# 4.6 Inheritance, Variation and Evolution

## Foundation

Name: _____

Class: _____

Date: _____

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Time: **369 minutes**

Marks: **366 marks**

Comments:

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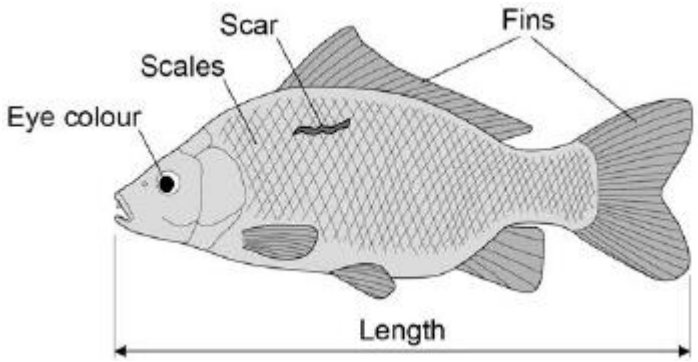
## Q1.

**Figure 1** shows a fish called a carp.

**Figure 1**




The characteristics of an animal can be a result of:

- only genetic causes
- only environmental causes
- both genetic **and** environmental causes.

(a) Give **one** characteristic shown in **Figure 1** for each different cause.

Only genetic causes _____

Only environmental causes _____

Both genetic **and** environmental causes _____

_____

**(3)**

(b) Two alleles control the body colour of carp:

- brown (**B**)
- blue (**b**).

The brown allele is dominant to the blue allele.

The genetic cross from breeding two carp is shown in **Figure 2**.

**Figure 2**

| | **B** | **b** |
|---|---|---|
| **b** | Bb | |
| **b** | | |

Complete **Figure 2**.

**(2)**

(c) Draw a ring around **one** blue offspring shown in **Figure 2**.

**(1)**

(d) What is the probability that the offspring from this genetic cross will be brown?

Tick **two** boxes.

0 ☐

0.25 ☐

0.5 ☐

1.0 ☐

**(1)**

(e) Carp can produce large numbers of offspring.

The two carp crossed in **Figure 2** had 260 000 offspring.

Approximately how many offspring are expected to be brown?

_____

Brown carp offspring = _____

**(1)**

(f) A pond contains carp used for breeding.

The carp for breeding are brown or blue.

A red carp has been seen.

The red carp was **not** added to the pond.

Suggest what might have caused the red carp to appear.

_____

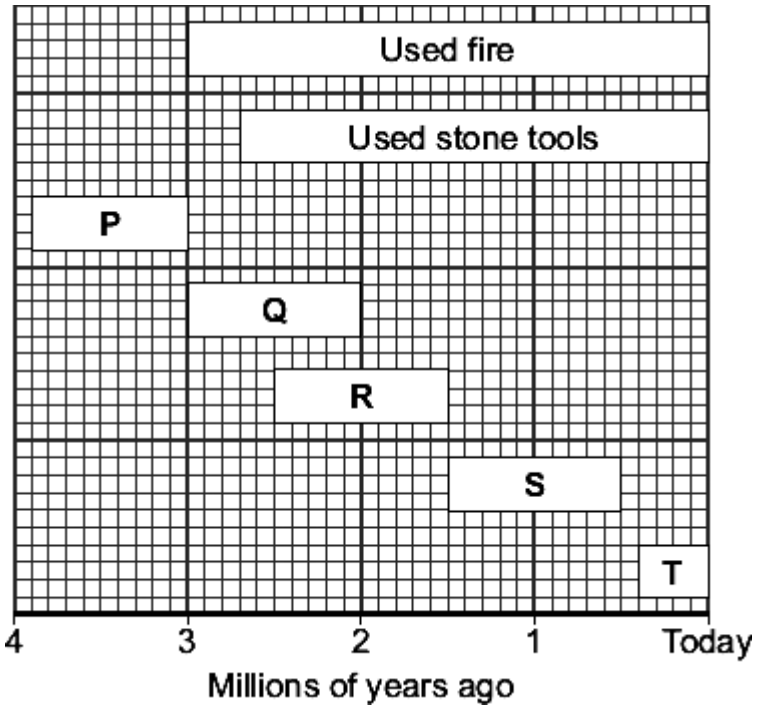
_____

**(1)**

**(Total 9 marks)**

## Q2.

The diagram shows a time line for the evolution of humans.




The letters **P**, **Q**, **R** and **S** show human ancestors.
The letter **T** shows modern humans.

(a) (i) How many millions of years ago did humans first use fire? ☐ millions of years ago

**(1)**

(ii) Which human ancestor, **P**, **Q**, **R** or **S**, was the first ancestor to use tools? ☐

**(1)**

(iii) For how many millions of years did human ancestor **R** live on Earth? ☐

**(1)**

(b) How do we know that human ancestors **P**, **Q**, **R** and **S** lived on Earth?

_____

_____

**(1)**

(c) Which scientist suggested that humans have evolved from ape-like ancestors?

Draw a ring around **one** answer.

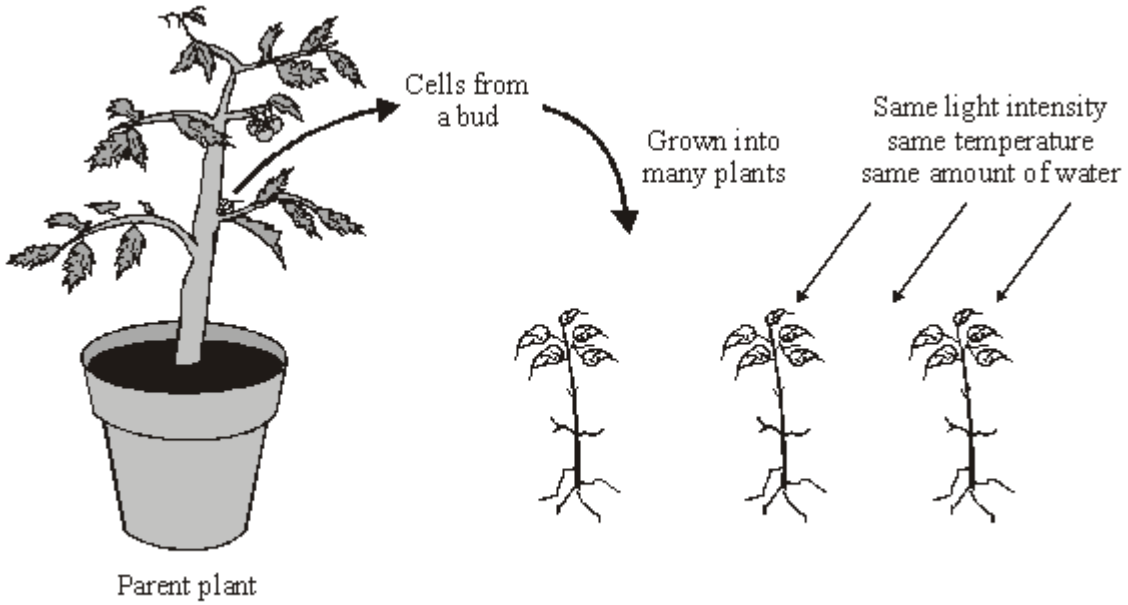
**Darwin** **Mendel** **Semmelweiss**

**(1)**

**(Total 5 marks)**

## Q3.

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)**

## Q4.

(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 | ☐ |

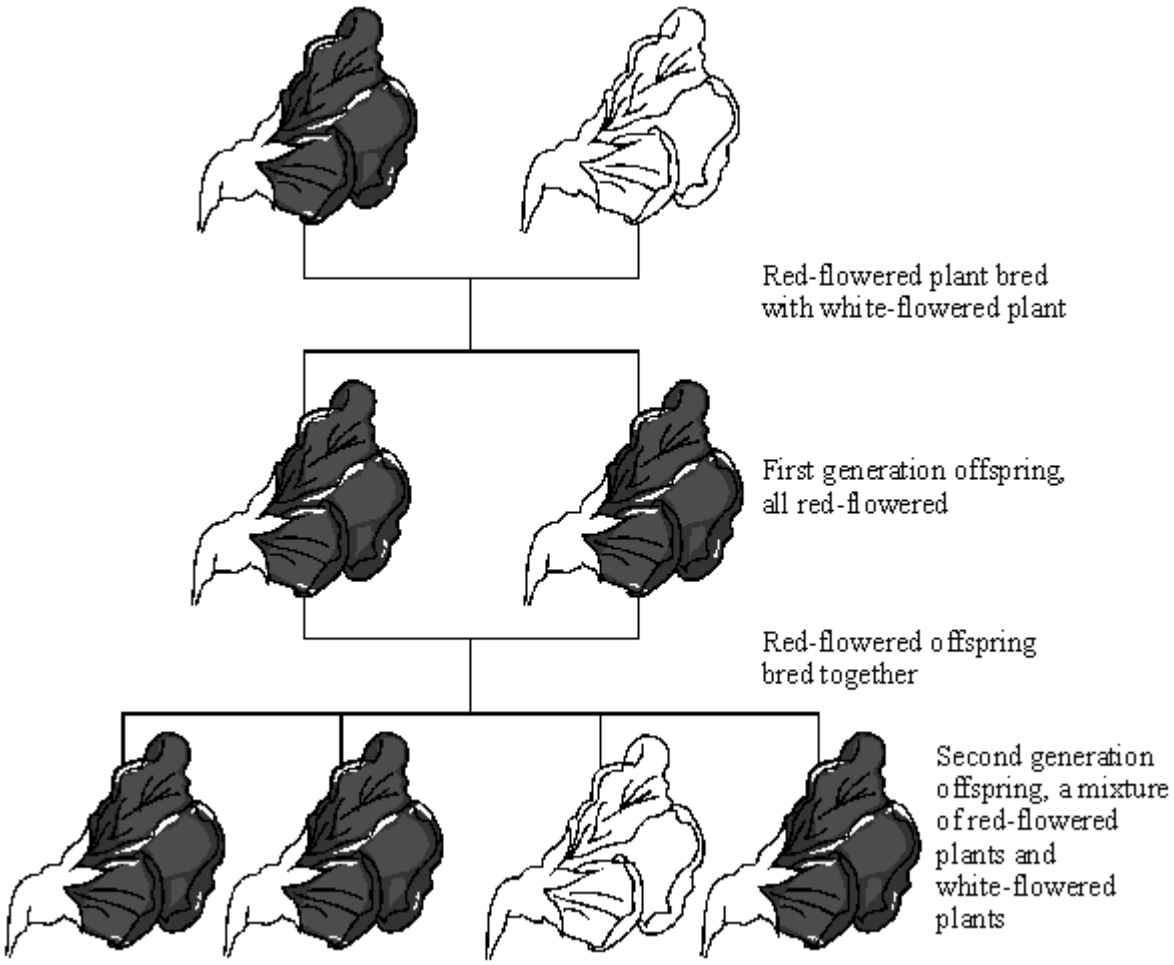
**(1)**

**(Total 3 marks)**

## Q5.

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<br>environmental<br>recessive | factors.

**(Total 5 marks)**

## Q6.

Choose words from this list to complete the sentences below.

| | | |
|---|---|---|
| bones | extinct | fossils |
| muscles | rocks | |

In the past some types of animals and plants have died out.

They have become _____ .

We know about these animals and plants because we find them as _____ .

Sometimes the hard parts of animals such as _____ did not decay.

In other cases the bodies of animals and plants were replaced by minerals.

You can still see their shape in _____ .

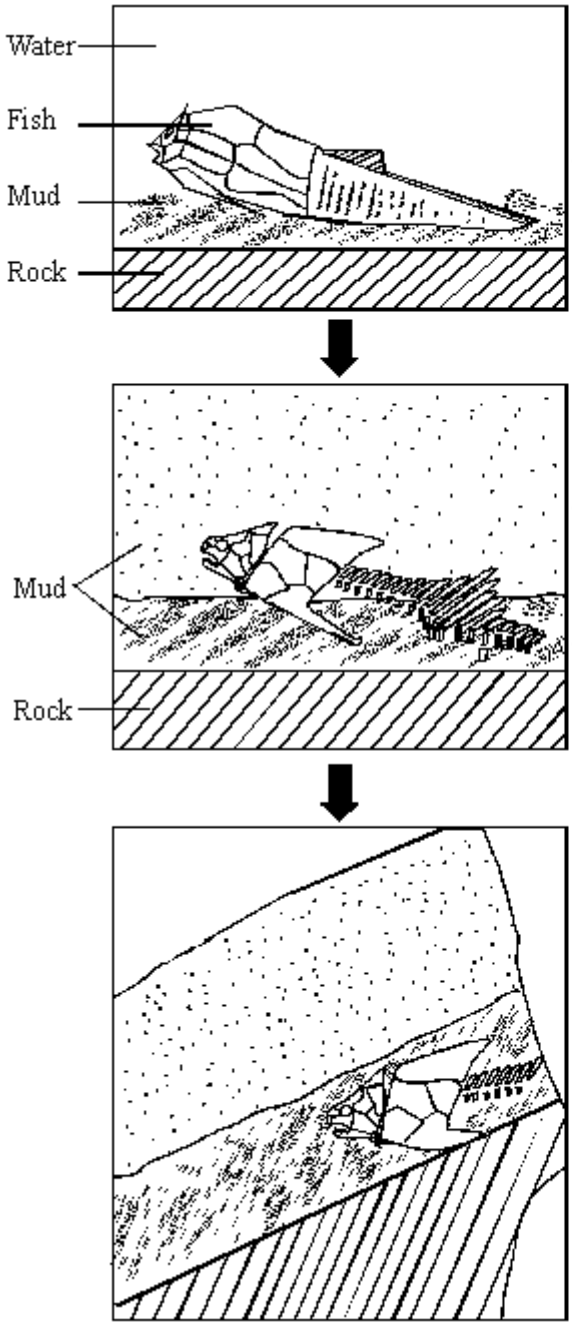
**(Total 4 marks)**

## Q7.

Fossils give us evidence for the theory of evolution.

The diagrams show how a fish became a fossil.

(a) In the sentences below, cross out the two lines which are wrong in each box.




**(4)**

(b) Give **one** way in which fossils provide evidence for the theory of evolution.

_____

_____

**(1)**

**(Total 5 marks)**

## Q8.

Choose words from this list to complete the sentences below.

**coal** **dinosaurs** **extinct** **fossils** **rocks**

Many animals and plants which once existed have died out.

They are now _____ .

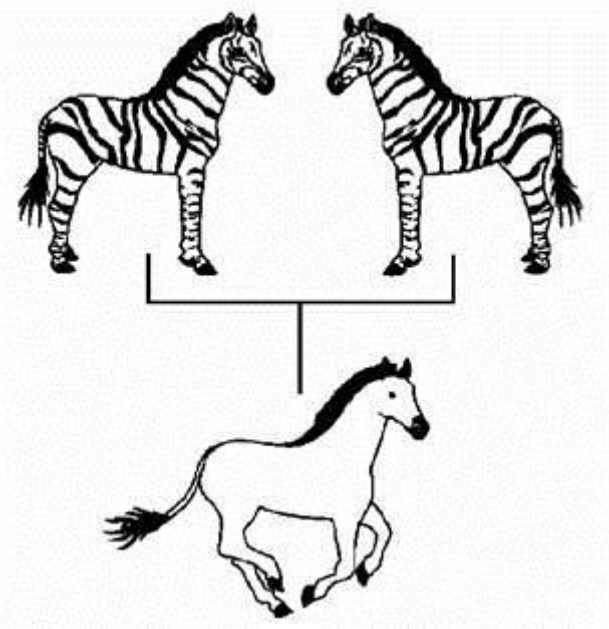
We know about them because their remains formed

_____ which are found in _____ .

**(Total 4 marks)**

## Q9.

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.*

_____

_____

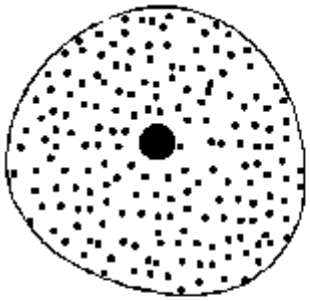
_____

**(2)**

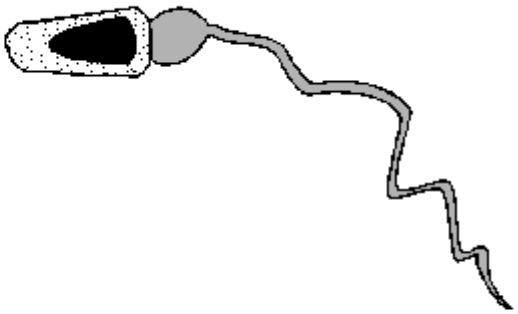
**(Total 5 marks)**

## Q10.

Men and women produce different gametes (sex cells).



Female gamete



Male gamete

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)**

## Q11.

(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 _____

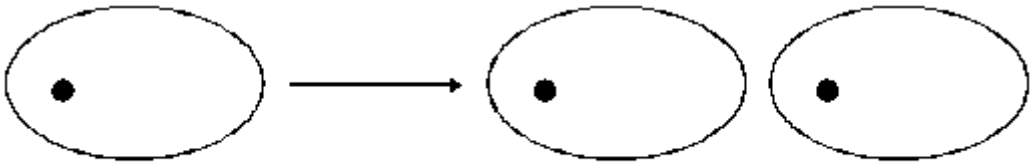
**(1)**

(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**?

_____

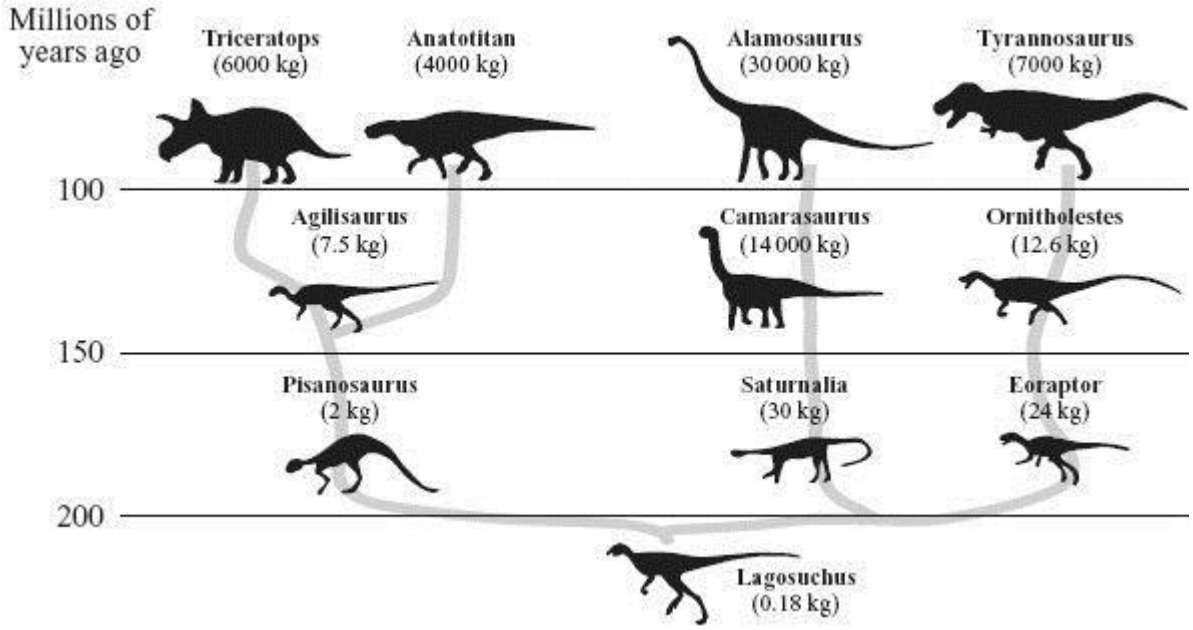
**(1)**

**(Total 5 marks)**

## Q12.

The diagram shows a timeline for the evolution of some dinosaurs.

The mass of each dinosaur is shown in the brackets by its name.




(a) Name **one** dinosaur which lived between 100 and 150 million years ago.

_____

**(1)**

(b) Which dinosaur did Ornitholestes evolve from?

_____

**(1)**

(c) Apart from body size and mass, give **one other** difference between Lagosuchus

and Alamosaurus.

_____

_____

**(1)**

(d) (i) Which dinosaur had the largest mass?

_____

**(1)**

(ii) What happened to the mass of dinosaurs during evolution?

_____

_____

**(1)**

(e) We know about dinosaurs from their fossils.

Describe **one** way in which fossils are formed

_____

_____

**(1)**

(f) Complete the sentence by using the correct words from the box.

| | | | | | |
|---|---|---|---|---|---|
| **billion** | **complex** | **large** | **million** | **simple** | **thousand** |

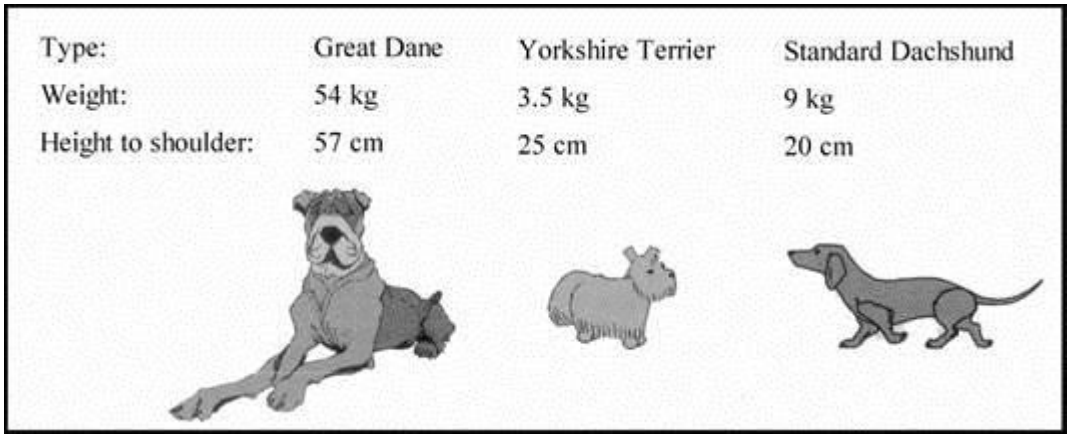
The theory of evolution states that all species of living things have evolved from _____ life forms which first developed more than three _____ years ago.

**(2)**

**(Total 8 marks)**

## Q13.

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



(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)**

## Q14.

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.

_____

_____

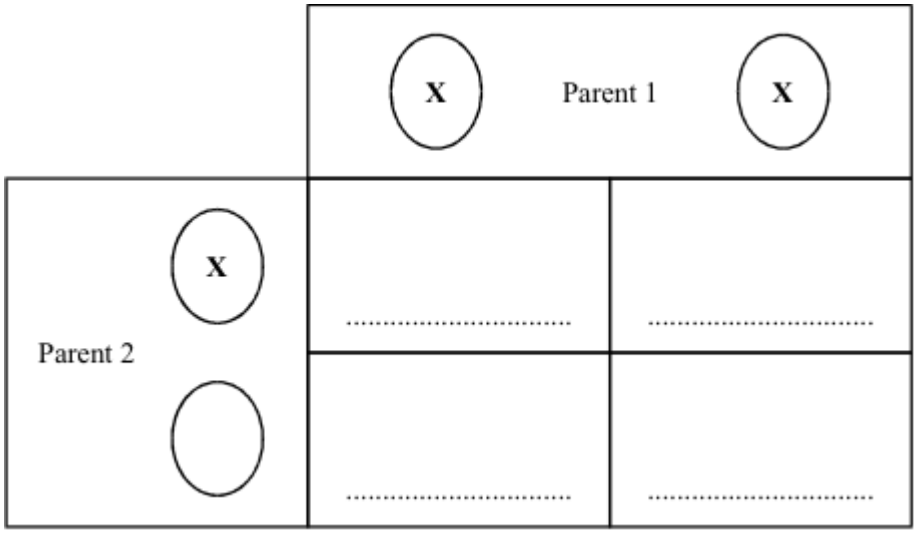
_____

**(2)**

**(Total 5 marks)**

## Q15.

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




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

**(3)**

(b) Which parent is the mother?

_____

**(1)**

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

_____

**(1)**

**(Total 5 marks)**

## Q16.

(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)**

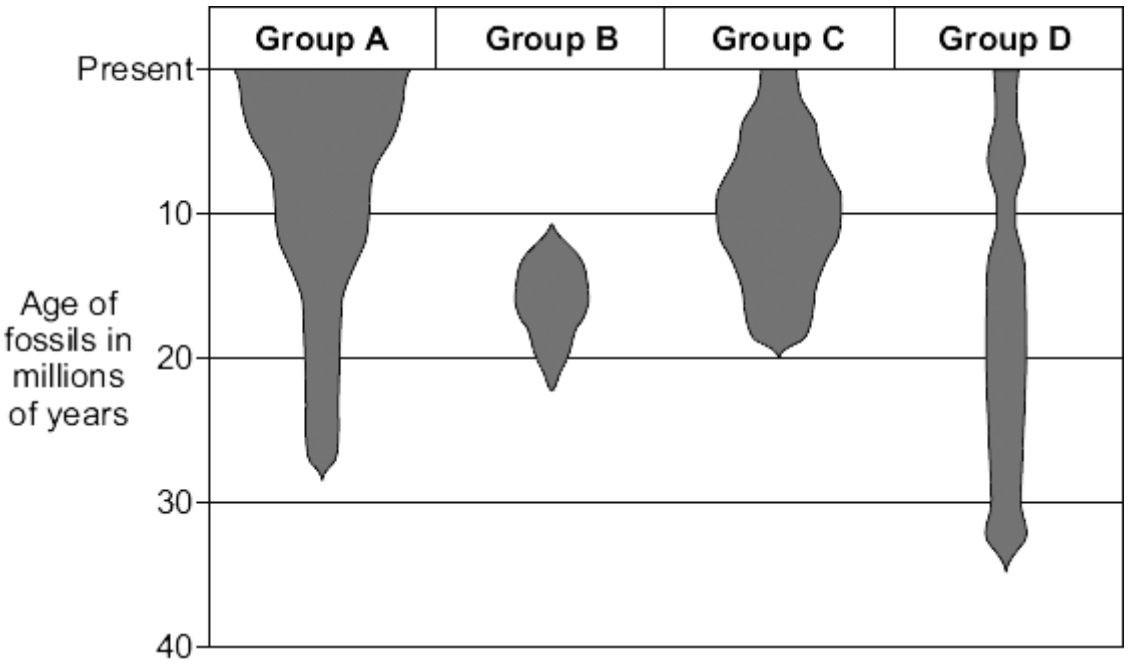
(b) Draw a labelled diagram to show that there is an equal chance of parents producing a baby boy or girl. Use the symbols **X** and **Y** for the chromosomes.

**(4)**

**(Total 6 marks)**

## Q17.

In the Grand Canyon, scientists have found fossils of several different groups of organisms.
The diagram shows the number and age of the fossils that the scientists found.
The width of each shaded area shows the number of fossils found.



(a) What is a fossil?

_____

_____

_____

_____

**(2)**

(b) (i) Which group of organisms, **A**, **B**, **C** or **D**, was the first to evolve?

**(1)**

(ii) Which group of organisms, **A**, **B**, **C** or **D**, is now extinct?

**(1)**

(iii) Give **one** environmental factor that might have caused this group of organisms to become extinct.

_____

_____

**(1)**

(c) Scientists suggested that, 10 million years ago, organisms of **Group C** were more common than organisms from any of the other groups.

What is the evidence for this in the diagram?

_____

_____

**(1)**

(d) The scientists suggested that the four groups of fossilised organisms evolved from a common ancestor.

Which of the following would provide the best evidence that their suggestion is correct?

Tick ( ✓ ) **one** box.

| **Statement** | **Tick (✓)** |
|---|---|
| All the groups lived in the same area. | |
| Fossils from each group were found in the same rock layer. | |

| | |
|---|---|
| Members of the groups have similar physical structures. | |

**(1)**

**(Total 7 marks)**

## Q18.

Animals have adaptations that enable them to survive.

(a) The photograph shows an echidna.

The echidna has pointed spines on its back.

Explain how these spines might help the echidna to survive.

_____

_____

_____

_____

_____

**(2)**

(b) The photograph shows a caterpillar.

© S.J. Krasemann / Peter Arnold / Still Pictures

Explain how the caterpillar's appearance might help it to survive.

_____

_____

_____

_____

_____

**(2)**

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

(i) Evolution can be explained by a theory called

| |
|---|
| genetic engineering |
| mutation |
| natural selection |

.

**(1)**

(ii) This theory was suggested by a scientist called Charles

| |
|---|
| Darwin |
| Lamarck |
| Semmelweiss |

.

**(1)**

(iii) This scientist said that all living things have evolved from

| |
|---|
| monkeys |
| dinosaurs |
| simple life forms |

.

**(1)**

(d) Many religious people oppose the theory of evolution.

Give **one** reason why.

_____

_____

**(1)**

**(Total 8 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

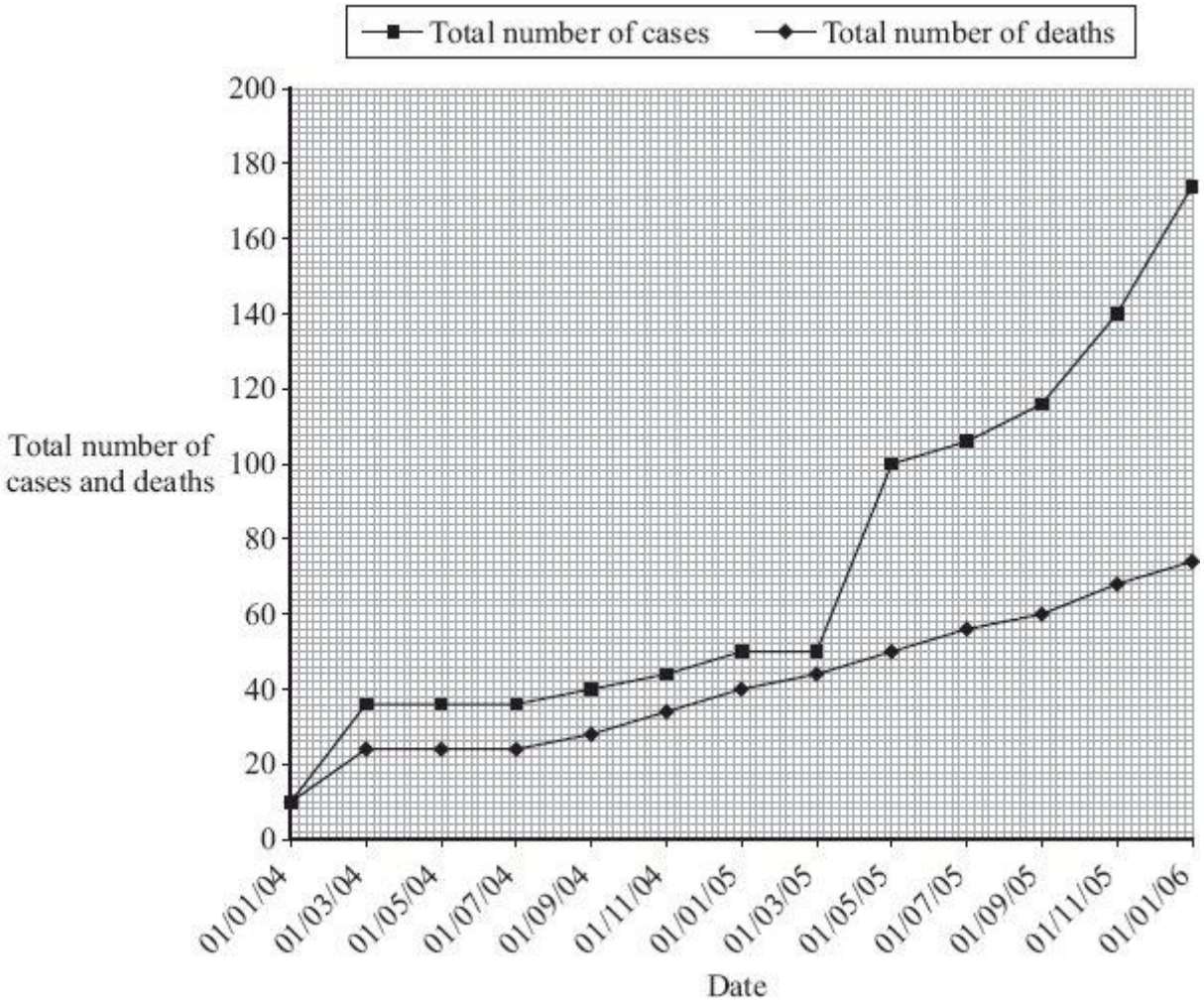
produced because no mixing of genetic material takes place.

**(Total 8 marks)**

## Q20.

Scientists began to keep records of cases of H5N1 bird flu in humans in January 2004.

The graph shows the total number of cases of bird flu in humans and the total number of deaths up to January 2006.




(a) (i) How many people had died from bird flu up to 01/07/05?

_____

**(1)**

(ii) Describe, as fully as you can, how the number of cases of bird flu in humans changed between 01/07/04 and 01/01/06.

_____

_____

_____

_____

**(2)**

(b) At present, humans can only catch bird flu from contact with infected birds. The bird flu virus may mutate into a form that can be passed from one human to another.

Explain why millions of people may die if the bird flu virus mutates in this way.

_____

_____

_____

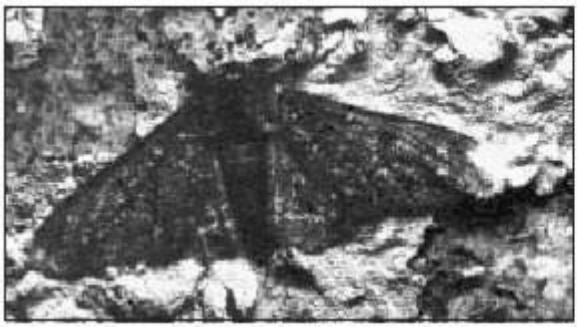
_____

**(2)**

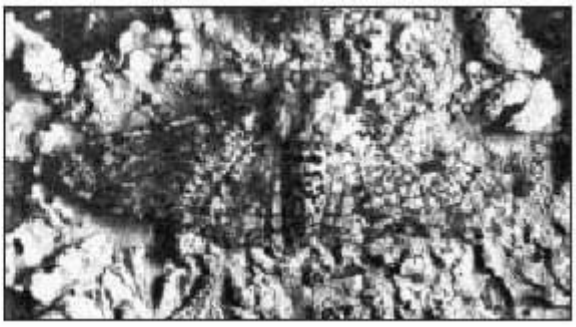
**(Total 5 marks)**

## Q21.

The photographs show two varieties of moths, **X**and **Y**. The moths belong to the same species.
The moths are resting on a tree trunk in open countryside.



Moth **X**



Moth **Y**

(a) Which variety of moth, **X** or **Y**, is more likely to be killed by insect-eating birds? Give a reason for your answer.

Variety of moth: _____

Reason _____

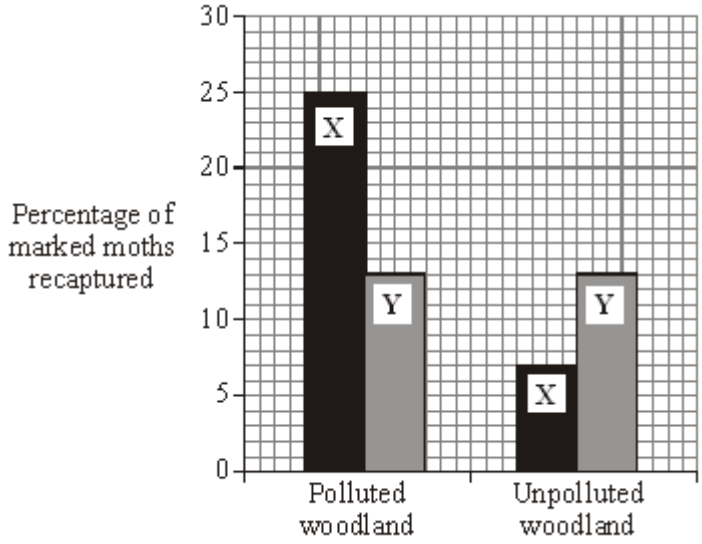
_____

**(1)**

(b) In an experiment, large numbers of each variety of moth were caught in a trap.

- They were marked with a spot of paint on the underside of one wing and then released.
- A few days later, moths were again trapped and the number of marked moths was counted.
- The experiment was carried out in a woodland polluted by smoke and soot, and also in an unpolluted woodland.

The results are shown in the bar graph.




(i) When the moths were being marked, suggest why the paint was put on the underside of the wing and not on the top.

_____

**(1)**

(ii) What percentage of moths of type **X** was recaptured in:

the polluted woodland; _____

the unpolluted woodland? _____

**(2)**

(iii) In each woodland, only a small number of marked moths of both varieties were recaptured. Suggest **one** reason for this.

_____

_____

**(1)**

(c) (i) The colour of the moths is controlled by a gene. The dark form was first produced by a mutation in the gene.

What chemical, found in a gene, is changed by a mutation? Draw a ring around your answer.

**carbohydrate** **DNA** **fat** **protein**

**(1)**

(ii) Some of the offspring from the original dark moth were also dark. What caused this?

_____

_____

**(1)**

**(Total 7 marks)**

## Q22.

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

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

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

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

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

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

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

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

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

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

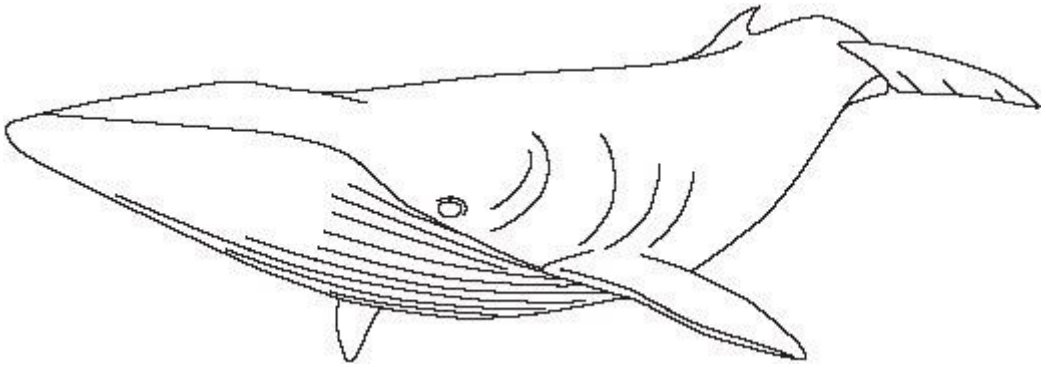
_____ allele.

**(Total 6 marks)**

## Q23.

(a) **Figure 1** shows a minke whale. Whales live in the sea.

**Figure 1**



Write down **two** ways in which the body of the whale is adapted for swimming.

1. _____

_____

2. _____

_____

**(2)**

(b) **Figure 2** shows the skeleton of a minke whale.

**Figure 2**

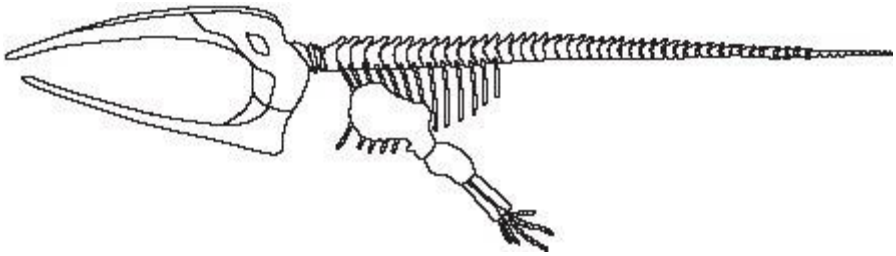
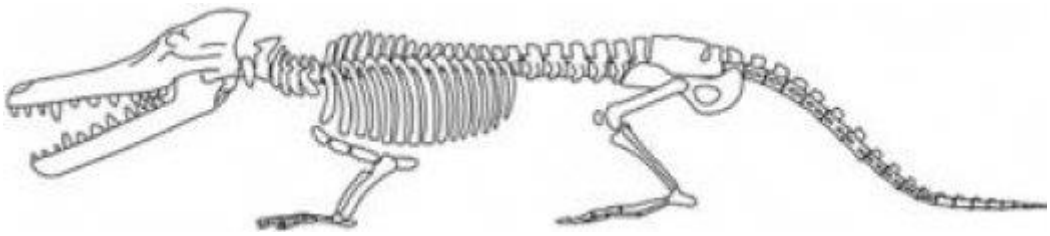


**Figure 3** shows the fossil skeleton of an extinct whale.

**Figure 3**



*Hans G Thewissen/ The Thewissen Lab*

(i) Apart from size, give **two** differences between the skeleton of the minke whale and the fossil skeleton of the extinct whale.

1. _____

_____

2. _____

_____

**(2)**

(ii) In each of the sentences below, draw a ring around the correct answer.

Life on Earth first developed more than three | billion / million / thousand | years ago.

Fossils | disprove / give evidence for / prove | the theory of evolution.

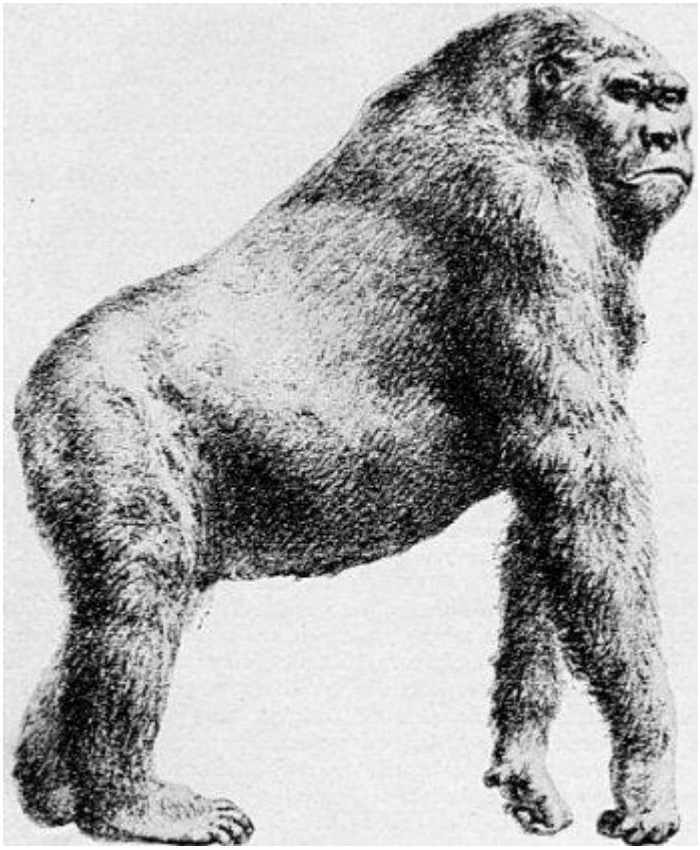
**(2)**

**(Total 6 marks)**

## Q24.

Read the article from a recent newspaper.

**‘King Kong’ with inch-wide teeth who walked alongside early man.**



*Gigantopithecus blackii, R F Zallinger*

The largest ape that walked on Earth was a prehistoric animal that weighed up to 540 kg. It was 3 metres tall and had inch-wide teeth. This giant ape roamed bamboo forests until 100 000 years ago. It is quite likely that the giant ape lived at the same time as early humans.

(a) What evidence might scientists have that the great ape existed?

_____

_____

**(1)**

(b) The drawing is an artist’s impression of what the giant ape might have looked like.

Why do scientists not know exactly what the animal looked like?

_____

_____

**(1)**

(c) Scientists do not know why this giant ape became extinct.

Suggest **two** reasons why this giant ape became extinct.

1. _____

_____

2. _____

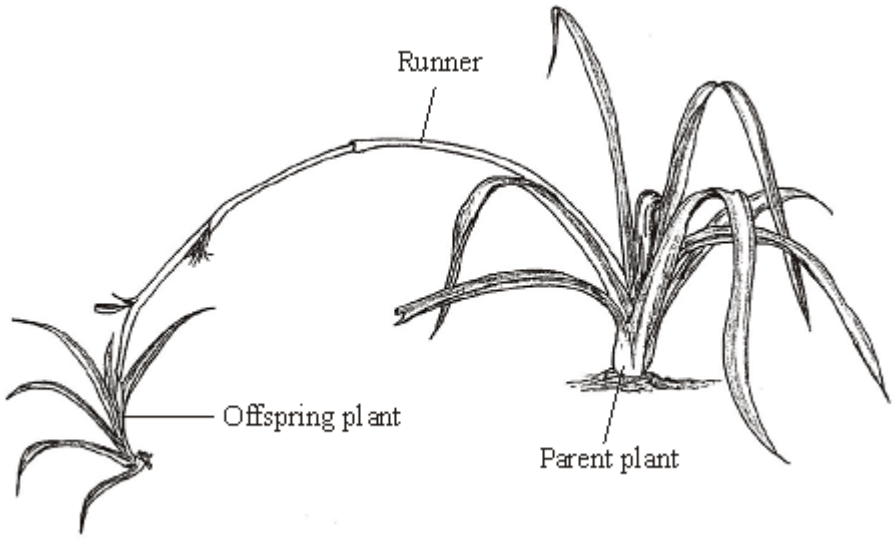
_____

**(2)**

**(Total 4 marks)**

## Q25.

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)**

## Q26.

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** |

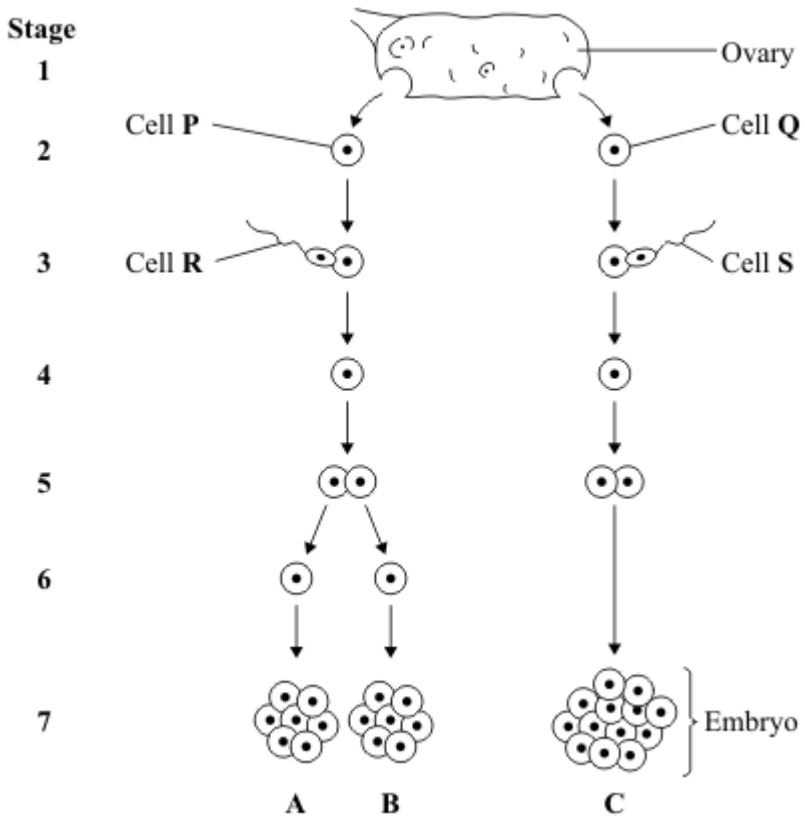
**(3)**

**(Total 4 marks)**

## Q27.

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)**

## Q28.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

| **clones** | **chromosomes** | **embryos** | **genes** |
|---|---|---|---|

GM crops are produced by cutting _____ out of the

_____ of one plant and inserting them into the cells of a crop plant.

**(2)**

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for GM crops can be bought from only one manufacturer.

- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. _____

_____

2. _____

_____

**(2)**

(ii) Give **two** reasons why many people are against the growing of GM crops.

1. _____

_____

2. _____

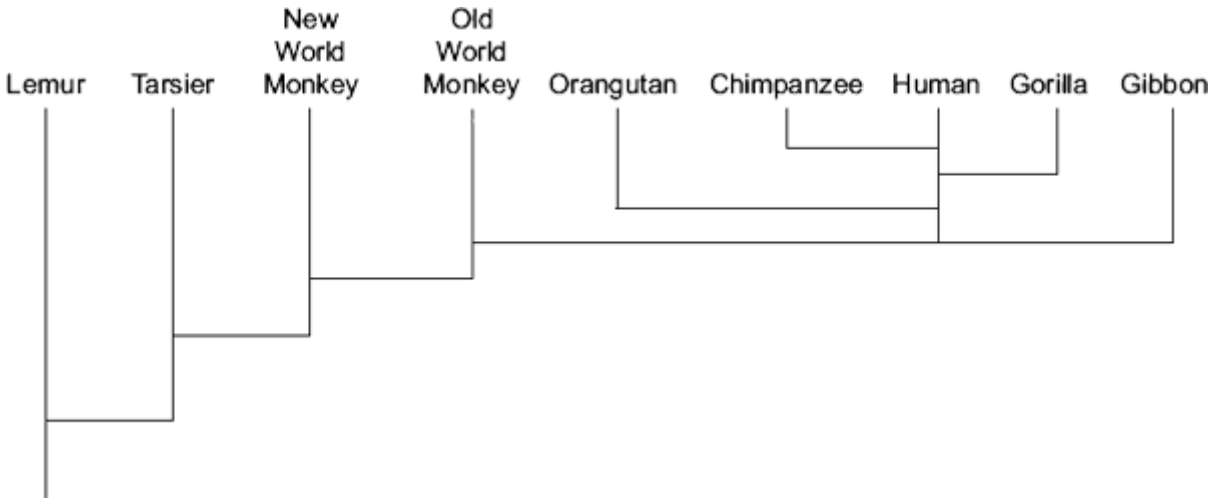
_____

**(2)**

**(Total 6 marks)**

## Q29.

The diagram shows the evolution of a group called the primates.




(a) Which primate evolved first?

_____

**(1)**

(b) Name **two** primates that developed most recently from the same common ancestor as humans.

1. _____

2. _____

**(2)**

(c) (i) The theory of evolution by natural selection was suggested in the 1800s.

Which scientist suggested this theory?

_____

**(1)**

(ii) Use words from the box to complete the passage about natural selection.

| | | |
|---|---|---|
| **evolution** | **environment** | **generation** |
| **mutate** | **survive** | **variation** |

Individual organisms of a species may show a wide range of

_____ because of differences in their genes.

Individuals with characteristics most suited to the _____

are more likely to _____ and breed successfully.

The genes that have helped these individuals to survive are then passed on to

the next _____

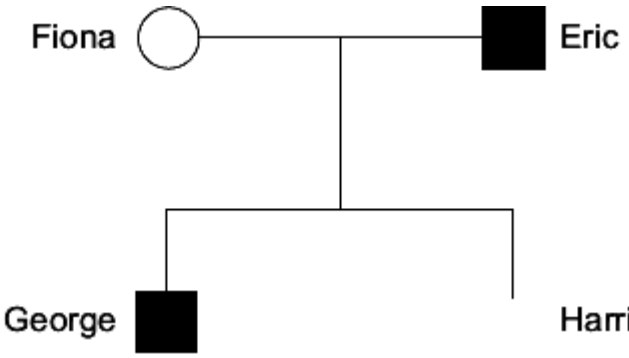
**(4)**

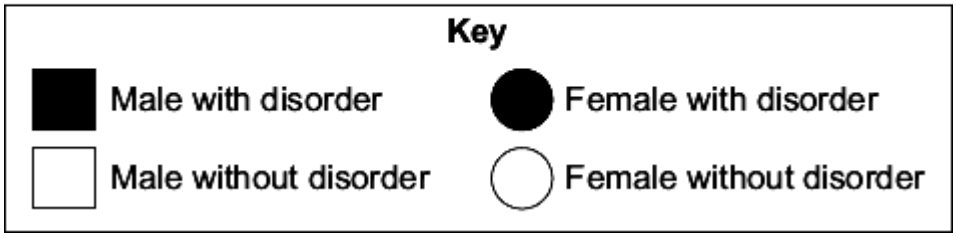
**(Total 8 marks)**

## Q30.

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)**

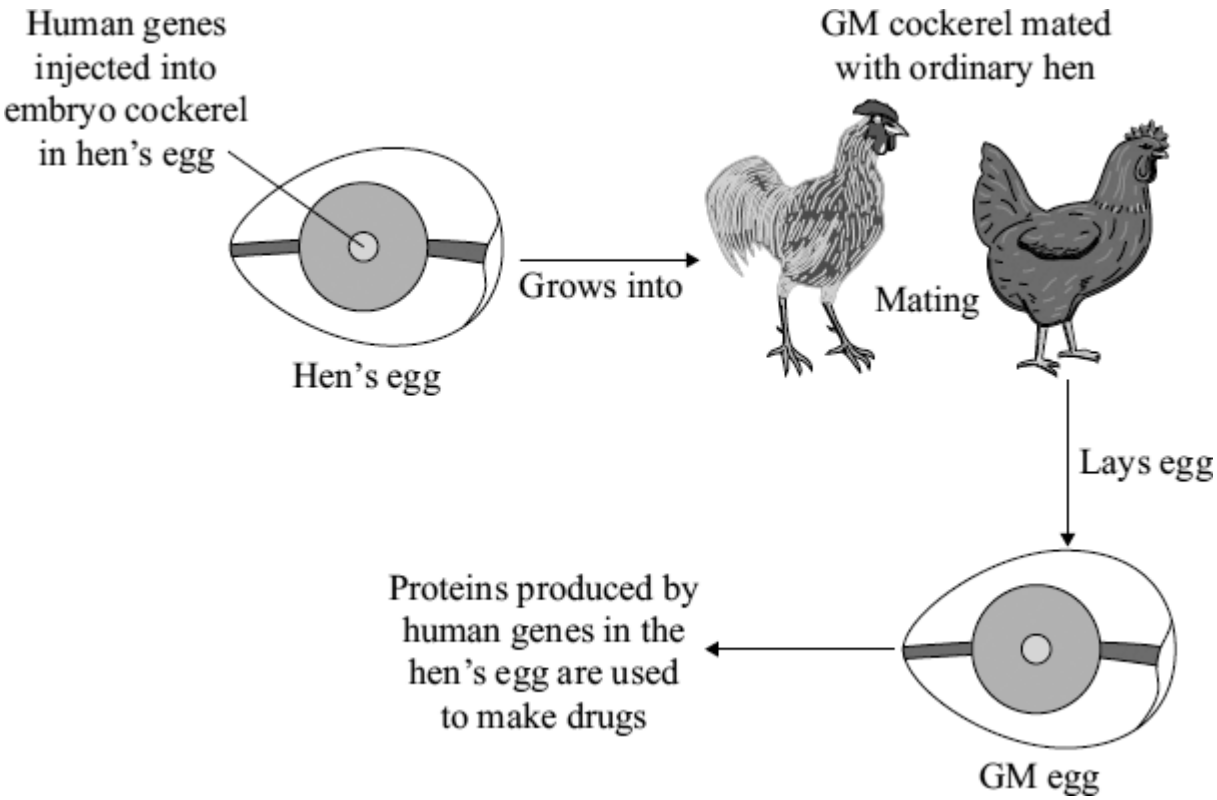
**(Total 7 marks)**

## Q31.

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)**

## Q32.

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.

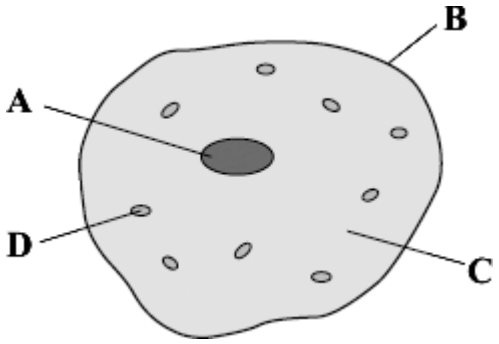
**(1)**

(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)**

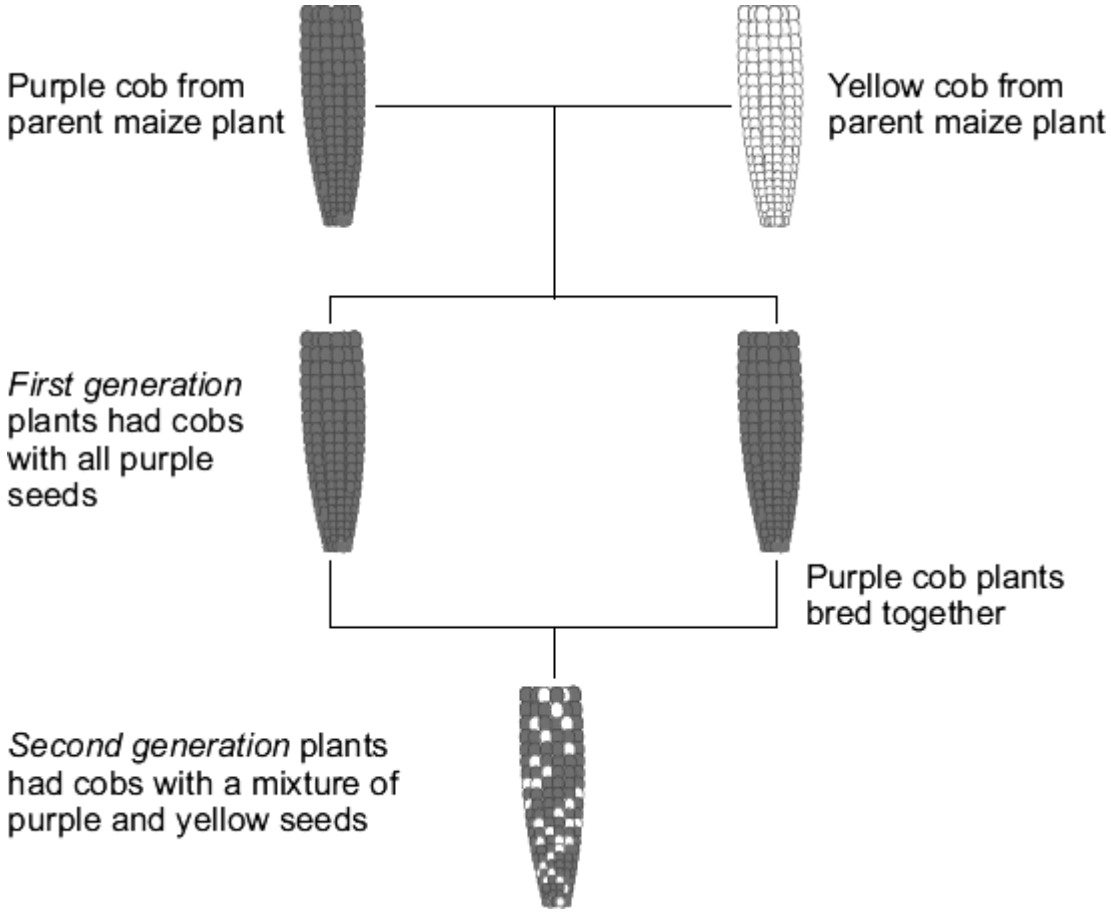
**(Total 8 marks)**

## Q33.

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)**

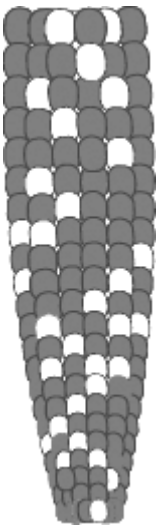
(ii) What alleles does a purple seed from a *first* generation plant have?

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)**

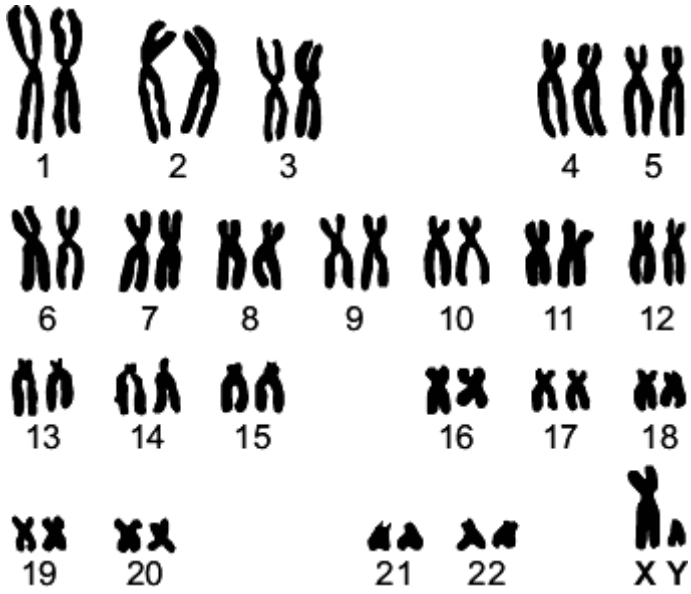
**(Total 5 marks)**

## Q34.

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)**

## Q35.

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 _____

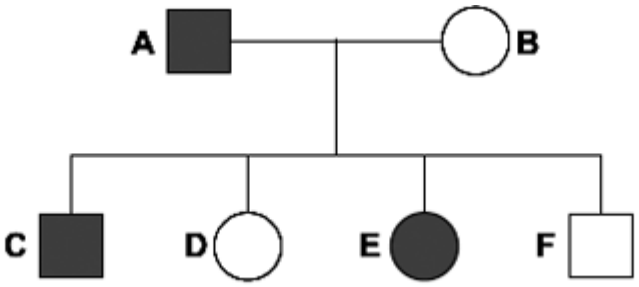
**(1)**

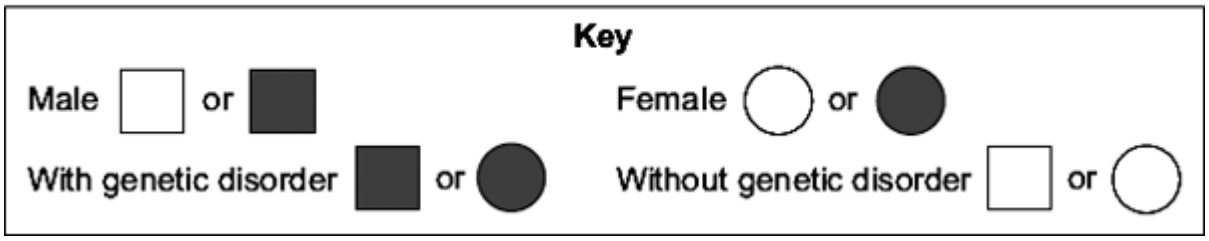
**(Total 3 marks)**

## Q36.

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.

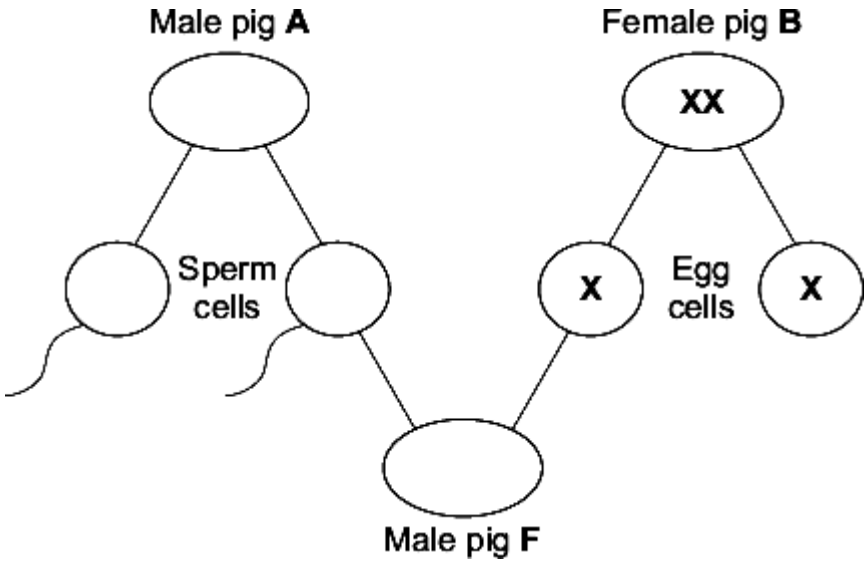
a gamete.

**(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)**

## Q37.

(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)**

## Q38.

The diagram shows a strawberry plant.

The parent plant grows side shoots.

New plants grow on the side shoots.


© D.G. Mackean

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

Complete the sentences to explain why.

Use words from the box.

| | | | |
|---|---|---|---|
| **asexual** | **differentiation** | **embryos** | **fertilisation** |
| **gametes** | **genes** | **mitosis** | **sexual** |

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

**(1)**

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

**(1)**

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

**(1)**

**(Total 3 marks)**

## Q39.

Insecticides are chemicals which kill insects.
Insecticides may be sprayed onto crops to increase crop yield.

(a) Killing insects on crops increases crop yield.

Suggest why.

_____

_____

**(1)**

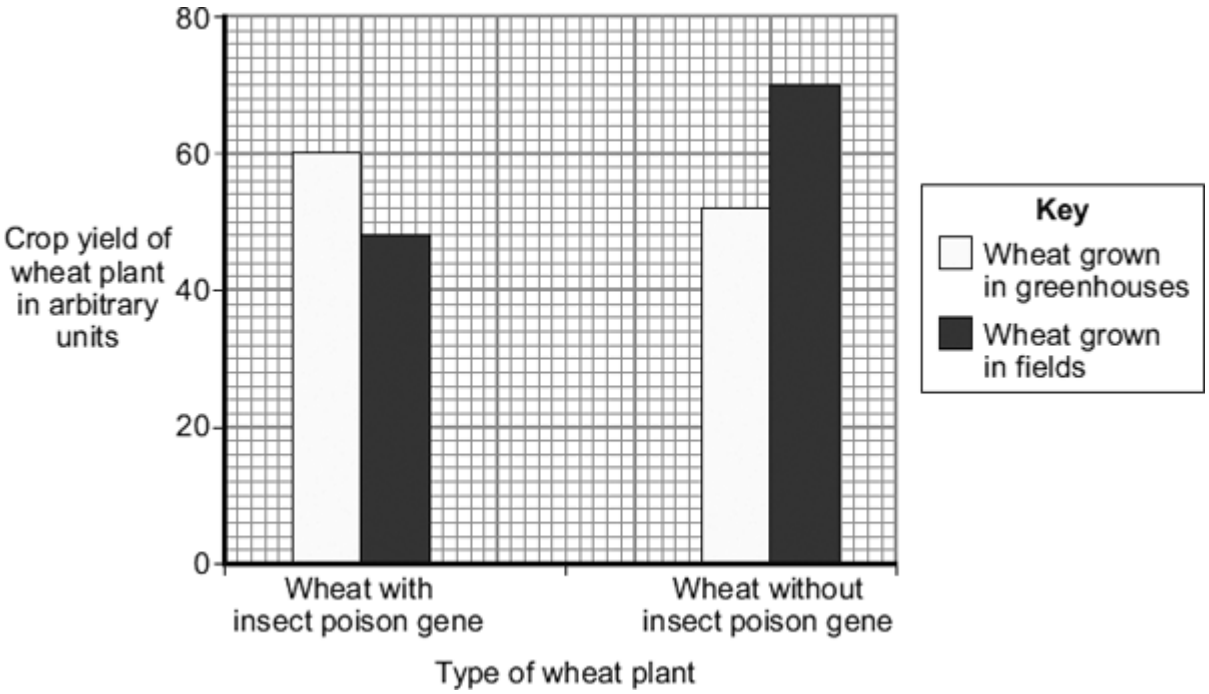
(b) A microorganism contains a gene which causes the production of an insect poison.

Scientists transferred the gene for production of the insect poison into wheat plants. This makes genetically modified (GM) wheat.

The scientists:

- grew wheat plants with the insect poison gene in fields and in greenhouses
- grew wheat plants without the insect poison gene in fields and in greenhouses
- measured the crop yield of the wheat plants.

The bar chart shows the results.




(i) What was the yield of the wheat with the insect poison gene grown in greenhouses?

_____ arbitrary units

**(1)**

(ii) The yield from wheat without the insect poison gene grown in greenhouses was different from the yield you gave in (b)(i).

Describe this difference in yield.

_____

_____

_____

_____

**(2)**

(iii) Look again at the bar chart.

What advice would you give to a farmer about the type of wheat to grow in fields?

Give a reason for your answer.

_____

_____

_____

_____

**(2)**

(c) Some people are concerned about the use of GM crops.

Why?

_____

_____

_____

_____

_____

**(2)**

**(Total 8 marks)**

## Q40.

Cystic fibrosis is an inherited disorder.

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

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

(i) The allele for cystic fibrosis is a

carrier allele.

dominant allele.

recessive allele.

**(1)**

(ii) Mr and Mrs Brown are both

carriers.

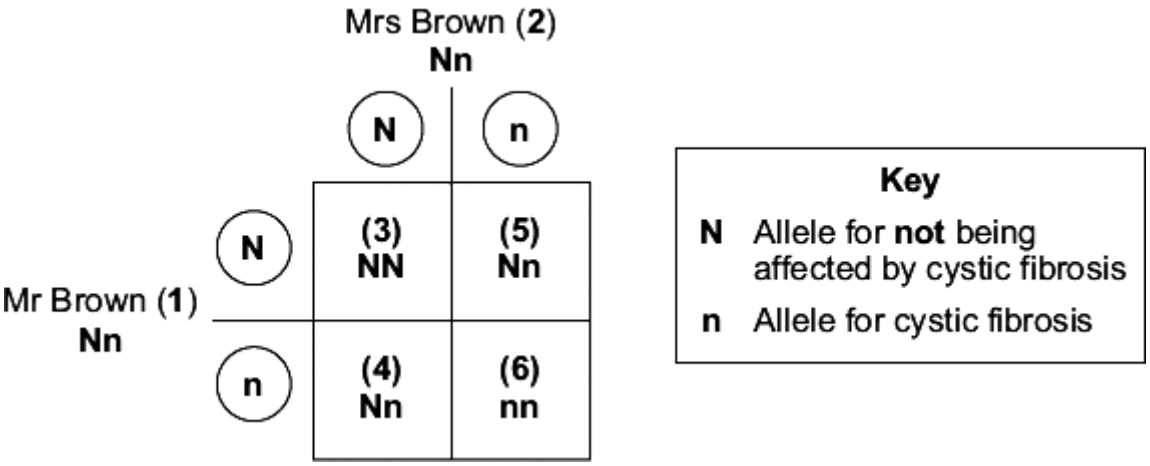
immune.

infected.

**(1)**

(b) The diagram shows how the allele for cystic fibrosis can be inherited by Mr and Mrs

Brown's children.




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

**(1)**

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

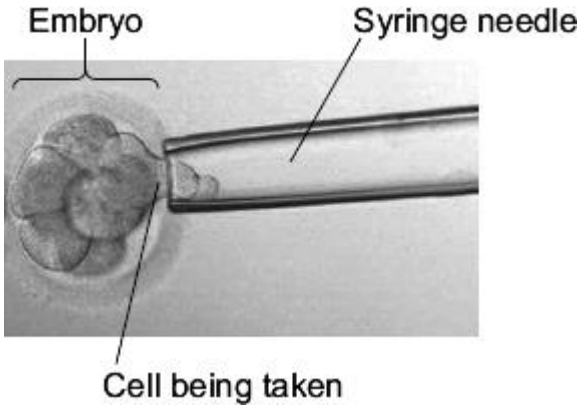
_____

**(1)**

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

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

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




©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)**

## Q41.

Living things can be classified into groups.

(a) Scientists look at structures inside cells to classify living things.

Suggest **one** structure found in cells that can be used to classify living things.

_____

**(1)**

(b) The table below shows one system for classifying humans.

| | |
|---|---|
| **X** | Animalia |
| **Phylum** | Chordata |
| **Class** | Mammalia |
| **Order** | Primates |
| **Family** | Hominidae |
| **Genus** | *Homo* |
| **Species** | *Sapiens* |

Who devised this system of classification?

Tick **one** box.

Darwin ☐

Linnaeus ☐

Wallace ☐

Woese ☐

**(1)**

(c) Look at the table above.

**X** is the largest category in this classification.

Name category **X**.

_____

**(1)**

(d) Give the **binomial name** of humans.

Use information in the table above.

_____

**(1)**

(e) Suggest **one** way that classification systems are useful to scientists.

_____

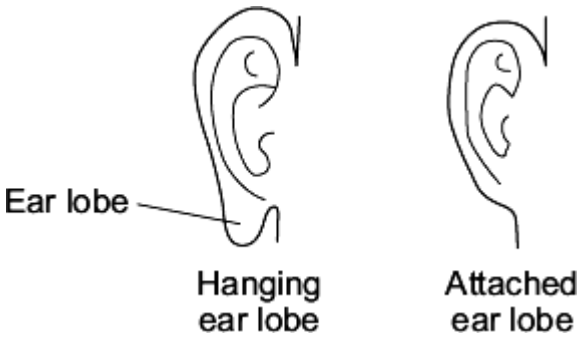
**(1)**

**(Total 5 marks)**

## Q42.

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

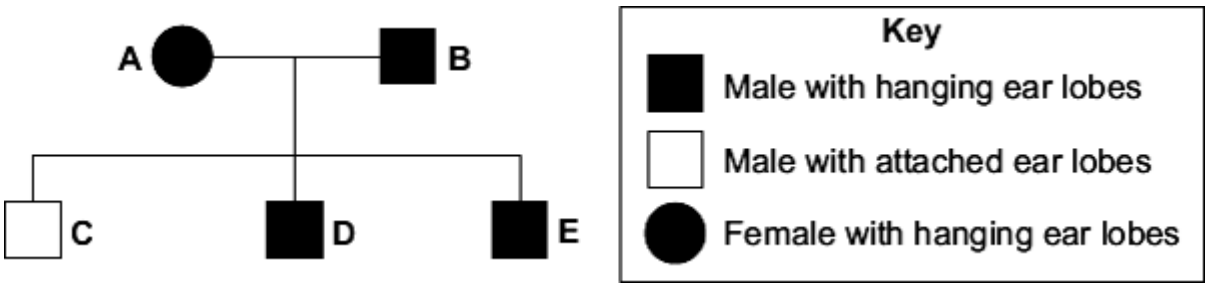
The diagrams show the two shapes of ear lobe.




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)**

## Q43.

(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 | Only in |
|---|---|---|

| | mitosis (✓) | 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)**

## Q44.

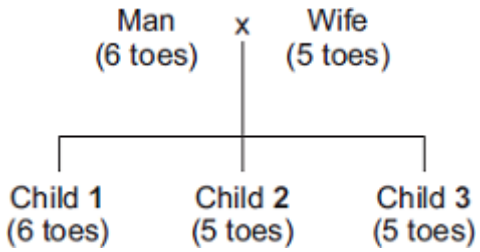
Polydactyly is an inherited condition. Polydactyly is controlled by a dominant allele.

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)**

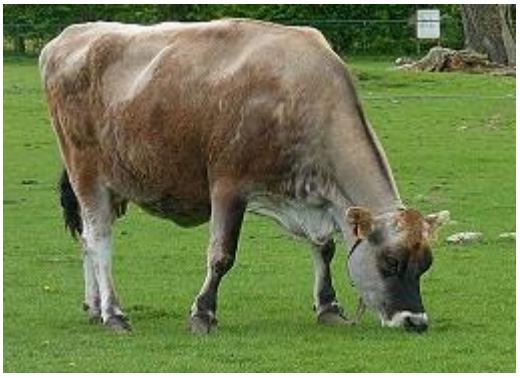
## Q45.

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.

| |
|---|
| clones. |

(i) The information for characteristics is carried by

| |
|---|
| 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)**

## Q46.

Evolution is the development of new species over time.
Evidence for evolution comes from *fossils*.

(a) (i) What is a *fossil*?

_____

_____

_____

_____

**(2)**

(ii) How can fossils give evidence for evolution?

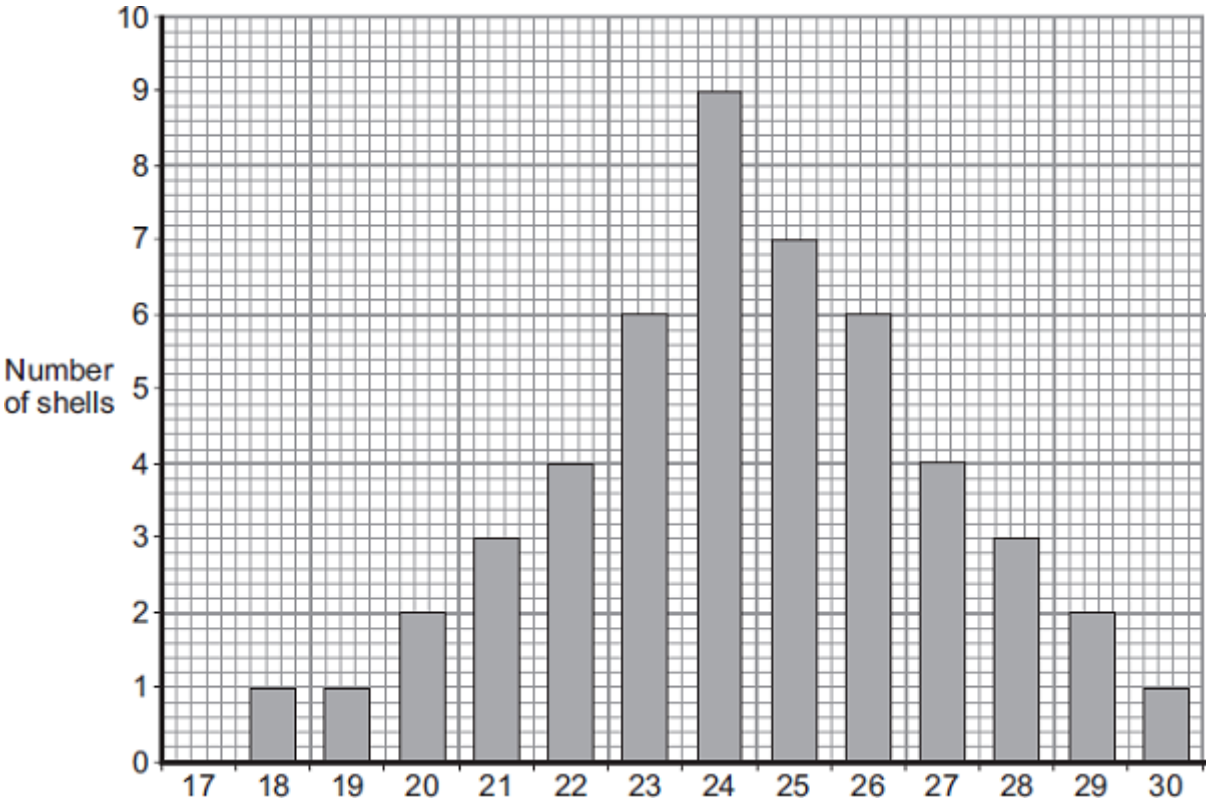
_____

_____

**(1)**

(b) A species of snail lived 400 million years ago.
Scientists measured the width of 49 fossil shells of this snail.

The bar chart shows the scientists' results.




(i) What is the range of the values for the width of the fossil shells for this species?

From _____ to _____

**(1)**

(ii) The scientists **cannot** be sure that this is the full range of fossil shell widths for this species.

Why?

_____

_____

**(1)**

(c) This species of snail became extinct 380 million years ago.

Give **one** possible reason why species become extinct.

_____

_____

**(1)**

**(Total 6 marks)**

## Q47.

Humans reproduce sexually.

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

(i) At fertilisation | chromosomes / 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)**

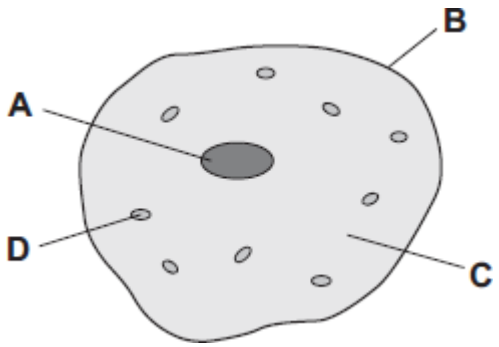
(ii) How many copies of the cystic fibrosis allele does the child have?

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)**

## Q48.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

| **clones** | **chromosomes** | **embryos** | **genes** |
|---|---|---|---|

GM crops are produced by cutting _____ out of the

_____ of one plant and inserting them into the cells of a crop plant.

**(2)**

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. _____

_____

2. _____

_____

**(2)**

(ii) Give **two** reasons why many people are against the growing of GM crops.

1. _____

_____

2. _____

_____

**(2)**

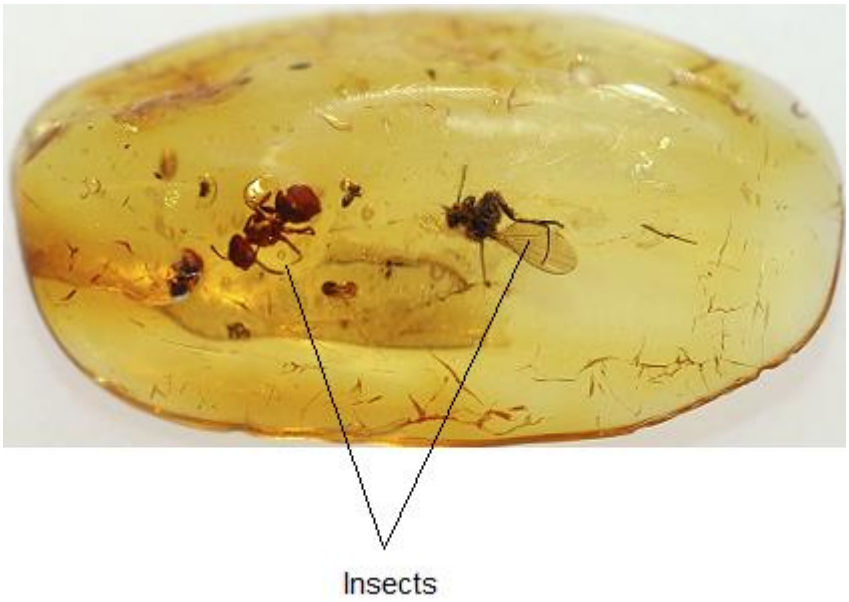
**(Total 6 marks)**

## Q49.

Fossils give us information about organisms from a long time ago.

(a) Amber is a solid, glass-like material. Amber is formed from a thick, sticky liquid which oozes out of pine trees.

The image shows two fossil insects in amber.




© fkienas/iStock/Thinkstock

(i) Suggest how the insects came to be preserved in the amber.

_____

_____

_____

_____

**(2)**

(ii) Give **two** other ways fossils are formed.

1. _____

_____

2. _____

_____

**(2)**

(b) The fossil record shows that many organisms, including the dinosaurs, became

extinct 65 million years ago.

One theory was that volcanic activity might have caused this mass extinction. Many scientists believe that this extinction was caused when an asteroid collided with the Earth.

(i) A new scientific theory may replace an old theory.

Why might this happen?

Tick (✓) **one** box.

| | |
|---|---|
| Evidence from amber is unreliable. | ☐ |
| Internet evidence is more reliable than fossil evidence. | ☐ |
| New technology provides more valid evidence. | ☐ |

**(1)**

(ii) Give **three** reasons, other than volcanic activity and collision with an asteroid, why a species may become extinct.

1. _____

_____

2. _____

_____

3. _____

_____

**(3)**

**(Total 8 marks)**

## Q50.

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)**

X and X.

(b) The sex chromosomes in the human male are

- 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)**

## Q51.

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

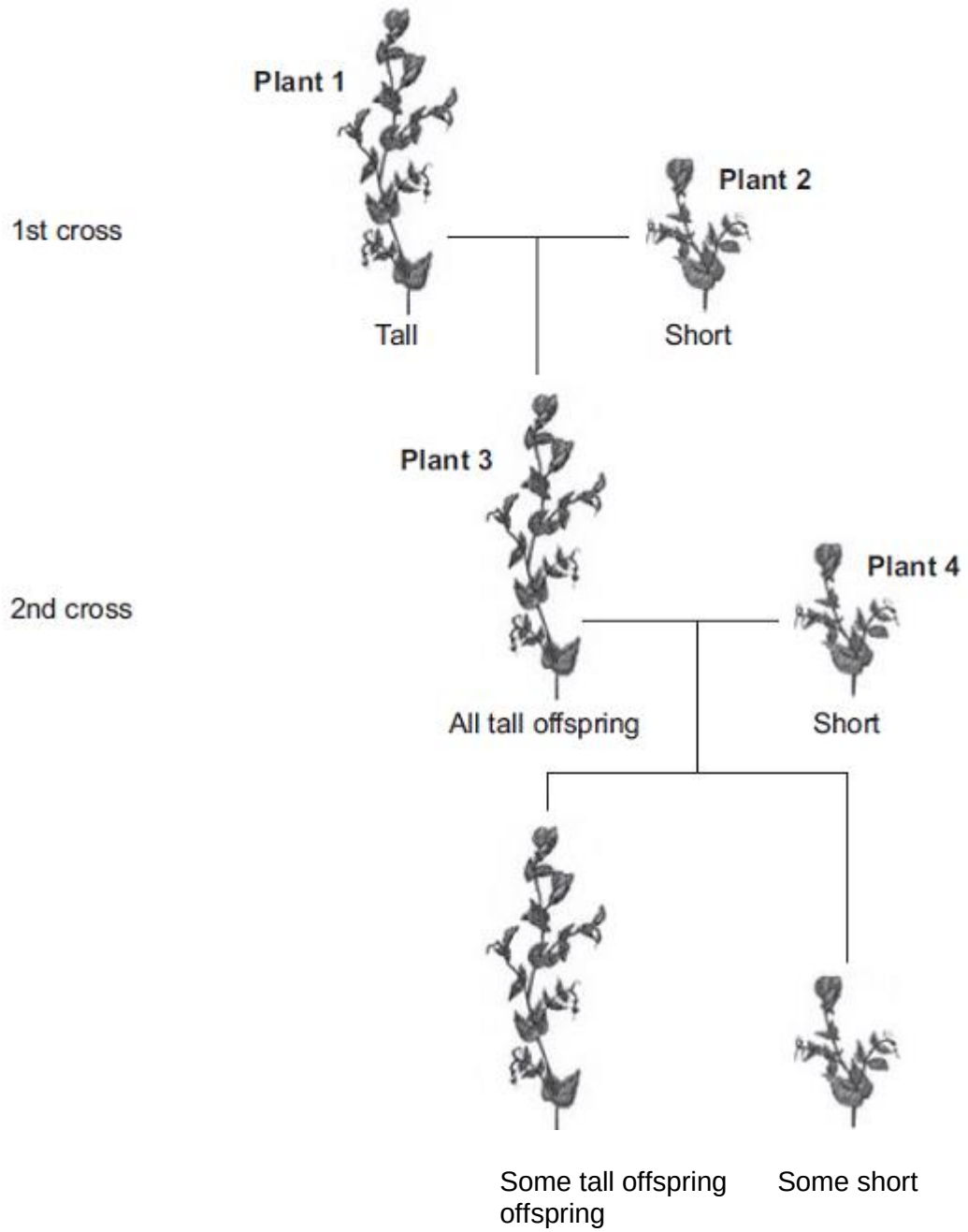
- Darwin.
- Lamarck.
- Mendel.

**(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**




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

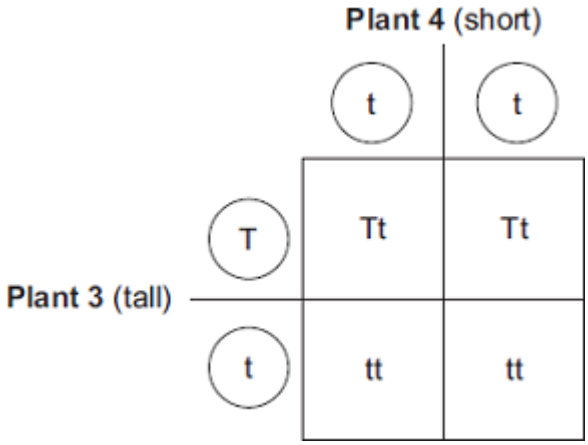
| |
|---|
| a dominant allele. |
| the environment. |

| |
|---|
| 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)**

## Q52.

The photograph shows a fossil footprint. The fossil was found in a rock at the bottom of a shallow river.

Scientists believe this is the footprint of a dinosaur. The dinosaur was alive 110 million years ago.

© Pearl Jackson/iStock

(a) (i) Suggest how the fossil shown in the photograph was formed.

_____

_____

**(1)**

(ii) Fossils may also be formed by other methods.

Describe **one** other method of forming a fossil.

_____

_____

**(1)**

(b) Dinosaurs are now extinct.

Give **two** factors that can cause extinction.

1. _____

_____

2. _____

_____

**(2)**

(c) How can fossils give evidence for evolution?

_____

_____

**(1)**

(d) Scientists are uncertain about how life began on Earth.

Why?

_____

_____

**(1)**

**(Total 6 marks)**

**Q53.**

(a) Complete the sentences about evolution.

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

(i) Darwin suggested the theory of evolution by

| |
|---|
| artificial |
| natural |
| asexual |

selection.

**(1)**

(ii) Darwin's theory of evolution says that all species of living things have evolved from

| |
|---|
| artificial |
| complex |
| simple |

life forms.

**(1)**

(iii) Most scientists believe that life first developed about

| |
|---|
| three billion |
| three million |
| three thousand |

years ago.

**(1)**

(b) Darwin's theory of evolution was only slowly accepted by other people.

Give **two** reasons why.

1 _____

_____

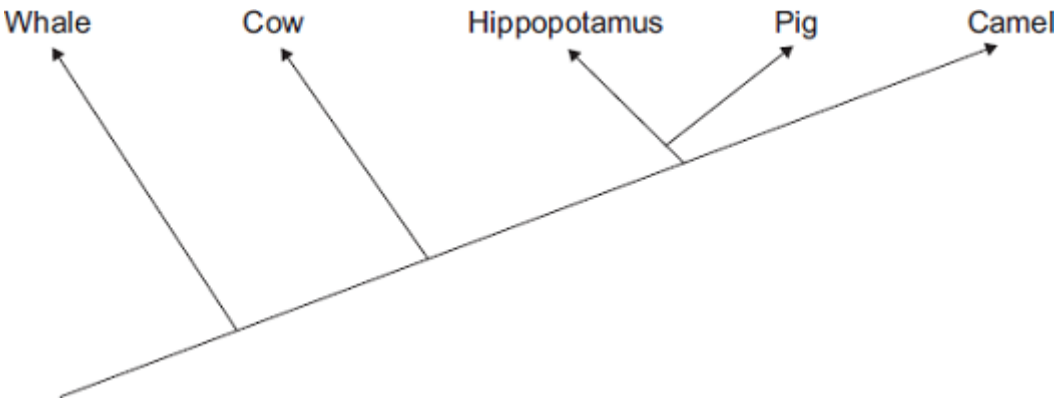
2 _____

_____

**(2)**

(c) **Diagram 1** shows one model of the relationship between some animals.

**Diagram 1**



(i) Complete the sentence.

The model shown in **Diagram 1** is an evolutionary _____ .

**(1)**

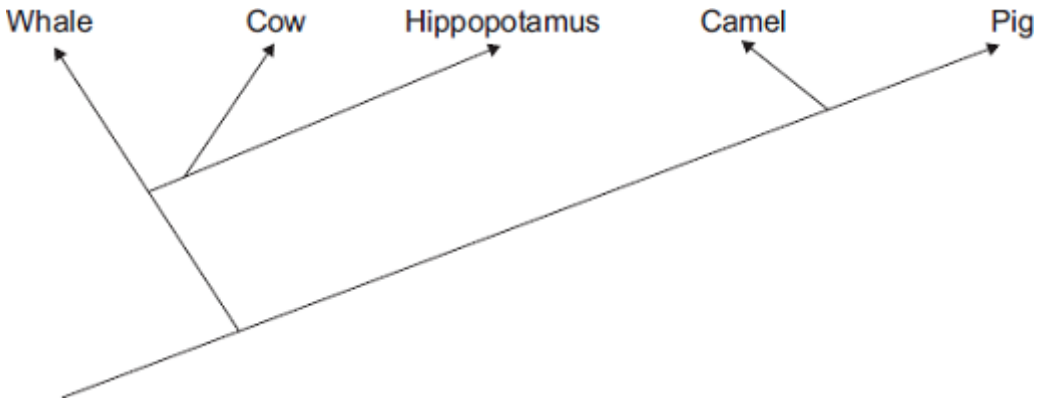
(ii) Which **two** of the animals in **Diagram 1** are most closely related?

_____ and _____

**(1)**

(iii) Diagram **2** shows a more recent model of the relationship between the animals.

**Diagram 2**




Suggest **one** reason why scientists have changed the model of the relationships between the animals shown in the diagram.

Draw a ring around the correct answer.

| | | |
|---|---|---|
| **more powerful computers** | **new evidence from fossils** | **new species discovered** |

**(1)**

**(Total 8 marks)**

## Q54.

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.

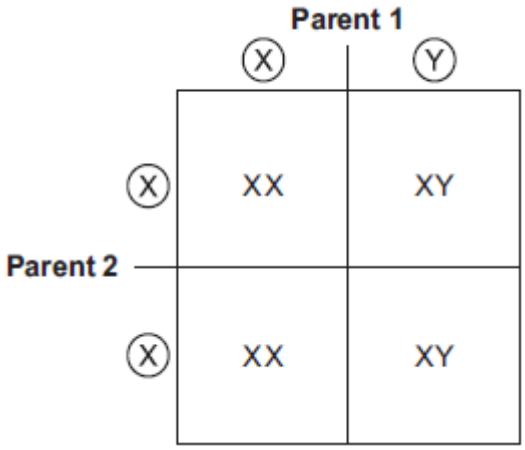
Draw a ring around the correct answer to complete the sentence.

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)**

## Q55.

**Figure 1** shows a fossil of a sea animal called a Plesiosaur.
The Plesiosaur was alive about 135 million years ago.

**Figure 1**

By Andy Dingley (Own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

(a) How can fossils give evidence for evolution?

Tick (✓) **one** box.

Newer fossils are simpler than older fossils. ☐

Fossils show change over time. ☐

All fossils show the bones of animals. ☐

**(1)**

(b) Plesiosaurs lived in the sea. There was mud at the bottom of the sea.

Suggest how the fossil shown in **Figure 1** may have been formed after the animal died.

_____

_____

_____

_____

_____

_____

**(3)**

(c) **Figure 2** shows what scientists think a living Plesiosaur may have looked like.

**Figure 2**

© Andreas Meyer/Hemera/Thinkstock

Scientists think that the Plesiosaur had smooth skin, with no scales.

The scientists **cannot** be certain what the skin of a Plesiosaur was like.
Suggest why.

_____

_____

**(1)**

(d) Plesiosaurs are now extinct.

Give **two** possible reasons why.

1. _____

_____

2. _____

_____

**(2)**

**(Total 7 marks)**

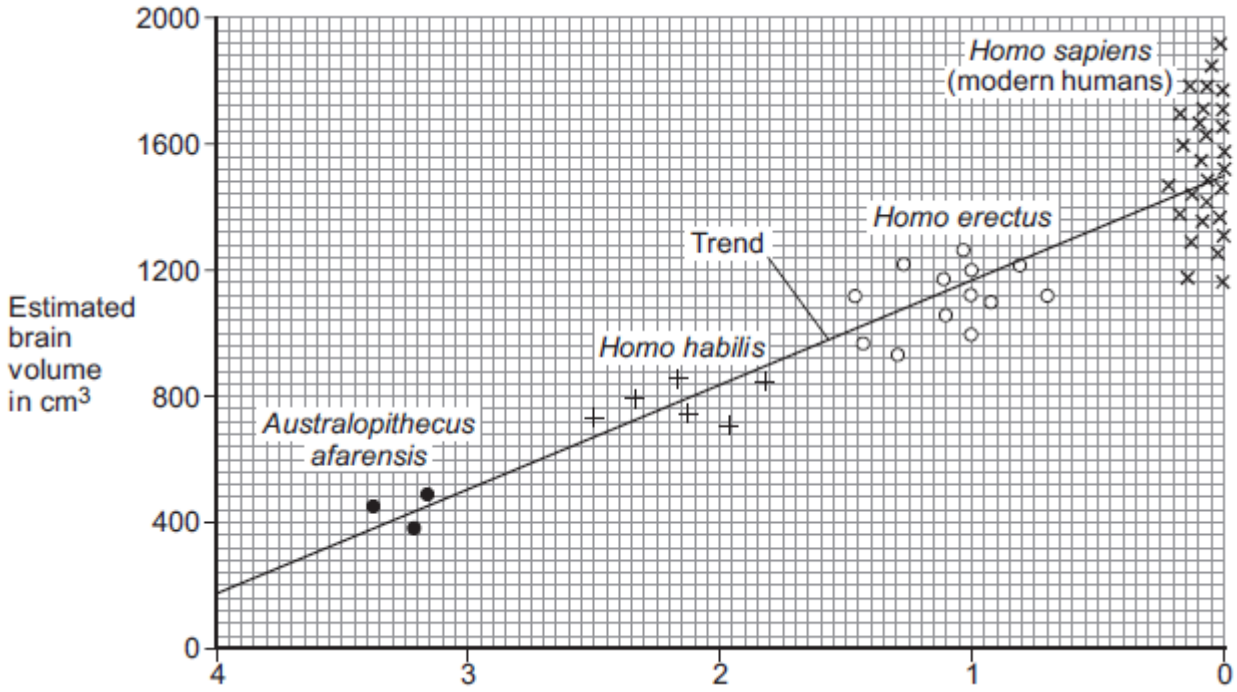
## Q56.

This question is about evolution in humans.

The graph shows:

- the estimated brain volume of different species of humans
- the time when the different species existed on Earth.

The data is plotted for modern humans (Homo sapiens) and for three types of extinct ancestors of humans.




**Key**
Each point plotted on the graph shows the estimate for one human.

(a) (i) As humans evolved, their brain volume changed.

What has happened to human brain volume over the past 4 million years?

_____

_____

**(1)**

(ii) Why is the evidence for estimated brain volume for *Homo sapiens* stronger than the evidence for *Australopithecus afarensis*?

_____

_____

**(1)**

(b) In a book, the brain volume of a different species, *Australopithecus africanus*, is stated to be about 600 $cm^3$.

Use evidence from the graphic above to estimate when *Australopithecus africanus* lived on Earth.

Estimate = _____ million years ago

**(1)**

(c) Scientists believe that modern humans evolved by natural selection from *Australopithecus afarensis.*

(i) Complete the following sentence.

In the nineteenth century, the scientist who suggested the theory of evolution by natural selection was Charles _____ .

**(1)**

(ii) In the nineteenth century, many people did not accept this scientist's theory.

Give **one** reason why.

_____

_____

**(1)**

**(Total 5 marks)**

## Q57.

Sexual reproduction in humans involves the joining together of an egg cell and a sperm cell.

The sex of an embryo is decided by the chromosomes they inherit from their mother and father.

(a) Where in the cell are the chromosomes?

Tick **one** box.

Cell membrane ☐

Cytoplasm ☐

Nucleus ☐

Ribosomes ☐

**(1)**

(b) Draw **one** line from each type of cell to the number of chromosomes in the cell.

| Type of cell | Number of chromosomes |
|---|---|
| | 23 |
| Sperm cell | 26 |
| | 46 |
| Embryo cell | 52 |
| | 69 |

**(2)**

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

Complete the genetic diagram in the figure below.

| | | Parent | |
|---|---|---|---|
| | | X | X |
| Parent | X | XX | |
| | Y | | |

**(2)**

(d) On the figure above, circle a male child.

**(1)**

(e) What is the chance of the man and woman having a boy?

Tick **one** box.

1 in 2 ☐

1 in 3 ☐

1 in 4 ☐

1 in 8 ☐

**(1)**

**(Total 7 marks)**

## Q58.

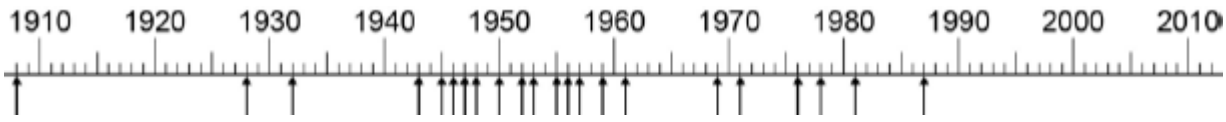
(a) Some antibiotics work by destroying the cell membranes of bacteria.

Suggest why these antibiotics may have side effects in the animals that are given these antibiotics.

_____

**(1)**

(b) Each arrow on the figure below shows the date of discovery of each new type of antibiotic.




In which 10 year period were most new types of antibiotic discovered?

_____

**(1)**

(c) The figure above shows 22 new types of antibiotic. These were discovered before 2010.

Determine the percentage of types of antibiotic that have been discovered between 1980 and 2010.

Use information from the figure above.

Give your answer to 2 significant figures.

_____

_____

_____ %

**(2)**

(d) Bacteria can evolve rapidly.

Many bacteria can develop into new strains which are resistant to antibiotics.

Complete the table below to show if each action is **more likely** or **less likely** to help bacteria to become antibiotic resistant.

Put a tick in each row.

| Action | More likely | Less likely |
|---|---|---|
| Take painkillers for headache | | |
| Washing with antiseptic hand gel | | |
| Adding antibiotics to food for cows | | |
| Giving antibiotics for colds and flu | | |
| Stopping antibiotics as soon as you feel better | | |

**(4)**

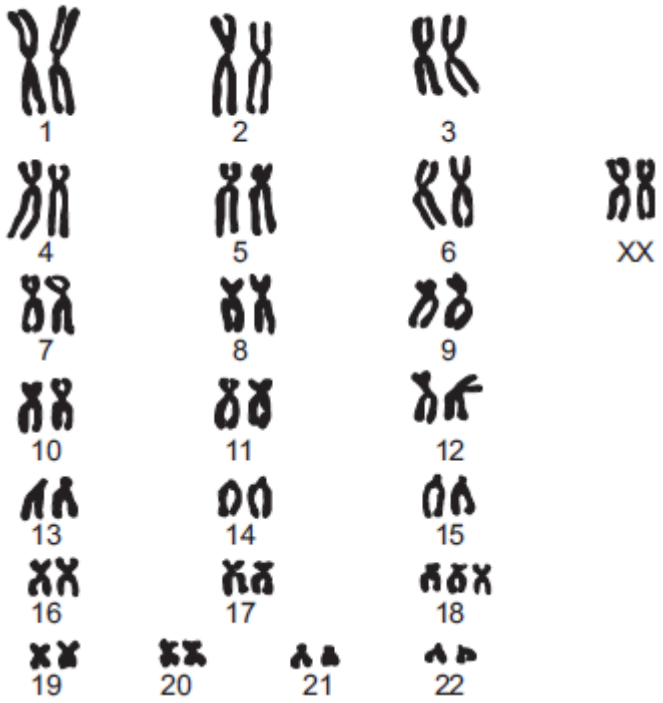
**(Total 8 marks)**

## Q59.

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**.

_____

_____

_____

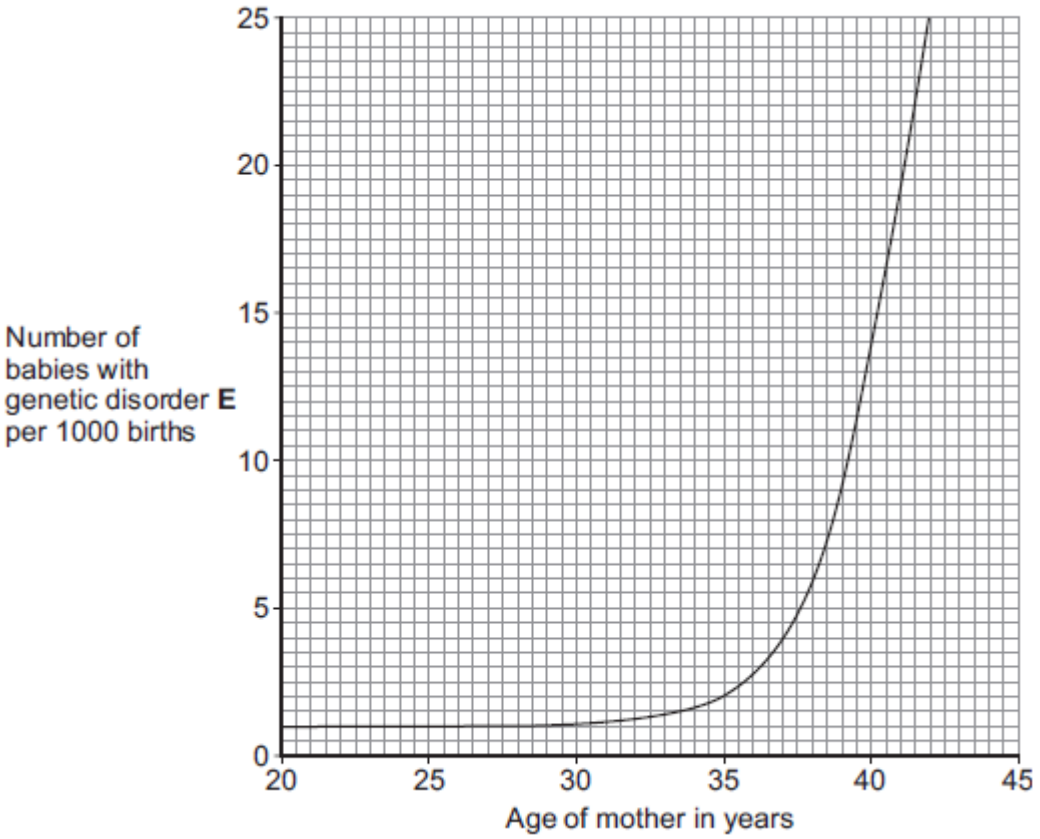
_____

**(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 | 1. The woman gets pregnant in the |

| | |
|---|---|
| dish. | 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.<br>Embryos that are not used are destroyed or used in medical research. | 4. An unaffected fetus is allowed to develop.<br>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)**

## Q60.

A person's characteristics can be due to:

- environmental causes
- genetic causes
- both environmental and genetic causes.

(a) Complete **Table 1**.

Put a tick to show what each characteristic is due to.

**Table 1**

| **Characteristic** | **Characteristic due to** |
|---|---|

| | Environmental causes | Genetic causes | Both environmental and genetic causes |
|---|---|---|---|
| Eye colour | | | |
| A scar | | | |
| Weight | | | |

**(3)**

(b) Draw **one** line from each key term to the correct definition.

| Key term | Definition |
|---|---|
| | The set of alleles for a characteristic |
| Genotype | The genus of an organism |
| | The inheritance of chromosomes |
| Phenotype | The mutation of genes |
| | The physical characteristic of an organism |

**(2)**

(c) Farmers use selective breeding to control the characteristics in cows.

**Table 2** shows the stages of selective breeding in cows.

Complete **Table 2** to show the correct order of the stages.

The first stage has been numbered for you.

**Table 2**

| Stage in selective breeding | Order of stage |
|---|---|
| Cows are bred over many generations | |
| Parents are bred together | |
| Cows with the desired characteristics are chosen | 1 |
| Calves with the most desired characteristics are bred together | |

**(2)**

(d) Farmers selectively breed cows for many different reasons.

Suggest **two** characteristics that cows may be bred for.

Do **not** suggest coat colour.

1. _____

_____

2. _____

_____

**(2)**

(e) Selective breeding can lead to problems.

Suggest how problems caused by selective breeding in cows can have negative financial effects for the farmer.

_____

_____

_____

_____

**(2)**

**(Total 11 marks)**

Mark schemes

## Q1.

(a) **only genetic causes**
any **one** from:

- pattern of scales
- number of fins
- eye colour

**1**

**only environmental causes:**

- scar

**1**

**both genetic and environmental causes:**

- length

**1**

(b)

| | **B** | **b** |
|---|---|---|
| **b** | | bb |
| **b** | Bb | bb |

*allow 2 correct for **1** mark*

**2**

(c) any bb circled

**1**

(d) 0.5

*allow ecf from **04.2***

**1**

(e) (260 000 / 2 =) 130 000

*allow ecf from **04.4***

**1**

(f) mutation

*allow change in diet / hormones / DNA*

**1**

**[9]**

## Q2.

(a) (i) 3

**1**

(ii) Q

**1**

(iii) 1

**1**

(b) from fossils / bones

*allow artefacts / named artefacts / drawings / evidence of fires*

**1**

(c) Darwin

**1**

**[5]**

## Q3.

(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]**

## Q4.

(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]**

## Q5.

dominant

**1**

recessive

**1**

genes

**1**

gametes

**1**

environmental

**1**

**[5]**

## Q6.

extinct (NOT fossils)
fossils

bones
rocks

*each for 1 mark*

**[4]**

## Q7.

(a) mud

**1**

decayed

**1**

skeleton

**1**

rock

**1**

(b) idea that living things have changed (over time)

*do **not** allow 'dating'*
*do **not** credit 'evolved'*
*allow 'compare the skeleton'*

**1**

**[5]**

## Q8.

fossils

*gains 1 mark*

**but**
extinct

*gains 2 marks*

fossils
rocks/coal

*each for 1 mark*

**[4]**

## Q9.

(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]**

## Q10.

(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]**

## Q11.

(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]**

## Q12.

(a) agilisaurus / camarasaurus / ornitholestes

1

(b) eorapter

*allow lagosuchus*

1

(c) lagusuchus (it) walks on hind limbs / two limbs / alamosaurus has <u>longer</u> neck / lagusuchus has back legs longer than front but alamosaurus has the reverse

1

(d) (i) alamosaurus

1

(ii) increased

1

(e) from hard parts / bones / imprints
e.g. footprints / parts replaced by other materials / conditions for decay absent or example

*buried is neutral*

1

(f) simple

1

billion

1

**[8]**

## Q13.

(a) breed (together)

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

1

to produce <u>fertile</u> 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]**

## Q14.

(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

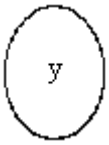
1

only male has the Y **or** wives had only X (chromosomes) or sex determined by the sperm

1

**[5]**

## Q15.

(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]**

## Q16.

(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]

## Q17.

(a) remains of an organism **or** bone / shell / hard part of an organism / impression

1

further detail – eg in rock / from a long time ago

*if numbers, greater or equal to hundreds of years*
*allow made of minerals*
*ignore over time*
*ignore fossil are rocks*

1

(b) (i) D

1

(ii) B

1

(iii) predation / disease / lack of food / competition / loss of habitat / climate change / catastrophic event – or volcanic eruption / flood / drought / temperature change / weather change / ice age / change in atmosphere

*ignore human effects*
*ignore pollution effects / acid rain*
*allow natural disaster*

1

(c) C = 'widest' thickest / wider
thicker column **or** more fossils
(of type C found)

*allow biggest / er*

1

(d) members of the groups have similar physical structures

*extra box ticked – cancel*

1

[7]

## Q18.

(a) protection / defence

*ignore insulation **or** rolls into a ball*
*ignore camouflage*

1

from predators / from being attacked / from being eaten

1

(b) looks like snake / looks scary

1

deters predators **or** has large eyes to spot predator **or** camouflage **or** warning colouration from predator or prey

*allow **two** separate adaptations for **2** marks*

1

(c) (i) natural selection

**1**

(ii) Darwin

**1**

(iii) simple life forms

**1**

(d) believe that God created all organisms **or** humans there from the beginning

**1**

**[8]**

## 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) (i) 56

*accept 54 – 58*

**1**

(ii) increased

**1**

reasonable qualification eg slowly then more quickly
**or**
to 174 / 176
**or**
by 138 / 140

**1**

(b) any **two** from:

- no immunity **or** antibodies ineffective
  *accept no resistance*
- no vaccines **or** humans not immunised
- idea of large scale contact **or** large scale travel
  *do **not** accept passed on*
  *ignore no cure*

**2**

**[5]**

## Q21.

(a) **X** (no mark)

**X** is more visible **or Y** is more camouflaged

**1**

(b) (i) so camouflage not changed **or** so not easier to see

**1**

(ii) 25

**1**

7

**1**

(iii) any **one** from:

- eaten (by birds) / died
- mixed in with large number of unmarked moths
- moved away

**1**

(c) (i) DNA

**1**

(ii) the gene / allele for being dark / dominant

**1**

**[7]**

## Q22.

in the correct order

DNA

**1**

23

**1**

XX

**1**

XY

**1**

recessive

**1**

dominant

**1**

**[6]**

## Q23.

(a) any **two** from:

- streamlined / shape reduces friction / long and thin / smooth surface OWTTE
- fins / flippers / tail / paddle
  *do **not** accept 'arms' or 'legs'*
- structures that push against water

**2**

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

fossil has hind limb / legs / feet
*it = minke*
*accept any valid comparison*

fossil has more ribs / bones

fossil has teeth

fossil has curved spine

**2**

(ii) billion

**1**

give evidence for

**1**

**[6]**

## Q24.

(a) fossils / teeth / bones / skeleton / foot prints
*allow cave drawings*
*do **not** accept scientists have seen them*

**1**

(b) only (some) bones remain / soft parts have decayed
*accept 'no-one has ever seen one'*
*allow no photos, no pictures, no drawings*

**1**

(c) any **two** from:

- hunted by human
- (new) predator
  *allow more predators*
- (new) competitor

- (new) disease
- environment changed / named environmental change
  *allow natural disaster*
- prey extinct / loss of food supply
  *ignore not enough food*

**2**

**[4]**

## Q25.

(a) characteristics

**1**

(b) genes

**1**

(c) chromosomes

**1**

(d) mitosis

**1**

(e) asexual

**1**

**[5]**

## Q26.

(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]**

## Q27.

(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]**

## Q28.

(a) genes

**1**

chromosomes

**1**

(b) (i) higher yield

**1**

less use of pesticides

**1**

(ii) any **two** from:

- uncertain about effects on health
- fewer bees
- might breed with wild plant
- seeds only from one manufacturer

**2**

**[6]**

## Q29.

(a) lemur(s)

**1**

(b) gorilla(s)

*in either order*

**1**

chimpanzee(s)

*accept chimps*

**1**

(c) (i) (Charles) Darwin

*accept (Alfred) Wallace*

*if first name given it must be correct*

**1**

(ii) variation

*in this order*

**1**

environment

*allow phonetic spellings*

**1**

survive

**1**

generation

**1**

**[8]**

## Q30.

(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]**

## Q31.

(a) sexual

**1**

(b) chromosome

**1**

(c) (i) any **two** from:
*ignore answers that do not relate to list*

- genetic-engineering can produce fast-growing food animals
- genetic engineering can be used to clone animals in danger of extinction
- using GM animals can reduce the number of animals used in medical research

**2**

(ii) GM animals might escape and breed with wild animals
*ignore answers that do not relate to list*

**1**

animals have the right to be free from genetic modification

**1**

**[6]**

## Q32.

(a) (i) sex cells

**1**

(ii) chromosomes

**1**

(b) (i) two

**1**

(ii) recessive

**1**

(c) (i) cell membrane
*allow membrane*

1

(ii) cytoplasm

1

(d) (i) A

1

(ii) B

1

**[8]**

## Q33.

(a) (i) dominant

*allow clear indication*

1

(ii) recessive

*allow clear indication*

1

(b) (i) aa

*extra ring drawn cancels the mark*

1

(ii) Aa

*extra ring drawn cancels the mark*

1

(c) 3 purple : 1 yellow

*extra box ticked cancels the mark*

1

**[5]**

## Q34.

(a) chromosomes

1

(b) (i) has XY / Y

*allow female would be XX / has no Y*

1

(ii) The strands are in pairs

1

(iii) nucleus

1

**[4]**

## Q35.

(a) warmer / dryer

*allow greenhouse effect / global warming*

*ignore wind*

1

(b) (i) genes / alleles / chromosomes / DNA / genetic material / genetics

*allow inheritance*
*allow nutrition / food / metabolism / growth <u>rate</u>*
*ignore environment*

**1**

(ii) natural selection / evolution
*allow survival of the fittest*

**1**

**[3]**

## Q36.

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

- A
- C

**1**

(ii) any **one** from:

- B
- D

**1**

(b) (i) pig A

**1**

(ii) a gamete

**1**

(c) XY **or** YX

**1**

X Y

**1**

XY **or** YX
*in this order only*

**1**

**[7]**

## Q37.

(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]**

## Q38.

(a) asexual

**1**

(b) mitosis

**1**

(c) genes

**1**

**[3]**

## Q39.

(a) insects don't eat / damage crop

*allow idea of insects carrying plant disease*

**1**

(b) (i) 60

**1**

(ii) lower (yield)

*accept 'higher' if answer clearly refers to wheat with transferred gene*
*allow yield is only 52* ***or*** *goes down to 52*

**1**

by 8 (arbitrary units)

*accept ecf from (b)(i) for* ***2*** *marks*

**1**

(iii) grow / use wheat without insect poison (gene)

**1**

higher yield (in fields)

*accept bigger crop / more wheat*
*ignore grows better*

**1**

(c) *ignore unnatural / unethical / against religion unqualified*

(concerned about)

*accept specific examples given*

effect on populations of (wild) flowers / insects

*ignore harms the environment*

**1**

effect of <u>eating</u> GM crops on human health

*allow harmful to humans if eaten*

**1**

**[8]**

## Q40.

(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 children produced

*allow 'after only 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]**

## Q41.

(a) Relevant organelle found in cells such as nucleus, mitochondria

**1**

(b) Linnaeus

**1**

(c) Kingdom

**1**

(d) *Homo Sapiens*

*ignore underlining, italics or not, capitals or not*

**1**

(e) Any **one** from:

- to know which species are closely related
  **or**
  study evolution
- to monitor biodiversity
- to identify different organisms such as two different species

**1**

**[5]**

## Q42.

(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]**

## Q43.

(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]**

## Q44.

(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]**

## Q45.

(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 / greate<u>r</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]**

## Q46.

(a) (i) (remains of) an organism / a bone / a shell / hard part of an organism / part of organism that does not decay / impression of an organism / footprint / burrow / rootlet trace

**1**

further detail – eg in rock / ice / amber / mineralisation

**or**

from a long time ago / many years ago

*if number, > 1000 years*

*ignore hundreds*

**1**

(ii) older fossils are simple(r)

*must make ref to change and time*

*allow deeper fossils are simple(r)*

**or**

fossils show change / adaptation with time

**1**

(b) (i) 18 to 30

*allow 30 to 18*

*allow 12*

*ignore units*

**1**

(ii) small sample

*allow <u>only</u> 49 shells / not representative / not enough evidence*

*allow not all fossils found*

**1**

(c) example of a physical factor such as flooding, volcanic activity (allow volcanoes) asteroid collisions, drought, ice age / temperature change

*allow natural disaster / climate change / weather change / catastrophic event / environmental change*

**or**

example of a biological factor such as predators / disease / competition / lack of food or mates / cyclical nature of speciation / isolation / lack of habitat or habitat change

*ignore human factors eg hunting / pollution*

**1**

**[6]**

## Q47.

(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]**

## Q48.

(a) genes

**1**

chromosomes

**1**

(b) (i) higher yield

**1**

less use of pesticides

**1**

(ii) any **two** from:

- uncertain about effects on health
- fewer bees
- might breed with wild plant
- seeds only from one manufacturer

**2**

**[6]**

## Q49.

(a) (i) any **two** from:

- trapped / held (since sticky)
- engulfed / covered by resin

*allow engulfed / covered by amber*

- prevented decay.

**2**

(ii) any **two** from:

- animal / plant (dies and) body covered in sediment / mud

*ignore ref to rock*

*allow covered in tar / ice*

- bones / shells / hard parts do not decay
- minerals enter bones / parts are replaced by other materials / mineralisation
- preserved traces / footprints / burrows / rootlet traces / impressions / casts.

**2**

(b) (i) New technology provides more valid evidence.

**1**

(ii) any **three** from:

examples of physical factors, e.g.

*accept 3 physical factors or 3 biological factors or some of each for full marks*

- flooding
- drought
- ice age / temperature change.

*ignore pollution*

examples of biological factors, e.g.

- (new) predators (allow hunters)
- (new) disease / named pathogen
- competition for food
- competition for mates

*competition must be qualified*

- cyclical nature of speciation
- isolation
- lack of habitat or habitat change.

***if no other answers given allow** natural disaster / weather change / catastrophic event / environmental change / climate change for **1** mark*

**3**

**[8]**

## Q50.

(a) DNA

**1**

(b) X and Y

**1**

(c) (i) 46 chromosomes

**1**

(ii) half the number

**1**

(d) meiosis

**1**

**[5]**

## Q51.

(a) Mendel

**1**

(b) (i) **TT**

**1**

(ii) a dominant allele

**1**

(c) 1 : 1

**1**

(d) 100 short plants

**1**

**[5]**

## Q52.

(a) (i) animal walking on soft material **or** suitably named material

**or**

further detail – eg dries out / buried / hardens / turns to rock

*do **not** allow general descriptions of how fossils are formed **or** reference to bones not decaying*

**1**

(ii) any **one** from:

- (from) bones / shells / hard parts **or** from parts that do not decay / rot or are preserved

  *ignore imprint / impression*

- animal trapped in resin / amber / ice / peat

  *allow frozen*

- infiltration with minerals / named

**1**

(b) any **two** from:

examples of physical factors such as flooding, volcanic activity (allow volcanoes) asteroid collision, drought, ice age / temperature change

*accept 2 physical factors or 2 biological factors or one of each for full marks*

*ignore pollution*

examples of biological factors such as predators (allow hunters), disease / named pathogen, competition lack of food / mates, cyclical nature of speciation / isolation / lack of habitat or habitat change

*If no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for **1** mark*

**2**

(c) older fossils simpler

*to gain the mark there must be implication of change*

**or**

change (with time)

*ignore evolve*
*ignore extinction*

**1**

(d) insufficient / no evidence / no remains **or** fossils survive

*ignore no people were there*
*allow no proof*

**1**

**[6]**

## Q53.

(a) (i) natural

**1**

(ii) simple

**1**

(iii) three billion

**1**

(b) any **two** from:

- reference to religion
- insufficient evidence / couldn't prove it / no proof
  *ignore no evidence*
- mechanism of inheritance / variation not known
  *allow genes / DNA not known about*
- reference to other theories
- reference to Darwin's status

**2**

(c) (i) tree

**1**

(ii) hippopotamus **and** pig

*both required, either order*
*allow hippo*

**1**

(iii) new evidence from fossils

**1**

**[8]**

## Q54.

(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]**

## Q55.

(a) fossils show change over time.

**1**

(b) covered in sediment / mud or sinks into the mud

**1**

soft parts decay / are eaten
**or**
bones / hard parts / shell do not decay

**1**

minerals enter bones / parts are replaced by minerals / mineralisation

*accept turns to rock*
*allow 'is an impression' / 'imprint' / 'cast'*

**1**

(c) skin is soft / skin not preserved / not fossilised / skin decays

*accept not enough / no evidence / no-one has seen one*
*allow 'this fossil is only bones'*

**1**

(d) any **two** examples of:

*accept 2 physical factors or 2 biological factors or one of each for full marks*

physical factors such as volcanic activity (allow volcanoes) / earthquakes /

asteroid (collision) / ice age / temperature change

*ignore pollution*

**and / or**

biological factors such as predators / disease / named pathogen / competition/ lack of food / mates / cyclical nature of speciation / isolation / lack of habitat or habitat change

*if no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for 1 mark*

**2**

**[7]**

## Q56.

(a) (i) (volume) increases (with time)

*ignore numbers*

**1**

(ii) there is more evidence / specimens / results (for Homo sapiens)

*allow examples of this, eg more / better fossils*

*allow converse if clearly referring to Australopithecus*

*ignore reference to being 'more recent'*

**1**

(b) 2.5 – 3.15 (million years ago)

*accept any number in range*

**1**

(c) (i) Darwin

**1**

(ii) any **one** from:

- they believed in other theories

  *allow they believed that God made all life*
- insufficient evidence

  *ignore 'no evidence'*
- no proof

  *allow not enough proof*
- genes / mechanism of inheritance not known / discovered

**1**

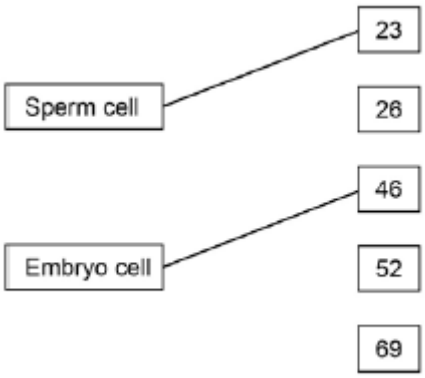
**[5]**

## Q57.

(a) Nucleus

**1**

(b) **Type of cell** **Number of chromosomes**




*extra lines from left cancel the mark*

**2**

(c)

| | X | X |
|---|---|---|
| X | XX | XX |
| Y | XY | XY |

*all three correct for **2** marks*
*one or two correct for **1** mark*
*allow XY or YX in correct places*

**2**

(d)

| | X | X |
|---|---|---|
| X | XX | XX |
| Y | (XY) | (XY) |

*either circled*

**1**

(e) 1 in 2

**1**

**[7]**

## Q58.

(a) animal cells also have cell membrane

**1**

(b) 1945–1955

*allow 1946–1956*
***or** 1947–1957*

1

(c) (2 / 22 =) $9.0\dot{9}$

*allow 9.09 (%) or 9 (%) with no working shown for **1** mark*

1

9.1 (%)

*allow 9.1 (%) with no working shown for **2** marks*

1

(d)

| More likely | Less likely |
|---|---|
| | ✔ |
| | ✔ |
| ✔ | |
| ✔ | |
| ✔ | |

*allow **3** marks for 4 correct*
*allow **2** marks for 3 correct*
*allow **1** mark for 2 correct*

4

*more than one tick in a row negates a mark*

**[8]**

## Q59.

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

*allow has X chromosomes*
*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) Advantages:
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 only 3 days old*
- tested before pregnancy
- no termination / abortion
- spare embryos have a potential use.

**2**

Disadvantages:
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]**

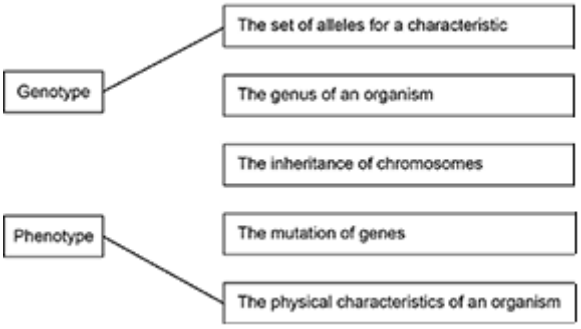
## Q60.

(a)

| Characteristic | Environmental | Genetic | Both |
|---|---|---|---|
| Eye colour | | ✔ | |
| A scar | ✔ | | |
| Weight | | | ✔ |

**3**

(b) **Key term** **Definition**




*extra lines from the left negate the mark*

**2**

(c)

| **Stage in selective breeding** | **Order of stage** |
|---|---|
| Cows are bred over many generations | 4 |
| Parents are bred together | 2 |
| Cows with the desired characteristics are chosen | 1 |
| Calves with the most desired | 3 |

| | |
|---|---|
| characteristics are bred together | |

*all 3 correct for **2** marks*

*1 or 2 correct for **1** mark*

**max. 2**

(d) beef / meat

*allow hardiness, disease resistance*

**1**

milk yield

**1**

(e) higher veterinary costs

**1**

less income from sale of (milk and meat) products

**1**

**[11]**