female with low(est) fat in milk **and** high(est) milk yield

allow choose from 7, 9, 12, 13 which has the highest yield

1

find male whose female offspring have high(est) milk yield **and** low(est) fat in milk

allow choose from 16 or 18 whose female offspring has the highest yield

1

or

find female with lowest fat in milk
or cow 13 (1)*

**or*
allow female with high(est) milk yield

find male whose female offspring have high(est) milk yield (1)*

**or*
allow male whose female offspring have lowest fat in milk / male 16

cross the best (for both features) female with the best male **1**

select best offspring (for both features) from each generation and repeat for several generations **1**

[16]

Q6.

(a) 46 **1**

(b) 23

allow ecf from 2.1 – ie half of answer given in 2.1 **1**

(c) egg **1**

sperm **1**

ovary **1**

meiosis **1**

fertilisation **1**

correct order only
correct spelling only

(d)

	X	Y
X	XX	XY
X	XX	XY

*all 4 correct = **2** marks*
*2 or 3 correct = **1** mark*
*0 or 1 correct = **0** marks*
ignore correct / incorrect identification of male and female offspring **2**

(e) 1 in 2 **1**

(f) any **two** from:

- multiple genes determine appearance
  allow several / many genes determine appearance
- different combinations of alleles
  allow description of combinations of alleles' allow genes for alleles
- different environmental effects
  allow example e.g. eat different diets
- from different egg / sperm

2

[12]

Q7.

(a) red blood cell

1

(b) 44

1

(c) retina

1

(d) **7** and **8** / the parents
do not have **A** (allele)
or only have **a** (allele) **or** are **aa**

*allow converse – if parents had an **A** (allele) they would have Stickler syndrome*

1

so children cannot inherit **A**
or can only inherit **a**

or

the parents show the recessive characteristic

so must be homozygous
(recessive)
or must be **aa**
or parents cannot have **A**

1

(e) parental genotypes:
12 = Aa and 18 = aa
or parental gametes:
12 = A + a and 18 = a + a

1

derivation of offspring genotypes

allow ecf

1

identification of **Aa** offspring as Stickler 1

probability = 0.25 / $\frac{1}{4}$ / 1 in 4 / 25% / 1:3

*allow ecf – e.g. 0.5 if **12 = AA***

*do **not** accept 3:1*

*do **not** accept 1:4*

1

[9]

Q8.

(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 <u>active site</u> 1

the 2 antibiotic resistance genes have different (sequence of) <u>bases</u> 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

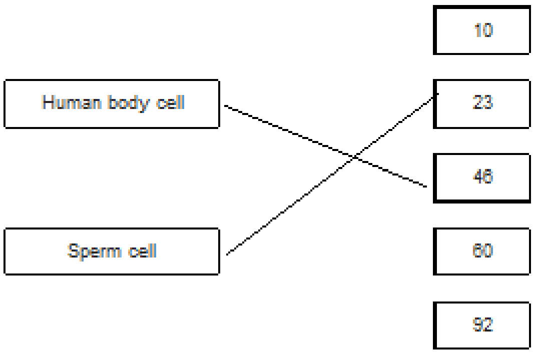
[10]

Q9.

(a) **A**

1

(b)



2

(c) one x circled under mother

accept if clearly indicated choice even if not circled

1

(d) XY

allow YX

1

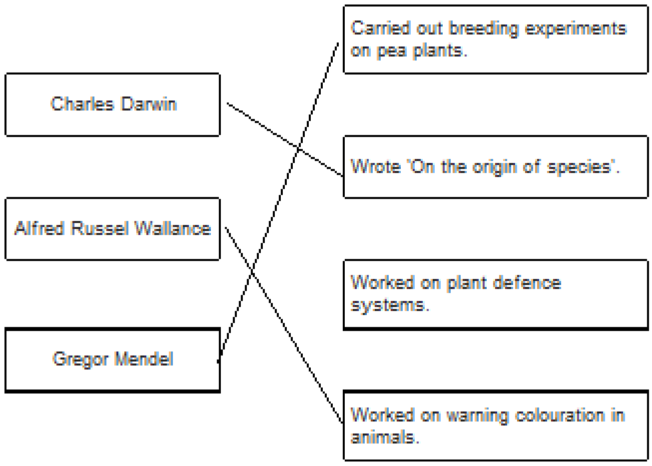
(e) 50 (%)

1

[6]

Q10.

(a)



3

(b) a gene

allow allele

1

(c) 4

1

(d) correct derivation of children's genotypes

1

identification of children with cystic fibrosis (dd)

1

0.25

allow ecf

allow ¼ / 25% / 1 in 4 / 1:3

1

*do **not** accept 1:4*

(e) heterozygous

1

[9]

Q11.

(a) phosphate

allow PO_4^{3-}

1

*do **not** allow P*

(b) A / adenine and T / thymine
and
C / cytosine and G / guanine

*do **not** allow U / uracil*

1

(c) (mutation) changes from C to T DNA code
or
there is a change in the three bases / triplet from CAG to TAG

1

(mutation) changes the amino acid **1**

(this could) change the protein **1**

(so it) forms a different shape / changed active site

accept different tertiary structure **1**

(therefore) the enzyme no longer fits the substrate / carbohydrate **1**

(d) mother / woman's gametes correct: A a **1**

father / man's gametes correct: a a **1**

correct derivation of offspring

ecf **1**

identification of child with syndrome H or genotype aa **1**

0.5

ecf

allow 50% / 1 / 2 / 1 in 2 / 1:1 **1**

*do **not** accept 1:2*

[12]

Q12.

(a) When the dominant allele is not present. **1**

(b) (i) Bb **1**

Woman
Brown hair

Person 3
Red hair

	B	b
b		bb
b	Bb	bb

(ii)

3 correct = 2 marks

2 correct = 1 mark

1 or 0 correct = 0 marks

allow bB for Bb

2

(iii) 1 in 2

allow ecf from part ii

1

[5]

Q13.

(a) ovary

1

(b) 46

1

(c) (i) does not fit the pattern

or

it is higher than the 3rd value / it should be lower than the 3rd value / it should be between the 3rd and 5th values

*do **not** allow use of incorrect figures*

1

(ii) As age increases % of women (having a baby) decreases

1

(d) (i) 33

allow 1 mark for $\frac{66}{2}$

if no answer / wrong answer

2

(ii) low success rate

1

more likely to have a baby with health problems / abnormalities / a faulty chromosome

1

[8]

Q14.

(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 = ½ B and E = ½ 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

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]

Q15.

(a) (i) man has (inherited) polydactyly (PD) allele (from mother)

1

man has (inherited) other / normal / recessive allele from father

1

because father does not have PD allele **or** if father had it father would have had PD **or** father only has normal allele **or** father is homozygous recessive

1

allow gene for allele

(ii) 0.5 / ½ / 1 in 2 / 1:1 / 50%

do not allow 1:2 or 50/50

allow 50:50

1

(b) parental phenotypes: both brown

1

parental genotypes: both **Bb**

1

gametes: **B** **b** and **B** **b**

1

allow only on gametes answer line
allow ecf from genotypes

offspring genotypes: **BB** **(2)Bb bb**
allow ecf from gametes

1

offspring phenotypes correctly assigned to genotypes:
BB & **Bb** = brown **bb** = red
do not penalise confusion of 'phenotypes' & 'genotypes' here

1

[9]

Q16.

(a) salivary gland

1

(b) liver

1

(c) any **four** from:
- merozoites released (from liver) and enter the red blood cells
- (some of these) turn into <u>schizonts</u>
- (which) burst the red blood cells
- releasing (more) merozoites
- coincides with fever attacks.

points credited must be in correct sequence

4

(d) (i) three bases code for one amino acid

1

middle code of CTC is now CAC / T changed to A

1

so will be a different amino acid (in the chain)

1

(and so chain / protein will have a different shape) due to a different sequence of amino acids

1

(ii) correct parental genotypes (both **Aa**)
allow ecf for 2nd and 4th marking points
or correct gametes (**A+a** **A+a**)

allow alternative symbols if defined

1

correct derivation of offspring genotypes from gametes

1

aa identified (homozygous for) SCA

1

0.25

allow 25% or 1 in 4 or 1:3 or 1 / 4

1

(iii) **(Aa)** <u>less</u> likely to get malaria (than homozygous dominant / **AA**)

allow resistance or protection if correctly qualified eg some protection

do not accept *'immune'*

1

[15]

Q17.

(a) any **two** from:

- right amount of nutrients **or** different / all foods
- right amount of energy
- for (individual) needs

'right amount' only needed once for both marks to be awarded

2

(b) (i) ovaries / ovary

allow placenta

1

(ii) any **one** from:

- inhibits follicle stimulating hormone / FSH production
- inhibits maturation of eggs

ignore ref to site of production of FSH

allow stimulates LH production ***or*** *stimulates preparation of womb lining*

1

(iii) any **one** from:

- stimulate muscle growth
- used in (oral) contraceptives

1

(c) small (rate of) decrease then bigger (rate of) decrease

1

idea that change of rate (of decrease) at 900 (mg per day)

If no other mark awarded allow ***1*** *mark for decrease*

1

(d) (i) gene(s) / nucleus / chromosome(s) / DNA

allow ribosome

1

(ii) reduces production of cholesterol (by liver)

allow idea of switching off gene for reductase (production)
allow switch off / reduce / inhibit reductase (production)
allow reduces absorption of cholesterol (by intestine)
allow statins (might) breakdown / destroy cholesterol

1

[9]

Q18.

(a) (i) (female) has XX / only X's / no Y

allow has X chromosome<u>s</u>
ignore ref to genes / cells

1

(ii) extra chromosome / has 47 chromosomes / one set has 3 copies

ignore reference to chromosome numbers other than 47 or no. 18

1

no. 18

1

(b) (i) 14

allow in range of 13.5 to 14.5

1

(ii) 7

allow in range of 6.75 to 7.25
accept ecf from 5bi

1

(c) <u>Advantages:</u>

any **two** from:

- more than 1 embryo (so more chance of success)

  allow method 2 may cause a miscarriage
- tested at 3 days cf 10 weeks **or** tested earlier

  tested when <u>only</u> 3 days old
- tested before pregnancy
- no termination / abortion
- spare embryos have a potential use.

2

<u>Disadvantages</u>:

any **one** from:

- needs an operation

  accept described hazard of operation
- (spare) embryos / human life destroyed / harmed

  must be comparative

- higher cost
- embryos might not implant / might not develop.

1

[8]

Q19.

(a) (i) in the chromosome(s)

ignore genes / alleles

1

in the nucleus

allow nuclei

allow mitochondria

1

(ii) the DNA / chromosomes / genes are replicated / copied / multiplied / doubled / duplicated

allow DNA is cloned

ignore same DNA / chromosomes / genes if unqualified

1

(b) (i) 1 / one

1

(ii) 2 / two

1

(c) **B**

1

[6]

Q20.

(a) (i) 3.15 : 1

accept 3.147:1 ***or*** *3.1 : 1* ***or*** *3 : 1*

do ***not*** *accept 3.14 : 1*

Ignore 705:224

1

(ii) any **two** from:

- fertilisation is random **or** ref. to chance combinations (of alleles / genes / chromosomes)
- more likely to get theoretical ratios **or** see (correct) pattern **or** get valid results if large number

  allow ref. to more representative / reliable

  do ***not*** *allow more accurate* ***or*** *precise*

  ignore fair / repeatable
- anomalies have limited effect / anomalies can be identified

  accept example of an anomaly

2

(b) (i) in sequence:

Homozygous
Homozygous
Heterozygous

All 3 correct = 2 marks

2 correct = 1 mark

1 or 0 correct = 0 marks

2

(ii) genetic diagram including:

Parental genotypes: **Nn** and **Nn**

allow other characters / symbols only if clearly defined

1

or

Gametes: **N** and **n + N** and **n** derivation of offspring genotypes:
NN Nn Nn nn

allow genotypes correctly derived from candidate's P gametes

1

identification: **NN** and **Nn** as purple **and nn** as white

allow correct identification of candidate's offspring genotypes but only if some F_2 are purple and some are white

1

(c) any **two** from:

- did not know about chromosomes / genes / DNA
  or did not know chromosomes occurred in pairs
  ignore genetics
- had pre-conceived theories
  eg blending of inherited characters
  ignore religious ideas unless qualified
- Mendel's (mathematical) approach was novel concept
  allow his work was not understood or no other scientist had similar ideas
- Mendel was not part of academic establishment
  allow he was not considered to be a scientist / not well known / he was only a monk
- work published in obscure journal / work lost for many years
- peas gave unusual results cf other species
  allow he only worked on pea plants
- Mendel's results were not corroborated until later / 1900

2

[10]

Q21.

(a) (different / alternative) forms of a gene

*do **not** accept types of genes*

1

(b) DNA isolated from embryo
1

(fluorescent) probe mixed with embryo DNA
1

probe (then) <u>binds</u> with embryo DNA
1

(UV light) <u>to show</u> alleles / gene for disorder
1

(c) genotypes of parents and gametes correct (Man **D** and **d**, Wife **d** and **d**)

*allow half-size genetic diagram with only one **d** from wife*
1

offspring genotypes correct (½ = **Dd** and ½ = **dd**)

allow ecf if parental genotypes are wrong
1

offspring phenotypes correctly assigned to genotypes
1

(d) genotypes of parents and gametes correct (**N** and **n**)

allow ecf if parental genotypes are wrong
1

offspring genotypes correct (**NN**, 2 × **Nn**, and **nn**)
1

offspring phenotypes correctly assigned to genotypes;
1

correct probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3, <u>only</u>;

*do **not** allow '3:1' / '1:4'*
1

[12]

Q22.

(a) (i) nucleus

correct spelling only

accept mitochondrion

ignore genes / genetic material / chromosomes
1

(ii) base(s)

Accept all four correct names of bases

ignore nucleotides and refs to organic / N-containing
1

(iii) 4
1

(iv) codes for sequence / order of amino acids

ignore references to characteristics

1

codes for a (specific) protein / enzyme

or

the sequence / order of <u>three</u> bases / compounds / letters

codes for a specific amino acid

or

the sequence / order of 3 bases / compounds / letters

codes for the order / sequence of amino acids

1

(b) (i) DNA

1

circular / a ring **or** a vector / described

1

(ii) kills any cells not having **kan**^{r} gene / so only cells with **kan**^{r} gene survive

1

hence surviving cells will also contain **Bt** gene / plasmid

1

(iii) cells divide by <u>mitosis</u>

ignore ref to asexual reproduction

correct spelling only

1

genetic information is copied / each cell receives a copy of (all) the gene(s) / all cells produced are genetically identical / form a clone

1

(iv) any **two** from:

- gene may be passed to pathogenic bacteria
- cannot then kill these pathogens with kanamycin
  or
  cannot treat disease with kanamycin
- may need to develop new antibiotics
- gene may get into other organisms
- outcome unpredictable

2

[13]

Q23.

(a) (i) alternative / different / one form of <u>a</u> gene

or

a mutation of a gene

do not allow a type of gene

(For info: CRAM = Childhood Recurrent Acute Myoglobinuria)

1

(ii) not expressed if dominant / other allele is present or it is heterozygous

or

only expressed if dominant allele not present / no other allele present or it is homozygous

need two copies to be expressed / not expressed if only one copy

allow 'gene' for allele

1

(iii) unaffected parents have an affected child

*allow **7** and **8** have **10***

allow skips a generation

1

(b) (i) has two alleles that are the same

*accept (person is) **nn** / **NN** or has two recessive / dominant alleles*

1

(ii) (all) inherit **N** / normal / dominant allele from **1** / from father

ignore they are carriers

1

all are **Nn** / none are **nn** / all are heterozygous

1

(c) (i) genetic diagram including:

1 gametes correct **or** parental genotypes correct:

N and **n** **+** **N** and **n** **or** **Nn** **+** **Nn**

accept alternative symbols, if defined

1

2 derivation of offspring genotypes:
NN + Nn + Nn + nn

allow alternative if correct for parental gametes

1

3 **nn** identified as CRAM

accept ¼ / 25% / 1 in 4 / 1 out of 4 / 1:3

1

4 correct probability: 0.25

*do **not** accept 3:1 / 1:4*

1

(ii) any **four** points + conclusion:

pro PGD:

detected at earlier stage / at 3 days c.f. several weeks / before becoming pregnant

no / less chance of miscarriage c.f. CVS

does not involve abortion / less trauma / less pain / ethical comparison

higher chance of having unaffected child – eg ref to use of spare embryos

provides embryos for research

4

pro CVS:

PGD may destroy some embryos

ethical implications of research on embryos (with PGD)

lower incidence of false positives / false results

low(er) financial cost

conclusion:

must relate to candidate's argument

must have at least one point from each technique for max marks

1

[15]

Q24.

(a) (i) Chromosomes

1

(ii) Characteristics

1

(iii) Classify

1

(b) Plants

ignore algae

1

[4]

Q25.

(a) (i) gamete(s)

ignore reproductive cells

1

(ii) womb / uterus

allow phonetic spellings

1

(b) (i) are formed from the same original embryo

1

(ii) embryo transplantation

1

(iii) any **one** from:

- (calves will have some) genes / DNA from bull / sperm
  allow not all genes from the cow
- idea that sexual reproduction produces variation
  allow may be male
  allow idea that gene for low fat milk may not be passed on

1

[5]

Q26.

(a) any **three** from:

- (gene) cut out
- (gene / cut out) from (bacterial) chromosome / DNA
  accept (gene / cut out) from (bacterial) plasmid
- ref to enzymes (at any point)
- (gene spliced) into maize chromosome / DNA
- (gene added) at an early stage of development

3

(b) any **four** from:

- justification based on comparison of the relative merits of at least one advantage and one disadvantage
  *max **3** marks if only advantages or disadvantages given*

Advantages:

- less effort for farmer **or** less likely to harm farmer
  ignore ref to cost
- (pesticide) always there **or** doesn't wash away
  allow examples eg no need to spray
- less insects to eat crop / maize **or** carry disease
  allow pesticide doesn't contaminate water courses
- so greater crop production / yield

Disadvantages:

- (toxin) kills other insects
  ignore ref to cost
- so (some) crops don't get pollinated / (sexually) reproduce
  allow maize not pollinated
- possible harm when eaten by humans / animals

allow may have unpleasant taste

- damage to food chains

  allow reduced biodiversity

- gene may spread to other species

4

[7]

Q27.

(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**

or

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

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

1

[7]

Q28.

(a) (i) one form of <u>a / one</u> gene

do ***not*** *allow 'a type of gene'*

allow a mutation of a gene

1

(ii) not expressed if dominant / other allele is present / if heterozygous

or

only expressed if dominant allele not present / or no other allele present

allow need two copies to be expressed / not expressed if only one copy / only expressed if homozygous

1

(b) (i) two parents without PKU produce a child with PKU / **6** and **7** → **10**

allow 'it skips a generation'

1

(ii) genetic diagram including:

accept alternative symbols if defined

Parental gametes:

6: **N** and **n**
and 7: **N** and **n**

1

derivation of offspring genotypes:

NN **Nn** **Nn** **nn**

allow genotypes correctly derived from student's parental gametes

1

identification: **NN** and **Nn** as non-PKU

OR nn as PKU

allow correct identification of student's offspring genotypes

1

correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3

*do **not** allow 3 : 1 / 1 : 4*

*do **not** allow if extra incorrect probabilities given*

1

(c) (i) mitosis

correct spelling only

1

(ii) 8

1

(iii) DNA

allow deoxyribonucleic acid

*do **not** allow RNA / ribonucleic acid*

1

(d) (i) may lead to damage to embryo / may destroy embryos / embryo cannot give consent

allow avoid abortion

allow emotive terms – eg murder religious argument must be qualified

allow ref to miscarriage

allow idea of avoiding prejudice against disabled people

allow idea of not producing designer babies

1

(ii) any **one** from:

- prevent having child with the disorder / prevent future suffering / reduce incidence of the disease

  ignore ref to having a healthy child

  ignore ref to selection of gender
- embryo cells could be used in stem cell treatment

  allow ref to long term cost of treating a child (with a disorder)

  allow ref to time for parents to become prepared

1

[12]

Q29.

(a) DNA

1

(b) X and Y

1

(c) (i) 46 chromosomes

1

(ii) half the number

1

(d) meiosis

1

[5]

Q30.

(a) Mendel

1

(b) (i) **TT**

1

(ii) a dominant allele

1

(c) 1 : 1

1

(d) 100 short plants

1

[5]

Q31.

(a) (i) mitochondrion / mitochondria

must be phonetically correct

1

(ii) carbon dioxide / CO_2

1

water / H_2O

1

in either order

*accept CO2 but **not** CO*[2]

*accept H2O **or** HOH but not H*[2]*O*

(iii) diffusion

1

high to low concentration

allow down a concentration gradient

1

through (cell) membrane **or** through cytoplasm

*do **not** accept cell wall*

1

(b) ribosomes make proteins / enzymes

1

using amino acids

1

part A / mitochondria provide the energy for the process

allow ATP

*do **not** accept produce or make energy*

1

[9]

Q32.

(a) (i) meiosis

allow mieosis

1

(ii) testis / testes

allow testicle

1

(b) (i) 23

1

(ii) fuses / joins with cell D / with egg cell **or** used in fertilisation

allow fuse with another cell

1

prevents doubling of chromosome number / restores original no. / 46 /

diploid no. / normal no. / full no.

accept 23 from each parent / from each gamete

1

[5]

Q33.

(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

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]

Q34.

(a) (use of) enzymes

1

(b) asexual reproduction / no gametes / no fusion / only one parent

ignore clones

1

cells all contain same genetic information / same genes (as parent) / same DNA

1

(c) can spray crop with herbicide – <u>only weeds</u> killed

crop survives herbicide insufficient

1

(d) any **one** from:

allow 'think that GM food is bad for health'

- fears / lack of knowledge about effects of GM food on health

  ignore not natural or against religion

- crop plants may pass on gene to wild plants
- encourages use of herbicides

1

[5]

Q35.

(a) (i) gametes

apply list principle

1

(ii) chromosomes

apply list principle

1

(b) (i) The allele is recessive

no mark if more than one box is ticked

1

(ii) two

apply list principle

1

(c) (i) **A**

apply list principle

1

(ii) **B**

apply list principle

1

[6]

Q1.

(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 discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- 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 destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

(1)

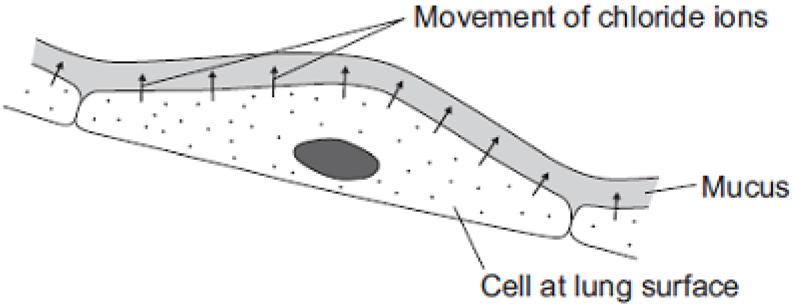
(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

____

____

____

____

____

____

____

____

(3)

(Total 11 marks)

Q2.

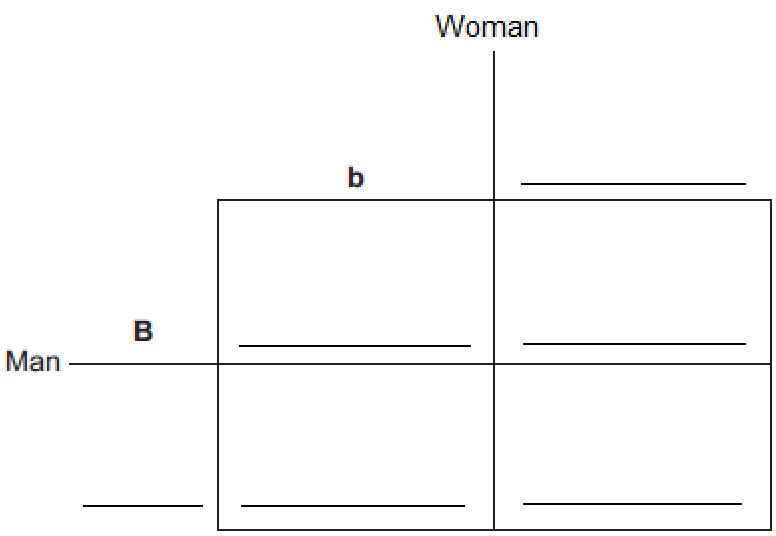
Eye colour is controlled by genes.

The dominant allele of the gene **(b)** produces brown eyes. The recessive allele (**b**) produces blue eyes.

A homozygous blue-eyed woman married a homozygous brown-eyed man.

All of their three children had brown eyes.

(a) (i) Complete the genetic diagram.



(2)

(ii) Give the reason why all of the children had brown eyes.

____

____

(1)

(b) The couple's brown-eyed son and his brown-eyed partner had five children. Two of the children had blue eyes and three of the children had brown eyes.

Use a genetic diagram to show how two of their children came to have blue eyes.

___

___

___

(3)
(Total 6 marks)

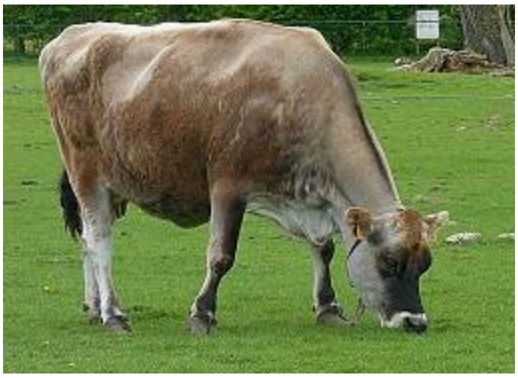
Q3.

The photographs show two breeds of cow.

Friesian cow

By Keith Weller/USDA (www.ars.usda.gov: Image Number K5176-3) [Public domain], via Wikimedia Commons

Jersey cow



By Jamain (Own work) [CC-BY-SA-3.0-2.5-2.0-1.0], via Wikimedia Commons

In parts (a) and (b) draw a ring around the correct answer to complete each sentence.

(a) Cows produce their young (calves) by

asexual reproduction.
cloning.
sexual reproduction.

(1)

(b) Cows and their calves have many similar characteristics.

(i) The information for characteristics is carried by

clones.
embryos.
genes

(1)

(ii) The information for characteristics is passed to the next generation in cells

called

body cells.
gametes.
neurones.

(1)

(c) Friesian and Jersey cows can both be used for meat or to produce milk.

The information shows features of Friesian and Jersey cows.

Friesian cows	Jersey cows
Body mass up to 600 kg	Body mass up to 400 kg
Milk contains 3.4% protein	Milk contains 3.8% protein
Can be milked for 325 days after giving birth	Can be milked for 250 days after giving birth
Produce no milk for 55 days before having a calf	Produce no milk for 45 days before having a calf
Produce > 30 litres of milk per day	Produce < 30 litres of milk per day

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

In your answers you must make comparisons between the two breeds of cow.

(i) Give **two** advantages of a farmer keeping Friesian cows and **not** Jersey cows.

1. ____

____

2. ____

____

(2)

(ii) Give **two** advantages of a farmer keeping Jersey cows and **not** Friesian cows.

1. ____

____

2. ____

____

(2)

(d) Cow's milk is different from human milk. Cow's milk should **not** be given to young human babies.

Scientists in China have *genetically engineered* cows to produce human milk. Milk from these cows can be fed to young human babies.

(i) What is *genetic engineering* ?

Tick (✓) **one** box.

Genes from one organism are transferred to a different organism	☐
Cells are separated from an embryo and are transferred to host mothers	☐
The nucleus from a body cell is transferred to an egg cell	☐

(1)

(ii) Some people are worried about using milk from genetically engineered cows, to feed human babies.

Give **one** reason why.

____

____

(1)

(Total 9 marks)

Q4.

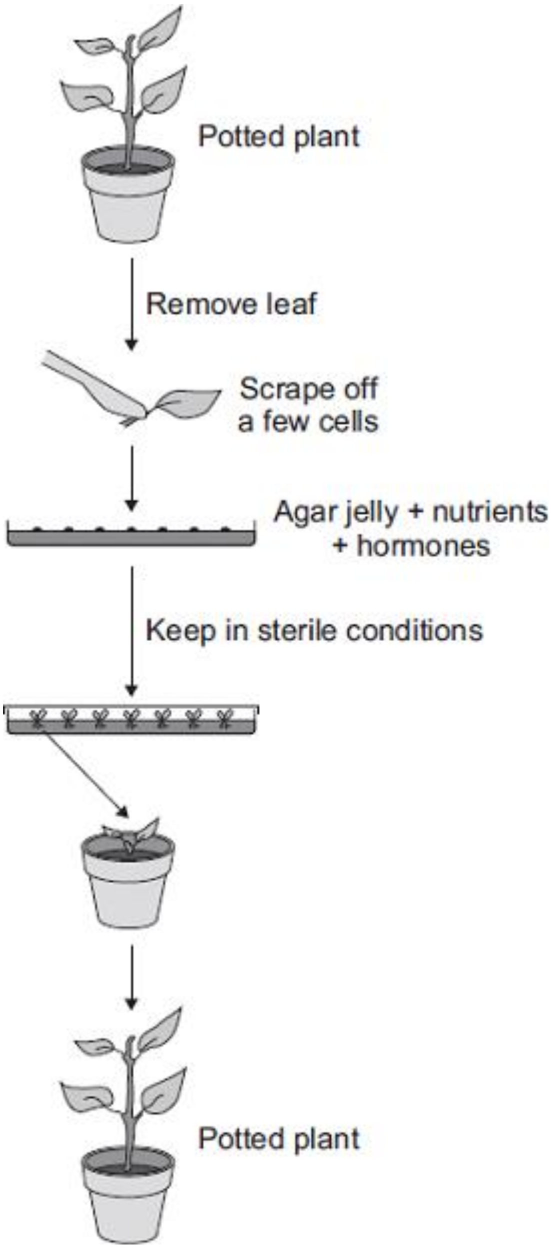
Plant hormones are used in horticulture.

(a) Name **one** plant hormone.

____

(1)

(b) The diagram shows how new plants are produced using tissue culture.



(i) Tissue culture is a type of *asexual reproduction* .

Give the main features of *asexual reproduction* .

____

____

____

____

____

____

(3)

(ii) Another method of producing new plants is by taking cuttings.

Suggest **one** advantage of using tissue culture and **not** using cuttings to produce plants.

____

____

____

(1)

(Total 5 marks)

Q5.

(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 mitosis (✓)**
Produces new cells during growth and repair		
Produces gametes (sex cells)		
Produces genetically identical cells		

(2)

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

a man ______________________

a woman ____________________

(2)

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

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

(i) a man ______________________

(1)

(ii) a woman? ____________________

(1)

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

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

(1)

(Total 7 marks)

Q6.

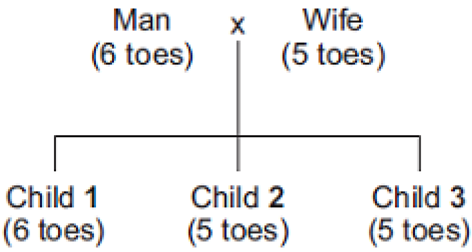
Polydactyly is an inherited condition. Polydactyly is controlled by a dominant allele.

The photograph shows the foot of a baby with polydactyly.

CNRI/Science photo library

A man and his wife have three children. The man has polydactyly.

The diagram shows the inheritance of polydactyly in this family.
The diagram also shows the number of toes each person has on each foot.



In the rest of this question, the following symbols are used to represent alleles.

D = allele for polydactyly (6 toes on each foot)
d = allele for 5 toes on each foot

(a) (i) How many alleles for the number of toes will there be in **one** sperm cell? ☐

(1)

(ii) Complete the sentence.

A sperm cell joins with an egg cell in a process called ____________________

(1)

(b) (i) What combination of alleles does the man have?

Tick (✓) **one** box.

DD ☐

Dd ☐

dd ☐

(1)

(ii) What combination of alleles does the man's wife have?

Tick (✓) **one** box.

DD ☐

Dd ☐

dd ☐

(1)

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

(i) The man and his wife plan to have a fourth child.

The probability that this child will have 6 toes on each foot is

1 in 2.
1 in 3.
1 in 4.

(1)

(ii) When Child **2** grows up, he marries a woman with 5 toes on each foot.

The probability that their first child will have 6 toes on each foot is

0.
1 in 2.
1 in 4.

(1)

(Total 6 marks)

Q7.

A certain gene codes for the production of an enzyme called 'HEXA'.

One human genetic disorder causes damage to nerve cells in the brain.
This disorder is caused by a small change in the DNA of the HEXA gene.
People with this disorder make a changed HEXA enzyme that does not work.

(a) Explain how a change in the DNA of the HEXA gene can result in the production of a changed HEXA enzyme that does not work.

____

____

____

____

____

____

(3)

(b) The gene coding for the HEXA enzyme is found on chromosome number 15.

(i) How many chromosomes are there in the nucleus of a human nerve cell?

____

(1)

(ii) A boy had the changed HEXA gene on the chromosome number 15 that he inherited from his father.
The changed HEXA gene coded for a HEXA enzyme that does not work.
The boy did **not** develop the genetic disorder.

Explain why the boy did **not** develop the genetic disorder.

____

____

____

____

(2)

(iii) The boy grew up and got married.

A blood test showed that his wife had also inherited the same changed HEXA gene.

There is a 1 in 4 chance that this couple's first child will have the genetic disorder.

Use a genetic diagram to explain why.

Use the following symbols in your explanation:

H = allele for making the normal HEXA enzyme
h = allele for making a HEXA enzyme that does not work.

(3)
(Total 9 marks)

Q8.

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 **Species B**

One chromosome **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)

Q9.

The photograph shows a zorse.

By Kumana @ Wild Equines [CC-BY-2.0], via Wikimedia Commons

A zorse is a cross between a male zebra and a female horse.
The zorse has characteristics of both parents.

(a) The zorse was produced by *sexual reproduction.*

(i) What is *sexual reproduction?*

___

___

(1)

(ii) The zorse has characteristics of a zebra and a horse.
Why?

___

___

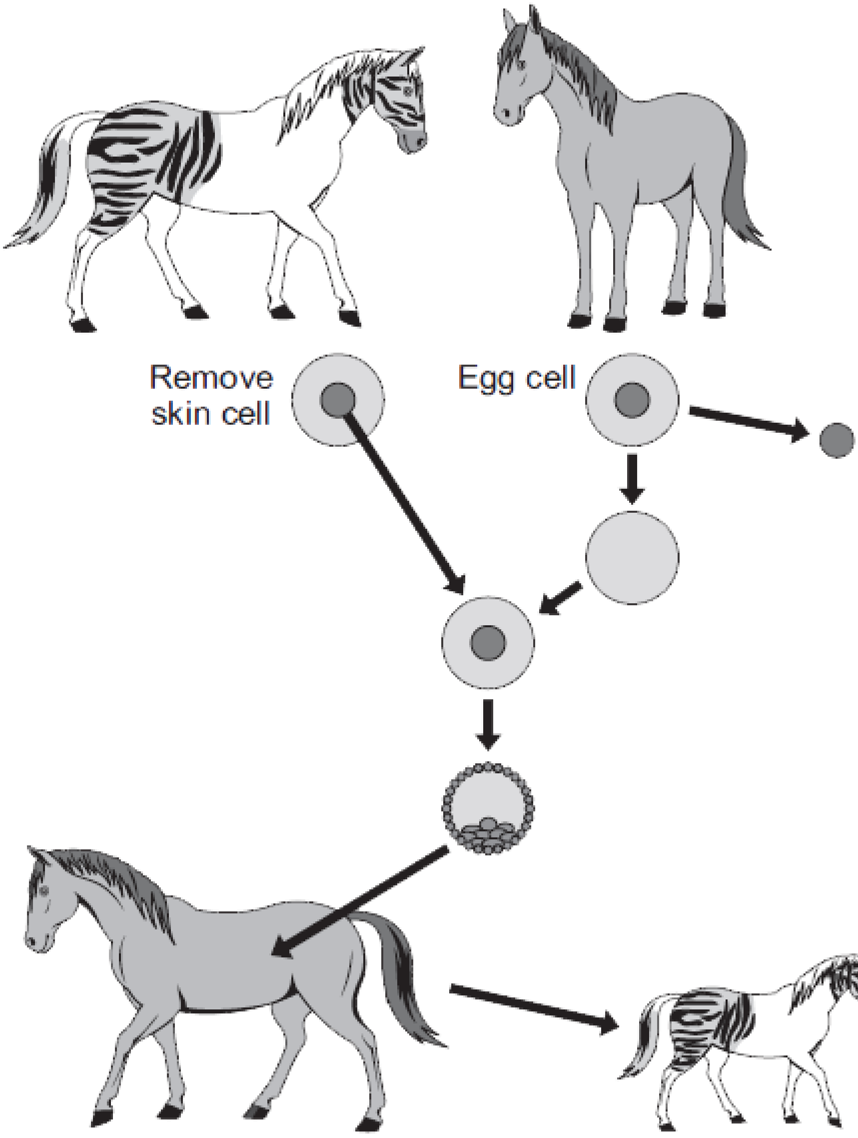
___

___

(2)

(b) Zorses are **not** able to breed.
Scientists could produce more zorses from this zorse by adult cell cloning.

The diagram shows how the scientists might clone a zorse.



In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Use information from the diagram and your own knowledge to describe how adult cell cloning could be used to clone a zorse.

___

___

___

___

___

___

___

___

(6)
(Total 9 marks)

Q10.

The Blue-moon butterfly lives on a small island called Samoa, in the Pacific Ocean.

By Emoke Dénes [CC-BY-SA-2.5], via Wikimedia Commons

In 2006 Blue-moon butterflies almost became extinct.

Wolbachia bacteria killed males before they could hatch from eggs. Only females were resistant to the bacteria.

In 2006 the number of male Blue-moon butterflies had decreased to only 1 per cent of the population. Two years later, the number of males was equal to the number of females.

(a) Scientists believe that a change in a gene suddenly occurred to make some males resistant to the bacteria.

What scientific term describes a change in a gene?

(1)

(b) The numbers of male Blue-moon butterflies in the population increased quickly after the new form of the gene had appeared.

Suggest why.

____

____

____

____

____

____

____

(4)

(Total 5 marks)

Q11.

Kangaroos have brown coats. The two parent kangaroos in the photograph produced a baby kangaroo with a white coat.

Photographs supplied by iStockphoto/Thinktsock

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

asexual	**characteristic**	**chromosome**
mutation	**nucleus**	**sexual**

The baby kangaroo was produced by ________________________ reproduction.

The coat colour of the adult kangaroo is a ________________________________

The different coat colour of the baby kangaroo is the result of a

_________________________________ of a gene.

The gene is found on a thread-like structure called a _______________________

(4)

(b) Some animals similar to kangaroos are endangered species.

Cloning is one way of making sure that endangered species do not die out.
The flowchart below shows one way of cloning an animal.

The four statements needed to complete the flowchart are numbered **1**, **2**, **3** and **4**.

Complete the flow chart by writing the **number** of the correct statement in the empty box.

Each number should be used **once** only.

1 Give a small electric shock

2 Transfer nucleus from body cell

3 Remove nucleus from egg cell

4 Insert embryo into womb of female

Remove egg cell from ovary
↓
______
↓
The egg cell is now empty
↓
______
↓
The egg cell now has the nucleus of a body cell
↓
______
↓
Ball of cells
↓
______
↓
Cloned animal

(3)

(Total 7 marks)

Q12.

(a) Animal breeders use sexual reproduction to produce new strains of animals.

How does sexual reproduction produce variation?

___

___

___

___

(2)

(b) A salmon is a type of fish.

Scientists have created a GM (genetically modified) 'super' salmon.

The scientists transferred a gene from a fish called a pout into a salmon. The gene increases the secretion of growth hormone in the salmon. The GM salmon grows much faster than an ordinary salmon, reaching market size up to one year earlier. Many more GM salmon will be grown in fish farms.

(i) Describe how a gene can be transferred from a pout into a salmon.

___

___

___

___

___

___

(3)

(ii) The government might not allow the production of GM salmon.

Suggest **one** reason why.

___

___

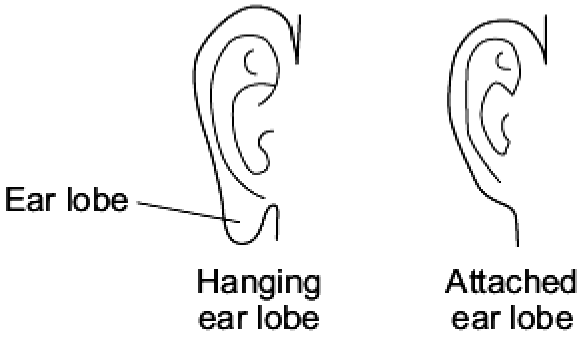
(1)

(Total 6 marks)

Q13.

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

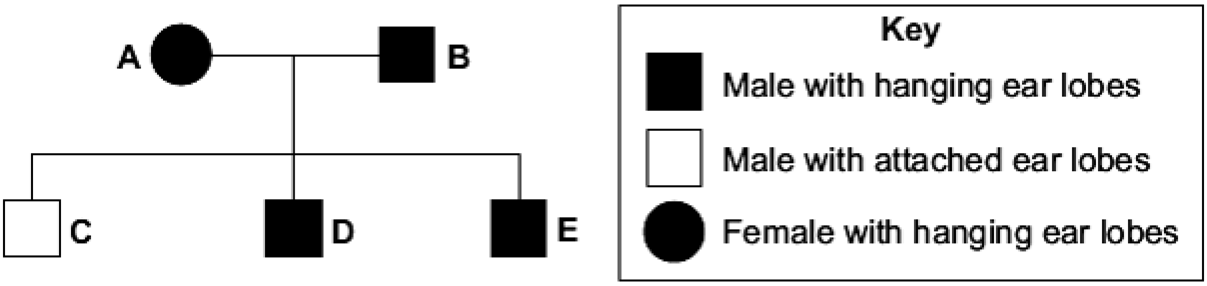
The diagrams show the two shapes of ear lobe.



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)

Q14.

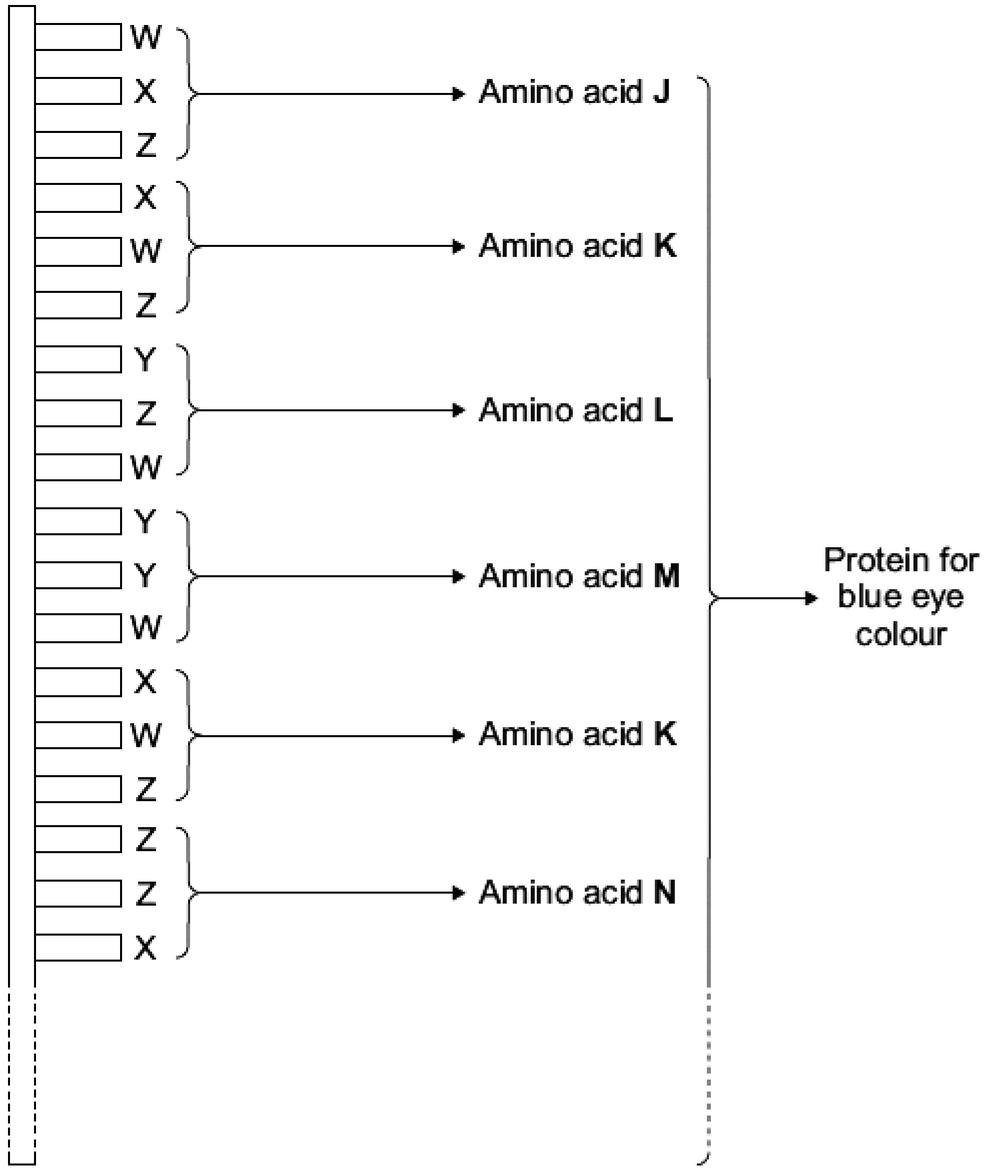
A molecule of DNA contains four different bases, **W**, **X**, **Y** and **Z**.

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)

Q15.

(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)

Q16.

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.

Mrs Brown (2)
Nn

Mr Brown (1) **Nn**	**N**	**n**
N	(3) **NN**	(5) **Nn**
n	(4) **Nn**	(6) **nn**

Key

N Allele for **not** being affected by cystic fibrosis

n Allele for cystic fibrosis

(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

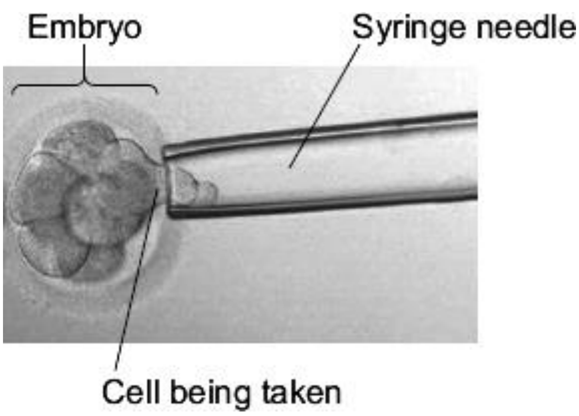
____

(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.



©Pascal Goetgheluck/Science Photo Library

- 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 ____

____

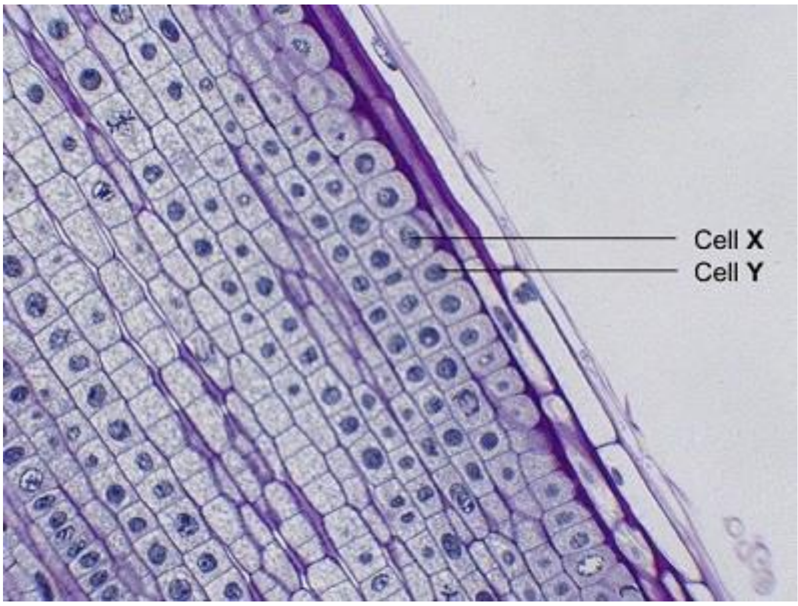
Disadvantage ____

____

(2)
(Total 6 marks)

Q17.

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)

Q18.

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)

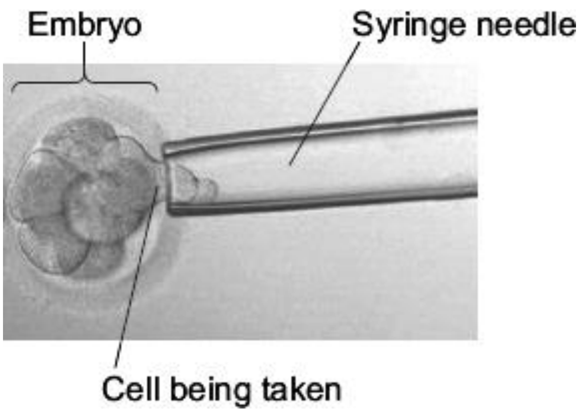
(ii) There is a 1 in 4 chance that Mr and Mrs Brown’s next child will have cystic fibrosis.
Use a genetic diagram to explain why.

(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**).

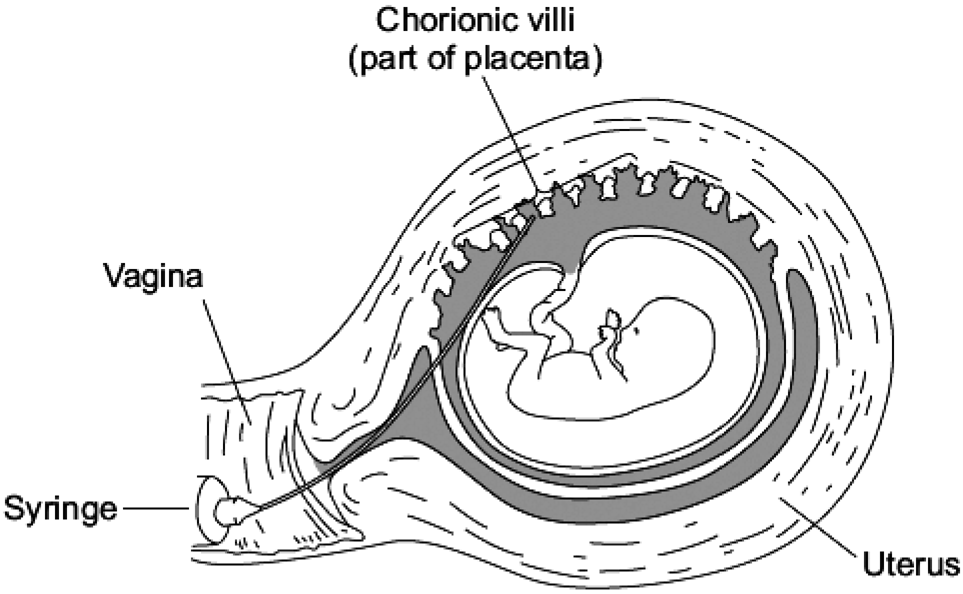
In **PGD**, eggs are fertilised in dishes and allowed to grow into embryos. A cell is taken from each embryo when the embryo is 3 days old. The photograph shows how the cell is taken.



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.

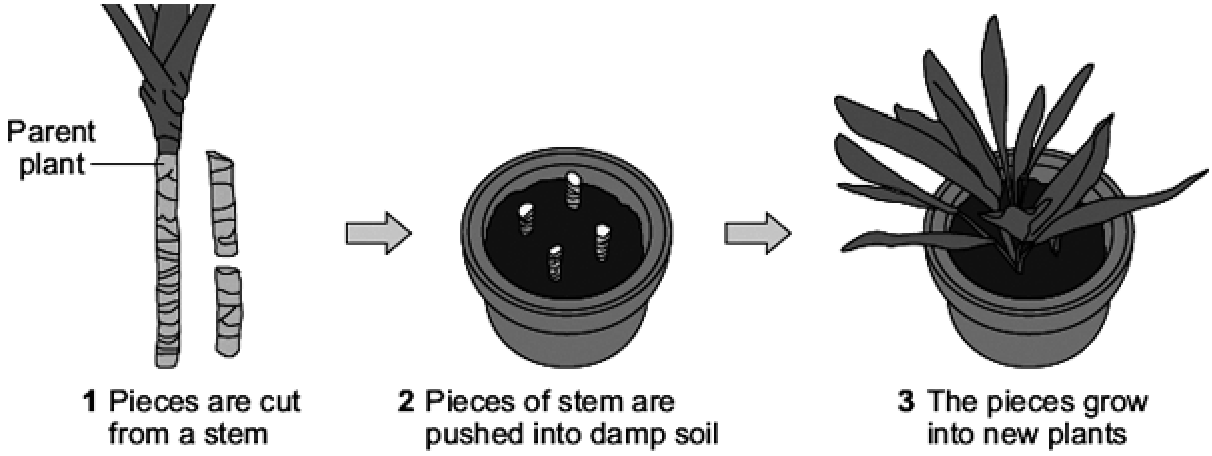
The genetic counsellor thinks that **PGD** is a better method than **CVS** for detecting cystic fibrosis in an embryo.

Evaluate this opinion.

(4)
(Total 10 marks)

Q19.

(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)

Q20.

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)

Q21.

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)

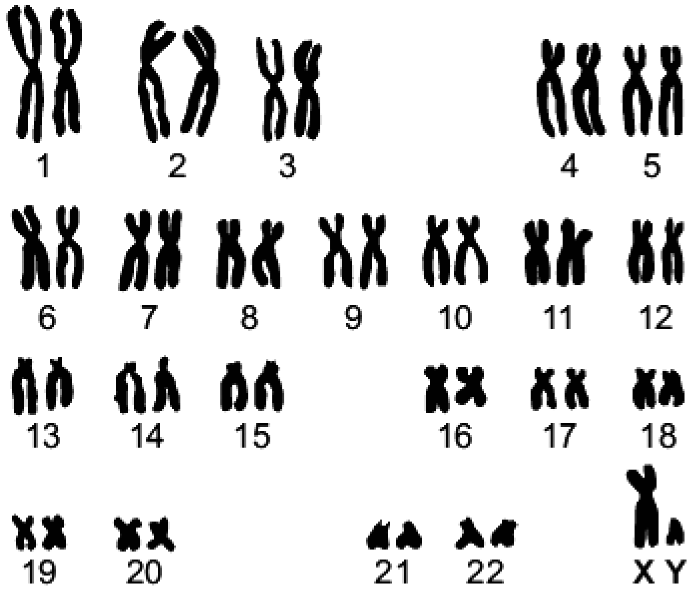
(c) The new plant has the same ____________________________ as the parent plant.
(1)
(Total 3 marks)

Q22.

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)

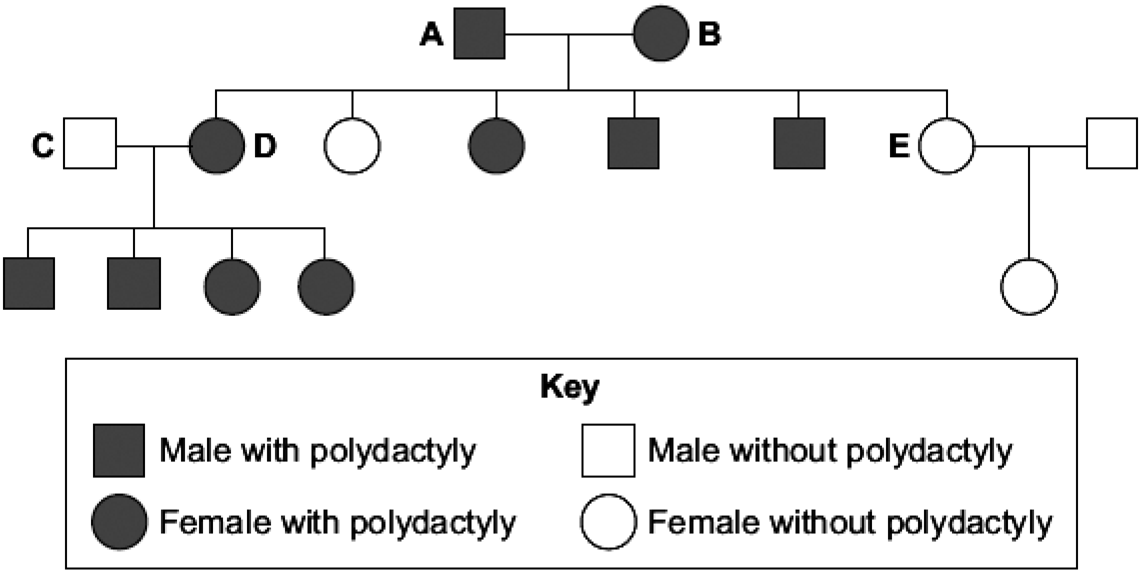
Q23.

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?

____

____

____

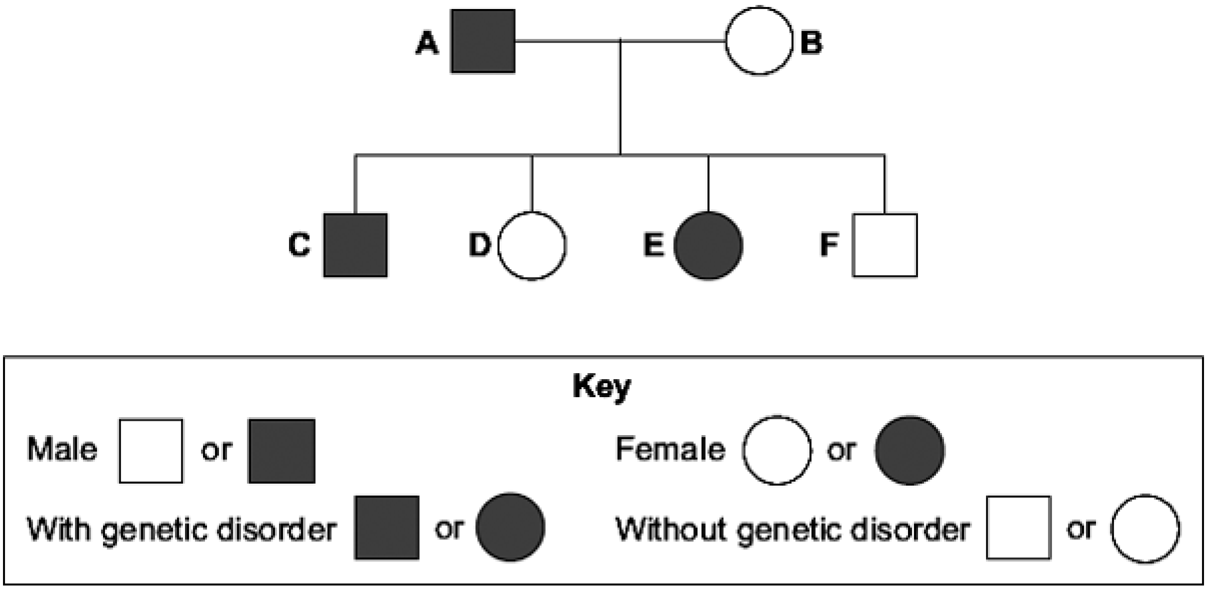
(1)

(Total 6 marks)

Q24.

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

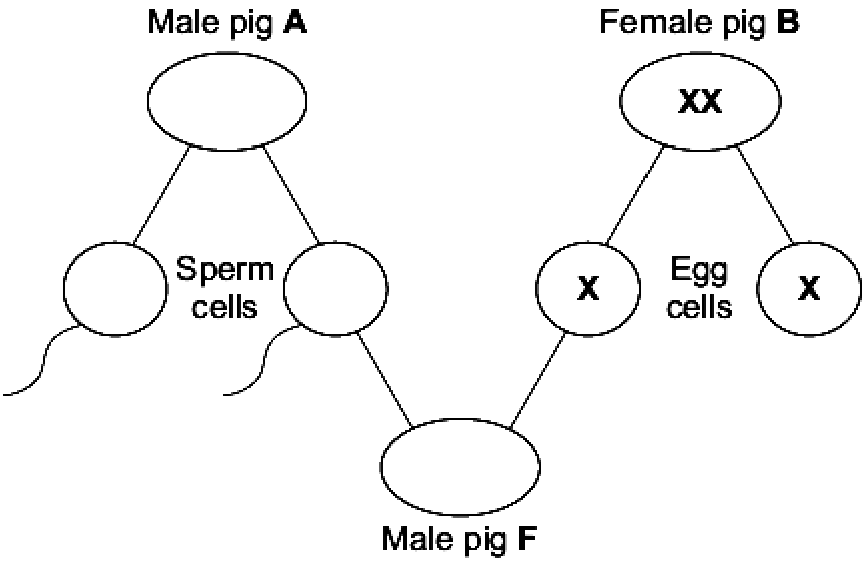
an embryo.
an enzyme.
a gamete.

(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)

Q25.

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)

Q26.

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)

Q27.

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)

Q28.

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)

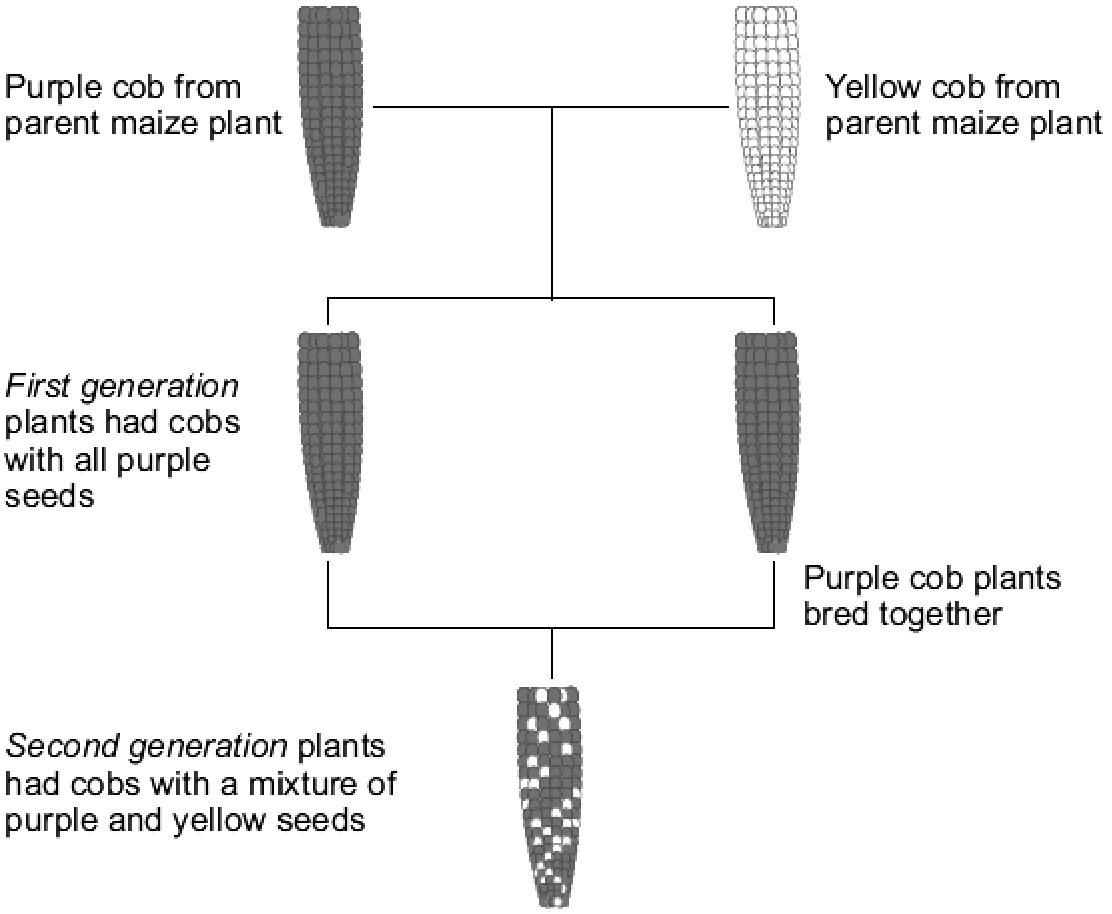
Q29.

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)

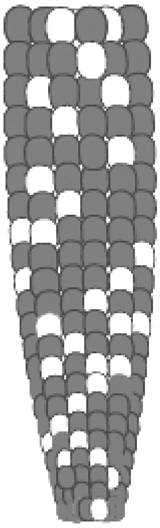
(ii) What alleles does a purple seed from a *first* generation plant have?

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 ☐

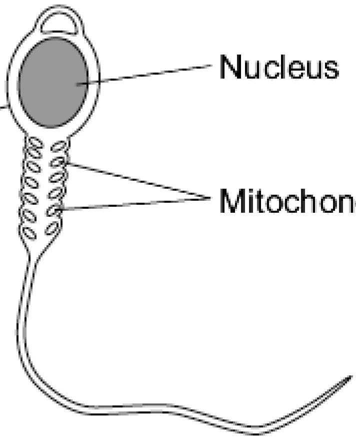
1 purple : 1 yellow ☐

(1)
(Total 5 marks)

Q30.

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)

Q31.

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

____

____

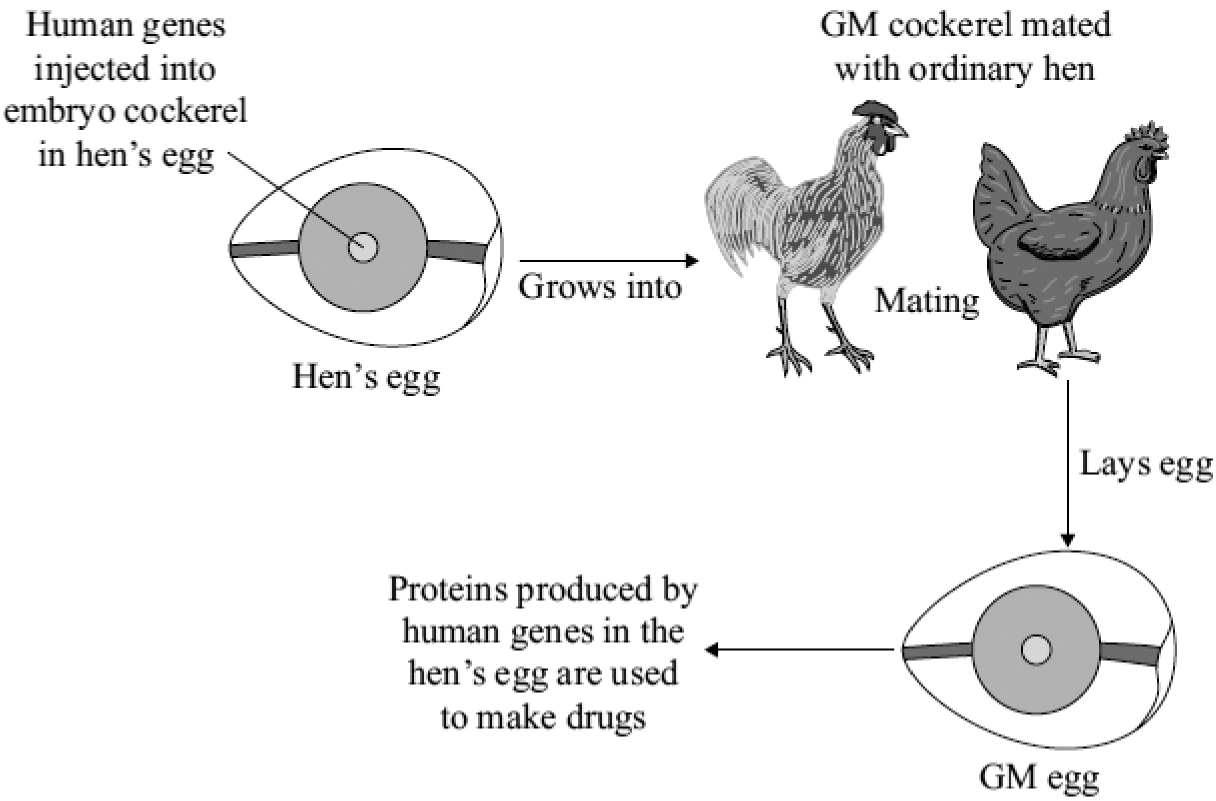
(1)
(Total 6 marks)

Q32.

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. ____

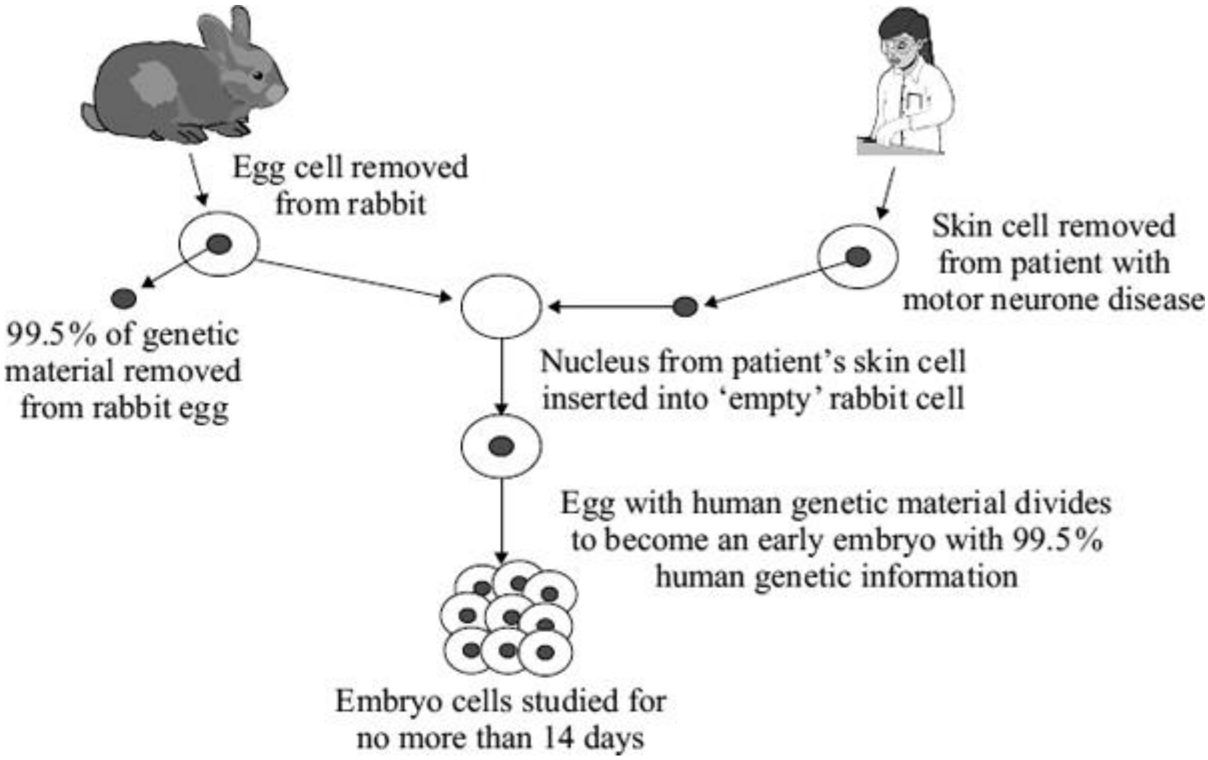
2. ____

(2)
(Total 6 marks)

Q33.

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)

Q34.

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.

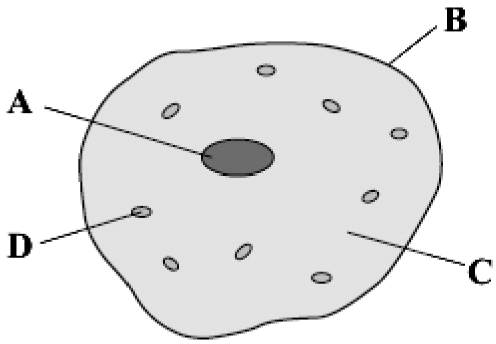
(i) A person who has cystic fibrosis has [two / three / four] copies of the cystic fibrosis allele.

(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)

Q35.

(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)

Mark schemes

Q1.

(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents
or
aa correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

accept converse if clear, eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

  accept some may have the allele

  reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

to gain 3 marks both advantage(s) <u>and</u> disadvantage(s) must be given

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantages

any **two** from:

- operation dangers / named eg infection
  ignore risk unqualified
- ethical or religious issues linked with killing embryos
  accept wrong / cruel to embryos accept right to life argument
  ignore embryos are destroyed
- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement
eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive
or
eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

__note__: the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made

do __not__ award the mark if the conclusion only states that advantages outweigh the disadvantages

1

(c) any **three** from:

- osmosis / diffusion
  do __not__ accept movement of ions / solution by osmosis / diffusion
- more concentrated solution outside cell / in mucus
  assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of 'water concentration'
- water moves from dilute to more concentrated solution
  allow correct references to movement of water in relation to concentration gradient
- partially permeable membrane (of cell)
  allow semi / selectively permeable

3

[11]

Q2.

(a) (i) correct parental genotypes (man BB and woman bb)

1

all offspring Bb

Woman

		b	b
Man	B	Bb	Bb
	B	Bb	Bb

ignore 'brown' or 'brown eyes' on diagram **1**

(ii) they have one B / dominant allele / heterozygous

or

B / brown allele / dominant allele is expressed even if only on one chromosome **1**

(b) correct parental genotypes (both Bb)
can be shown in a diagram
can be shown as gametes **1**

correct derivation of offspring genotypes from gametes
allow correct derivation from wrong gametes **1**

bb identified as blue-eyed **1**

[6]

Q3.

(a) sexual reproduction **1**

(b) (i) genes **1**

(ii) gametes **1**

(c) (i) any **two** from:
answers must be comparative

- <u>more</u> meat (per cow)
  ignore bigger unqualified
- <u>more</u> milk each day
- can be milked for <u>more</u> time after giving birth / great<u>er</u> proportion of time

accept '(produce) <u>more</u> milk', for **1** *mark, if neither more milk each day nor can be milked for more time after giving birth are given*

2

(ii) (milk contains) <u>more</u> protein

answers must be comparative

1

<u>less</u> time before having a calf when no milk produced

1

(d) (i) genes from one organism are transferred to a different organism

1

(ii) (possible) harm to babies' long term health

allow don't know long-term / side effects (on baby)

accept idea that there may be other things in (genetically engineered) cow's milk that might harm babies' health e.g. bacteria

ignore ethical / religious arguments

1

[9]

Q4.

(a) auxin

accept other named plant hormones

1

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

- no (fusion of) gametes / fertilisation
  allow no meiosis ***or*** *new cells <u>only</u> produced by mitosis*
- only one parent
  allow not two parents
- no mixing of <u>genetic</u> material
- no <u>genetic</u> variation **or** <u>genetically</u> identical offspring
  allow clones

3

(ii) more / many offspring / plants (produced from one parent plant)

allow less damage to parent plant

ignore speed / cost

1

[5]

Q5.

(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

1

(c) ½ / 0.5 / 50% / 1:1 / 1 in 2

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

allow 50:50

allow 2 in 4

1

[7]

Q6.

(a) (i) 1

1

fertilisation / fusion

allow <u>sexual</u> reproduction

allow fertilise / fuse

ignore joining

1

(b) (i) **Dd** 1

(ii) **dd** 1

(c) (i) 1 in 2 1

(ii) 0 1

[6]

Q7.

(a) changes code /sequences of bases
or
sequence of amino acids is different 1

the enzyme has different / wrong shape / structure
allow the active site is changed 1

so substrate will not fit into enzyme / will not join to enzyme 1

(b) (i) 46
allow 23 pairs 1

(ii) also inherited (from mother) normal chromosome 15 / normal allele / normal gene / boy is heterozygous / **Hh**
allow the boy is a carrier 1

(allele for) this disorder is recessive
or
the normal allele would give a working enzyme
ignore converse 1

(iii) genetic diagram including:

Parental gametes:

H and **h** from both parents
accept alternative symbols, if defined 1

<u>derivation</u> of offspring genotypes:

HH Hh Hh hh
allow alternative if correct for student's parental genotypes / gametes 1

identification of **hh** (having the disorder) if 1 in 4 1

[9]

Q8.

(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]

Q9.

(a) (i) fusion / joining / combining of gametes / egg **and** sperm / sex cells

accept fertilisation

allow fusion / joining / combining DNA from two parents

ignore meeting / coming together / mixing of gametes etc

1

(ii) (mixture of) genes / DNA / genetic information / chromosomes

ignore nucleus / inherited information but allow second mark if given

1

from both parents / horse **and** zebra

dependent on sensible attempt at 1st mark

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1-2 marks)
There is simple description of the early stages of adult cell cloning. However there is little other detail and the description may be confused or inaccurate.

Level 2 (3-4 marks)
There is an almost complete description of the early stages of the process and description of some aspects of the later stages. The description may show some confusion or inaccuracies.

Level 3 (5-6 marks)
There is a clear, detailed and accurate description of all the major points of how adult cell cloning is carried out.

Examples of Biology points made in the response could include:

- skin cell from zorse
- (unfertilised) egg cell from horse
- remove nucleus from egg cell
- take nucleus from skin cell
- put into (empty) egg cell
- (then give) electric shock
- (causes) egg cell divides / embryo formed
- (then) place (embryo) in womb / uterus

6

[9]

Q10.

(a) <u>mutation</u>

correct spelling only

ignore other adjectives eg random / spontaneous

1

(b) *ignore references to X / Y chromosomes*

idea of mutant gene / new form / this allows <u>hatching</u> (of males)

1

(individual with advantage) (more) survive / (more) live / (more) don't die

allow immunity rather than resistance throughout

1

(so survivors) breed / reproduce

1

mutation / gene passed (from survivors) to offspring / next generation

allow resistance / characteristic for gene

'gene passed on' is insufficient

1

[5]

Q11.

(a) sexual

1

characteristic

1

mutation

1

chromosome

this order only

1

Remove egg cell from ovary
↓
3
↓
The egg cell is now empty
↓
2
↓
The egg cell now has the nucleus of a body cell.
↓
1
↓
Ball of cells
↓
4
↓
Cloned animal

(b)

*four correct gains **3** marks*

*two or three correct gains **2** marks*

*one correct gains **1** mark*

accept correct connection between statement and box

3

[7]

Q12.

(a) fusion of gametes / named gametes

allow meet / join / fertilise

1

results in mixing of genetic information / DNA / chromosomes

accept genetic information / DNA / chromosomes from two parents

1

(b) (i) use enzyme

1

to cut gene from pout <u>chromosome / DNA</u>

1

insert <u>gene</u> into salmon chromosome / DNA / egg / embryo / nucleus

accept use of plasmid as carrier

ignore salmon / cell

1

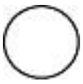
(ii) eg fear of gene transfer to wild salmon / extinction of wild salmon / fear of harmful effect on consumers / unsure of long term effects

ignore cruel / ethics / morals / religion / unnatural / economics

1

[6]

Q13.

(a) 

*the shape must be (roughly) circular **and** not shaded, for the mark*

accept the shape drawn in the key if it is not contradictory

1

(b) dominant

1

(c) (i) a half (50%)

1

(ii) Some of B's sperm cells have an X chromosome

1

[4]

Q14.

(a) gene / allele

1

(b) (in / on) ribosome(s)

1

(c) any **three** from:

- amino acids make up a protein
- (protein is) particular combination / sequence (of amino acids)
- bases form a <u>code</u>
- the bases work in threes or description
  accept bases work in triplet
- (code / three bases) for one amino acid
  *accept eg (bases) WXZ for amino acid J for **2** marks*

3

(d) (i) different / wrong amino acid (coded for) **or** different / wrong shape

ignore reference to amino acid 'made'

ignore change unqualified

ignore different protein

1

(ii) different / example of different eye colour

allow protein may / would not be made / function (normally)

1

[7]

Q15.

(a) (i) 23

1

(ii) nucleus / 'the head'

allow phonetic spelling

1

(b) (i) **X** and **X**

1

(ii) **X** and **Y**

1

(c) 150 million / 150,000,000 / half (of them) / 50% / 1 in 2

1

[5]

Q16.

(a) (i) recessive allele

1

(ii) carriers

1

(b) (i) 6

allow nn

1

(ii) 1 in 4 / 0.25 / ¼ / 25 % / 1:3

*do **not** accept '3:1' / 1:4 / 1 in 3 / 25*

1

(c) **advantage:**

detect CF qualified – eg at early stage / before becoming pregnant **or** (only) healthy <u>children</u> produced

allow 'after <u>only</u> 3 days'

allow reduces health care costs

1

disadvantage:

some embryos are destroyed / may damage embryo

allow increased risk of miscarriage
ignore not natural
ignore cost

1

[6]

Q17.

(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

<u>one</u> 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]

Q18.

(a) (i) (alternative) forms / types of <u>a</u> / the same gene

1

(ii) only expressed if 2 copies inherited
or not expressed if other allele present

allow over ruled / over powered by the other allele

1

(b) (i) **Nn**

ignore heterozygous

1

(ii) genetic diagram including:

accept alternative symbols, if defined gametes: **N** and **n** from <u>both</u> parents

accept alternative symbols if correct for answer to (b)(i)

1

correct derivation of offspring genotypes:

NN Nn Nn nn

allow if correct for candidate's parental genotypes / gametes

1

identification of **nn** as having cystic fibrosis

1

(c) **Argued evaluation**

any **four** from:

- PGD <u>higher</u> financial cost
  accept CVS <u>only</u> costs £600
- PGD occurs before pregnancy / implantation
  accept detected at <u>earlier</u> stage so less unethical / less trauma
- PGD does not involve abortion so less trauma / less pain / ethical

Q1.

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)

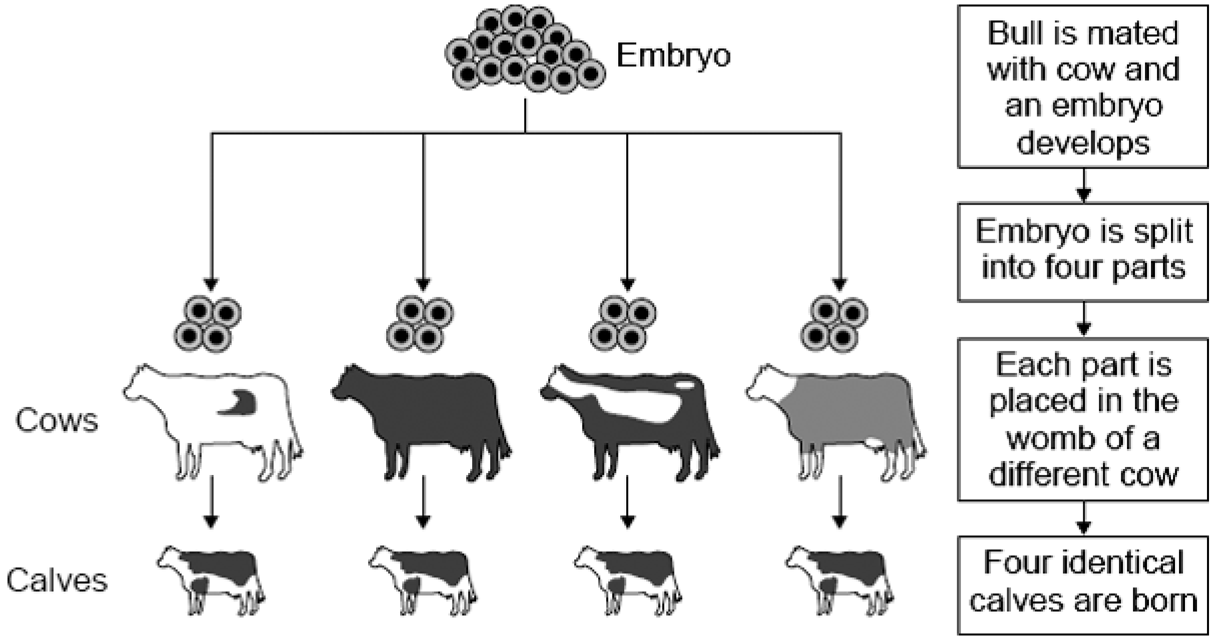
(ii) This colour is controlled by a ________________________

(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.

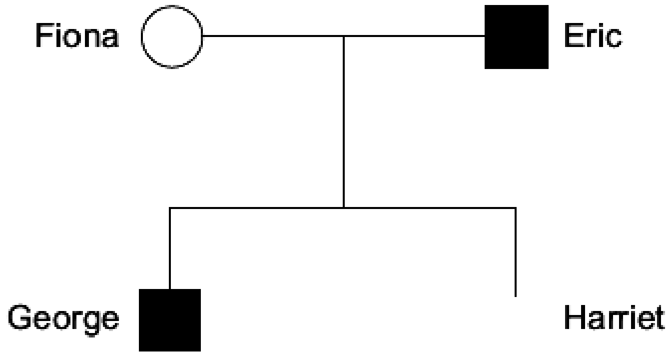
The identical calves are known as ________________________

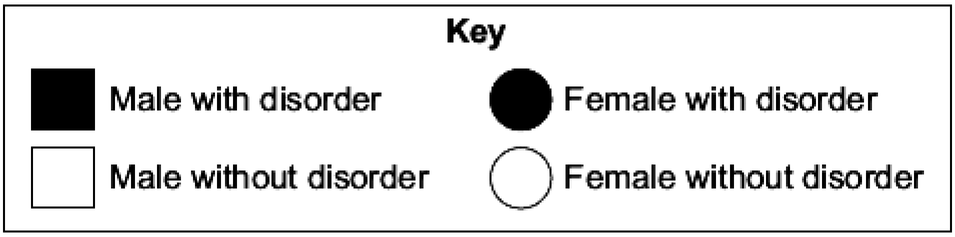
(3)
(Total 6 marks)

Q2.

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)

Q3.

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.

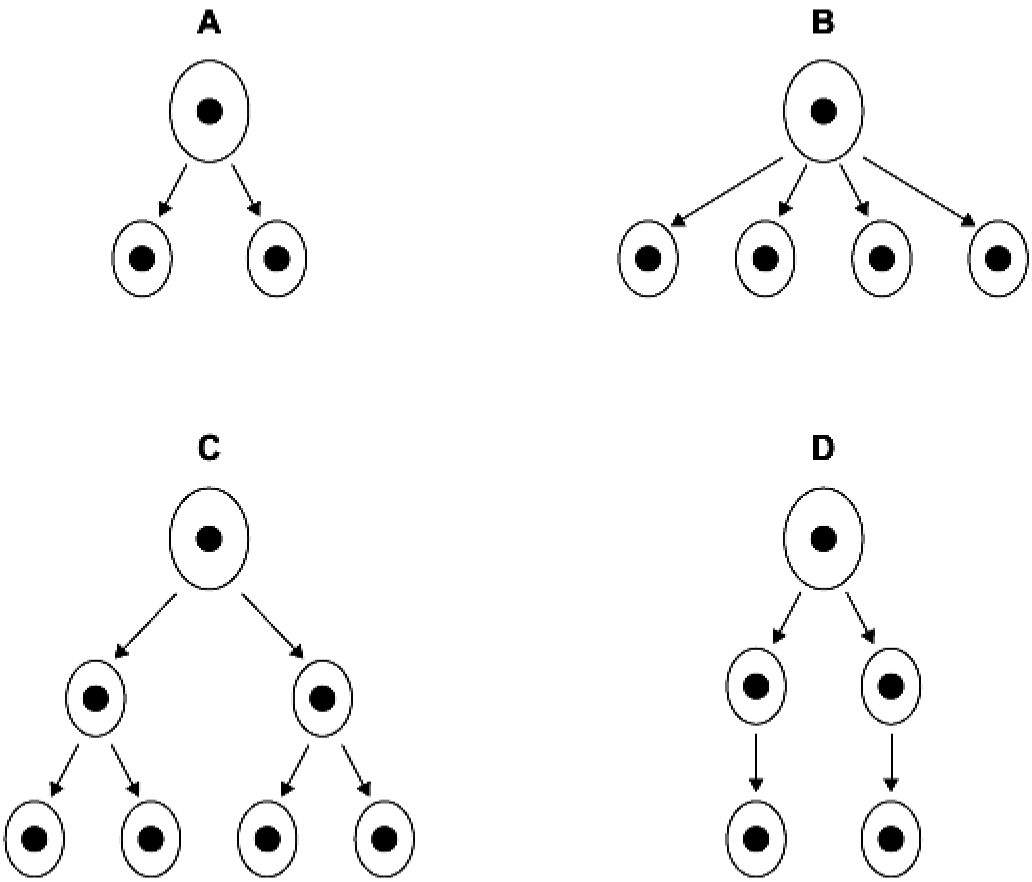
___

___

(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)

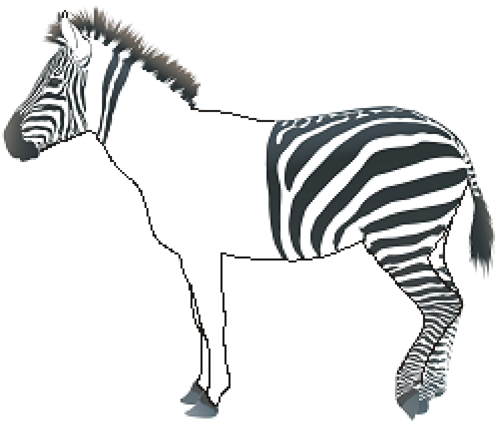
Q4.

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**

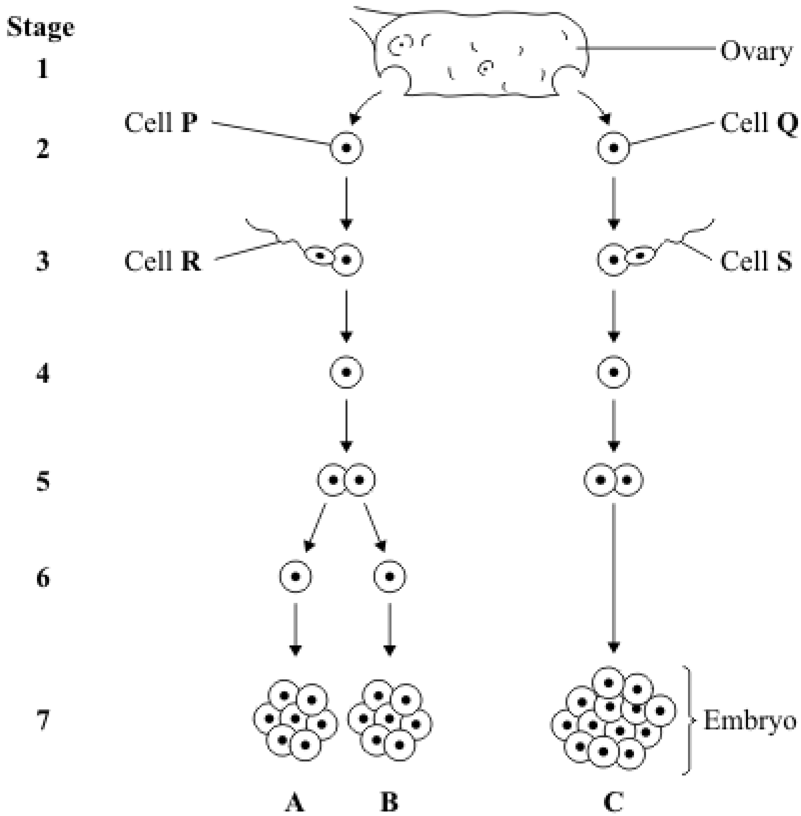
(3)

(Total 4 marks)

Q5.

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.

____

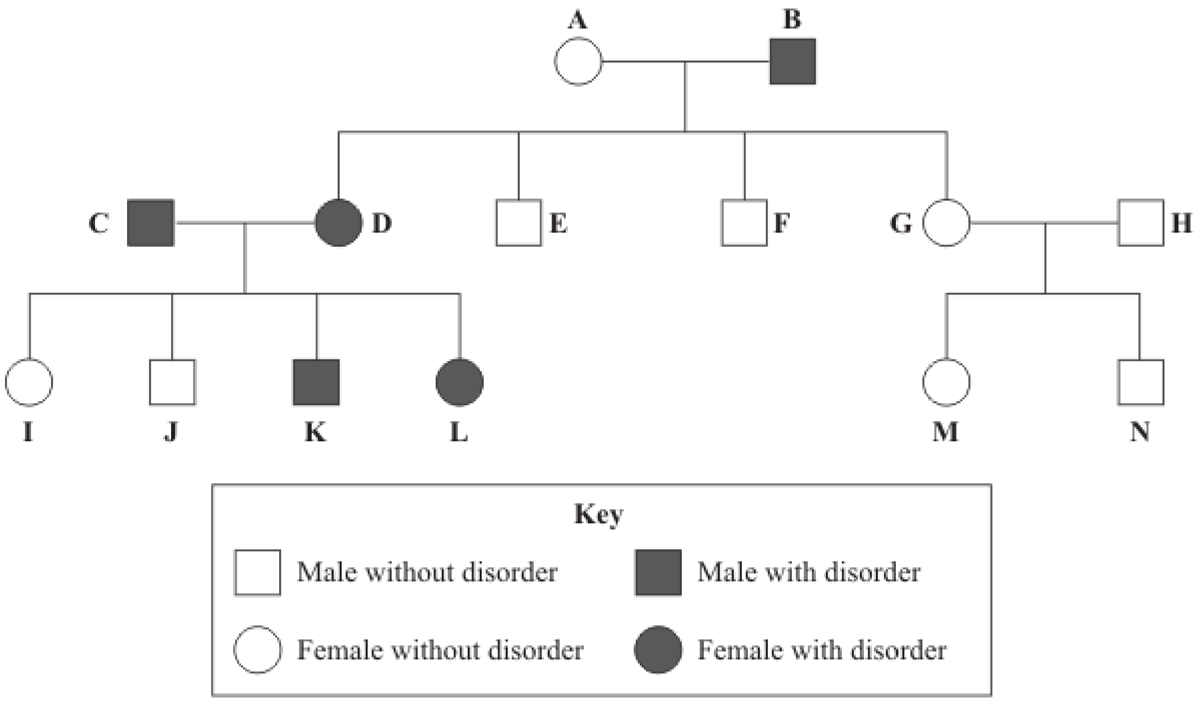
____

____

(1)
(Total 9 marks)

Q6.

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.

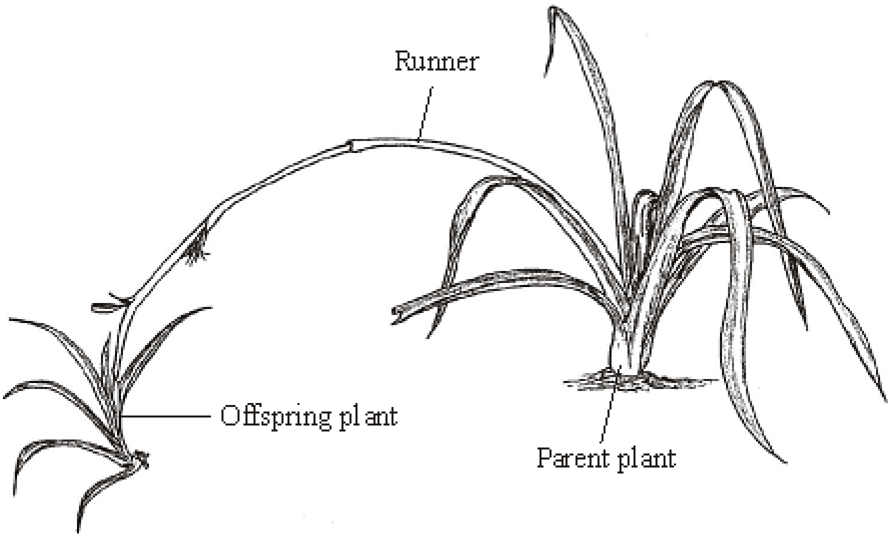
Explain the reasons for the doctor's suggestions.

(3)

(Total 8 marks)

Q7.

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)

Q8.

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

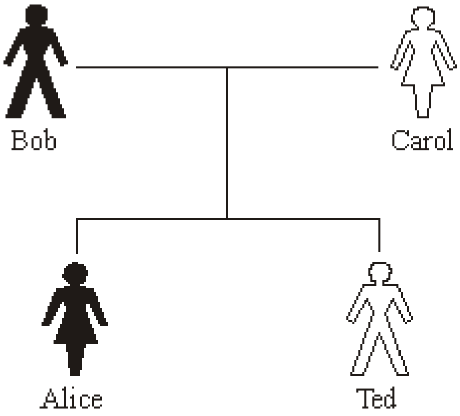
(a) Which **one** of these is affected by cystic fibrosis?

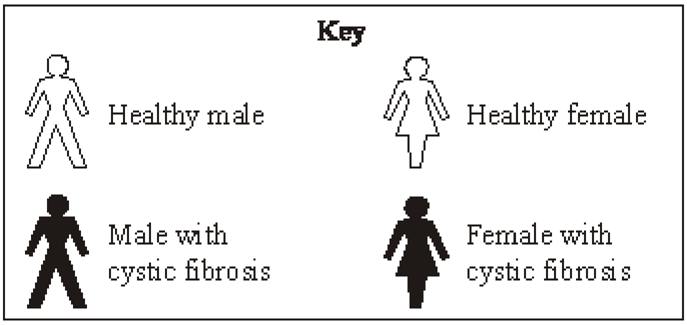
Draw a ring around your answer.

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)

Q9.

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?

____

____

____

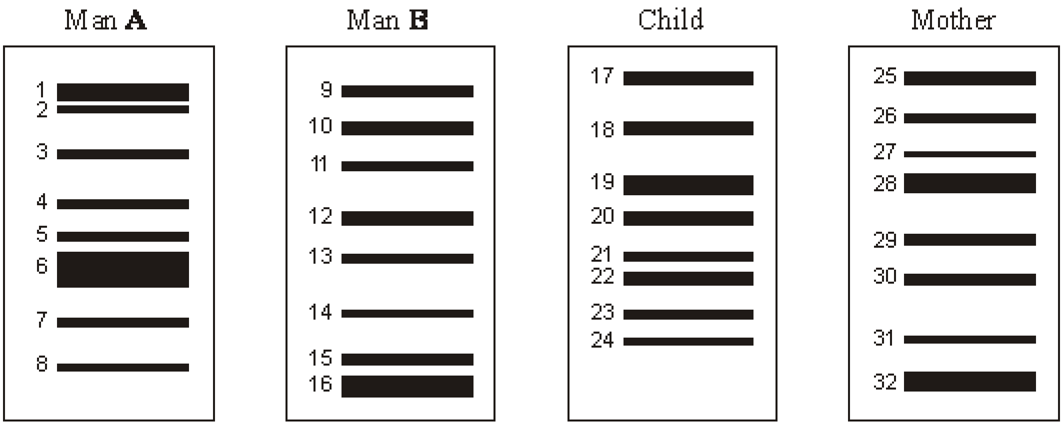
____

(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)

Q10.

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.

____

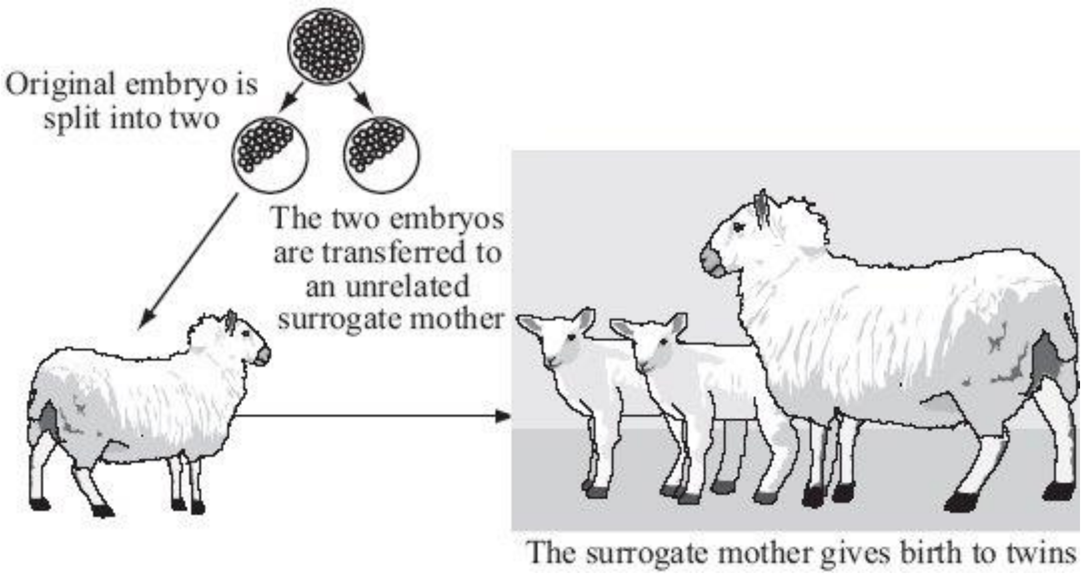
____

(1)

(Total 5 marks)

Q11.

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)

Q12.

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 ________________ .

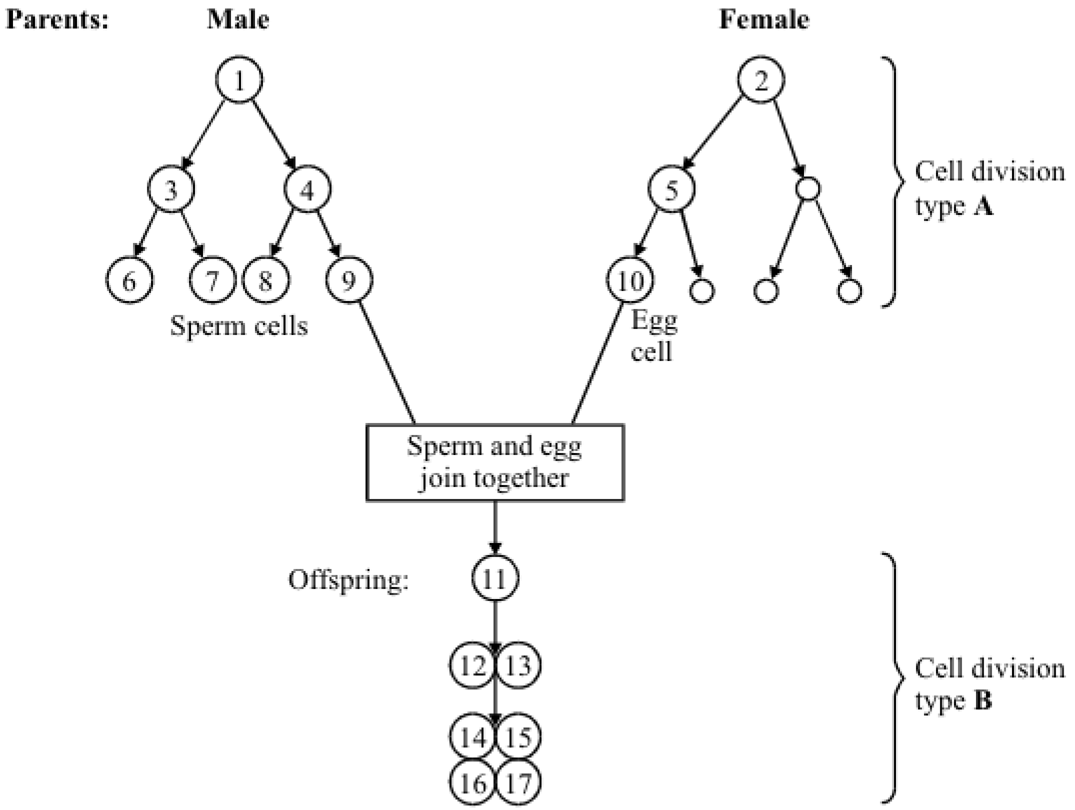
Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a ____________________ allele. The two parents are healthy because they also have the

____________________ allele.

(Total 6 marks)

Q13.

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)

Q14.

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

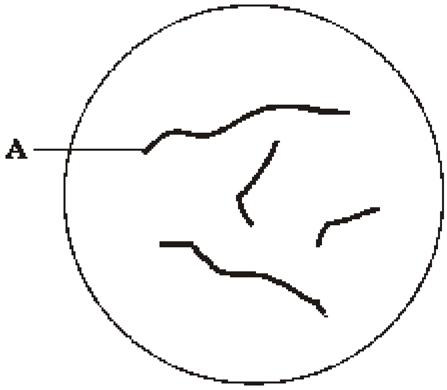


Diagram 1

(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.

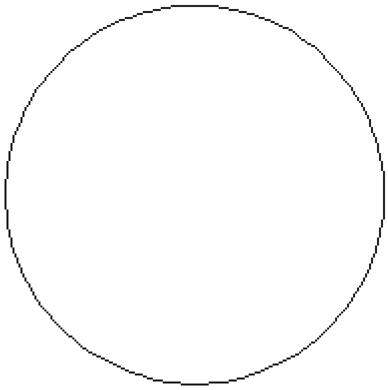


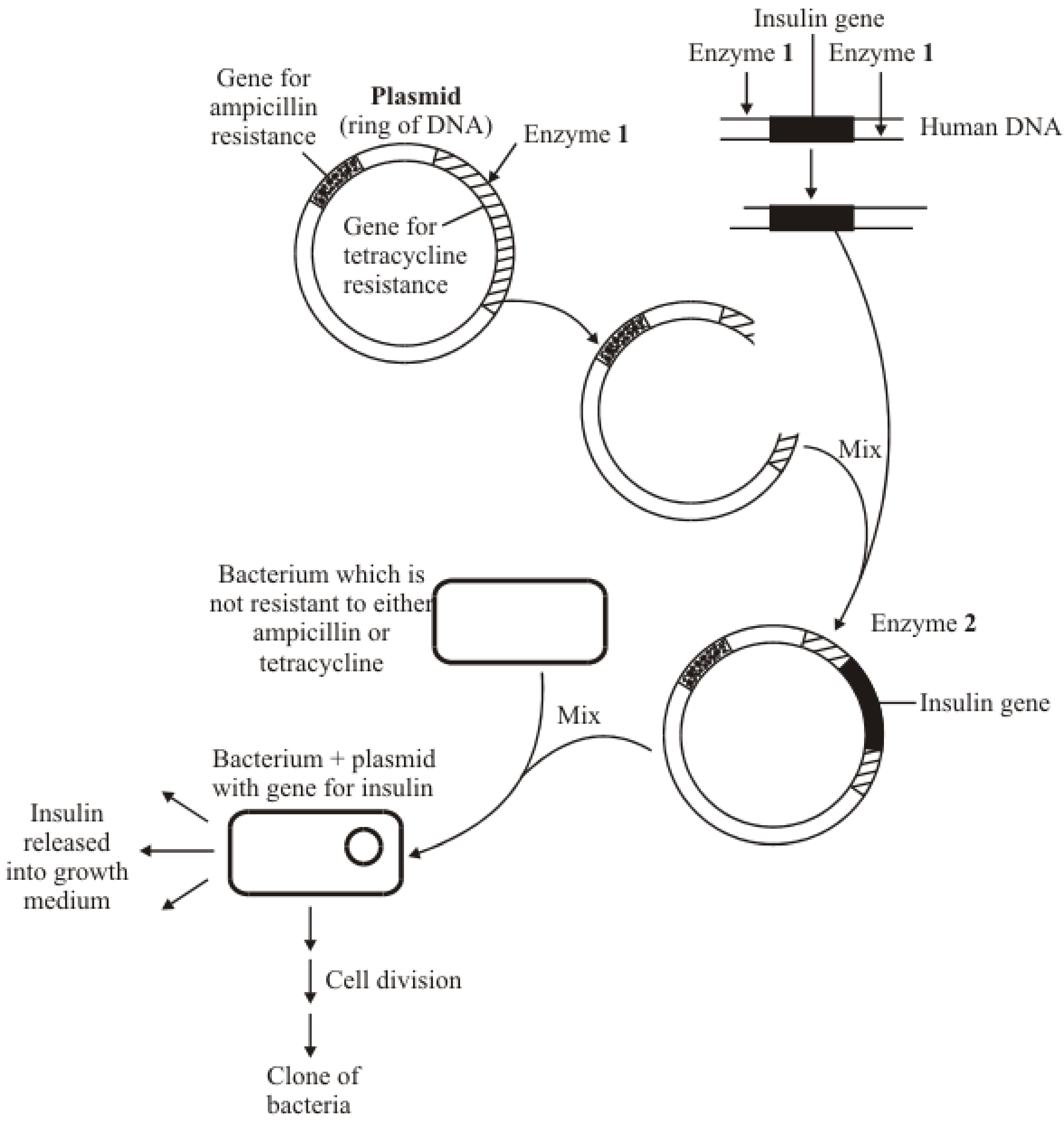
Diagram 2

(2)

(Total 3 marks)

Q15.

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.

____

____

____

____

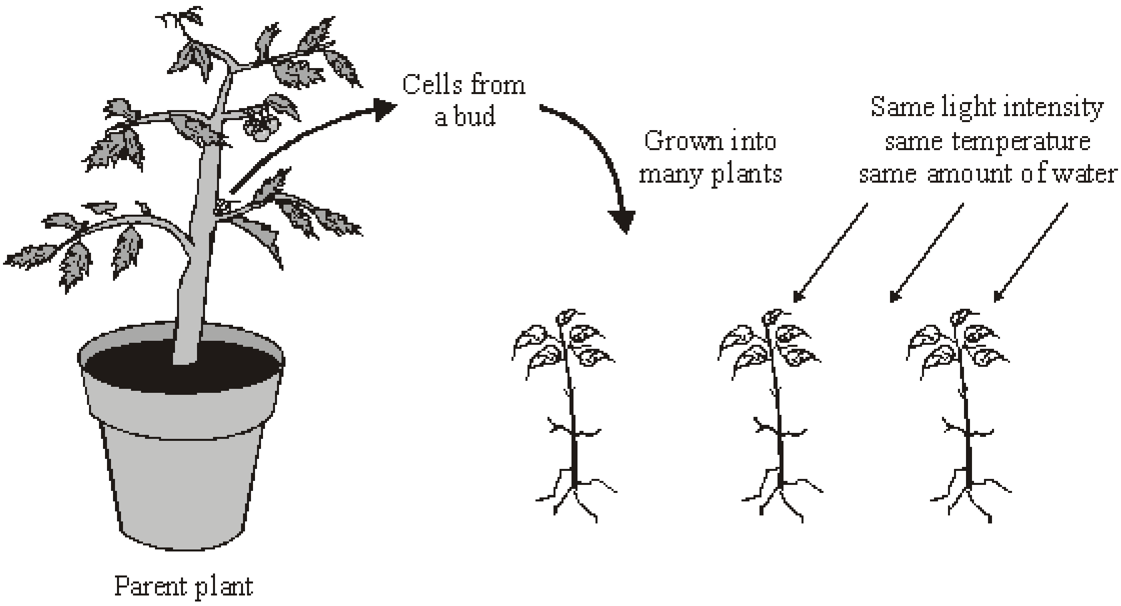
____

____

(3)
(Total 6 marks)

Q16.

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)

Q17.

(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.

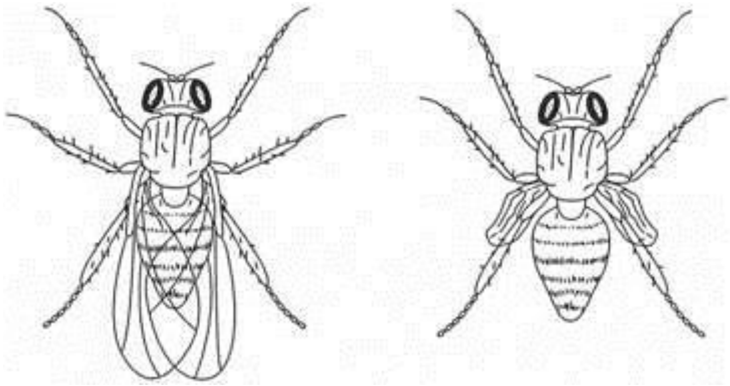
Parent 1	Parent 2	
NN	NN	☐
NN	Nn	☐

Nn	Nn	☐
nn	nn	☐

(1)
(Total 3 marks)

Q18.

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)

Q19.

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)

Q20.

(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)

Q21.

(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)

Q22.

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.

Parental phenotypes	
Yellow seeds	Green seeds

↓

F2 phenotype	
6022 yellow seeds	2001 green seeds

(4)

(Total 5 marks)

Q23.

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)

Q24.

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

	Parent 1: X	X
Parent 2: X	______	______
( )	______	______

(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)

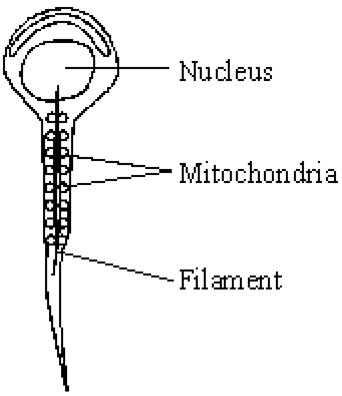
(c) What are the chances of getting a baby boy?

____

(1)
(Total 5 marks)

Q25.

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)

Q26.

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.

____

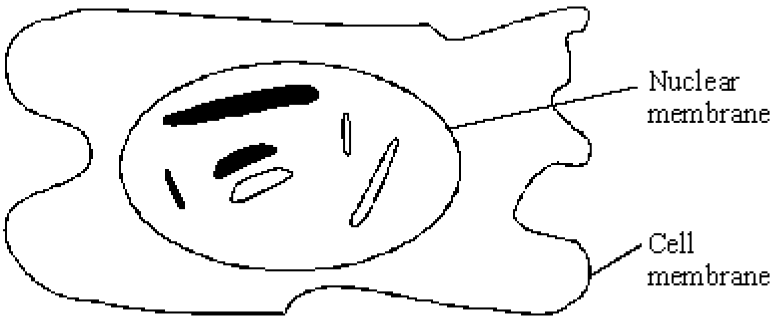
____

____

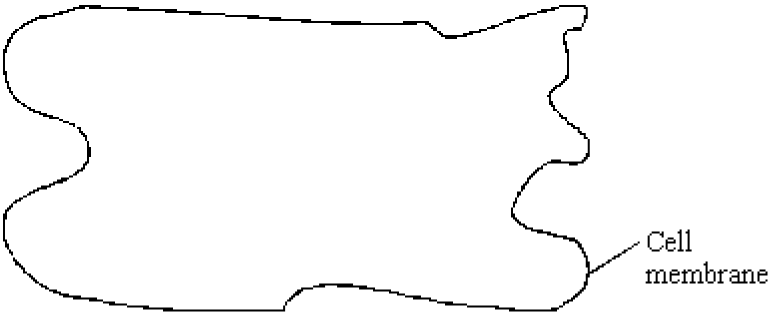
(2)
(Total 10 marks)

Q27.

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

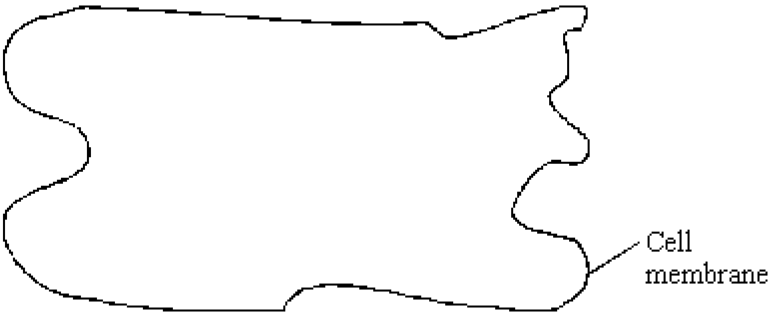


(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis.*



(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)

Q28.

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)

Q29.

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)

Q30.

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)

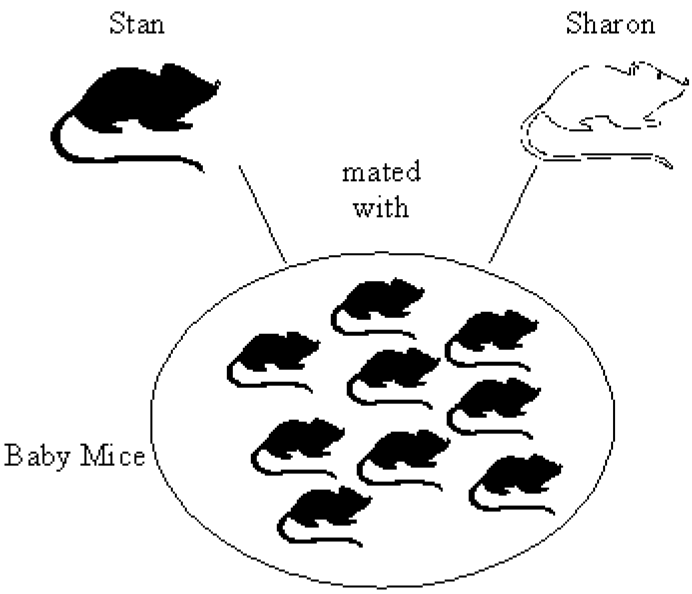
(Total 13 marks)

Q31.

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.

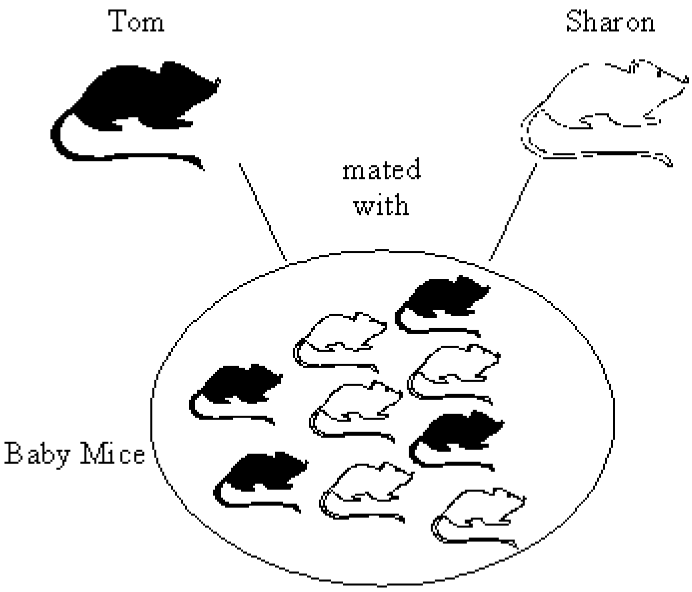
(a) The student first crossed Stan with Sharon. The results are shown on the diagram.



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)

Q32.

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.

____

____

____

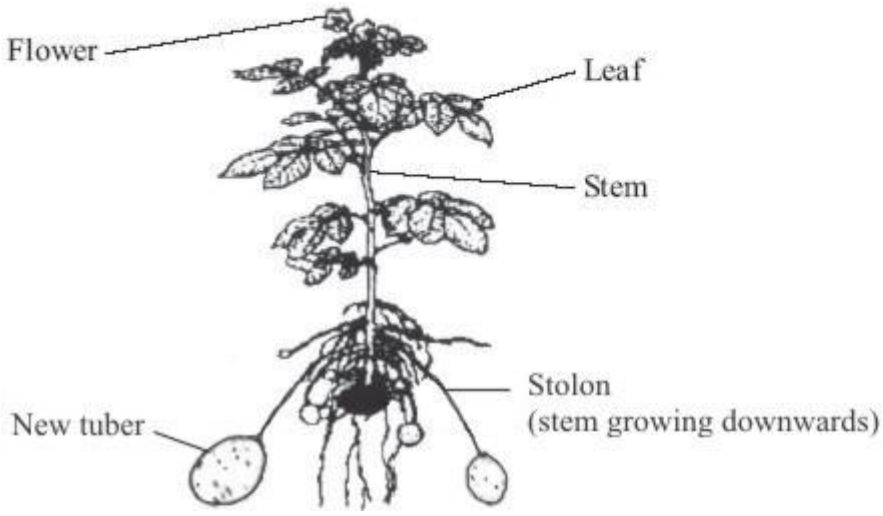
____

(2)

(Total 4 marks)

Q33.

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)

Q34.

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)

Q35.

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)

Mark schemes

Q1.

(a) (i) characteristic 1

(ii) gene 1

(iii) gamete 1

(b) sexual 1

asexual 1

clones 1

[6]

Q2.

(a) (i) circle

mark independently 1

unshaded

could be in body of script 1

(ii) (Harriet) dd

in first box 1

DD

if another letter is chosen it must be used throughout and upper or lower case must be clear 1

Dd 1

(b) (i) to check for the D allele. 1

(ii) any **one** from:

- may harm / kill foetus / embryo / baby / mother
  allow could affect the baby
- immoral / unethical / religion
  ignore playing God
  ignore references to unnatural

ignore wrong unqualified
ignore expense / prejudice unqualified
ignore lack of permission
ignore results are unreliable

1

[7]

Q3.

(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:

- <u>code</u>
- 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]

Q4.

(a) sexual reproduction

1

(b) any **three** from:

- coat colour inherited / controlled by genes
- it has horse and zebra features
- gets gametes from both parents
- genes / DNA / chromosomes / genetic information in gametes
- zorse receives genes / DNA / chromosomes / genetic information from parents

3

[4]

Q5.

(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]

Q6.

(a) 1 in 4 / 1/4 / 1: 3 / 25% / 0.25

*do **not** accept 3:1 / 1:4 / 2:6*

1

(b) **either** from C **and** D

accept synonyms for dominant / recessive eg Normal / faulty

accept genetic diagram if clearly referring to correct individuals or genotypes on family tree

allow 'gene' for 'allele'

any **three** from:

- C **and** D have disorder

  ignore 'C & D are carriers'
- I/J don't have disorder
- C **and** D have dominant **and** recessive alleles
- recessive alleles from C **and** D passed to I/J **or** I/J have two recessive alleles

  *NB if allele was recessive then all offspring of C **and** D would have the disorder = **3** marks*

or from A **and** B

assume response refers to A + B unless contradicted

- A is homozygous recessive / rr, **and** B is heterozygous / Rr can be shown in words or symbols

  allow any symbol
- offspring can be rr **or** Rr described

  allow without key

3

(c) (i) (embryos) checked for inherited / genetic disorders / conditions

accept diseases for disorders

1

(ii) any **three** from:

- C/D have disorder / have dominant allele

  accept disease / condition

  accept 'gene' for 'allele'

ignore reference to 'carriers'

- chance of embryo / foetus / child having disorder **or** may pass on alleles for disorder to their offspring
- C/D might want to decide on termination **or** prepare for child with disorder
- G **and** H don.t have disorder / both homozygous recessive / have no dominant alleles (for this disorder)
- so offspring (of G **and** H) cannot / don.t have disorder

3

[8]

Q7.

(a) characteristics 1

(b) genes 1

(c) chromosomes 1

(d) mitosis 1

(e) <u>a</u>sexual 1

[5]

Q8.

(a) cell membranes 1

(b) (i) two recessive / cystic fibrosis / faulty / diseased / the allele(s) / genes

two can be implied by second marking point

ignore chromosomes

1

from Bob **and** Carol / both parents / the parents

*if no other marks awarded 'Carol is a carrier' gains **1** mark*

1

(ii) (inherited) dominant / normal allele / gene 1

from Carol / mother

ignore references to recessive allele / gene from father / Bob

*if no other marks awarded he has <u>just</u> / <u>only</u> one recessive allele gains **1** mark*

1

(c) (i) reduce number of people with cystic fibrosis (in population)

or

reduce health-care costs

or

expensive to have baby with cystic fibrosis

accept to allow decision / emotional argument qualified eg allows abortion

or

allows people to make choices about termination

or

help to prepare financially / emotionally etc

1

(ii) any **one** from:

- possible damage / risk to embryo / fetus / baby
  allow possible harm / risk to mother
- screening / it is expensive
- (may) have to make ethical / moral / religious decisions
  ignore not natural / playing God / unethical / immoral / religious unqualified
- right to life

1

[7]

Q9.

(a) any **two** from:

- to combine / use amino acids
  *do **not** allow to make amino acids*
- in specific / particular / correct / right order
- to manufacture protein / enzymes / hormones
  allow examples of proteins / enzymes / hormones

2

(b) (i) (man) B

*no mark for this **but** max **2** marks if A given*

any **three** from:

- child gets DNA / bars / lines from mother and father / parent<u>s</u>
  ignore genes / chromosomes

- (child has) mother's 25 / 28 / 30 / 31
  or child gets 17 / 19 / 22 / 24 from mother

- (child has) man B's 10 / 12 / 13 / 14
  or child gets 18 / 20 / 21 / 23 from B

Man B	Child	Mother
	17	25
10	18	
	19	28
12	20	
13	21	
	22	30
14	23	
	24	31

  contradictions disqualify 2nd and / or 3rd marking points
  ignore genes / chromosomes

- no bars / DNA / lines from man A correspond to child

3

(ii) any **two** from:

- gametes / eggs / sperm
- contain only half of (mother's / father's) DNA / chromosomes / genes / genetic information
- due to meiosis

2

[7]

Q10.

(a) have identical genes / chromosomes / genetic material

1

since asexual reproduction
accept mitosis

1

(b) mixture of genes / chromosomes / genetic material from two parents
accept meiosis

1

sexual reproduction / fusion of gametes

1

(c) public misunderstand technique as cloning **or** worried about large numbers of clones **or** moral / ethical / religious issues **or** unnatural process **or** scientists must not play god **or** technique may lead to embryo death
*do **not** allow mark for embryos lost*

1

[5]

Q11.

joining 1

sexual 1

identical 1

asexual 1

clones 1

[5]

Q12.

in the correct order

DNA 1

23 1

XX 1

XY 1

recessive 1

dominant 1

[6]

Q13.

(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]

Q14.

(a) chromosome

accept chromosomes

1

(b) drawing shows:

1

just 2 chromosomes

one long + one short

1

[3]

Q15.

(a)

Ampicillin	Tetracycline
✓	–
–	–
✓	✓

*accept blank **or** cross **or** –*

*1 st: mark by rows to maximum **3** marks*

*2 nd: if no marks by rows, mark by columns to maximum **1** mark*

*table completely blank = **0** marks*

3

(b) 1st: Yes (no mark)

*if 'no' - read on for logical argument e.g. loss of plasmid **or** gene mutation*

2nd: all formed from same original cell

must be one cell i.e. bacterium

1

by asexual reproduction / no fusion / not sexual

allow reference to 'mitosis'

1

offspring cells are genetically identical **or**
all have a copy of the insulin gene / of the plasmid

1

[6]

Q16.

(i) clones

accept other positive indications

1

(ii) same genes / alleles / DNA

*accept same genetics / genetic information do **not** accept same chromosomes*

1

grown in same (environmental) conditions **or** correct eg – same amount of water / same temperature / same amount of light

1

[3]

Q17.

(a) one from each parent / one from egg and one from sperm

*do **not** accept egg and sperm join / fertilisation unqualified*

1

(b) (i) nn

accept a ring around printed nn

1

(ii) Nn Nn

1

[3]

Q18.

(a) (i) **Aa** or aA

1

(ii) allele / gene for vestigial wings / **a** is recessive
or vestigial is recessive **or A** is dominant **or**
A would override the effect of **a or A** present gives long wings

1

(b) parental genotypes correct – both **Aa**

NB can pick up chain of logic at any point correctly derived from candidate's previous point

1

gametes correctly derived from **P** genotypes

1

offspring genotypes correctly derived from gametes

1

3:1 ratio recognised

wrong cross and not 3:1 ratio = max 2

1

[6]

Q19.

eggs

accept gamete once 1

ovaries 1

sperms

accept gamete once 1

testes 1

sexual 1

gametes

*allow egg **and** sperm once* 1

fertilisation 1

asexual 1

[8]

Q20.

(a) genes/DNA 1

female/girl/woman/ ♀

*both required **in** the correct place for this last mark*

male/boy/man/ ♂

*do **not** accept homo/heterogametic, homo/heterozygous* 1

(b) parents correct

n.b if parents are wrong, candidates can score a maximum of 3 marks 1

gametes correct

allow just 1 mark for female 1

combinations correct 1

correct analysis of the 50:50 ratio of what is written 1

[6]

Q21.

(a) (i) gametes i.e. B b and B b

1

correct combination of genotypes i.e. BB, Bb, Bb, bb

1

correct analysis of phenotypes i.e. 3 black fur 1 with brown fur

1

(ii) award one mark for the recognition that it is down to chance (which two gametes fuse) and not simply 'because it's a prediction'

*do **not** accept mutation*

1

(b) (i) **B** is dominant/ an allele is dominant if it is expressed in the heterozygous phenotype

candidates are likely to use a variety of ways of expressing their ideas

1

b is recessive/ a recessive allele is not expressed in the presence of its contrasting allele

*do **not** accept powerful*
*do **not** accept stronger*

1

(ii) alleles are different forms of a gene controlling a characteristic and occupying the same site on homologous chromosomes (e.g. B or b)

1

genes are the units of DNA/sites on chromosomes carrying the information that determines characteristics (e.g. bB)

1

(c) homozygous: BB / bb / possessing a pair of identical alleles for a character/true breeding

give credit to an explanation using a diagram

1

heterozygous: Bb / carrying a pair of contrasting/different alleles for a characteristic

*do **not** accept references to xx, xy*
*do **not** accept gene by itself*

1

[10]

Q22.

(i) (sweet) peas

1

(ii) homozygous parents crossed [1]

heterozygous (F1) offspring crossed [1]

recognition of yellow dominant over green [1]

recognition that results support 3:1 **or** 0.75 to 0.25 ratio

*up to **4** marks awarded for an understanding of the monohybrid cross and the expected outcome*

4

[5]

Q23.

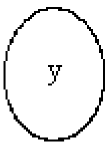
one mark for each of the following comparisons to a maximum of **6**

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

meiosis	**mitosis**
sexual	asexual
gametes	growth
ovary **or** testes **or** gonads	all other cells
half number of chromsomes	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]

Q24.

(a) 

clearly labelled ‘y’

1

mark the offspring in two horizontal rows
1 mark for each fully correct row

***allow** transferred error if parent 2 is incorrect*

XX Xx

1

XY *XY*

accept YX

1

(b) parent 1

accept XX

1

(c) 50:50
or
equal **or** even
or
1:1 **or** 50%

accept 1/2 ***or*** *2/4*

1

[5]

Q25.

(a) **award one mark for each key idea**

energy released **or** energy transferred **or** respiration

allow provides ***or*** *gives*

do ***not*** *allow produces* ***or*** *makes*

3

near to the site of movement **or** energy available quickly **or** more energy

accept allows more mitochondria to fit in

(mitochondria) packed (around filament) **or** efficient arrangement **or** spiral arrangement

(b) contains chromosomes **or** genes **or** DNA

not *genetic material*

1

(which) contribute half (the genes) to the fetus **or** offspring

23 chromosomes ***or*** *half the genes*
or *reference to X,Y chromosome determining sex (if the notion of halfness is there)*
nucleus contains half genes for the offspring = 2 marks

1

[5]

Q26.

(a) breed (together)

accept have same number of chromosomes

do ***not*** *accept have the same number of genes*

1

to produce fertile offspring

1

(b) male **or** testes

accept dog

1

testes **or** male

accept testis

*do **not** accept testicles*

1

ovary **or** ovaries

1

gametes

1

fertilisation

*do **not** accept conception*

1

fetus **or** zygote **or** embryo

*do **not** accept baby **or** puppy*

1

(c) genetic information **or** genes **or** chromosomes **or** DNA

*do **not** accept characteristics by itself*

1

(comes) **from** two parents

*accept **from** both parents*

1

[10]

Q27.

(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 × 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]

Q28.

(a) (i) gametes correct

allow by implication from line diagram

only need on X from female

1

offspring genotype correctly derived

on suitable diagram

	X	**X**
X	XX	XX
Y	XY	XY

or

	X
X	XX
Y	XY

1

(ii) 1:1 **or** 50% **or** ½ **or** 0.5 **or** 1 in 2
or 1 out of 2 or 50 : 50

*do **not** accept 50/50*
accept 'equal' (probability)

1

(b) Y chromosome needed for male child

1

only male has the Y **or** wives had only X (chromosomes)
or sex determined by the sperm

1

[5]

Q29.

(a) on chromosomes/DNA within the nucleus

each for 1 mark

2

(b) parental genotypes correct i.e. Aa Aa;
gamete genotypes correct i.e. A or a A or a/correct lines;
F1 genotypes correct i.e. AA Aa Aa aa;
aa recognised as child with cystic fibrosis

each for 1 mark

4

(d) (i) molecule has two long strands/double helix;
idea of held together by (weak) bonds;
each strand has 4 different types of base;)
which pair with specific bases in opposite strand;)
when strands separate;) OWTTE
each strand acts as a 'complementary' template;)
makes 2 identical strands)

each for 1 mark

6

(ii) order of bases acts as a code;
which controls the order;
in which amino acids are assembled into protein;
read in triplet

each for 1 mark

3

[15]

Q30.

(a) select for breeding;
the plants with the sweetest taste

each for 1 mark

2

(b) natural population has a wide range of variations;
because it has a large number of alleles;
selective breeding reduces the number of alleles;
cloning perpetuates this reduced number of alleles

each for 1 mark

4

(c) 3 of:
reference to cuttings;
reference to tissue culture;
reference to hormones;
cloning

each for 1 mark

3

(d) 4 of:
cut genes for disease resistance;
from <u>chromosomes</u> of ‘cooking banana’;
introduce into chromosomes of ‘ordinary banana’;
tissue culture to produce disease resistant plants/clone;
enzymes cut chromosomes

each for 1 mark

4

[13]

Q31.

(a) Stan BB
Sharon bb
all offspring Bb

3

(b) Tom Bb
black offspring Bb
white offspring bb

3

[6]

Q32.

(a) (i) e.g. B and b

for 1 mark

1

(ii) e.g. bb

for 1 mark

1

(b) no black genes in flock
all double recessive

for 1 mark each

2

[4]

Q33.

(a) grow from parents,
by vegetative reproduction/asexual reproduction/
no sexual reproduction

for 1 mark each

2

(b) e.g. different environmental conditions/named condition

for 1 mark

1

[3]

Q34.

(a) mutation

for 1 mark

1

(b) fall,
idea that resistant beetles more likely to survive to breed,
∴ their offspring more likely to appear in the next generation

for 1 mark each

3

(c) inbreeding between resistant brothers and sister,
will produce some individuals with 2 copies of the resistance allele,
if 2 of these individuals breed all their offspring will be resistant

for 1 mark each

3

[7]

Q35.

(i) DNA

for 1 mark

1

(ii) contains the code for manufacturing the protein,
as order of bases,
which determine the order in which amino acids are
assembled into protein

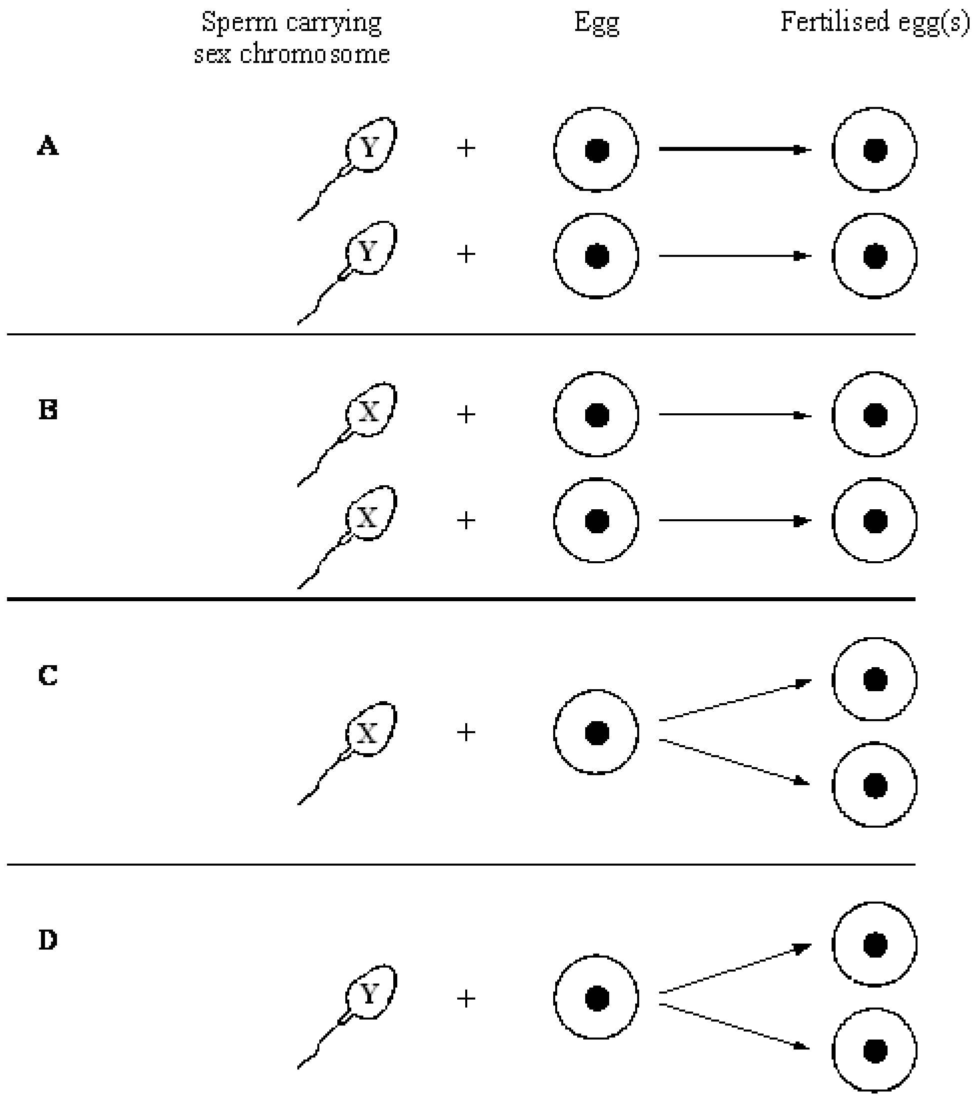
for 1 mark each

3

[4]

Q1.

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)

Q2.

The black pigment in human skin and eyes is called melanin. Production of melanin is controlled by a single pair of genes. A person who is homozygous for a recessive allele of the gene has no melanin and is said to be albino.

(a) A man is albino. His wife is heterozygous for the melanin-producing allele.

(i) The fertilised egg cell produced by the couple divides to form two cells.

Name the process of cell division involved.

____

(1)

(ii) How many albino genes would there be in each of these two cells?

____

Explain you answer.

____

____

____

(3)

(b) (i) Albino people are more likely than people with melanin to suffer mutations that cause cancer in their skin. Suggest why albino people have an increased chance of mutation in their skin cells.

____

____

(1)

(ii) Sometimes, mutation in skin cells leads to cancers in other organs, such as the liver.

Explain how.

____

____

____

____

(2)

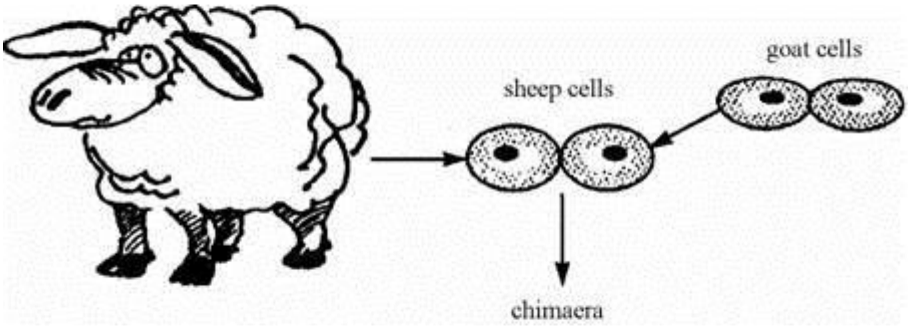
(Total 7 marks)

Q3.

Read the passage.

One reason for cloning animals is to prevent rare breeds from becoming extinct. Early embryos can be divided into four to produce identical quads. Dividing a young embryo into more than four parts is a problem because each part may not have enough cells to create both an embryo and a placenta.

The problem can be overcome by adding cells from another embryo, to make a mixture of cells called a chimaera. The two sets of cells may be from two different breeds of animals, or even two different species, such as sheep and goats.



The aim is not to create freaks but chimaeras in which the added cells form the placenta only. The sheep embryos are given cells to make goat placentas and are carried to full term in the uteri of goats. They are born as pure sheep.

(a) Explain why the sheep embryos with added goat placental cells develop into sheep, not goats.

____

____

____

____

____

(2)

(b) Use information from the passage and your own knowledge and understanding to evaluate the use of cloning techniques in agriculture.

____

____

____

____

____

____

____

____

(6)

(Total 8 marks)

Q4.

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

alleles **chromosomes** **gametes** **genes** **mutations**

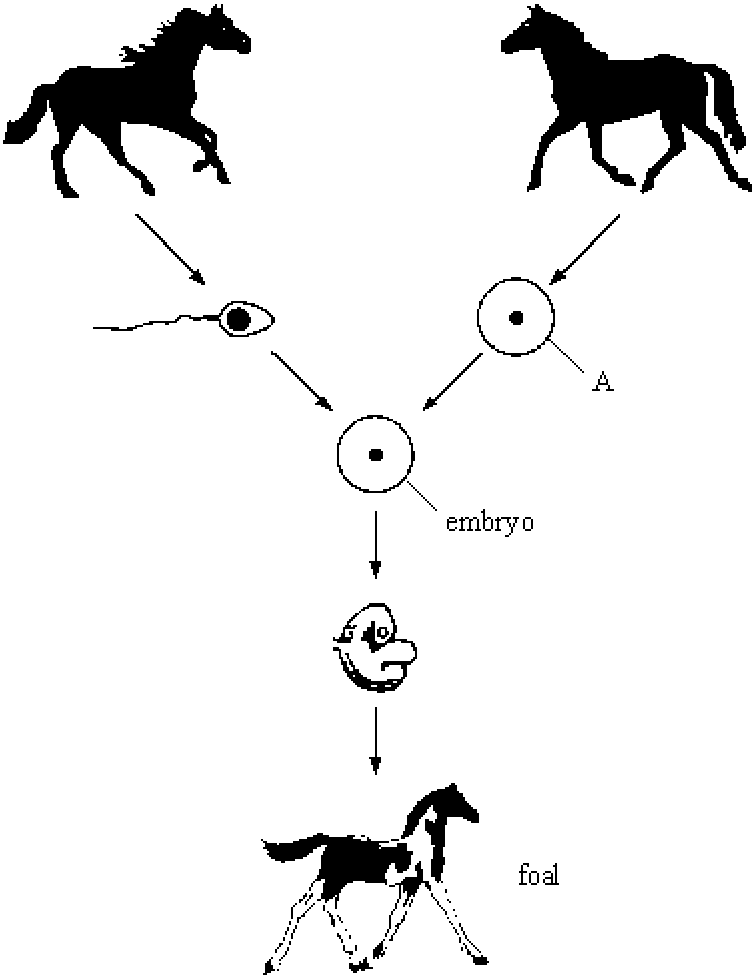
The nucleus of a cell contains thread-like structures called ________________ .

The characteristics of a person are controlled by ________________

which may exist in different forms called ________________ .

(3)

(b) The drawing shows some of the stages of reproduction in horses.



(i) Name this type of reproduction ________________________________

(1)

(ii) Name the type of cell labelled **A** ________________________________

(1)

(c) When the foal grows up it will look similar to its parents but it will **not** be identical to either parent.

(i) Explain why it will look similar to its parents.

____

____

(1)

(ii) Explain why it will **not** be identical to either of its parents.

____

____

____

____

(2)
(Total 8 marks)

Q5.

This couple has just found out that the woman is pregnant. They wonder whether the child will be a boy or a girl.

Sex chromosomes ______	Sex chromosomes ______

(a) Fill in the boxes to show the sex chromosomes of the woman and the man.

(2)

(b) The couple already has one girl. What is the chance that the new baby will be another girl?

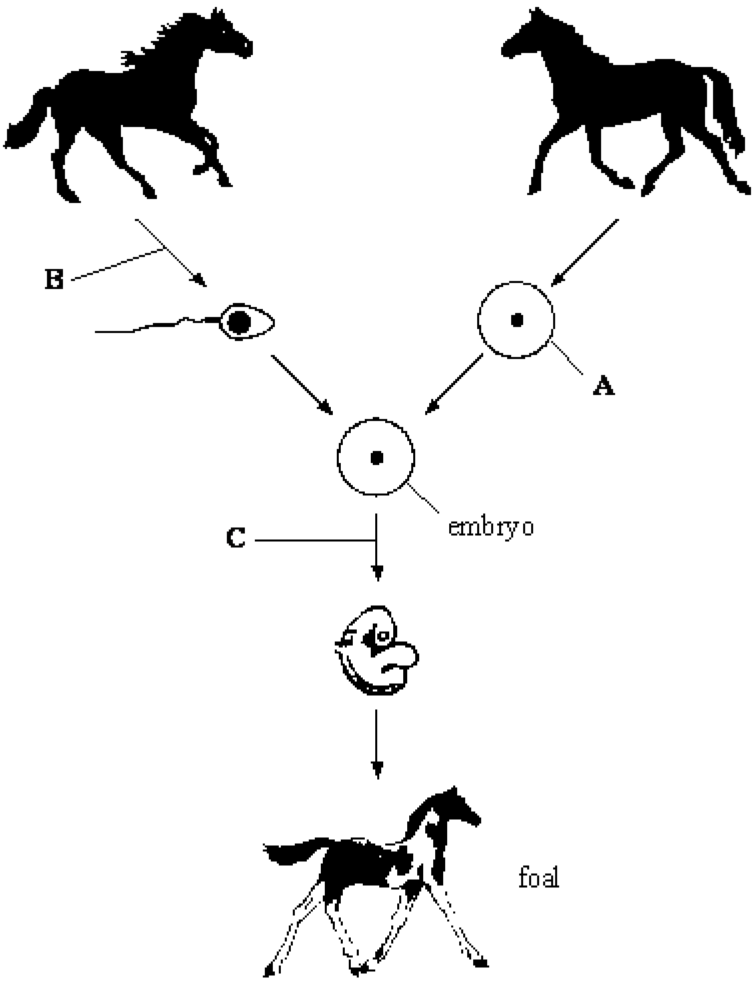
____

Explain the reason for your answer. You may use a genetic diagram if you wish.

(3)
(Total 5 marks)

Q6.

The drawing shows some of the stages of reproduction in horses.



(a) (i) Name this type of reproduction ____________________________

(1)

(ii) Name the type of cell labelled **A** ___________________________________

(1)

(b) Name the type of cell division taking place at the stage labelled:

(i) **B** ___________________________________

(ii) **C** ___________________________________

(2)

(c) How does the number of chromosomes in each cell of the embryo compare with the number of chromosomes in cell **A**?

____

(1)

(d) When the foal grows up it will look similar to its parents but it will **not** be identical to either parent.

(i) Explain why it will look similar to its parents.

____

____

(1)

(ii) Explain why it will **not** be identical to either of its parents.

____

____

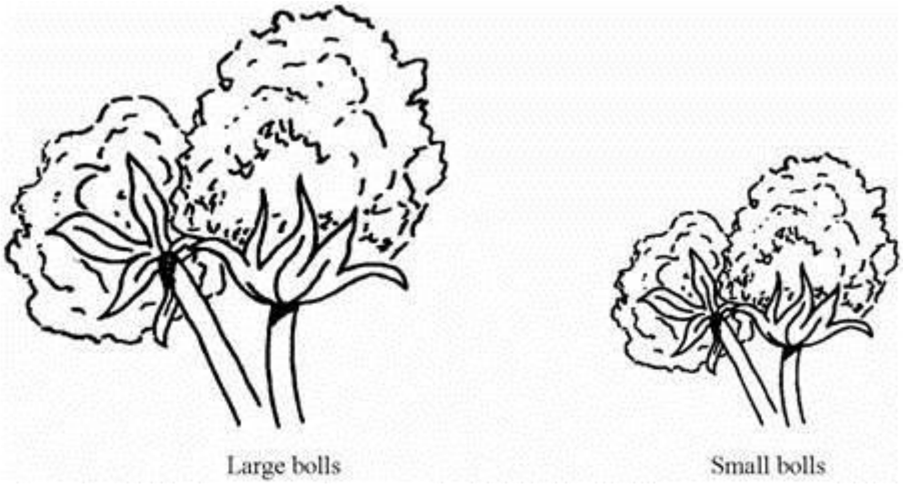
____

(2)

(Total 8 marks)

Q7.

The drawings show bolls on cotton plants. Cotton thread is made from these bolls.



The size of the bolls is controlled by a single gene. This gene has two alleles. The dominant allele **B** is the allele for large bolls. The recessive allele **b** is the allele for small bolls.

Use a genetic diagram to show how two cotton plants with large bolls may produce a cotton plant with small bolls.

(Total 4 marks)

Q8.

Read the passage.

> **Designer Denim Genes**
>
> USA scientists have successfully used genetic engineering to insert genes for blue pigment into cotton plants. Their aim is to get cotton plants which produce blue cotton so that denims can be manufactured without the need for dyeing. The scientists have also inserted genes that prevent cotton fibres twisting, with the aim of producing drip dry shirts made from natural fibres. Other cotton plants are being genetically engineered to produce their own insecticides. When they have perfected these new types of cotton plants, the scientists will use cloning techniques to produce large numbers of them.

(i) Name the substance in cells which carries genetic information.

____

(1)

(ii) Explain how molecules of this substance control characteristics such as blue colour in cotton plants.

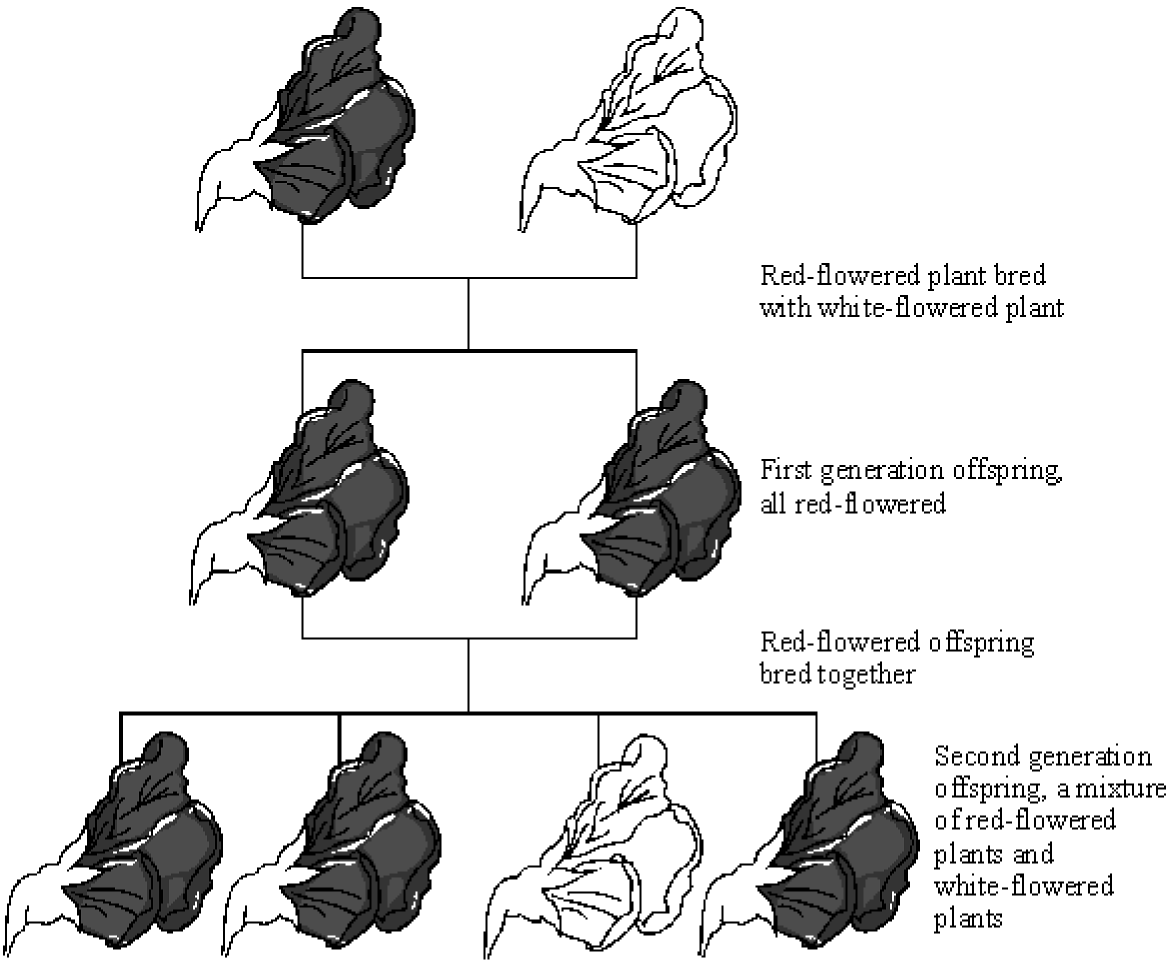
____

(3)
(Total 4 marks)

Q9.

The diagrams show one of the experiments performed by a scientist called Mendel.

He bred sweet pea plants.



In the sentences below, cross out the **two** lines which are wrong in each box.

Mendel proposed that flower colour was controlled by inherited factors.

The first generation plants show that the red factor is

dominant
environmental
recessive

The second generation plants show that the white factor is

dominant
environmental
recessive

We now call inherited factors

chromosomes
gametes
genes

These factors are passed from generation to generation in

gametes
glands
organs

The red-flowered sweet pea plants did not all grow to the same height.

This was due to

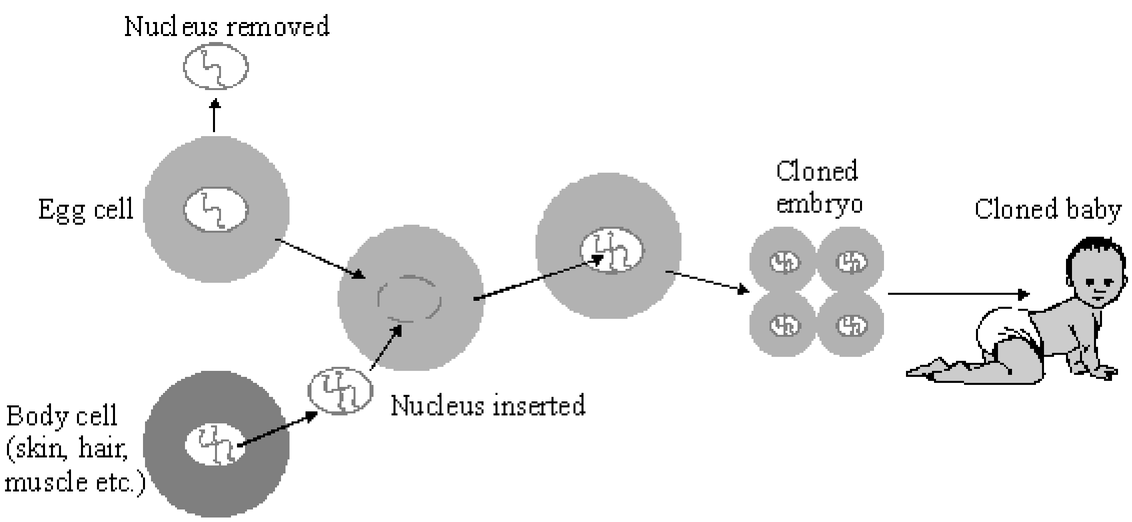
dominant
environmental
recessive

factors.

(Total 5 marks)

Q10.

It is now possible to clone humans. The diagram shows one way in which this can be done.



(a) What type of reproduction is this?

____

(1)

(b) Will the baby have the characteristics of the egg cell or the body cell?

___

Explain the reason for your answer.

___

___

___

___

(2)

(c) The procedure in the diagram could be used to produce several cloned embryos.

Suggest how this might be done.

___

___

(1)
(Total 4 marks)

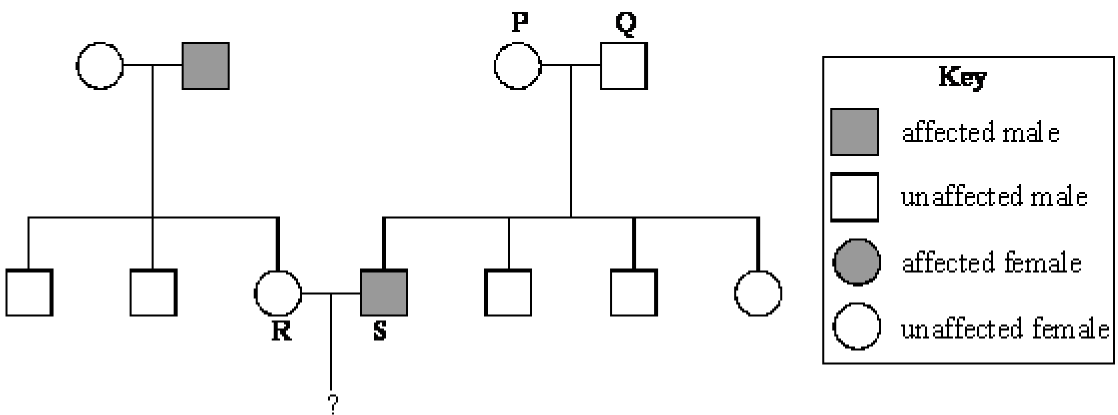
Q11.

The black pigment in human skin and eyes is called melanin.

A single gene controls the production of melanin.

A person who is homozygous for the recessive allele of the gene has no melanin and is said to be albino.

The diagram shows the inheritance of albinism in a family.



(a) Use a genetic diagram to explain the inheritance of the albino allele by children of parents **P** and **Q**.

(3)

(b) **R** and **S** decide to have a child.

What is the chance that this child will be an albino? ______________________

Use a genetic diagram to explain your answer.

(3)
(Total 6 marks)

Q12.

In humans, one of the pairs of chromosomes in each cell carries the genes which determine sex.

What is the difference between the sex chromosomes of a man and a woman?

____

____

____

____

(Total 2 marks)

Q13.

(a) Sex cells are produced by meiosis.

Describe what happens to the chromosomes when a cell divides by meiosis.

(2)

(b) Darwin’s theory of natural selection depends on the fact that individual organisms within a species may show a wide range of variation.

Explain how meiosis and sexual reproduction give rise to variation.

(2)

(c) Mutation may also give rise to variation.

(i) What is meant by mutation?

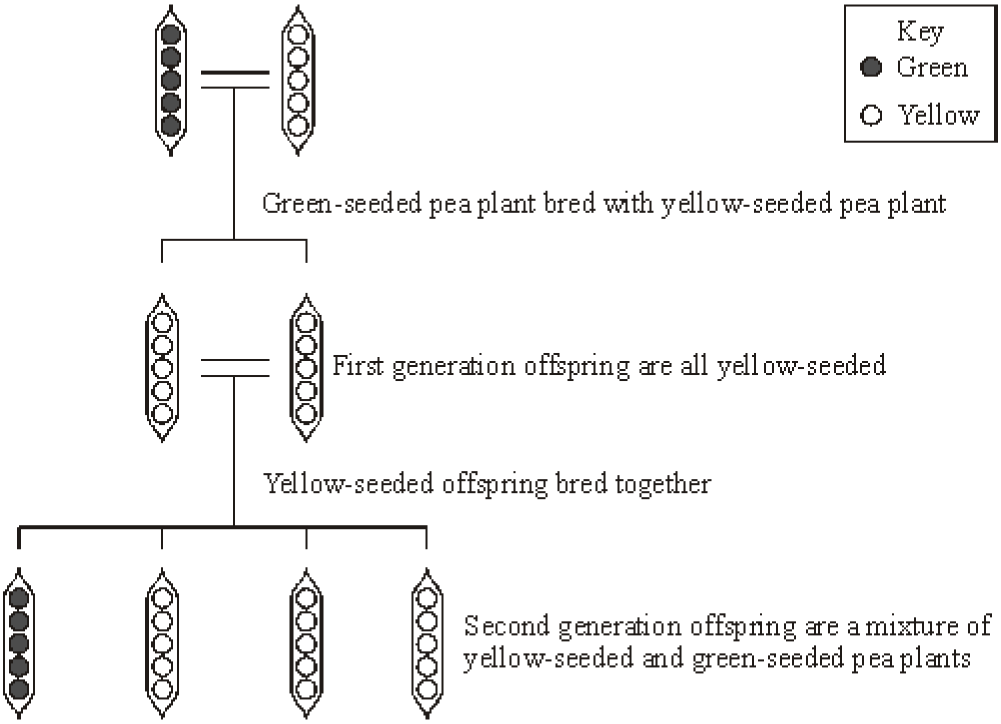
(1)

(ii) Are all mutations harmful? Explain the reason for your answer.

(2)
(Total 7 marks)

Q14.

The diagram shows one of the experiments performed by a scientist called Mendel in the 1850s. He bred pea plants which had different coloured pea seeds.



(a) Use words from the box to help you to explain the results of this experiment.

dominant	**factor**	**recessive**

____

____

____

____

____

____

(3)

(b) Mendel explained these results in terms of *inherited factors*.

(i) What do we now call *inherited factors*?

____

(1)

(ii) Where, in a cell, are these *inherited factors* found?

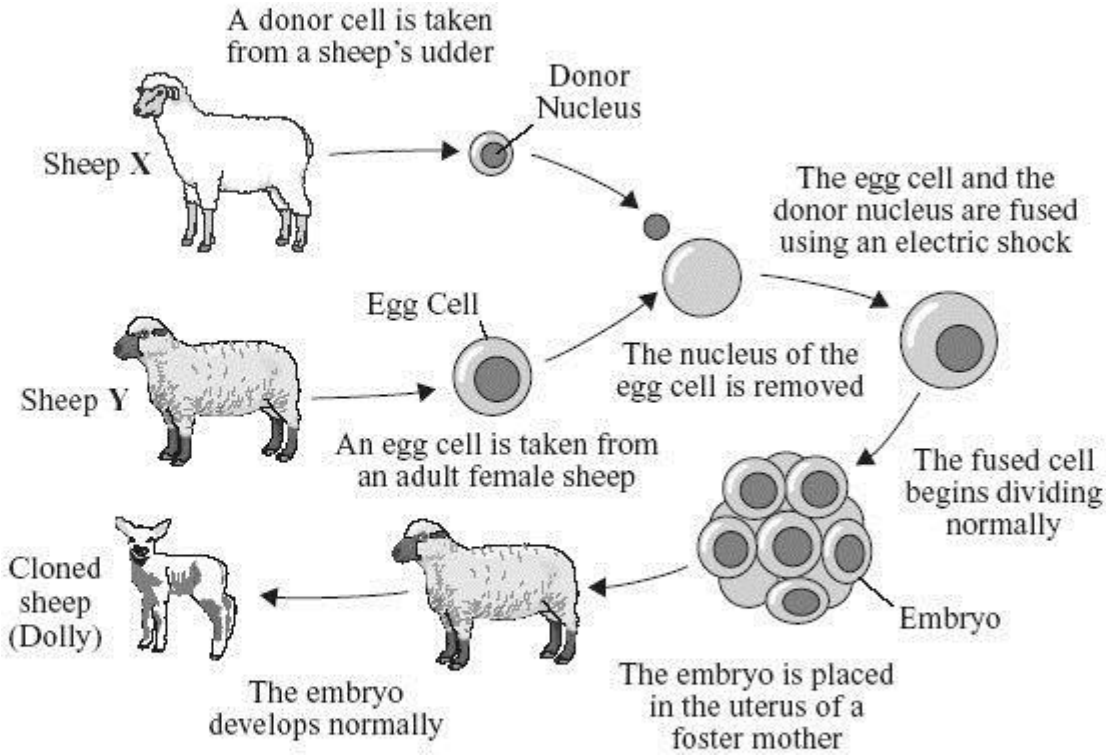
____

(1)

(Total 5 marks)

Q15.

The diagram shows how Dolly the sheep was cloned.



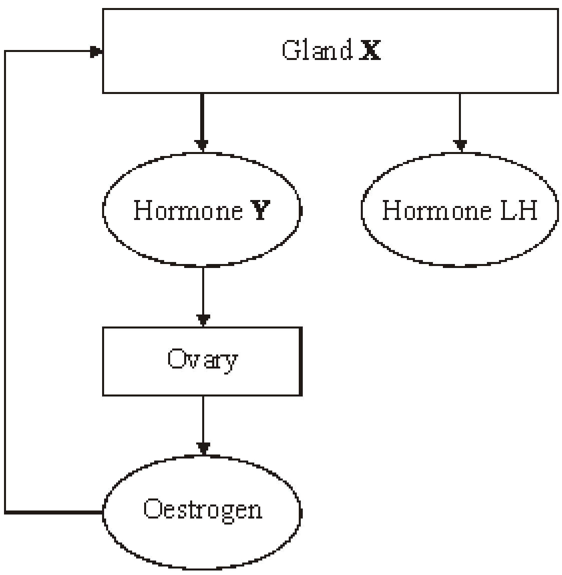
(a) Name the type of cell division that occurs:

(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)

Q16.

(a) In sexual reproduction a sperm cell joins with an egg cell.

Complete the sentences by choosing the correct words from the box.

bladder	**kidney**	**liver**	**lung**	**ovary**	**testis**

(i) The organ in which a sperm cell is made is the ______________________

(1)

(ii) The organ in which an egg cell is made is the ______________________

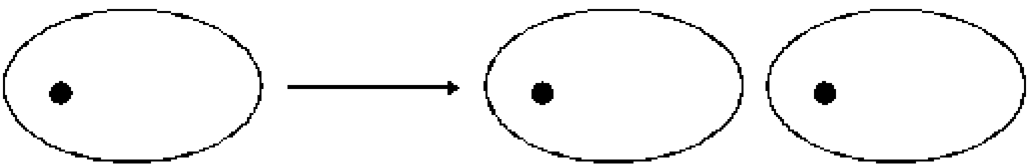
(1)

(b) What name is given to the process in which sperm cells and eggs cells join together?

____

(1)

(c) Two new cells are formed from one cell by **asexual** reproduction.



Original cell **A** New cell **B** and New cell **C**

How, genetically, does the nucleus of new cell **C** compare with:

(i) the nucleus of the other new cell **B**;

____

(1)

(ii) the nucleus of the original cell **A**?

____

(1)
(Total 5 marks)

Q17.

(a) (i) Complete the genetic diagram to show the possible combinations of gametes for the four children and state the sex of the child for each combination.

Parents	XX	XY

Possible combinations				
Sex of child	________	________	________	________

(1)

(ii) What name is given to the process when a cell divides to produce gametes?

____

(1)

(iii) How many pairs of chromosomes are there in each human body cell?

____

(1)

(iv) How many chromosomes are present in a human ovum?

____

(1)

(b) (i) Give **two** advantages to living things of reproducing sexually rather than asexually.

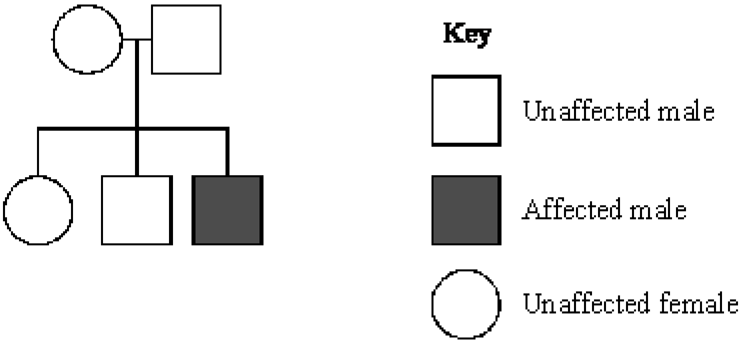
____

____

____

(2)

(ii) The genetic diagram shows two parents and three children.



Only the son has cystic fibrosis, which is caused by a recessive allele. What conclusion may be made about the parents' genes?

____

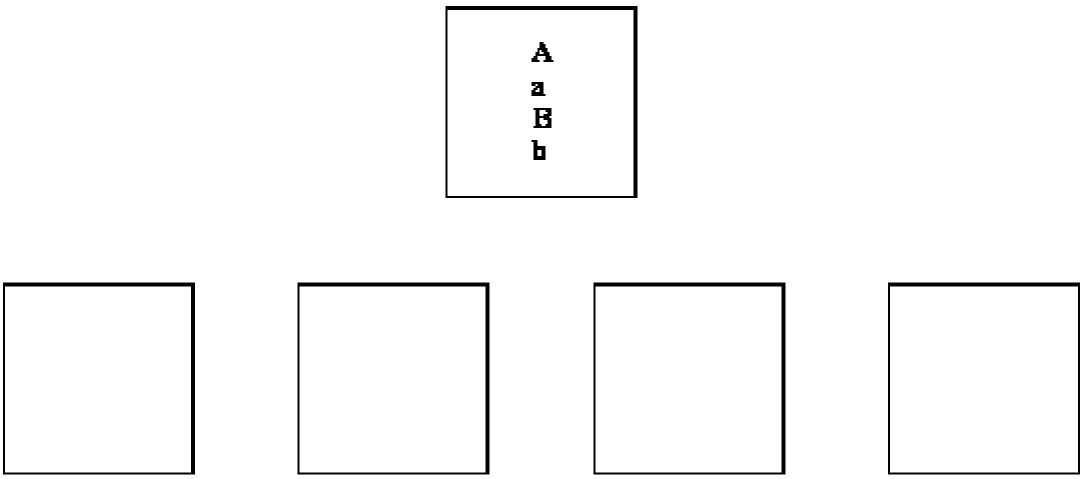
____

(1)
(Total 7 marks)

Q18.

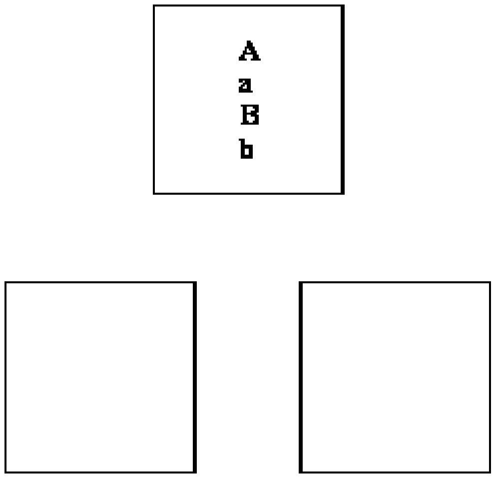
In the cell shown in the diagram as a box, one chromosome pair has alleles **Aa**. The other chromosome pair has alleles **Bb**. The cell undergoes meiosis.

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



(2)

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



(2)

(c) State the number of chromosomes in:

(i) a normal human cell;

____

(1)

(ii) a human gamete;

____

(1)

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

____

(1)

(Total 7 marks)

Q19.

Two heterozygous parents, with alleles Rr, produce offspring.

(i) Draw a genetic diagram to show all the possible arrangements of alleles in their offspring.

(2)

(ii) One of the offspring is dominant homozygous. What is the chance of this occurring?

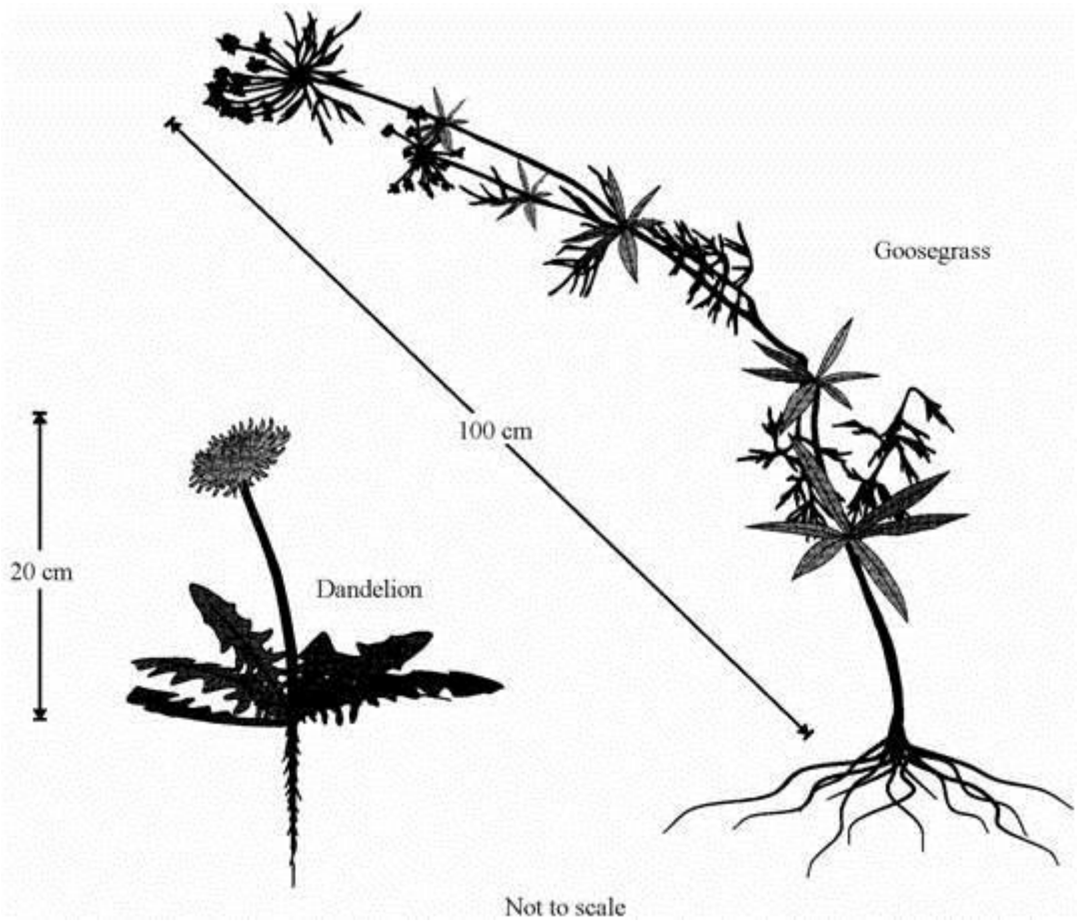
____

(1)

(Total 3 marks)

Q20.

Dandelions have become adapted to live in lawns and grass areas where animals graze. Goosegrass, however, has become adapted to live alongside hedgerows and cannot survive being mown.



(a) Use the information in the drawings to suggest **one** advantage of each of the following adaptations.

(i) Dandelion leaves lie flat on the ground.

____

____ **(1)**

(ii) A dandelion has a thick tapered root.

____

____ **(1)**

(iii) Goosegrass stems are long.

(1)

(iv) Goosegrass roots are thin and very long.

(1)

(b) Dandelions and goosegrass are different species of plants.

(i) What name is given to the unit of inheritance which controls one particular characteristic of a plant or animal?

(1)

(ii) Why would you be unlikely to succeed if you tried to breed a new species of plant by crossing a dandelion with goosegrass?

(1)

(c) Animals as well as plants have become adapted to live in different environments.

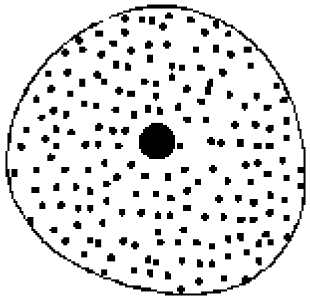
State **one** way a polar bear has become adapted to living in the Arctic, and the reason for the adaptation.

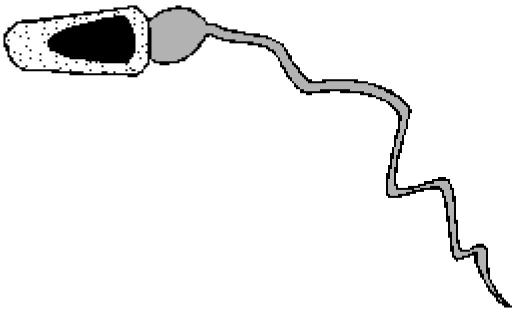
(2)

(Total 8 marks)

Q21.

Men and women produce different gametes (sex cells).





Not to scale

(a) In sexual reproduction the male and female gametes join together.

What is the name for this process?

____

(1)

(b) Complete the sentences about sex cells.

(i) Male gametes are called ______________________________________

They are produced in the ______________________________________

(2)

(ii) Female gametes are called ______________________________________

They are produced in the ______________________________________

(2)

(Total 5 marks)

Q22.

One of Mendel's original experiments was to cross pure-breeding, red-flowering pea plants with pure-breeding white-flowering pea plants. The next year he grew the seed he had collected. This first generation, $\mathbf{F_1}$, of pea plants all had red flowers. Mendel then made each flower on these plants self-pollinate. He collected the seed from these flowers and grew them. The second generation, $\mathbf{F_2}$, gave the following result:

705 red-flowering plants and 224 white-flowering plants.

(a) Which flower colour is due to the recessive allele?

____

(1)

(b) Draw a genetic diagram to show the inheritance of flower colour in the first generation ($\mathbf{F_1}$) of plants.

Use the letters **r** and **R** to represent the alleles for flower colour.

(3)

(c) Explain why Mendel made the first generation of plants self-pollinate.

___

___

___

(2)

(d) If Mendel had taken any two of his white-flowering peas and crossed them, what would have been the colour of the flowers of the next generation of plants?

___

(1)

(e) It is very difficult to get red-flowering pea plants that breed true. Explain why you cannot guarantee to breed, by self-pollination, pea plants that only have red flowers.

___

___

___

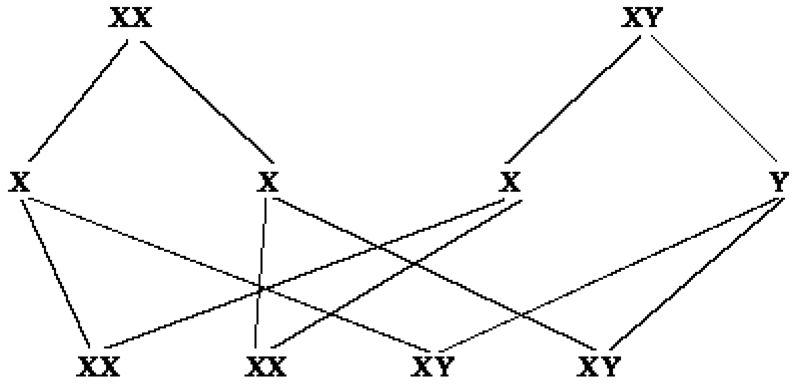
___

(2)

(Total 9 marks)

Q23.

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?

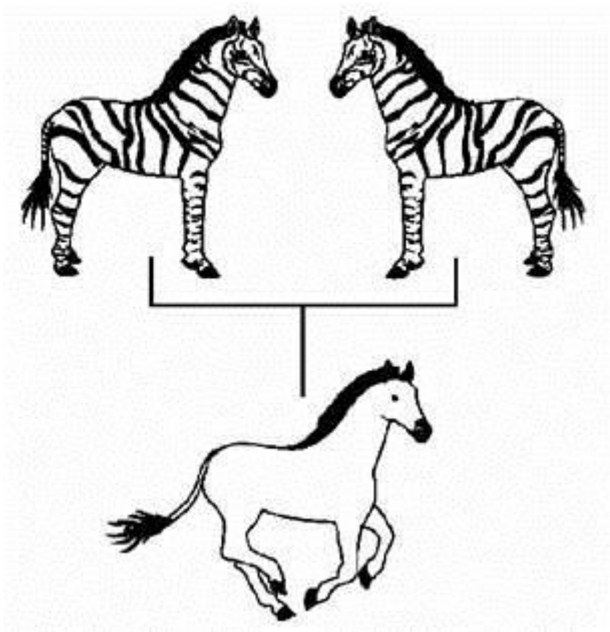
____

(1)

(Total 7 marks)

Q24.

Sometimes an adult offspring will show a distinct variation from its parents, like a zebra appearing to have no stripes.



(a) (i) Changes of this sort are called ________________________________

(1)

(ii) Which part of the cell has chemically changed to cause this variation? Circle the correct answer.

Cytoplasm gene membrane nucleus

(1)

(b) Give a cause of this type of chemical change in a cell.

____

(1)

(c) Use zebras as an example to explain the term *species.*

____

____

____

(2)

(Total 5 marks)

Q25.

(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)

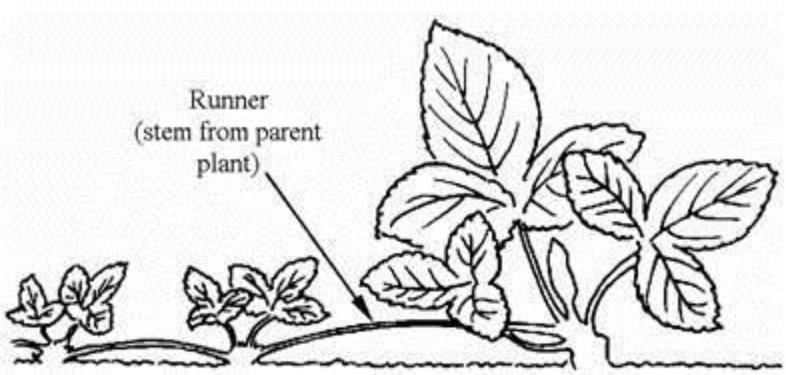
(Total 8 marks)

Q26.

A grower found some small strawberries with a nice taste, growing on a strawberry plant.

The grower then developed plants with strawberries which were larger but had the same nice taste.

Once the grower had developed his new plants, he could use runners to produce more plants which had the new large and tasty strawberries.



(i) What type of reproduction is this called?

____

(1)

(ii) Why would he use this type of reproduction to produce more new plants?

____

(1)
(Total 2 marks)

Q27.

Cystic fibrosis is a disease which affects 1 in 1600 babies.

(a) What are the symptoms of cystic fibrosis?

____

____

____

____

____

____

(3)

(b) Two parents with normal characteristics have a child who was born with cystic fibrosis.

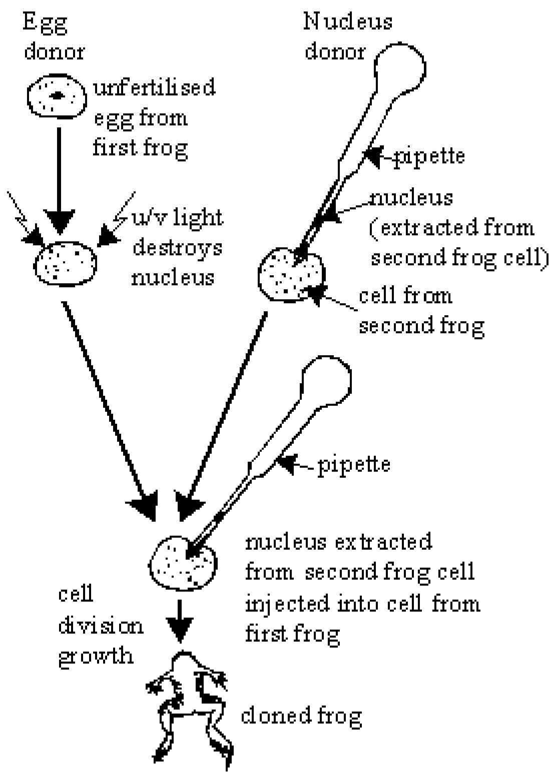
Explain, as fully as you can, how this can happen.

You may use a genetic diagram if you wish.

(4)
(Total 7 marks)

Q28.

The diagram shows how a frog can be cloned.



(a) In the example shown, will the cells of the cloned frog be the same as those of frog 1 or frog 2?

Explain your answer as fully as possible.

____

____

____

____

____

____

(4)

(b) Discuss the advantages and disadvantages of cloning compared to sexual reproduction.

____

____

____

____

____

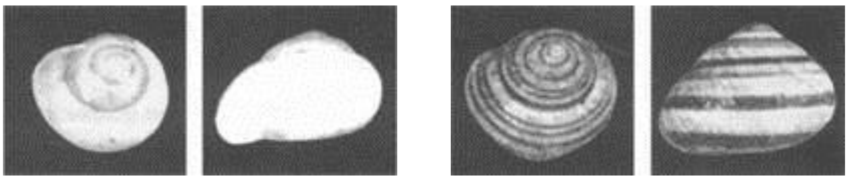
____

____

(5)
(Total 9 marks)

Q29.

Cepaea nemoralis is a snail which is found on sand dunes. It may have a plain or banded shell. The snails are found on grass stalks and leaves.



Plain Banded

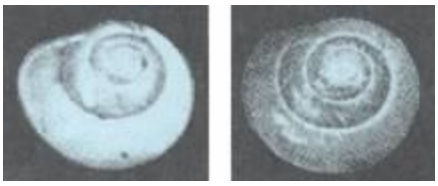
A scientist collected young unbanded snails and kept them until they were fully grown and mated them.

The eggs laid produced 35 unbanded and 12 banded snails.

(a) Explain these figures as fully as you can. You may use a genetic diagram if you wish to make your answer clearer.

____

(7)



Variation in colour

Variation in banding

(b) The snail shells show a lot of variation in colour. They are yellowy/green, brown, pink or cream. The banding varies from a single wide band to a mixture of thick and thin bands.

Describe briefly the factors which have produced this variation and explain how these factors may themselves have arisen.

(4)

(Total 11 marks)

Q30.

Many insecticides contain “active” ingredients called pyrethrins. These are extracted from pyrethrum daisies. These plants are grown in Kenya, a developing country in Africa. They provide income for farmers and valuable exports.

An American biotechnology company has now transferred the gene for making a specific pyrethrin to brewers' yeast. This can be grown easily, so this pyrethrin can be produced cheaply. However, insect populations can build up resistance to specific pyrethrins.

(a) What are the advantages and disadvantages of using brewers' yeast to produce pyrethrins?

____

____

____

____

____

____

____

____

____

____

(6)

(b) Describe, as fully as you can, how a gene for making pyrethrins is transferred from daisy to yeast.

____

____

____

____

____

(3)

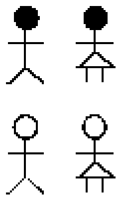
(Total 9 marks)

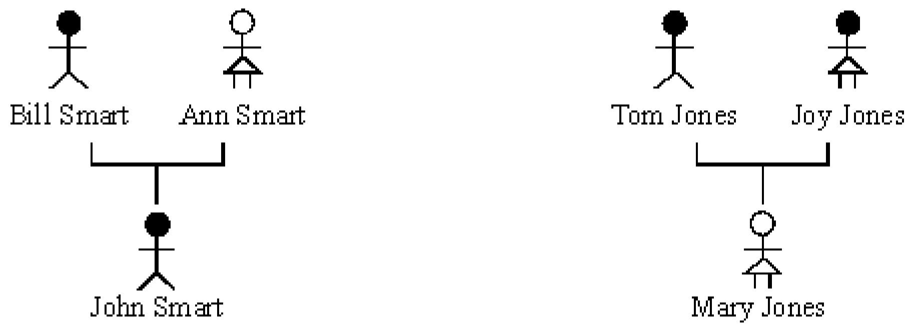
Q31.

The family trees below show the inheritance of hair colour in two families.

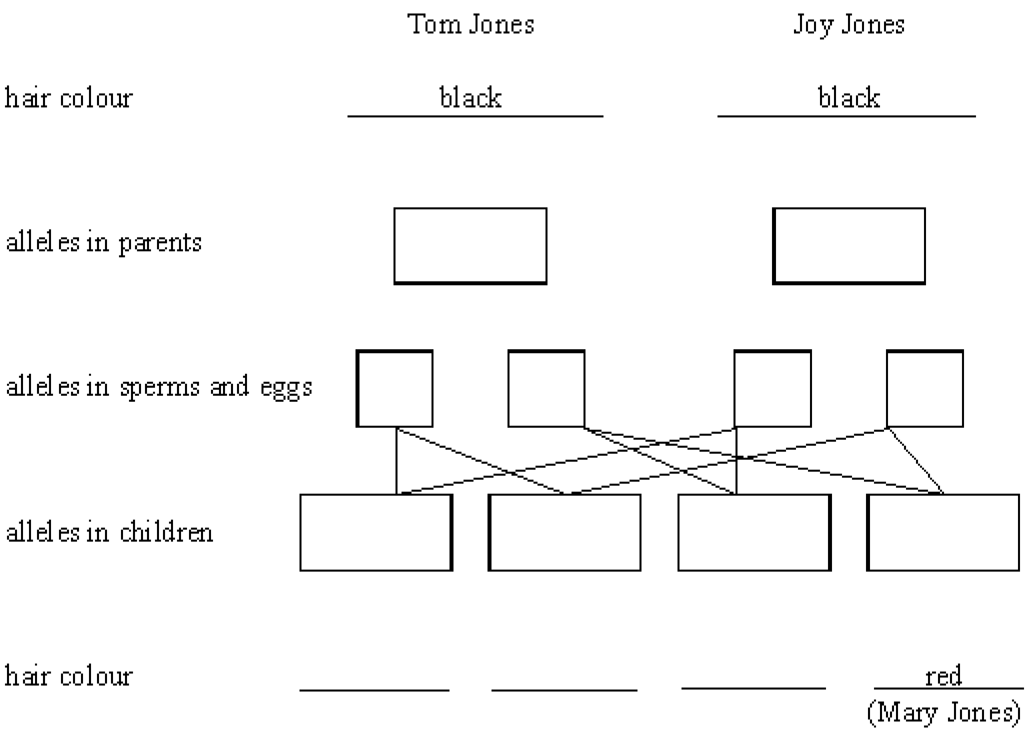
People with black hair are shown as:

People with red hair are shown as:





(a) The allele for black hair is dominant over the allele for red hair.
Use the letter **B** as the allele for black hair.
Use the letter **b** as the allele for red hair.
Complete the diagram below to show the chances of Mary Jones inheriting red hair.



(4)

(b) John Smart and Mary Jones grew up, got married and had a child.
What would the chances be that the child had red hair?

____

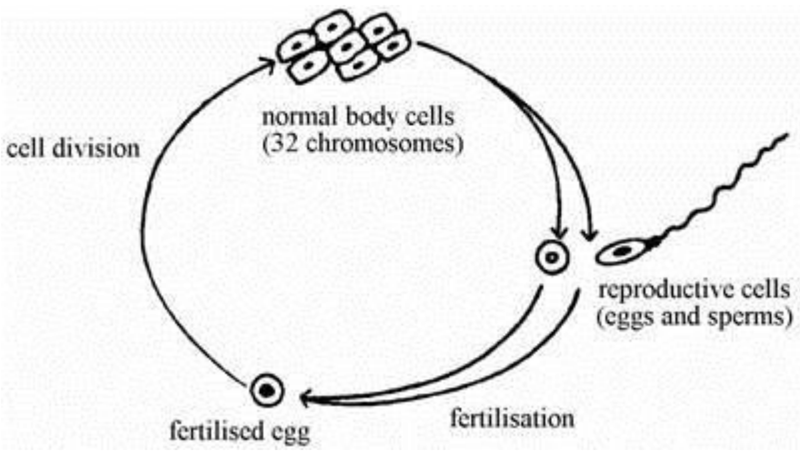
(1)

Explain your answer. Use a genetic diagram if it makes your answer clearer.

(3)
(Total 8 marks)

Q32.

The diagram shows three types of cells in a life history of a simple animal.



(a) How do the chromosomes of the body cells compare with the chromosomes in the fertilised egg from which they came?

(1)

(b) Describe what happens to chromosomes in the nucleus of a body cell when it forms reproductive cells.

(4)

(Total 5 marks)

Q33.

Spiders produce a protein thread which is extremely strong compared to man-made fibres of the same diameter.

Explain how genes control the way the protein is made in the spider's body.

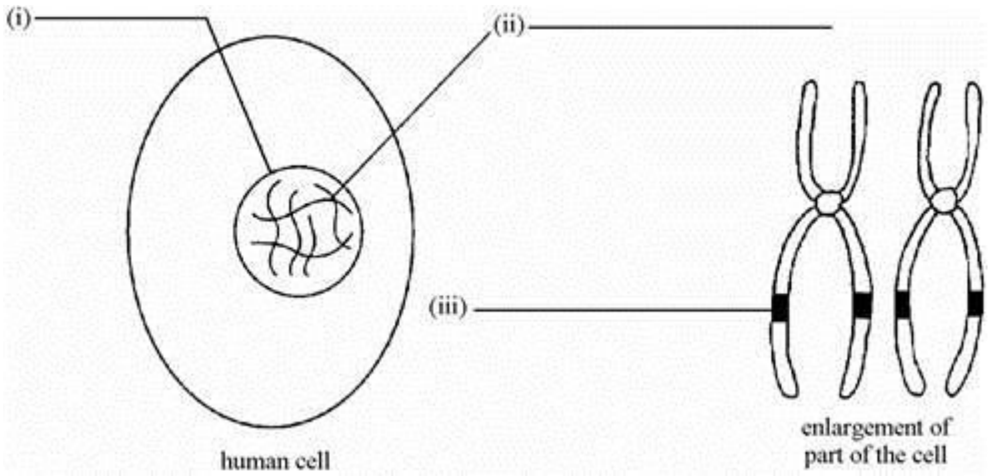
(Total 4 marks)

Q34.

The diagram shows a human cell and some of its contents.

(a) Choose words from this list to label the diagrams.

chromosome **cytoplasm** **gene** **nucleus**



(3)

(b) Choose words from this list to complete the sentence.

a body cell **an egg cell** **a gamete** **a sperm cell**

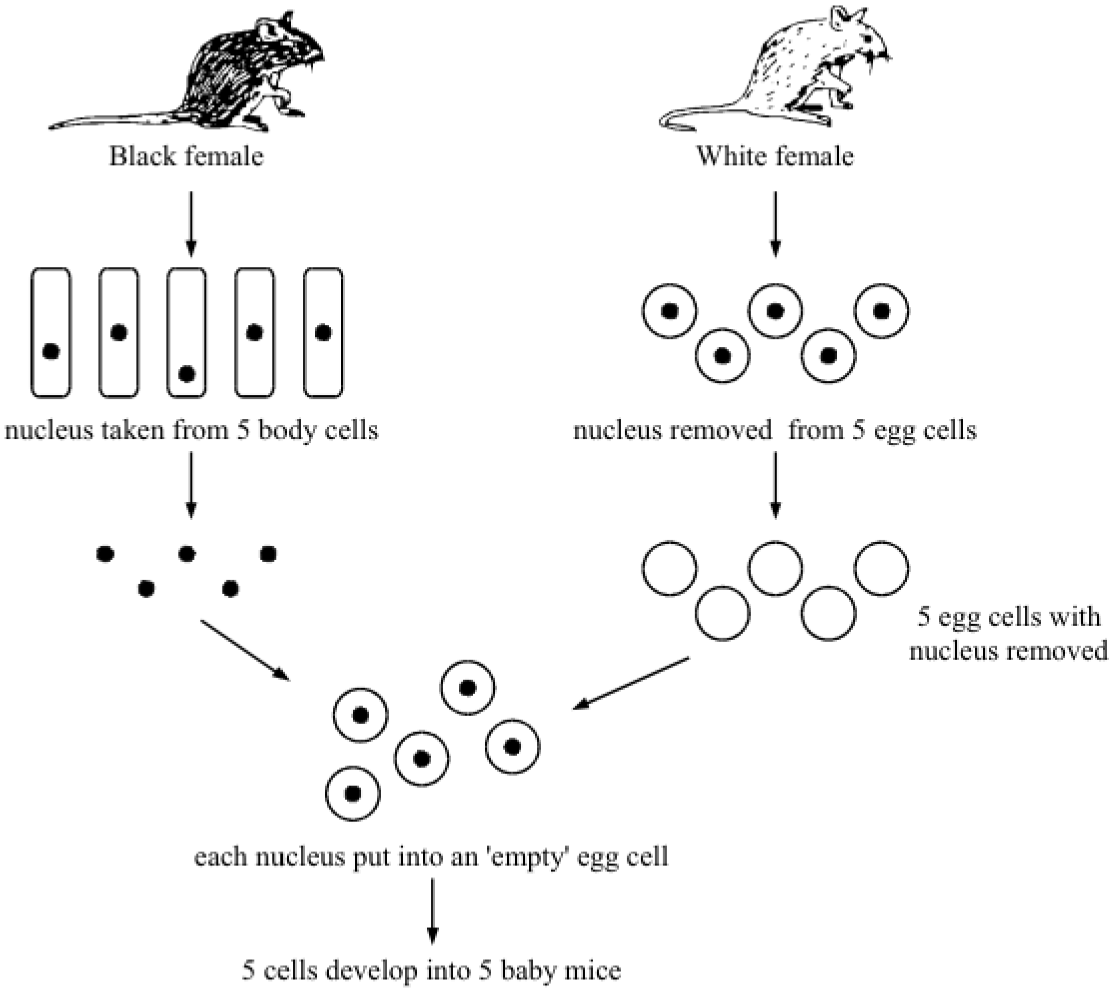
In the cell above, the chromosomes are found in pairs so this cell must be

____

(1)
(Total 4 marks)

Q35.

The diagram shows how you can breed mice without using male sex cells.



(a) (i) What type of reproduction is shown above?

____

(1)

(ii) Which part of the nucleus carries the information to make a mouse black or white?

____

(1)

(iii) Carefully describe how the baby mice

(A) compare with each other, ____

____

(B) compare with the parent mice ____

____

(3)

(b) Mice normally reproduce in a similar way to humans.

(i) Which organs in the white mouse released the five egg cells?

(1)

(ii) What treatment could you give the white mouse to make her release more eggs?

(1)

(Total 7 marks)

Mark schemes

Q1.

D
idea that twins have come from one (fertilised) egg
idea that Y sperm / Y chromosome produces boys

each for 1 mark
allow 1 mark if candidate selects ***A and*** *states that Y sperm / Y chromosome produce boys (reject Y gene unqualified) OR allow 1 mark if candidate selects* ***C and*** *states that twins must have come from one (fertilised) egg*

[3]

Q2.

(a) (i) mitosis

for 1 mark

1

(ii) 1
fertilised egg cell has 1 albino gene from father splits to produce identical cells / produced by mitosis

each for 1 mark

3

(b) (i) less protection from UV light / UV radiation

for 1 mark

1

(ii) ideas of uncontrolled multiplication of mutated cells reject fast / rapid cell division cells invade of other parts / cells transported in blood

each for 1 mark

2

[7]

Q3.

(a) *ideas that*
embryos develop from cells with sheep nuclei / chromosomes / DNA
which contains genetic information / information for development
OR placental cells (from goat) provide only e.g. nutrition

any two for mark each

2

(b) *Max. 3 pros e.g. ideas that* avoids extinction of rare breeds
rapid method for plants large numbers with same features can be produced
preserves features produced by genetic engineering *e.g. Tracey*
maintains particular genetic strains *e.g. produced by extensive selective breeding*
reject simple idea of identical offspring unless qualified as above

any three each for one mark

3

Max. 3 cons e.g. ideas that moral / ethical objections animal 'rights'
identical individuals less adaptable to change or changing needs
reduced gene pool

any three each for one mark

3

[8]

Q4.

(a) chromosomes
genes (*reject* alleles)
alleles

for 1 mark each

3

(b) (i) sexual / sex

for one mark

1

(ii) egg / gamete / sex cell / ovum (*reject* ovule)

for one mark

1

(c) (i) information / genes / DNA passed from parents (*reject* chromosomes)

for one mark

1

(ii) genes / genetic information / chromosomes from <u>two</u> parents
alleles may be different
environmental effect / named may have been mutation

any two for 1 mark each

2

[8]

Q5.

(a) woman XX
man XY

for 1 mark each

2

(b) 50% / 1 in 2 / evens / 0.5 / 50:50

for 1 mark

<u>mark scheme for genetic diagram</u>

gametes all correct
genotypes of offspring all correct in relation to <u>gametes</u>

for 1 mark each

1

<u>mark scheme for written explanation</u>

half sperm have X chromosome, half have Y
and

all eggs have X chromosome

50% / 1 in 2 / evens / 0.5 chance of egg being fertilised
by X or Y sperm

for 1 mark each

2

[5]

Q6.

(a) (i) sexual / sex

(ii) egg / gamete / sex cell / ovum (*reject* ovule)

for 1 mark each

2

(b) (i) meiosis / reduction

(ii) mitosis / somatic

for 1 mark each

2

(c) twice as many (*reject* answers based on 23 / 46 chromosomes)

for one mark

1

(d) (i) information / genes / DNA passed from parents
(chromosomes neutral)

for one mark

1

(ii) genes / genetic information / chromosomes from two parents
<u>alleles</u> may be different
environmental effect / named may have been mutation

any two for 1 mark each

2

[8]

Q7.

parental genotypes both correct – both Bb
gamete genotypes all correct B and b B and b
genotype of bb offspring correctly related to gametes
bb offspring identified as small bolls

for 1 mark each

[4]

Q8.

(i) DNA (*accept* RNA)

for one mark

1

(ii) DNA carries <u>coded</u> information

which controls the order of amino acids
in proteins

for 1 mark each

3

[4]

Q9.

dominant

1

recessive

1

genes

1

gametes

1

environmental

1

[5]

Q10.

(a) asexual

mitosis is neutral

1

(b) (body cell)
nucleus *is* from body cell

no mark for just body cell – mark the explanation
allow converse nucleus from egg cell is removed

1

nucleus contains (genetic) information / instructions / chromosomes / genes / DNA / allele

*do **not** credit 'contains characteristics'*

1

(c) splitting apart (cells from clonal) embryo

*do **not** credit 'repeat process'*

1

[4]

Q11.

(a) gametes A **or** a A **or** a

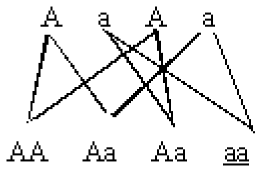
1

F_1 genotypes correctly derived

1

albino identified

OR



gametes – 1

F1 genotypes corresponding to 'lines' – 1
lines must be correct

Albino (aa) identified – 1 (lower case)

1

OR

	A	a
A	AA	Aa
a	Aa	aa

gametes –1
boxes all correct –1
albino (aa) identified –1

(b) $\frac{1}{2}$ / half / 50% evens / 1 in 2

*do **not** credit 1 to 2 or 50/50*

1

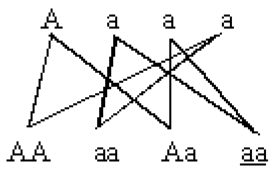
gametes A **or** a a **or** a or one parent heterozygous, one parent homozygous recessive

1

F_1 genotypes correctly derived

OR

(R) **(S)**



gametes correctly identified – 1

F_1 genotypes correctly derived – 1

OR

(R)

(S)

	A	a
a	Aa	aa
a	Aa	aa

gametes correctly derived – 1
F_1 genotypes correctly derived – 1

1

[6]

Q12.

man XY

allow (chromosomes) different

1

woman XX

allow (chromosomes) same
genes and alleles are neutral
allow 1 mark for one is XX and one is XY

1

[2]

Q13.

(a) any **two** from

- copies of <u>chromosomes</u> made
- <u>cell</u> divides twice **or** 4 cells formed
- each gamete / cell now has single set of chromosomes
  allow chromosome number halved /
  cells haploid / cells n

2

(b) any **two** from

- sex cells / gametes fuse / fertilisation
- offspring receive genes or chromosomes or alleles from both parents / DNA
- alleles in a pair may vary

2

(c) (i) new form of gene
allow change in genetic material / DNA / chromosomes / gene

1

(ii) (no)

any **two** from

- some neutral
- exemplified
  e.g. extra digit

- some increase chances of survival / reference to natural selection or evolution
- exemplified
  e.g. example of disease resistance

2

[7]

Q14.

(a) any **three** from:

factor for colour has two forms
accept gene for factor and allele for form

yellow dominant since <u>all</u> first generation yellow
accept F1 for first generation

green recessive since reappears in second generation
accept F2 for second generation

3

(b) (i) genes
accept alleles / genetic

1

(ii) nucleus
accept chromosomes / DNA

1

[5]

Q15.

(a) (i) meiosis

1

(ii) mitosis

1

(c) (i) **X** pituitary

1

Y FSH

1

(ii) stimulates LH production

1

inhibits FSH production / production of **Y**

1

[6]

Q16.

(a) (i) testis

1

ovary

1

(b) fertilisation **or** fertilise(d) / (ing)

accept fusion

*do not credit conception **or** intercourse*

1

(c) (i) the same, identical

do not credit very similar make clear their genetic material is the same

do not credit the same number of chromosomes or genes

1

(ii) the same, identical

make clear their genetic material is the same

do not credit the same number of chromosomes or genes

1

[5]

Q17.

(a) (i) XX XY XY XX

female male male female

the four correct genotypes and sex are required they may be in any order

1

(ii) meiosis

correct spelling required but

accept meisosis not miosis or meosis

1

(iii) 23

1

(iv) 23

1

(b) (i) any **two** from

(introduces) variation

*accept can crossbreed **or** offspring may gain beneficial characteristics*

prevents the risk of all being the same and a disease wiping out population
or prevent monoculture

two parents to raise offspring

2

(ii) both parents carry a recessive allele
or gene **or** are heterozygous

accept both parents are carriers

1

[7]

Q18.

(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]

Q19.

(i)

	R	r
R	RR	Rr
r	rR	rr

a cross over diagram is also acceptable 1 mark for the separation of alleles to form the two axes (gametes)
1 mark for the four combinations

2

(ii) 25 **or** 1 in 4 **or** 1:3

accept ¼ do not credit 1 to 4

1

[3]

Q20.

(a) (i) to go under teeth **or** mower

accept not damaged by grazing animals

accept do not get cut or bitten

accept reduces competition by other plants

do not credit maximum surface of leaves facing Sun

1

(ii) any **one** from

it can force its way through grass roots

accept in competition with grass roots

it is a store of food (to help the plant recover)

do not credit a good store of water

to reach down to water

to give good anchorage

accept it is hard to pull up

1

(iii) any **one** from

to reach more light

accept to get out of the shadow of the hedge ***or*** *tall grass*

to let seeds be caught on animals' coats (more easily)

accept improves access ***or*** *visibility* ***or*** *ease for pollination*

do not credit to help it grow up the hedge

1

(iv) any one from

(they reach out from hedge) to find water

accept increase surface area

accept to find nutrients ***or*** *minerals*

do not award mark if food mentioned

to give good anchorage

1

(b) (i) gene **or** allele

do not credit chromosome

1

(ii) any **one** from

they do not crossbreed **or** interbreed

*accept different species do not breed together **or** do not fertilise each other*

do not produce fertile offspring

have different numbers or types of chromosomes

accept genes are incompatible

*do not credit have different genes **or** are genetically different*

do not credit do not pollinate each other

1

(c) one mark is for the adaptation and one is for an appropriate reason

have white fur

for camouflage

are huge

for large volume to surfae area

thick layer of fat

*for insulation or to reduce heat loss **or** retain heat*

*do not credit to stop it losing heat **or** withstand the cold **or** keep it warm*

have thick fur

*for insulation **or** to reduce heat loss **or** retain heat*

hibernate

to avoid the coldest part of year

is a carnivore

because animals provide high energy food

has big paws **or** claws

to be able to walk on snow

have small ears

to reduce heat loss

have furry feet

for insulation from the snow

2

[8]

Q21.

(a) fertilisation

credit conception 1

(b) (i) sperm

*do not accept offensive answers **or** those in the vernacular* 1

testes **or** testicles 1

(ii) ovum **or** ova **or** eggs

do not accept ovules 1

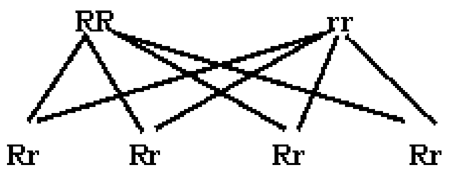
ovary 1

[5]

Q22.

(a) white 1

(b)



or a Punnett square

1 mark for parents and separation of genes

*1 mark correct set of four pairs, **rR*** 1

	R	R
r	rR	rR
r	rR	rR

1

all are red **or** R is red **or** Rr are red

1 mark for explanation of colour 1

(c) any **two** from

accept allele for gene

to stop cross pollination

*credit so they could not breed with other flowers **or** colours*

to control the gene pool **or** prevent other genes getting in

*credit characteristics **or** factors*

do not accept to use the same genes again

to see which genes were present

credit factors

to test if F_1 **or** they contained any genes for white **or** recessive genes

credit a suitable Punnett square

referenced to white

credit to see if there was variation in the

*genes **or** to see if he got any white flowers*

do not accept for a fair test

2

(d) white

1

(e)

the term gene may be in place of allele

the situation mark

red is dominant so masks any white
alleles **or** could be heterozygous

credit some (may) have both alleles

credit you do not know if a white allele is there

the consequence marks

1

EITHER

if a recessive **or** white allele is present
there is a chance of a white flower

credit if white alleles are there the recessive can show

OR

chance of white flower could be 1 in 4
if all red flowers contain a dominant and a recessive allele

1

[9]

Q23.

(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*

1

(c) (i) 23

1

(ii) 23

credit the same as the one above to be marked consequential

1

(d) DNA

do not accept nucleic acid

1

(e) same

1

[7]

Q24.

(a) (i) any **one** from

mutations

discontinuous variation

1

(ii) gene

accept any clear indication such as a tick

1

(b) any **one** from
gamma radiation

accept radiation

X-rays

ultra violet rays

chemicals

accept mutagens

chance

1

(c) zebras breed (to produce)

1

fertile offspring

do not accept mating

1

[5]

Q25.

(a) 23

1

(b) chromosome nucleus gene cell
2 3 1 4

1

(c) (i) any **one** from

(cells which are bigger) take up more space

(cells) have to get bigger **or** mature to divide

1

(ii) chromosomes duplicate **or**
make exact copies of self

accept forms pairs of chromatids

1

nuclei divide

*accept chromatids **or***
chromosomes separate

1

identical (daughter) cells formed

accept for example, skin cells make
*more skin cells **or** cells are clones*

1

(d) any **two** from

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

2

[8]

Q26.

(i) vegetative/asexual/cloning

for 1 mark

(ii) clones/identical copies/all same

for 1 mark

not clones if cloning in b(i)

[2]

Q27.

(a) *idea that*
thicker/sticky/viscous mucus;
difficult breathing/trachea blocked;
digestion difficult/glands blocked

each for 1 mark

3

(b) *idea*
'normal' gene/allele dominant
or
cystic fibrosis gene/allele recessive;

idea that
parents heterozygous/carrier;
children heterozygous, homozygous dominant, homozygous recessive (clearly implied by diagram);
idea one in four chance of cystic fibrosis

each for 1 mark

4

[7]

Q28.

(a) *ideas:*
frog 2
nucleus comes from this frog
DNA/genes/information in nucleus
this controls development

for 1 mark each

4

(b) *advantages:*
large number of identical offspring
guaranteed desired features
quick
economic

disadvantages:
may all succumb to unexpected disease/change in conditions
cut adaptation/reduce gene pool/limits variation

any 5 for 1 mark each

5

[9]

Q29.

(a) idea

- unbanded dominant/plain **or** banded recessive
- because banded appears in young/
- parents heterozygous/Bb
- offspring BB }
  Bb } credit response consistent with parents
  Bb } even if not both heterozygous
  bb }

Accept any clear and consistently used notation

- identify BB, Bb as plain
- identify bb as banded
- ratio 3:1 unbanded/banded (stated or clearly implied
- matches 35:12 results e.g. <u>all</u> the outcomes clearly identified as banded/unbanded)

for 1 mark each

7

(b) *idea*

- many genes control [accept "continuous variation"]
- many alleles for a gene/large genepool
- snails can inherit lots of different combinations
- mutation (gives rise to many alleles)
  allow selection allows alleles to be passed on unless [very]disadvantageous or if advantageous

any 4 for 1 mark each

[Also credit, for 1 mark each, up to <u>2</u> causes of mutation, e.g. mistakes in cell division, radiation]

4

[11]

Q30.

(a) *idea*
advantages

- large scale

- cheaper
- easy to grow/produce or quick to produce
- non-seasonal

disadvantages

- loss of farmers' income
- loss of foreign exchange
- less work in Kenya/developing country
- mass use of a of particular pyrethin
- can allow insect populations to become resistant

any 6 for1 mark each
maximum of 4 in
advantages/disadvantages

6

(b) *idea*
chromosomes /DNA carry genes
cut off gene/part of chromosome/DNA
insert into yeast chromosome/DNA/plasmid/nuclear
Accept DNA answers

for 1 mark each

3

[9]

Q31.

(a)

alleles in parents	$\boxed{Bb}$		$\boxed{Bb}$	
alleles in sperms/eggs (*)	B	b	B	b
alleles in children (*)	$\boxed{BB}$	$\boxed{Bb}$	$\boxed{bB}$	$\boxed{bb}$
hair colour	black	black	black	red

(*) NB ecf
Allow other letters if a clear key

each line correct for 1 mark each

4

(b) evens/50:50/equal/half (e.c.f. from cross below)

for 1 mark

parents	J Smart Bb	M Jones bb	
children	Bb Bb black	bb bb red	*(ecf)

each line correct for 1 mark each

3

J Smart must be BB or Bb
M Jones must be bb or from (a)

Credit cross shown in a matrix:

	B	b
b	Bb	bb
b	Bb	bb

for 2 marks

Bb identified as black hair
bb identified as red hair
or
2 red : 2 black

for 1 mark

1

[8]

Q32.

(a) *idea*

identical (do <u>not</u> allow simply "the same number")

for 1 mark

1

(b) *idea*

chromosomes double/duplicate/copies made

for 1 mark

separate into 2 sets/divide*

gains 1 mark

but
separate into 4 sets/divide twice*

gains 2 marks

number halved compared to bodycell
or
single set (only) 16
accept in terms of cells but only if chromosomes referred to in first and/or last items)

for 1 mark

4

[5]

Q33.

idea

- (gene) in DNA (i.e. mention of DNA)

- (DNA) contains bases
- (bases) code for amino acids (in protein)
- (amino acids) in correct order
- to make the (spider) protein

any four for 1 mark each

(No credit for double helix, **pairs** of bases - but no penalty)

[4]

Q34.

(a) (i) nucleus

(ii) chromosome

(iii) gene

each for 1 mark

3

(b) a body cell

for 1 mark

1

[4]

Q35.

(a) (i) asexual / non-sexual / cloning *[not artificial]*

for 1 mark

1

(ii) gene / allele / chromosome / DNA

for 1 mark

1

(iii) A) same / look alike / similar

gains 1 mark

but same sex / all female / all black / identical / clones

gains 2 marks

B) same as the black (female)

for 1 mark

3

(b) (i) ovaries [not reproductive organs]

for 1 mark

1

(ii) hormones / fertility drugs / FSH

for 1 mark

Allow LH

[Do not allow oestrogen / fertility treatment]

1

[7]

Q1.

For many years scientists studied the organisms in an area of grassland.

One of the animals was a species of black fly. In this population only one allele **B** existed for colour. All the flies were homozygous **BB**.

A mutation occurred which produced a new recessive allele **b** which could produce a green colour.

(a) Draw **two** genetic diagrams to show how the single **b** allele in just one fly was able to produce homozygous **bb** green flies in two generations.

First generation

Second generation

(4)

(b) Although this new allele was recessive and the mutation only occurred once, a large proportion of the fly population was soon green.

Suggest in terms of natural selection why the recessive **b** allele was able to spread through the population.

____

____

____

____

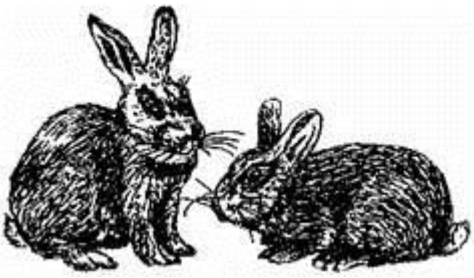
____

____

(3)
(Total 7 marks)

Q2.

These young rabbits look like their parents. This is because information about characteristics such as fur colour is passed from parents to their young.



Choose words from this list to complete the sentences below.

body **chromosomes** **clones** **cytoplasm**

genes **nucleus** **sex**

Information is passed from parents to their young in ______________________ cells.

Each characteristic, e.g. fur colour, is controlled by _______________________ .

The structures which carry information for a large number of characteristics are

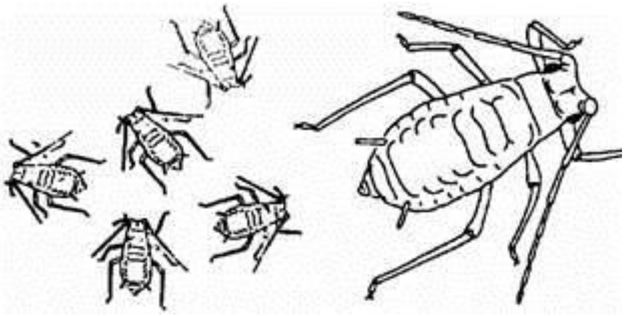
called ________________________ .

The part of the cell which contains these structures is called the _________________ .

(Total 4 marks)

Q3.

The bean aphid is a type of black-fly which lives on broad bean plants in summer. In the autumn, males and females mate and produce eggs.



(a) Name the type of reproduction which produces the eggs.

____

(1)

(b) In spring these eggs hatch. The young aphids are all female.

Explain why they are all similar but not identical to each other.

___

(1)

(c) These females are then able to produce offspring without needing any males.

(i) Name the type of reproduction where females do **not** need males to produce offspring.

___

(1)

(ii) How will the offspring from one of these females:

A compare with each other

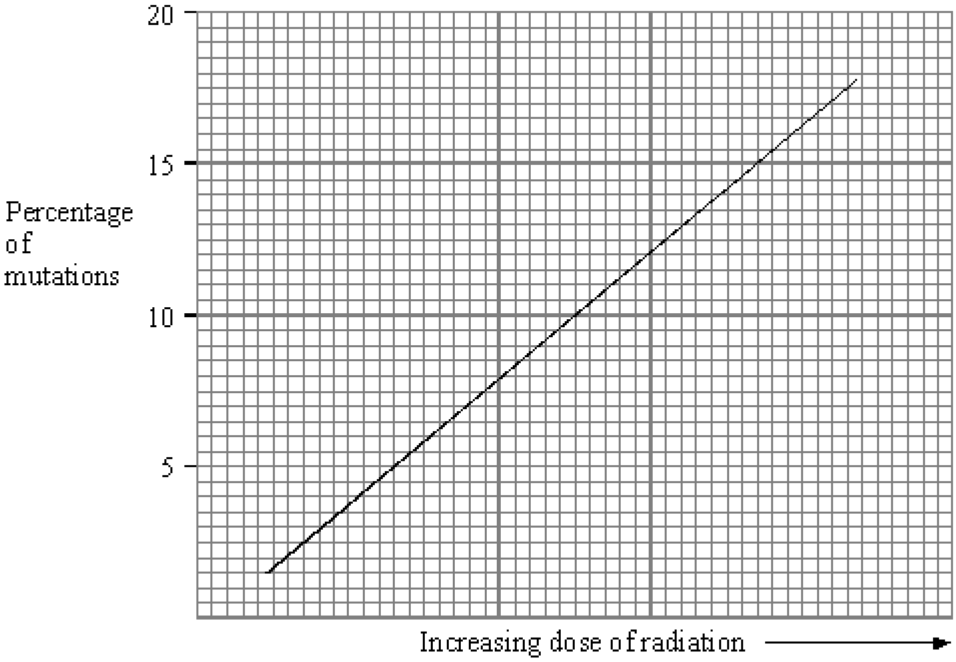
___

B compare with the offspring from other females?

___

(2)

(d) Some scientists investigated mutations in these aphids. They exposed the aphids to X-rays.
They plotted their results.



(i) What was the connection between the dose of X-rays and the percentage of mutations?

___

(1)

(ii) Name **one** other possible cause of mutations.

(1)
(Total 7 marks)

Q4.

Cystic fibrosis is an inherited disease which causes the tubes in the lungs to be blocked with sticky mucus. Two parents who do not have the disease can still produce children who do have the disease.

(a) Explain how children can inherit this disease from parents who do not have it (use a genetic diagram in your answer if you want to).

(4)

(b) Mucus contains protein. The information for the production of this protein is stored in a gene.

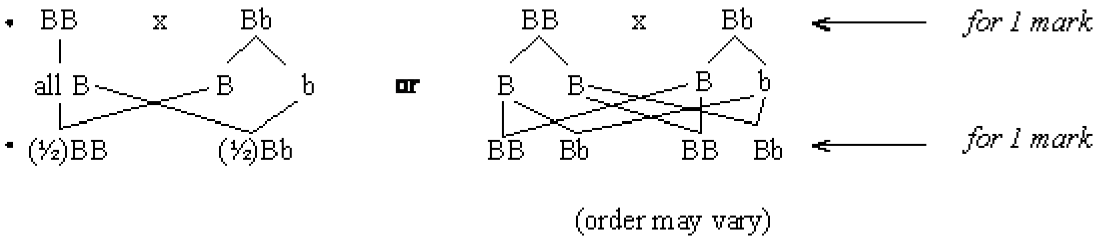
Explain how a change in a gene causes a different protein to be produced.

(3)
(Total 7 marks)

Mark schemes

Q1.

(a) <u>First Generation</u>



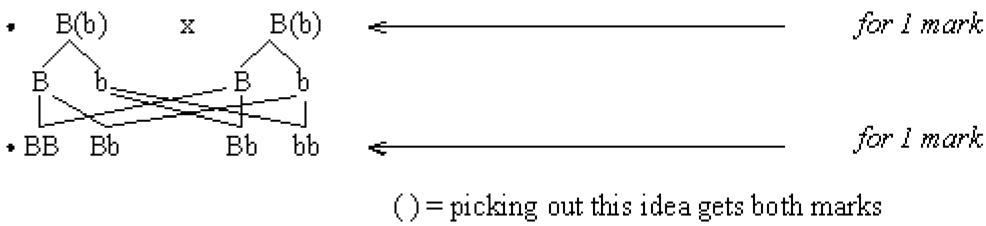
<u>or</u> as matrix

	B	B
B	BB	BB
b	Bb	Bb

1 mark for correct column and row headings
1 mark for correct outcomes

allow one mark for being able to produce a correct genetic cross (even if from an incorrect starting point)

<u>Second generation</u>



or as a matrix

	B	b
B	BB	Bb
b	Bb	bb

1 mark for correct column and row headings
1 mark for correct outcomes

4

(b)
- green colour gives an advantage/camouflage
- more green flies dm black flies survive to <u>breed*</u>
- pass on their genes to the next generation
- (* but implied by 3rd bullet point)

for 1 mark each

3

[7]

Q2.

sex
genes
chromosomes
nucleus *in order*

for 1 mark each

[4]

Q3.

(a) sexual / sex

for 1 mark

1

(b) *idea that*
sexual reproduction brings about a mixture of genes
or similar / different genes / parents / gametes / DNA / characteristics / chromosomes (*not* features)

for 1 mark

1

(c) (i) asexual / cloning (*allow* vegetative)

for 1 mark

1

(ii) (A) *idea that* (they are exactly the same). *Do not allow* similar or just <u>one</u> named feature.

for 1 mark

2

(B) different (*allow* similar but *do not allow* same). *Allow* any one named difference

for 1 mark

(d) (i) greater the X-ray dose, greater the % of mutations
or % of mutations increases steadily / in proportion to X-ray dose

for 1 mark

1

(ii) ionising radiations / ultra-violet light / alpha particles / beta particles / gamma rays / radio activity / chemicals / drugs / smoking / natural in meiosis / spontaneous / cell replication / toxic waste / pollution

1

Accept radioactivity but not radiations alone.

for 1 mark

[7]

Q4.

(a) • caused by a recessive* gene / allele

(allow non / not dominant)

• both parents heterozygous / carry the gene / allele *for 1 mark each*

offspring needs two recessive genes to have / inherit disease
for 2 marks

or

- Nn × Nn
- NN Nn Nn nn
for 1 mark each

nn identified as having the disease*
for 2 marks

4

(b) any reference to DNA
gains 1 mark

but
different genes means difference in DNA
gains 2 marks

idea of
different codes / instructions for making proteins
or
different (order of) amino acids (in proteins)
for 1 mark

3

[7]