VARIATION AND EVOLUTION PART 1

Q1.

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

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

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

(3)

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

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

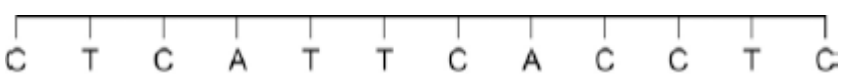
_____

(1)

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

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

Figure 1



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

Tick **one** box.

2 ☐

3 ☐

4 ☐

6 ☐

(1)

(d) Mutations of DNA cause some inherited disorders.

One inherited disorder is cystic fibrosis (CF).

A recessive allele causes CF.

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

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

Each parent does not have CF.

The following symbols have been used:

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

d = recessive allele for having CF

Figure 2

		Mother	
		D	d
Father	D	DD	
	d		

Probability of a child with CF = _____

(3)

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

Tick **one** box.

Heterozygous ☐

Homozygous dominant ☐

Homozygous recessive ☐

(1)

(Total 9 marks)

Q2.

Charles Darwin proposed the theory of natural selection.

Many people at the time did not accept his theory.

(a) There was a different theory at the same time as Darwin's theory.

The different theory said that changes in an organism during its life could be inherited.

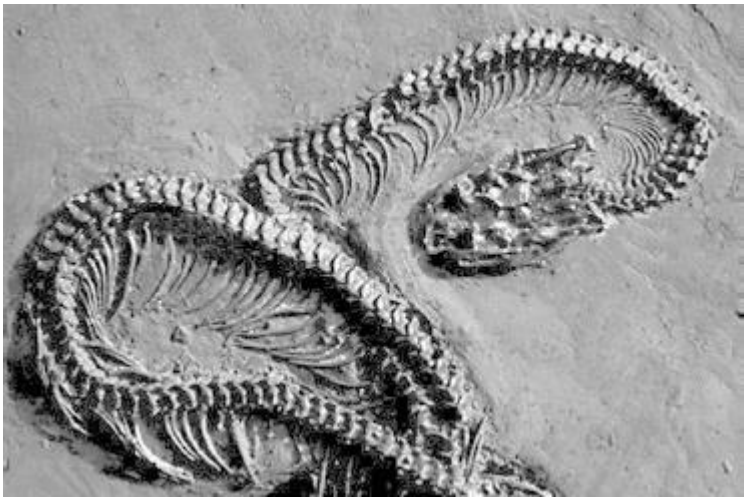
Who proposed this theory?

_____

(1)

(b) Studying fossils helps scientists understand how living things have evolved.

The diagram below shows a fossilised snake.



© Peter Menzel/Science Photo Library

Explain how the fossil in the diagram above may have formed.

_____

_____

_____

_____

_____

_____

(3)

(c) There are many types of rat snake in the world.

The table below shows two types of rat snake.

	 © Kazzpix/iStock/Thinkstock	 © Talkir/iStock/Thinkstock
Type of snake	Japanese rat snake	Texas rat snake
Colour of snake	Green	Pale brown
Type of environment	Grass	Dry and dusty

The different types of rat snake have evolved from similar ancestors.

The rat snakes have evolved to to suit their environments.

Explain how the Japanese rat snake evolved to be different from the Texas rat snake.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) Many species of snake have become extinct.

Give **one** reason why a species might become extinct.

_____

_____

(1)

(Total 9 marks)

Q3.

Many different types of animals are produced using selective breeding.

Some cats are selectively bred so that they do not cause allergies in people.

(a) Suggest **two other** reasons why people might selectively breed cats.

1. _____

_____

2. _____

_____

(2)

(b) Selective breeding could cause problems of inbreeding in cats.

Describe **one** problem inbreeding causes.

_____

(1)

(c) Many people have breathing problems because they are allergic to cats.

The allergy is caused by a chemical called Fel D1.

Different cats produce different amounts of Fel D1.

A cat has been bred so that it does not produce Fel D1.

The cat does **not** cause an allergic reaction.

Explain how the cat has been produced using selective breeding.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q4.

Darwin's theory of natural selection states that all living things have evolved from simple life forms.

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

three billion	**three million**	**three thousand**

Darwin's theory states that life began on Earth _____ years ago.

(1)

(b) Life evolved due to changes in genes. Changes in genes cause variation.

Complete the sentences.

Changes in genes are called _____ .

Individuals with characteristics most suited to the environment are more likely

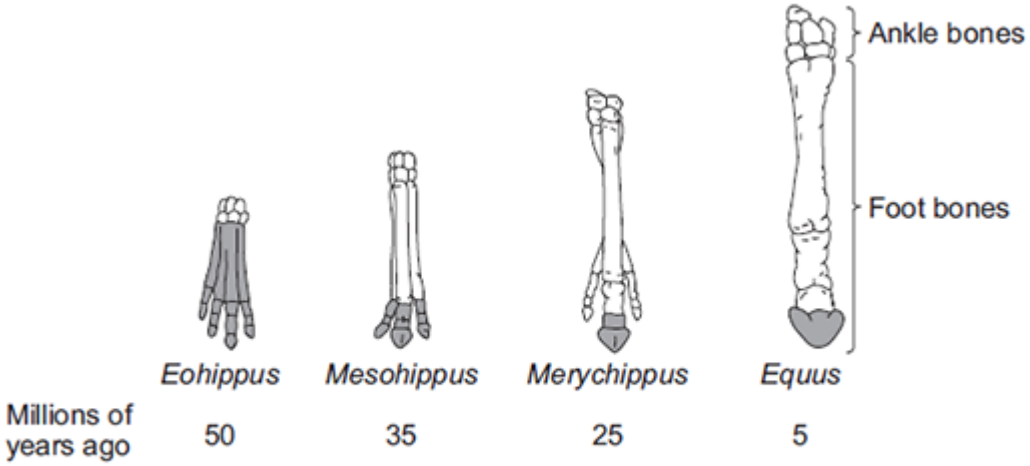
to survive and _____ .

(2)

(Total 3 marks)

Q5.

The diagram below shows changes in the foot bones of four ancestors of modern horses over the past 50 million years.



Key: The shaded bones are the bones which touched the ground.

(a) Describe **two** changes to the bones in the feet of horses that have taken place over the past 50 million years.

_____

_____

_____

_____

(2)

(b) *Eohippus* lived in swampy areas with soft mud.

Since this time the ground in the habitat has become drier and harder.

All of the horse ancestors were preyed upon by other animals.

(i) Explain **one** advantage to *Eohippus* of the arrangement of bones in its feet.

_____

_____

_____

_____

(2)

(ii) The changes in the arrangement of the foot bones of horses support Darwin's theory of evolution by natural selection.

Explain how the arrangement of the foot bones of *Eohippus* could have evolved into the arrangement of the foot bones of *Equus.*

_____

_____

_____

_____

_____

_____

_____

_____

(4)

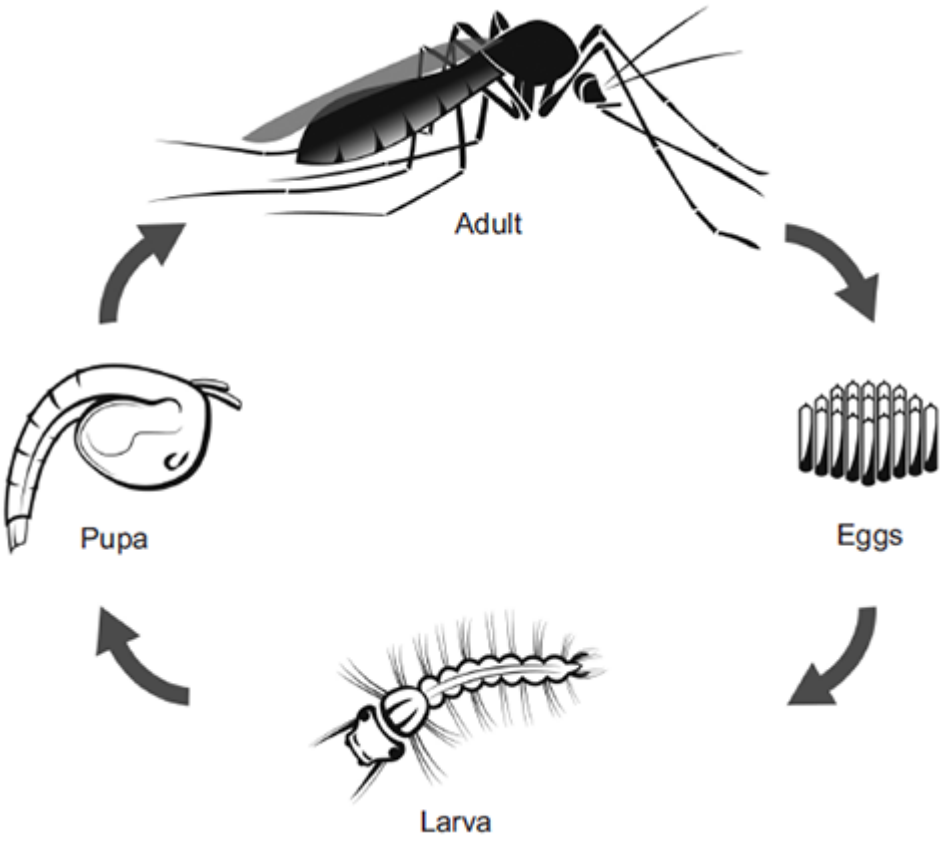
(Total 8 marks)

Q6.

Malaria is a disease caused by a microorganism carried by mosquitoes.

The microorganism is transferred to humans when adult female mosquitoes feed on human blood.

The figure below shows the life cycle of a mosquito.



The World Health Organisation estimates that 3×10^8 people are infected with malaria every year.

Scientists estimate that malaria kills 2×10^6 people every year.

The people who are infected with malaria but do not die, may be seriously ill and need health care for the rest of their lives.

(a) Based on the estimated figures, what percentage of people infected with malaria die from the disease?

_____

_____

_____

_____

(2)

(b) An internet article states:

1 Mosquito larvae are at the start of the food chain for some fish.
2 Adult mosquitoes provide food for bats and birds.
3 Mosquitoes are also important in plant reproduction because they feed from flowers of crop plants.

(i) The first sentence in the article is **not** correct.

Explain why.

_____

(2)

(ii) A company plans to produce genetically modified (GM) adult male mosquitoes.
The GM mosquitoes will carry a gene from bacteria. The gene causes the death of offspring before they become adults.

Male mosquitoes do **not** feed on blood.
Scientists are considering releasing millions of adult male GM mosquitoes into the wild.

Do you think scientists should release millions of male GM mosquitoes into the wild?

In your answer you should give advantages and disadvantages of releasing GM mosquitoes into the wild.

(4)

(iii) Describe the process for creating a GM mosquito.

(3)

(Total 11 marks)

Q7.

Over millions of years:

- new groups of organisms have evolved

- other groups of organisms have become extinct.

(a) If an asteroid collided with the Earth, large amounts of dust and water vapour would be thrown up into the air. This would mean less light and heat would reach the Earth's surface from the Sun.

(i) A reduced amount of light and heat could have caused the extinction of plants.

Suggest how.

_____

_____

(1)

(ii) How could the extinction of plants have caused the extinction of some animals?

_____

_____

(1)

(iii) Give **two** reasons, other than collision with an asteroid, why groups of animals may become extinct.

1. _____

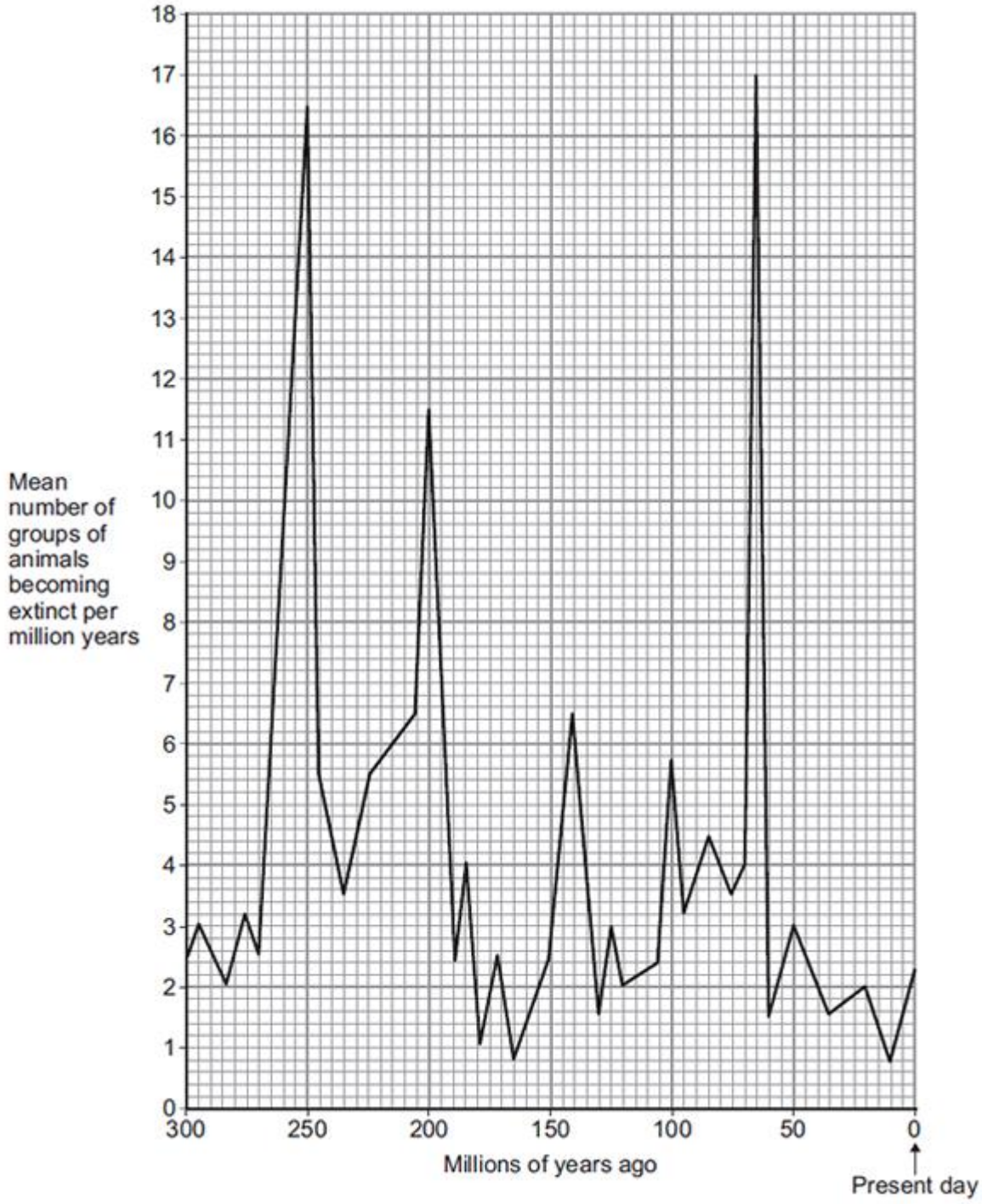
_____

2. _____

_____

(2)

(b) The graph shows how the rate of extinction of groups of animals has varied over the past 300 million years.



(i) If more than 10 groups of animals become extinct in a 1 million year period, scientists call this a 'mass extinction'.

How many mass extinctions occurred over the past 300 million years?

_____

(1)

(ii) How do we know what types of animals lived hundreds of millions of years ago?

_____

_____

(1)

(c) Use information from the graph to answer part (i) and (ii).

(i) How many years ago did the most recent mass extinction of animals occur?

Tick (✔) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

(ii) What was the mean number of groups of animals becoming extinct per million years in the most recent mass extinction?

_____ groups per million years

(1)

(iii) Why are scientists not sure how many groups of animals became extinct in the most recent mass extinction?

_____

_____

(1)

(Total 9 marks)

Q8.

Figure 1 is a map showing a group of islands in the Pacific Ocean, near the coast of California, USA.

Figure 1

A species of fox, called the Island Fox, lives on each of the six islands shown in **Figure 1**.

Figure 2 shows an Island Fox.

Figure 2

© GaryKavanagh/iStock

The foxes on each island are slightly different from those on the other islands.

The Island Foxes are similar to another species of fox, called the Grey Fox.

The Grey Fox lives in mainland California.

(a) Suggest how scientists could prove that the six types of Island Fox belong to the same species.

_____

_____

_____

_____

(2)

(b) Scientists believe that ancestors of the modern Island Fox first colonised what is now Santa Cruz Island during the last Ice Age, approximately 16 000 years ago. At that time, lowered sea levels made the three northernmost islands into a single island and the distance between this island and the mainland was reduced to about 8 km.

(i) How could the Island Fox have developed into a completely different species from the mainland Grey Fox?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(ii) Suggest why the Island Foxes have developed into different varieties of the same species instead of six different species.

_____

_____

_____

(1)

(Total 8 marks)

Q9.

(a) Which of the following is the **best** definition of a species?

Tick (✓) **one** box.

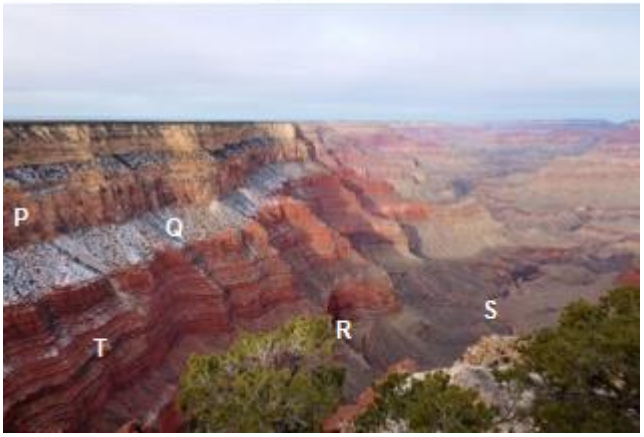
Organisms with many features in common	☐
Organisms that live in the same habitat and eat the same food	☐
Organisms that reproduce together to form fertile offspring	☐

(1)

(b) **Figure 1** is a photograph of the Grand Canyon.

The layers of rock contain fossils.

Figure 1



Scientists found five fossils of different species of animal, **P**, **Q**, **R**, **S** and **T**, at the positions shown in **Figure 1.**

(i) What is the evidence in **Figure 1** that animals **P** and **Q** were alive at the same time?

_____

_____

(1)

(ii) Was animal **R** alive at an earlier time or at a later time than animals **P** and **Q**?

Give the reason for your answer.

_____

_____

(1)

(iii) Which **two** of the following would be evidence that animal **T** may have evolved from animal **S**?

Tick (✓) **two** boxes.

The fossils of animals **S** and **T** have many features in common, but **T** is more complex than **S**. ☐

The fossils of animals **S** and **T** are the same size. ☐

The fossils of animals **S** and **T** have the same skin colour. ☐

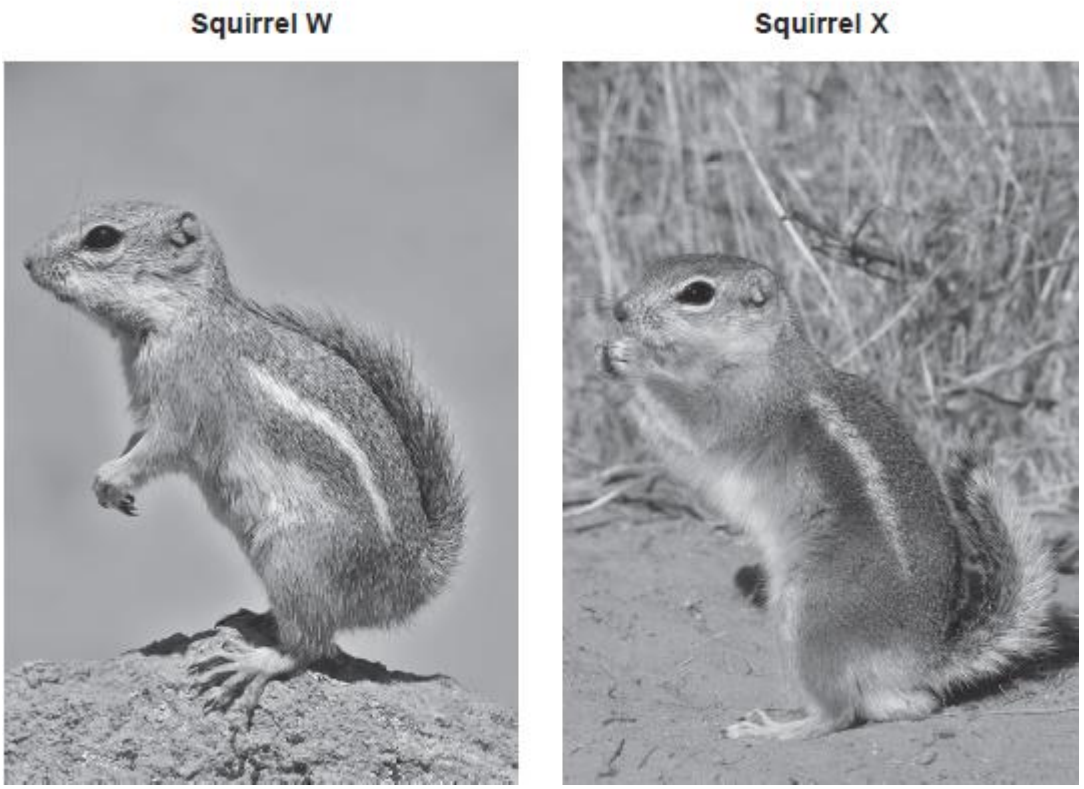
The fossil of animal **S** was found in a deeper layer of rock than the fossil of animal **T**. ☐

The fossil of animal **T** is more similar to the fossil of animal **R** than to the fossil of animal **S**.

(2)

(c) **Figure 2** shows two species of ground squirrel, **W** and **X**.

Figure 2



Squirrel **W** lives on the high ground to the south of the Grand Canyon.

Squirrel **X** lives on the high ground to the north of the Grand Canyon.

The land to the north of the Grand Canyon is about 300 metres higher than the land on the south side. The north side also has lower winter temperatures and has more rain and snow than the south side.

(i) The two species of squirrel are very similar.

Describe **one** way, which you can see in **Figure 2**, in which squirrel **X** is different from squirrel **W**.

_____

_____

(1)

(ii) The Grand Canyon was formed about 6 million years ago.

Explain how the two different species of squirrel could have developed from a common ancestor.

_____

_____

(6)

(iii) Squirrels **W** and **X** are separate species, but they are still very similar.

Suggest why the two species have **not** become more different over time.

(2)

(Total 14 marks)

Q10.

Glyphosate is a herbicide.

Crop plants have been genetically modified to make them resistant to glyphosate.

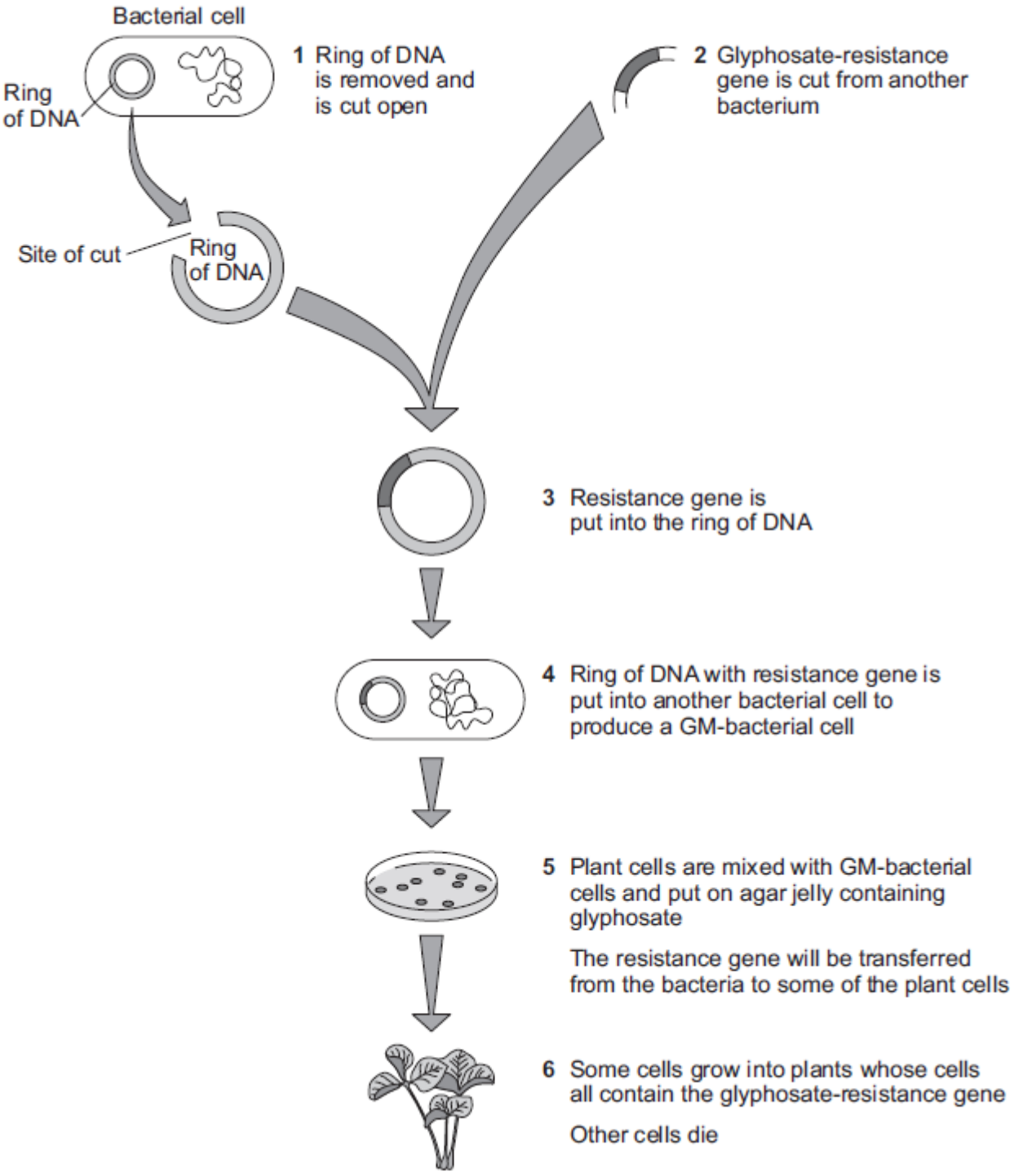
(a) Why is it an advantage to make crop plants resistant to glyphosate?

(3)

(b) **Figure 1** shows how scientists produce genetically modified (GM) crop plants.

The scientists use a GM-bacterium that can invade plant cells.

Figure 1



(i) The ring of DNA shown in **Figure 1** acts as a vector for the resistance gene.

What is the scientific name for this ring of DNA?

_____

(1)

(ii) At step **1** in **Figure 1**, the ring of DNA is cut open.

How do scientists cut open the ring of DNA?

(1)

(iii) At step **5** in **Figure 1**, plant cells and GM-bacteria are put on agar containing glyphosate.

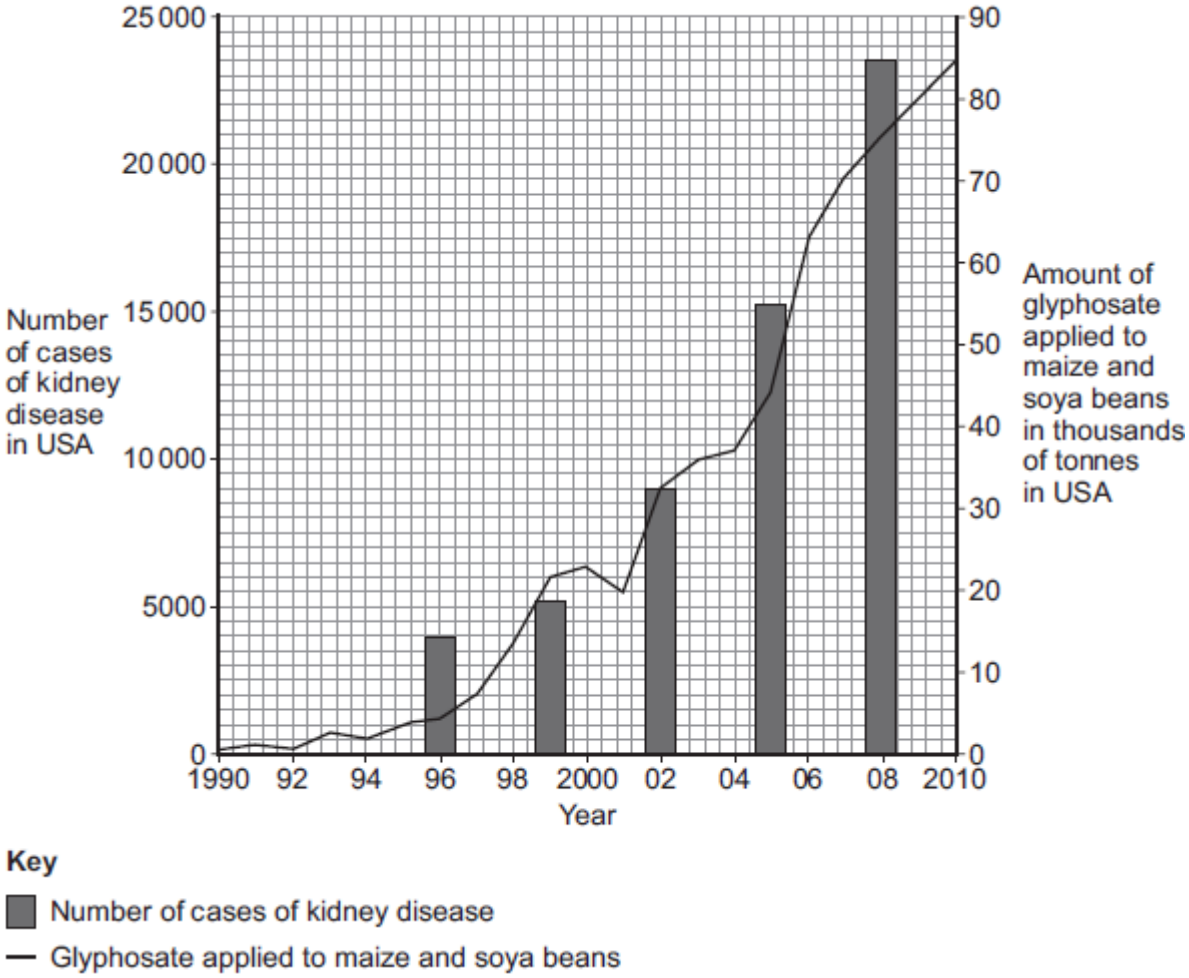
Explain why the scientists add glyphosate to the agar.

(2)

(c) Some people disagree with the use of GM herbicide-resistant crop plants.

Figure 2 shows data published on a website in 2013.

Figure 2



A journalist used the data to claim: 'Scientists show that GM crops cause kidney disease in humans.'

Use information from **Figure 2** to evaluate the evidence for this claim.

(4)

(Total 11 marks)

Q11.

Modern scientists use cloning techniques.

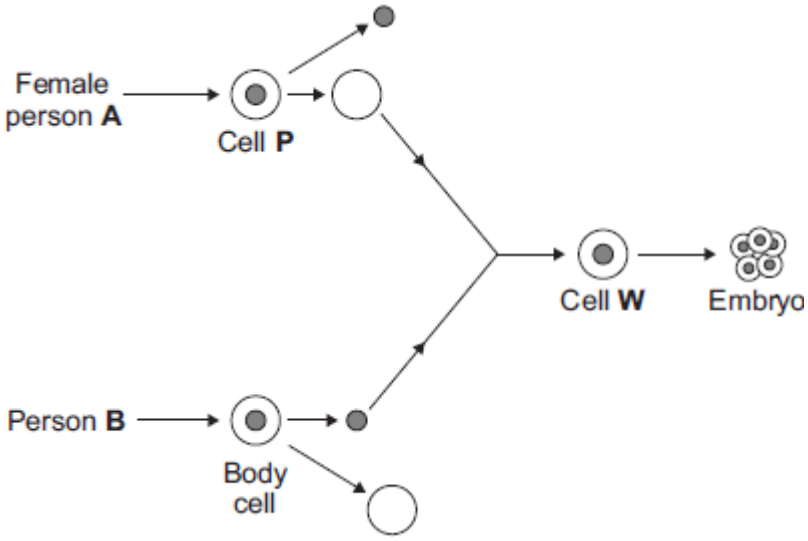
(a) Which **one** of the following is a method of producing cloned plants?

Tick (✓) **one** box.

Joining male and female sex cells	☐
Taking cuttings from plants	☐
Transferring genes from one plant to another plant	☐

(1)

(b) The diagram shows a method that could be used in the future to produce a human.



(i) What is the name of the method shown?

Tick (✓) **one** box.

Adult cell cloning ☐

Embryo transplant ☐

Tissue culture ☐

(1)

(ii) What type of cell is cell **P**?

Draw a ring around the correct answer.

an egg cell **a skin cell** **a sperm cell**

(1)

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

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

The _____ of cell **P** is removed and is discarded.

The _____ of cell **P** is removed and is discarded.

(1)

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

an electric shock	**enzymes**	**hormones**

To make cell **W** divide to form an embryo, the cell must be treated with

_____ .

(1)

(v) The embryo must be placed in an adult female to develop into a child.

Where, in the adult female, should the embryo be placed?

_____

(1)

(c) Some children have kidney disease. Kidney disease cannot be cured. In the future, scientists could make a healthy clone of a child with kidney disease. One kidney could then be transplanted from the cloned child into the child with kidney disease. The cloned child would still live with only one remaining kidney.

Suggest **two** reasons why people might disagree with cloning a child to get a kidney for transplanting.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q12.

In the 1800s, Charles Darwin visited the Galapagos Islands. On the islands he found many different species of bird called finches. Darwin thought that all the different finch species had evolved from one species of finch that had reached the islands many years before.

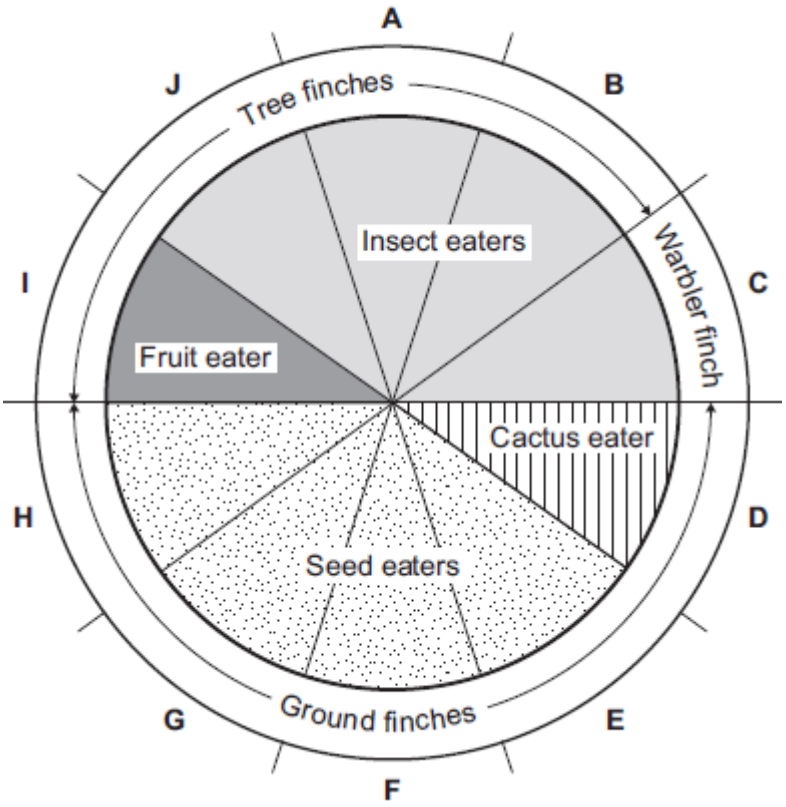
(a) Complete the following sentence.

Darwin suggested the theory of evolution by natural

_____

(1)

(b) The pie chart shows information about ten species of finch, **A − J**.



(i) How many of the species of finch eat insects?

Draw a ring around the correct answer.

4 **5** **6**

(1)

(ii) Describe finch species **G**.
Use **only** information from the pie chart.

_____

_____

_____

_____

(2)

(c) When Darwin returned to the UK very few people believed his theory of evolution.

A different scientist suggested that the changes that occur in an organism during its lifetime can be inherited by its offspring.

What was the name of this scientist?

Tick (✓) **one** box.

Lamarck ☐

Mendel ☐

Semmelweis ☐

(1)

(Total 5 marks)

Q13.

As embryos develop, some genes in cells are turned off and some genes are turned on.This allows cells to become specialised for particular functions.

Usually, after cells have become specialised, they cannot change again into different types of cells.

(a) What is a gene?

_____

_____

_____

_____

(2)

(b) Scientists have developed a way to change specialised cells back into embryo-like cells by a method called iPS.

Read the information in the box.

> Cells made using iPS can be changed into different types of cells.
>
> Scientists plan to take skin cells from an endangered species of monkey called a drill and change these cells into iPS cells. These iPS cells can then be changed into egg cells or sperm cells.
>
> After fertilisation, the embryo can be inserted into the womb of a female of a non-endangered species called a mandrill. The mandrill is closely related to the drill.

Describe similarities and differences between the iPS method and adult cell cloning.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Suggest **one** advantage of trying to preserve endangered species such as the drill.

_____

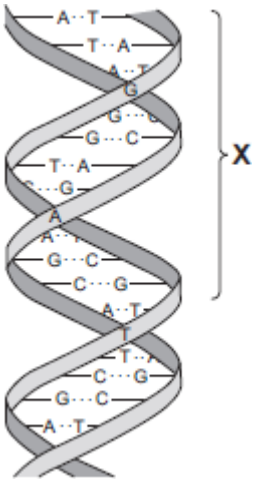
_____

(1)

(Total 7 marks)

Q14.

The diagram shows part of a DNA molecule.



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

_____

(1)

(ii) Complete the following sentence.

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

called _____ .

(1)

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

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

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

(1)

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

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

Explain why.

_____

_____

_____

_____

(2)

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

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

Scientists carried out the following steps.

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

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

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

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

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

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

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

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

(2)

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

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

_____

_____

_____

_____

(2)

(iv) Kanamycin is an antibiotic.

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

Suggest why.

_____

_____

_____

_____

_____

_____

(2)

(Total 13 marks)

Q15.

Darwin's theory of evolution states that all species of living things have evolved from simple life forms.

Darwin's theory was published in 1859.

(a) Give **two** reasons why Darwin's theory was only slowly accepted.

_____

_____

_____

_____

(2)

(b) Darwin observed birds called finches on the Galapagos Islands, 1000 km from the coast of South America.

He saw that the birds were similar to, but not the same as, birds he had seen on the

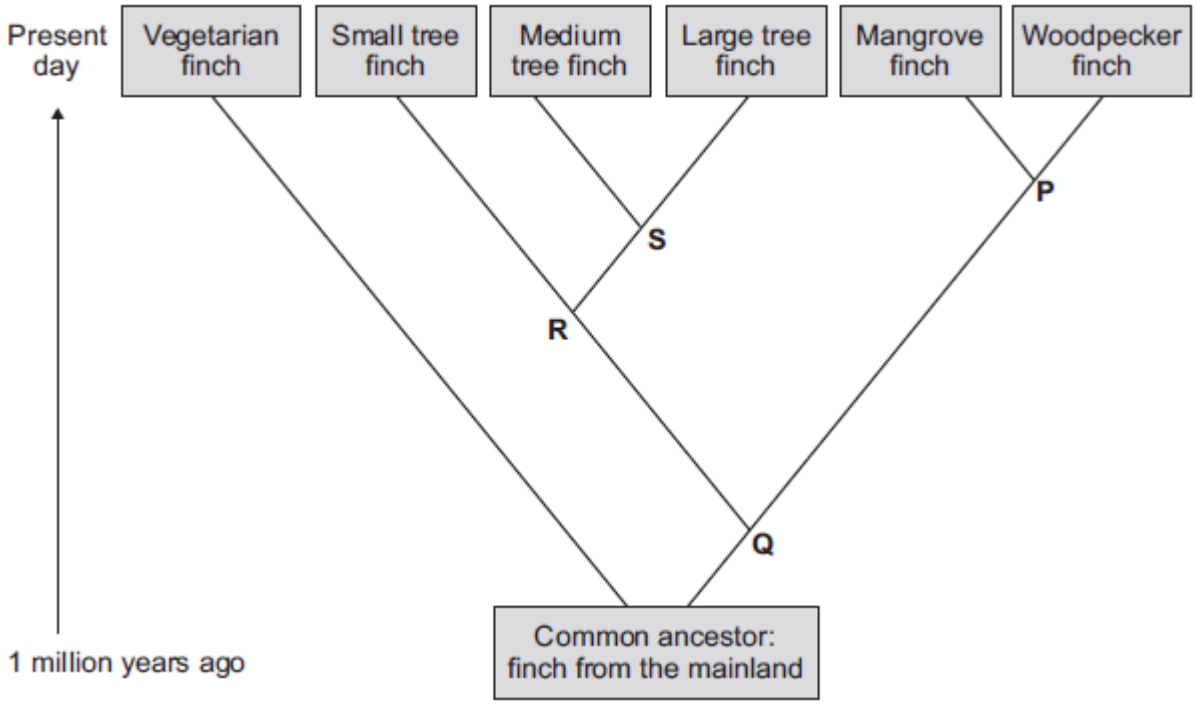
mainland of South America.

Recent evidence suggests that 13 different species of finch on the islands evolved from 1 species of finch that arrived from the mainland about 1 million years ago.

Describe how a new finch species may have evolved from the original species of finch that arrived from the mainland.

(4)

(c) The diagram below shows the evolutionary tree for some Galapagos finches.



(i) Which type of present-day finch is **least** closely related to all the others?

(1)

(ii) Which branching point, **P, Q, R** or **S**, on the diagram above shows the most recent common ancestor of all the **tree finches**?

Write the correct answer in the box. ☐

(1)

(iii) Which **two** finches have the most recent common ancestor?

1. _____

2. _____

(1)

(Total 9 marks)

Q16.

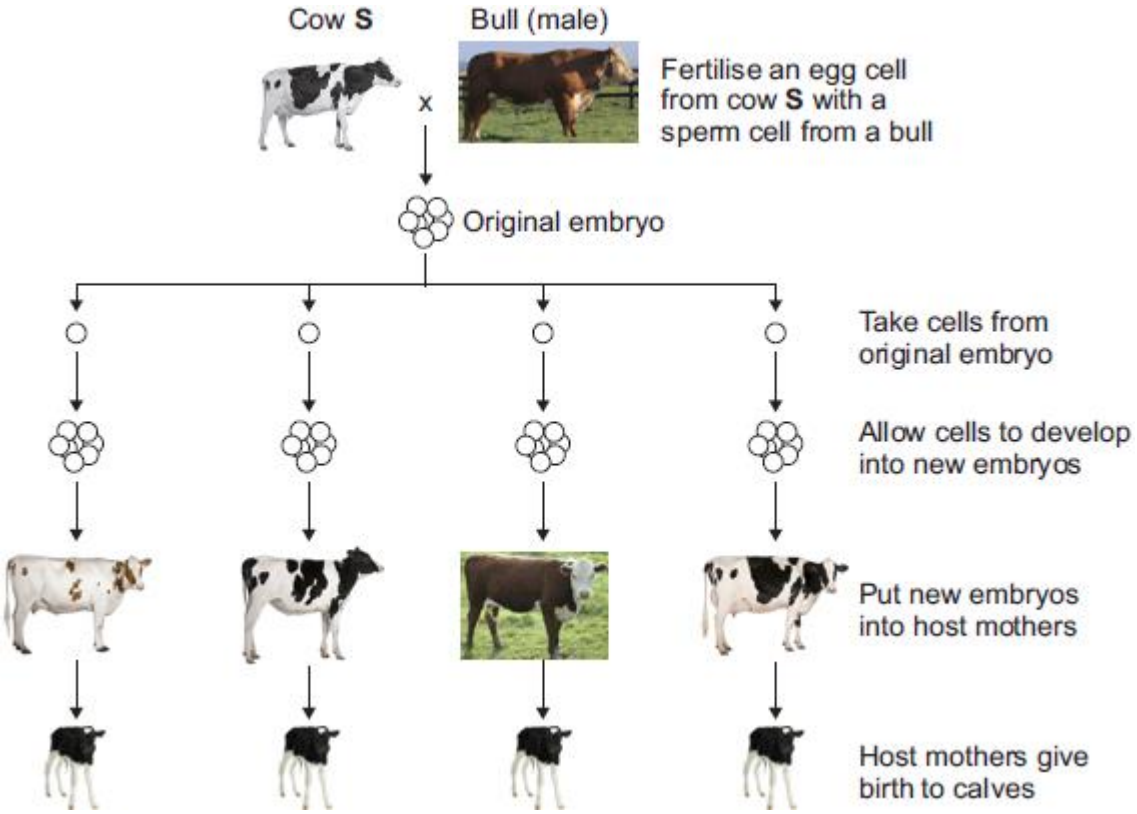
Most cows produce milk with a fat content of 3.4%.

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

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

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

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



Cow S © GlobalP/iStock/Thinkstock, **Bull** © Fuse/Thinkstock, **Whitish cow** © Eric Isselee/iStock/Thinkstock, **Brown cow** © DC Productions/Photodisc/Thinkstock, **Holstein cow(1)** © GlobalP/iStock/Thinkstock, **Holstein cow(2)** © GlobalP/iStock/Thinkstock, **Calf** © Eric Isselee/iStock/Thinkstock.

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

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

_____

(1)

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

These cells develop into new embryos.

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

_____

(1)

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

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

The calves are genetically identical to each other because

they

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

(1)

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

Tick (✓) **one** box.

Adult cell cloning ☐

Embryo transplantation ☐

Genetic modification ☐

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

_____

_____

(1)

(Total 5 marks)

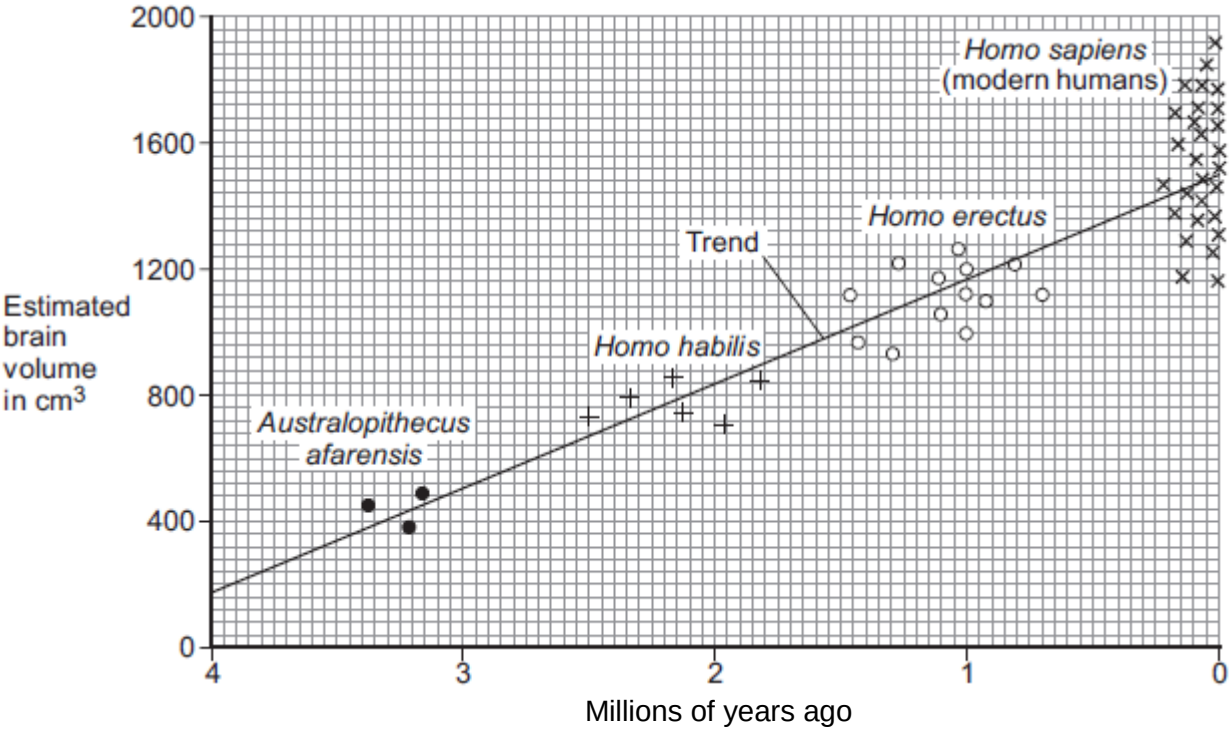
Q17.

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)

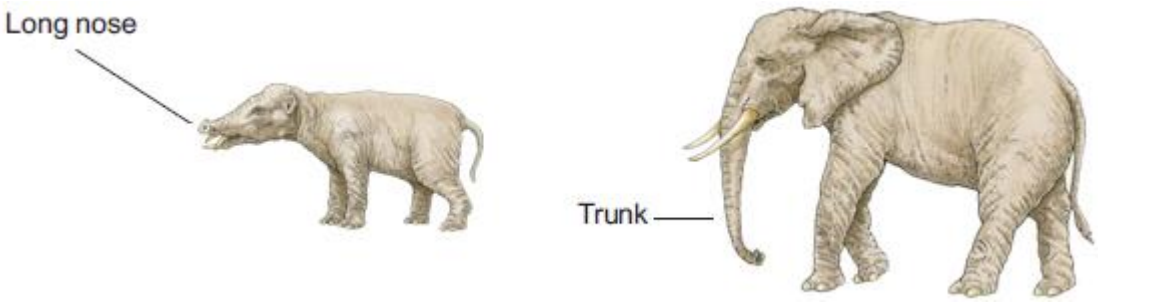
Q18.

The image below shows:

- *Phiomia*, an ancestor of elephants
- a modern African elephant.

Phiomia lived about 35 million years ago.

Phiomia **African elephant**



Both *Phiomia* and the African elephant reach up into trees to get leaves.

In the 1800s, Darwin and Lamarck had different theories about how the long nose of *Phiomia* evolved into the trunk of the African elephant.

(a) (i) Use Darwin's theory of natural selection to explain how the elephant's trunk evolved.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) Lamarck's theory is different from Darwin's theory.

Use Lamarck's theory to explain how the elephant's trunk evolved.

_____

_____

_____

_____

(2)

(b) (i) In the 1800s, many scientists could **not** decide whether Lamarck's theory or Darwin's theory was the right one.

Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(ii) Before the 1800s, many people had a different idea to explain where all the living things on Earth came from.

What idea was this?

_____

_____

(1)

(Total 9 marks)

Q19.

(a) Fossils provide evidence for what early life forms were like. From the evidence, scientists think that life began on Earth more than 3 billion years ago.

Many early life forms were soft-bodied.
Explain why this makes it difficult for scientists to be certain about what these early life forms were like.

_____

_____

_____

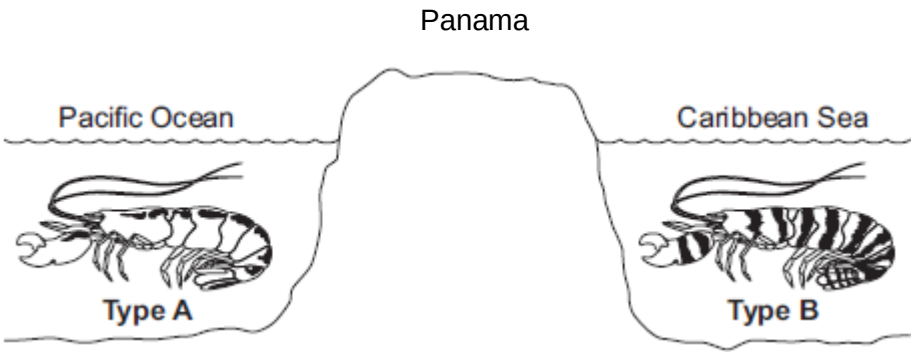
_____

_____

(2)

(b) The illustration below shows two types of pistol shrimp.

The shrimps live in shallow, tropical seas on opposite sides of Panama.



Not to scale

Scientists put one **Type A** shrimp and one **Type B** shrimp together in a tank of seawater.
The two types of shrimp snapped their claws aggressively at each other.
They did not mate.

The scientists said that this was evidence for the **Type A** and **Type B** shrimps being classified as two different species.

(i) Give **one** reason why the scientists' opinion may be correct.

_____

_____

(1)

(ii) Suggest **two** reasons why the scientists' opinion may **not** be correct.

1. _____

_____

2. _____

_____

(2)

(c) Panama is a narrow strip of land which today joins North America and South America.
It was formed by land moving up from beneath the sea. Panama has separated the Pacific Ocean and the Caribbean Sea for the past 3 million years.

Explain how two different species of pistol shrimp could have developed from an ancestral species of shrimp.

_____

_____

_____

_____

(6)

(Total 11 marks)

Q20.

(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 _____

_____

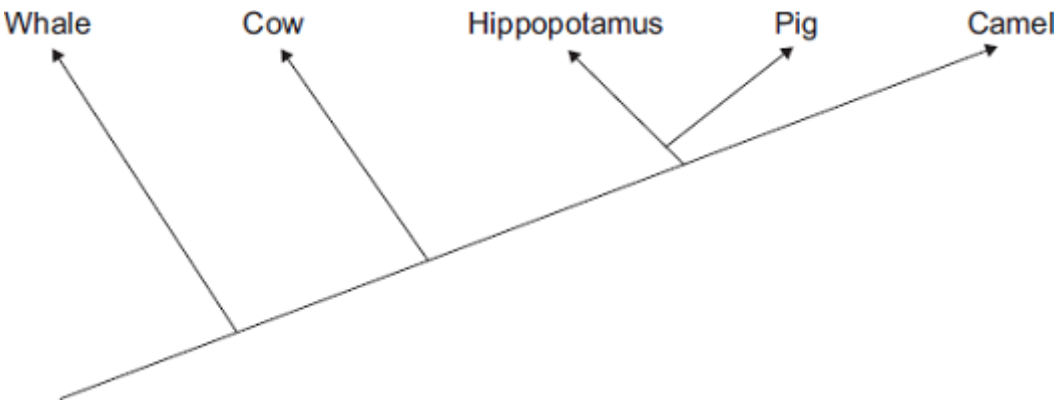
2 _____

_____

(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)

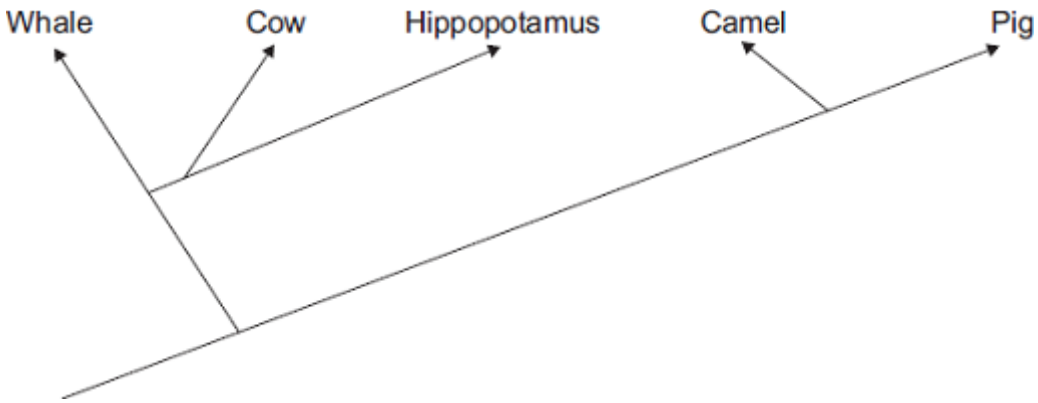
(ii) Which **two** of the animals in **Diagram 1** are most closely related?

_____ 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.

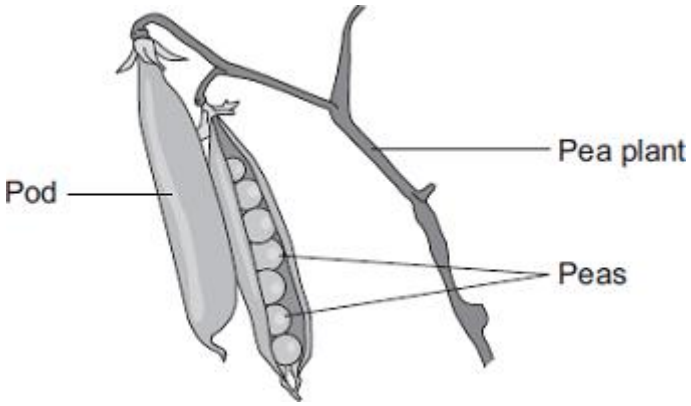
more powerful computers	new evidence from fossils	new species discovered

(1)

(Total 8 marks)

Q21.

Peas grow in pods on pea plants.



A gardener grew four varieties of pea plants, **A** , **B** , **C** and **D** , in his garden.
The gardener counted the number of peas in each pod growing on each plant.

The table shows his results.

Variety	Range of number of peas in each pod	Mean number of peas in each pod
A	2–6	4
B	3–7	5
C	3–8	6
D	6–8	7

(a) Give **one** environmental factor and **one other** factor that might affect the number of peas in a pod.

Environmental factor _____

Other factor _____

(2)

(b) The gardener thinks that he will get the largest mass of peas from his garden if he grows variety **D**.

Why is the gardener **not** correct?

Suggest **one** reason.

_____

(1)

(c) It is important that carbon is cycled through living things.

After he has picked the peas, the gardener puts the dead pea plants onto a compost heap.

Over the next few months, the carbon in the carbon compounds from the pea plants is returned to the air.

Describe how.

(4)

(Total 7 marks)

Q22.

Howea forsteriana and *Howea belmoreana* are two species of palm tree.

The two *species* grow together on a small island in the South Pacific.

(a) What is meant by the term *species* ?

(2)

(b) The table gives some information about these two species of palm tree.

	Howea forsteriana	***Howea belmoreana***
Optimum pH of the soil for growth of the palm tree	pH 8	pH 6

Height above sea level of most common habitat	30 to 60 metres	above 120 metres
Month when most palm trees flower	October	December
Method of pollination	Wind carries pollen	Wind carries pollen

Scientists believe that these two species of palm tree began to evolve from a single species over 2 million years ago.

Suggest how these two different species developed.

In your answer you should use information from the table and your own knowledge.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 7 marks)

Q23.

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. _____

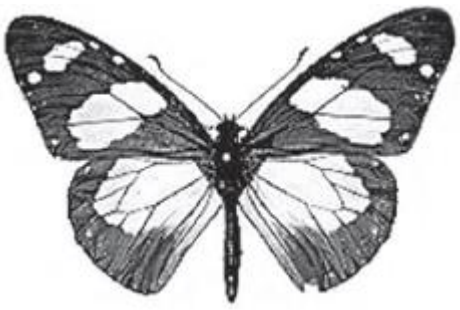
_____

(2)

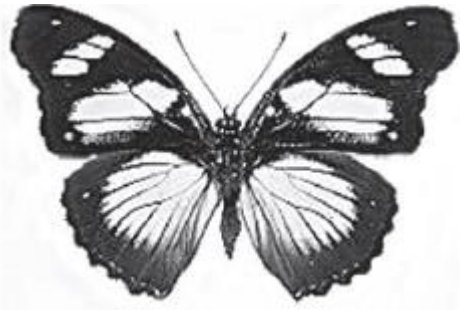
(Total 6 marks)

Q24.

The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.
- *Amauris* has an unpleasant taste which birds do **not** like, so birds have learned **not** to prey on it.

- *Hypolimnas* does **not** have an unpleasant taste but most birds do **not** prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

_____

_____

_____

_____

(2)

(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

_____

_____

_____

_____

_____

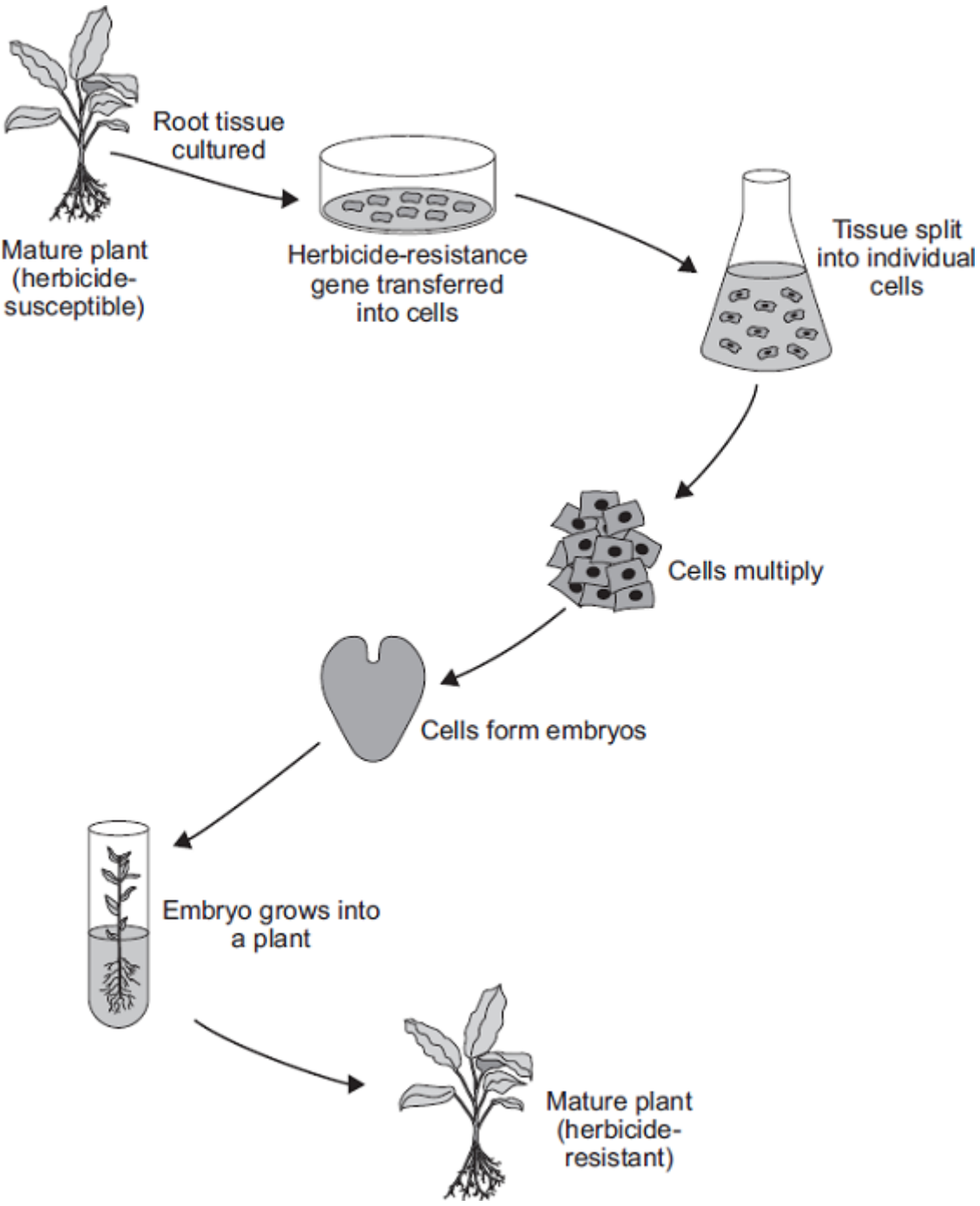
_____

(3)

(Total 5 marks)

Q25.

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



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

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

_____

_____

(1)

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

Explain why.

_____

_____

_____

_____

(2)

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

_____

_____

(1)

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

Suggest **one** reason why.

_____

_____

(1)

(Total 5 marks)

Q26.

There are two forms of peppered moth, dark and pale.
Birds eat the moths when the moths are resting on tree bark.

Pollution in the atmosphere may:

- kill lichens living on tree bark
- make the bark of trees go black.

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

Lichens are very sensitive to air pollution caused by

carbon dioxide.
nitrogen.
sulfur dioxide.

(1)

(b) The photographs show the two forms of peppered moth, on tree bark.

Tree bark covered with lichens Tree bark made black by pollution

(i) The dark form of the peppered moth was produced by a change in the genetic material of a pale moth.

Use **one** word from the box to complete the sentence.

characteristic	**clone**	**mutation**

A change in genetic material is called a _____

(1)

(ii) In the 19th century, pollution made the bark of many trees go black.

Explain why:

- the population of the pale form of the moth in forests decreased
- the population of the dark form of the moth in forests increased.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) (i) The larvae (young) of the peppered moths eat the leaves of birch trees.

The diagram shows the food chain:

birch trees → peppered moth larvae → birds

Draw a pyramid of biomass for this food chain.

Label the pyramid.

(2)

(ii) Which **two** reasons explain the shape of the pyramid you drew in part (c)(i)?

Tick (✓) **two** boxes.

Some material is lost in waste from the birds	☐
The trees are much larger than peppered moth larvae	☐
Peppered moth larvae do not eat all the leaves from the trees	☐
The trees do not use all of the Sun's energy	☐

(2)
(Total 9 marks)

Q27.

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.

asexual

(a) Cows produce their young (calves) by

reproduction.
cloning.
sexual reproduction.

(1)

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

(i) The information for characteristics is carried by

clones.
embryos.
genes

(1)

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

body cells.
gametes.
neurones.

(1)

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

The information shows features of Friesian and Jersey cows.

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

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

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

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

1. _____

_____

2. _____

_____

(2)

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

1. _____

_____

2. _____

_____

(2)

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

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

(i) What is *genetic engineering* ?

Tick (✓) **one** box.

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

(1)

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

Give **one** reason why.

_____

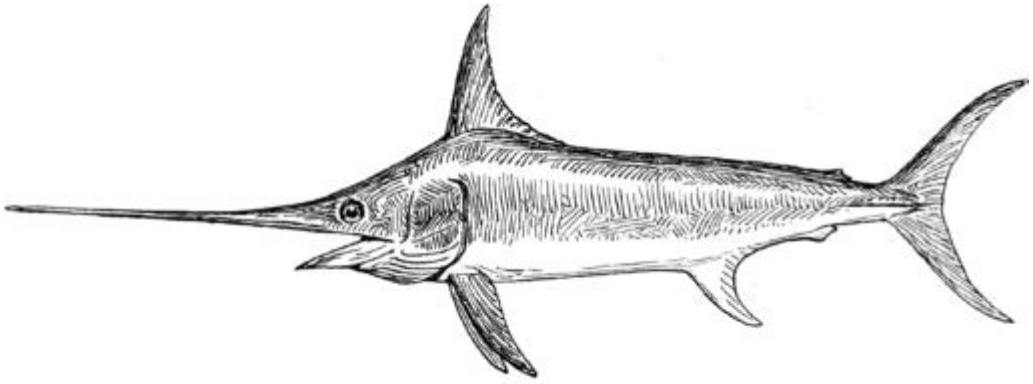
_____

(1)

(Total 9 marks)

Q28.

The picture shows a modern swordfish.

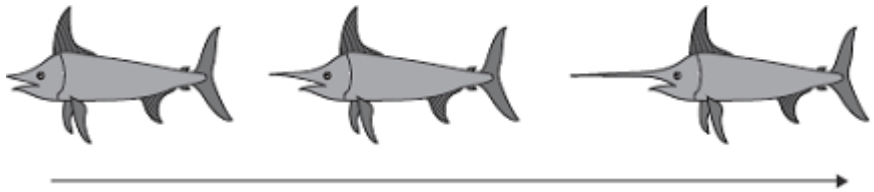


By Pearson Scott Foresman [Public domain], via Wikimedia Commons

Ancestors of swordfish had short swords. Modern swordfish have long swords. Swordfish use their swords to injure prey. The injured prey are easier to catch.

The information in the box shows one theory of how the length of the sword of swordfish changed.

The sword grew longer as each swordfish used its sword more and more.
Each time a swordfish reproduced, the longer sword was passed on to its offspring.



Many generations

(a) Which scientist suggested the theory shown in the box?

_____

(1)

(b) (i) Darwin suggested that evolution is a result of natural selection.

Describe how natural selection could result in modern swordfish with long swords
developing from ancestors with short swords.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) Scientists in the 1800s accepted both the theory shown in the box, and Darwin's theory.

Now most scientists only accept Darwin's theory.

Give **one** reason why.

_____

_____

_____

(1)

(Total 6 marks)

Q29.

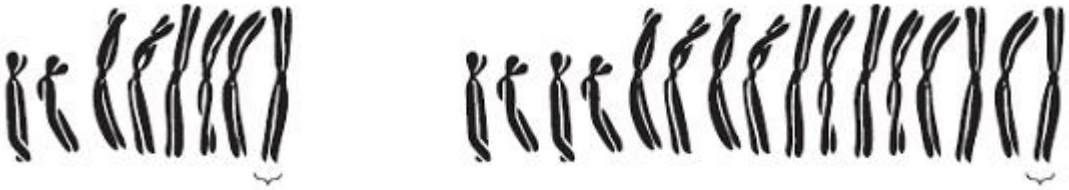
The photographs show the flowers of two closely-related species of plant.

Species A Species B

Images: © iStock/Thinkstock

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

Species A Species B



One chromosome **One chromosome**

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

(i) How does a chromosome become two strands?

_____

_____

(1)

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

_____

_____

_____

_____

(2)

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

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

(1)

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

Species A ☐ **Species B** ☐

(1)

(iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.
How many chromosomes would there be in each cell of one of the offspring plants? ☐

(1)

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

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

_____

_____

_____

_____

(2)

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

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

Species A Species B

The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

_____

_____

_____

_____

_____

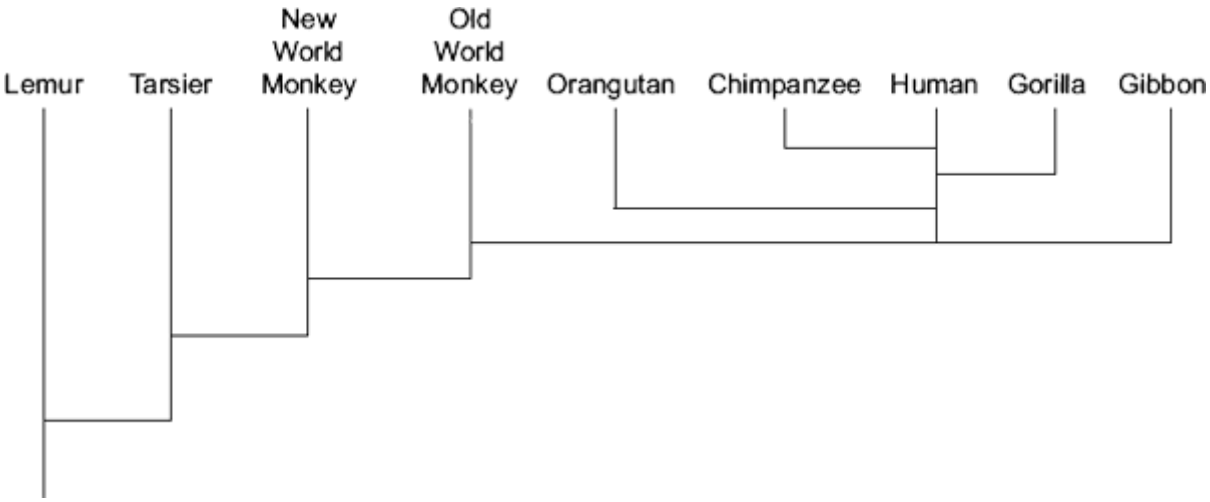
_____

(2)

(Total 10 marks)

Q30.

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)

Q31.

The photograph shows a zorse.

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

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

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

(i) What is *sexual reproduction?*

_____

_____

(1)

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

_____

_____

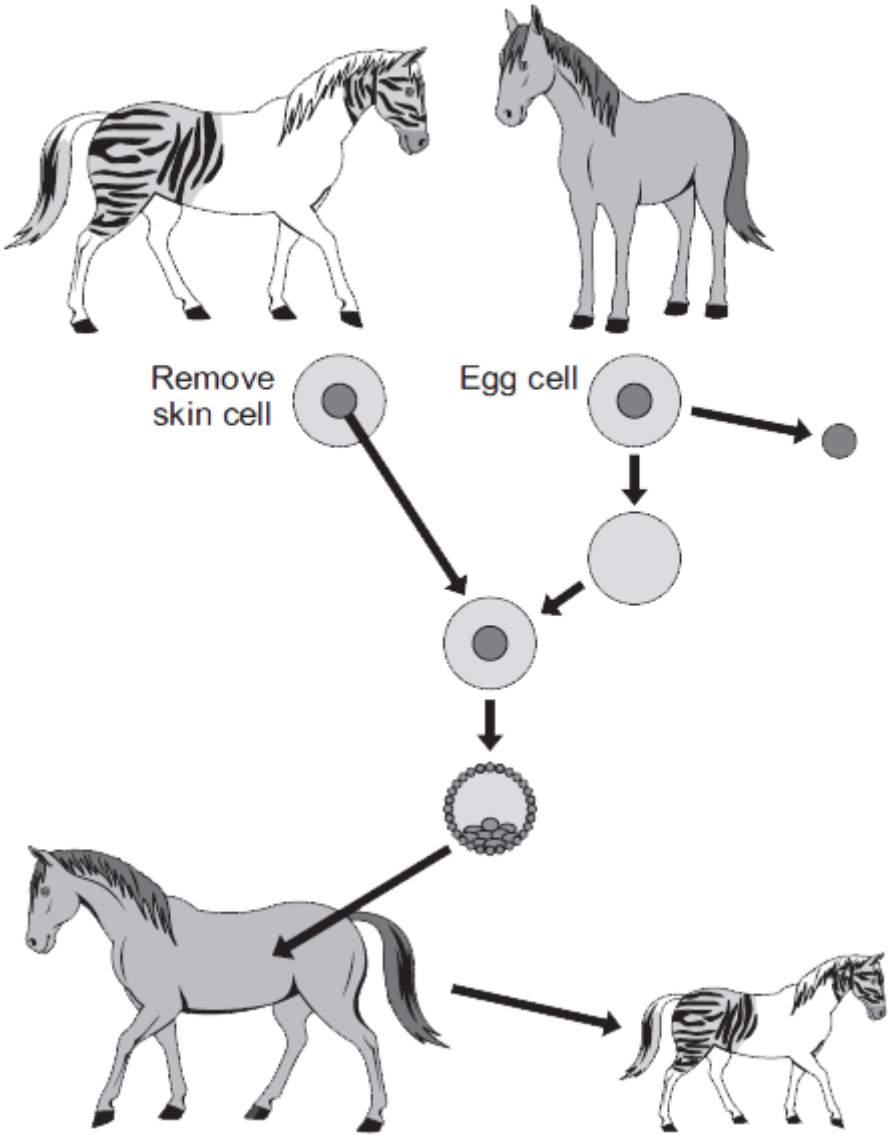
_____

_____

(2)

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

The diagram shows how the scientists might clone a zorse.



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

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

(6)

(Total 9 marks)

Q32.

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

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

In 2006 Blue-moon butterflies almost became extinct.

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

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

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

What scientific term describes a change in a gene?

_____

(1)

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

Suggest why.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 5 marks)

Q33.

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

Photographs supplied by iStockphoto/Thinktsock

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

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

The baby kangaroo was produced by _____ reproduction.

The coat colour of the adult kangaroo is a _____

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

_____ of a gene.

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

(4)

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

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

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

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

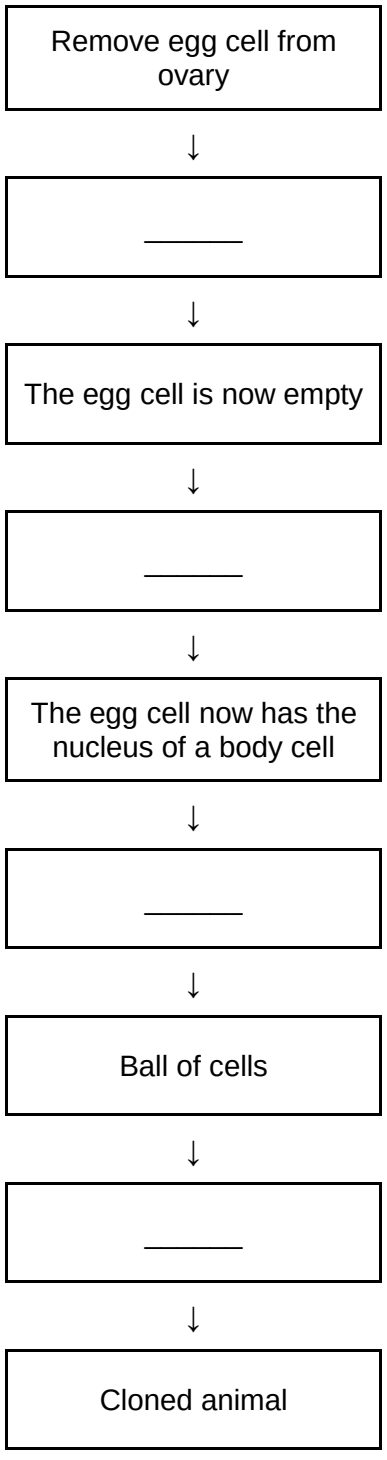
Each number should be used **once** only.

1 Give a small electric shock

2 Transfer nucleus from body cell

3 Remove nucleus from egg cell

4 Insert embryo into womb of female



(3)

(Total 7 marks)

Q34.

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

How does sexual reproduction produce variation?

_____

_____

_____

_____

(2)

(b) A salmon is a type of fish.

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

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

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

_____

_____

_____

_____

_____

_____

(3)

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

Suggest **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q35.

When animals die, they usually fall to the ground and decay.

In 1977 the body of a baby mammoth was discovered.
The baby mammoth died 40 000 years ago and its body froze in ice.

The picture shows the mammoth.

By Thomas Quine [CC BY-SA 2.0], via Wikimedia Commons

(a) Explain why the body of the baby mammoth did **not** decay.

_____

_____

_____

_____

(2)

(b) Mammoths are closely related to modern elephants.
The pictures show these two animals.

What scientists think a mammoth looked like

By WolfmanSF (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

Modern elephant

By Caitlin from Hertfordshire, UK [CC-BY-2.0], via Wikimedia Commons

Mammoths are *extinct*. What does *extinct* mean?

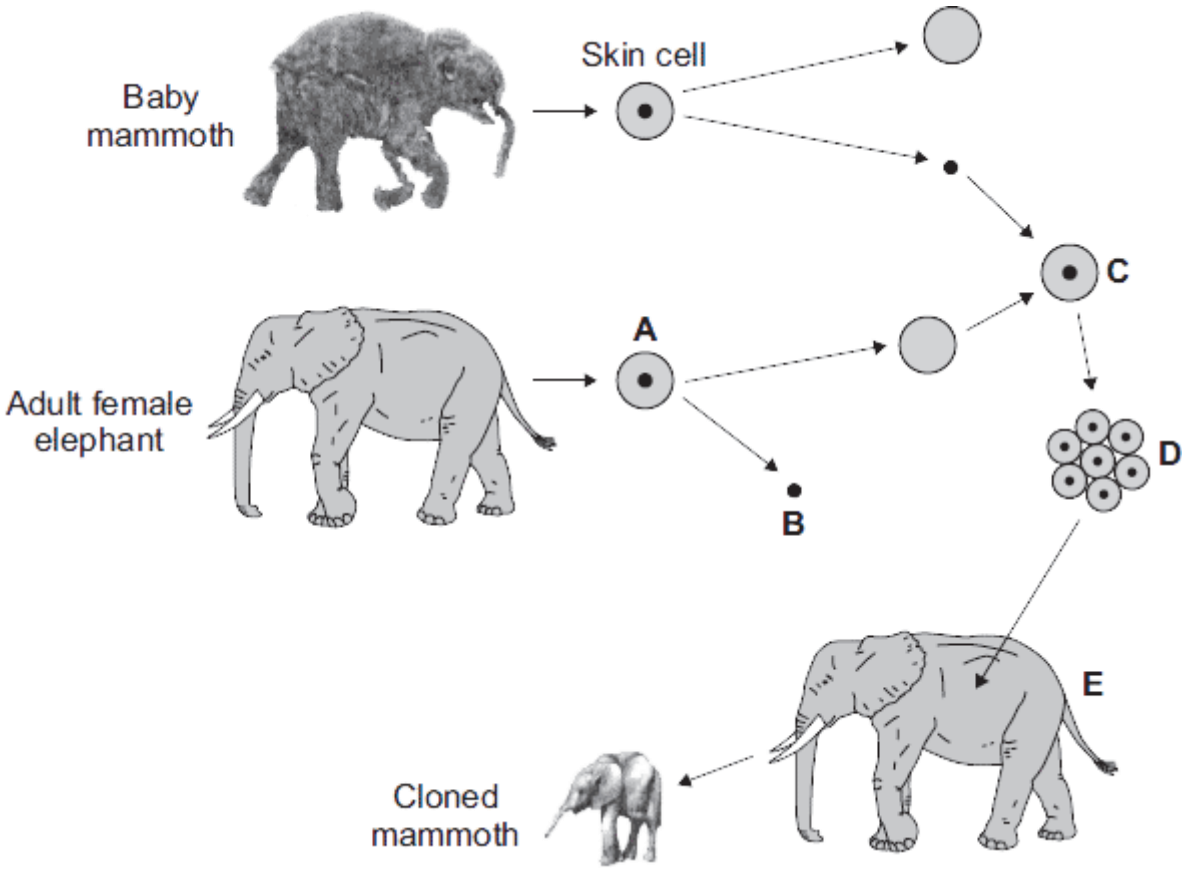
_____

(1)

(c) Scientists believe they may be able to use adult cell cloning to recreate a living mammoth.

The scientists will use a skin cell from the baby mammoth.

The diagrams show how the skin cell will be used.



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

(i) What type of cell is cell **A**?

skin cell **egg cell** **sperm cell**

(1)

(ii) Part **B** is removed from cell **A**.

What part of the cell is part **B**?

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

(1)

(iii) After cell **C** is formed, it divides into embryo cells.

What is done to cell **C** to make it divide?

treated with enzymes.

Cell **C** is

mixed with sperm cells.
given an electric shock.

(1)

(iv) The embryo cells form a ball of cells. The ball of cells will be put into female elephant, **E**.

Which part of elephant **E** is the ball of cells put into?

womb **stomach** **ovary**

(1)

(d) The scientists expect any offspring of the adult cell cloning to look like a mammoth and **not** like an elephant.

Why?

_____

_____

(1)

(Total 8 marks)

Q36.

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)

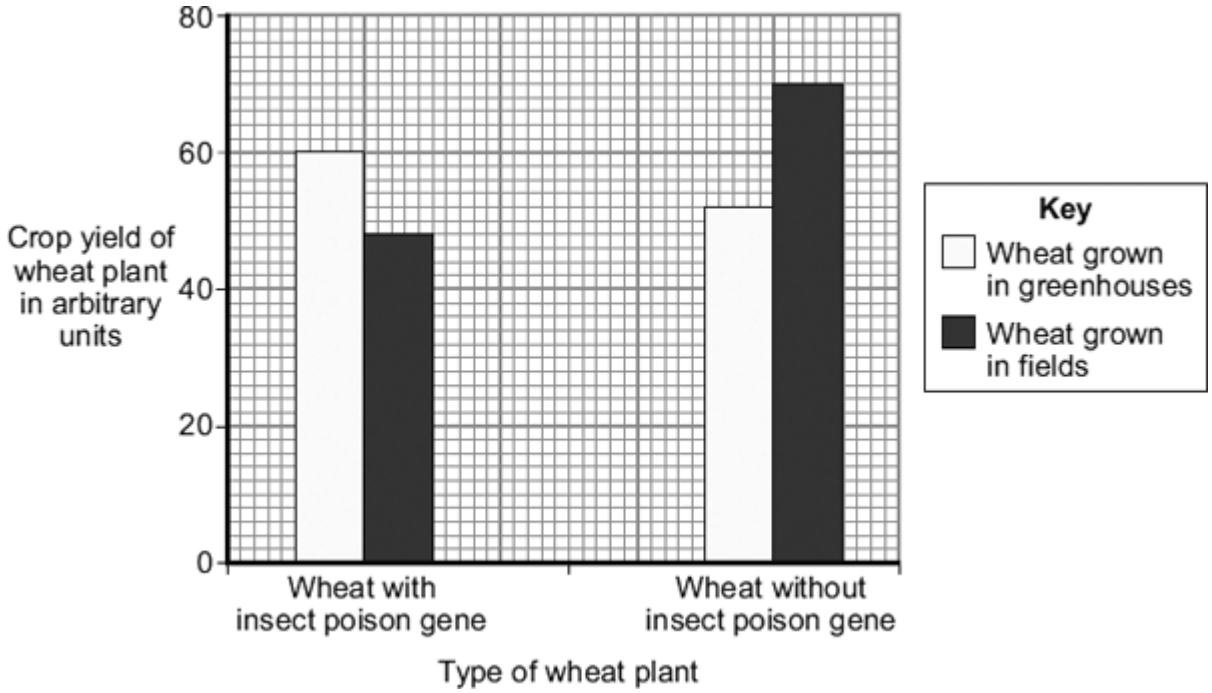
(b) A microorganism contains a gene which causes the production of an insect poison.

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)

Q37.

The picture shows a zebra fish.

Illustration © Emily S. Damstra

Zebra fish are small freshwater fish that usually have black and silver stripes.
Zebra fish can tolerate a wide range of environmental conditions.

(a) Scientists have genetically modified zebra fish to act as pollution indicators.
The genetically modified zebra fish have a gene transferred from a jellyfish.
The gene allows the stripes of the zebra fish to change colour.

Describe how the scientists produced the genetically modified zebra fish.

(3)

(b) Some scientists are worried about the production of genetically modified zebra fish.

Suggest reasons why.

(2)

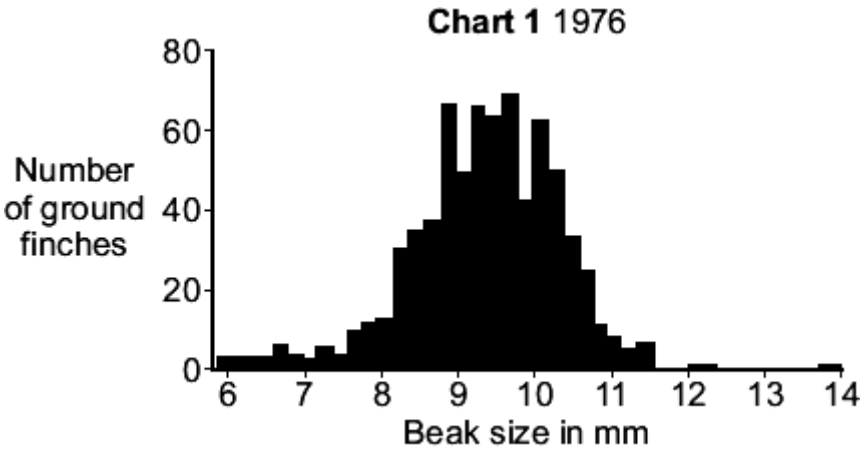
(Total 5 marks)

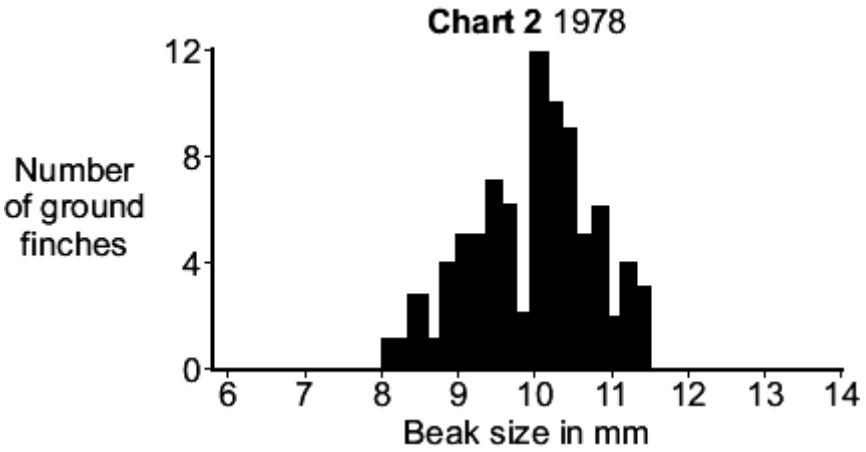
Q38.

The Galapagos Islands are in the Pacific Ocean, 1400 km from South America.
A type of bird called a ground finch lives on the islands.
The picture shows a ground finch.

By Charlesjsharp (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

The size of the seeds the ground finch can eat depends upon the size of the beak.
To eat large seeds, a large beak is needed.
The bar charts show the sizes of the beaks of ground finches on **one** island, in 1976 and in 1978.





(a) The population of the ground finches and their beak sizes changed between 1976 and 1978.

Describe these changes.

_____

_____

_____

_____

_____

_____

(3)

(b) In 1977 there was very little rain on the island. The lack of rain affected the seeds that the finches ate.
The table shows how the seeds were affected.

Year	Mean number of seeds per m^2	Mean mass of each seed in mg
1976	8.5	3.5
1978	2.8	4.2

Suggest an explanation for the changes in beak sizes between 1976 and 1978.

(4)

(Total 7 marks)

Q39.

(a) How do fossils provide evidence that species alive today have evolved from simpler organisms?

(3)

(b) The photographs show two species of gull.

Herring gull (*Larus argentatus*)

By Ken Billington (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

Lesser black-backed gull (*Larus fuscus*)

By Andreas Trepte (Own work) [CC-BY-SA-2.5], via Wikimedia Commons

Both species are now found in the UK but the two species cannot interbreed with

each other. Scientists believe that these two species have evolved from a common ancestor.

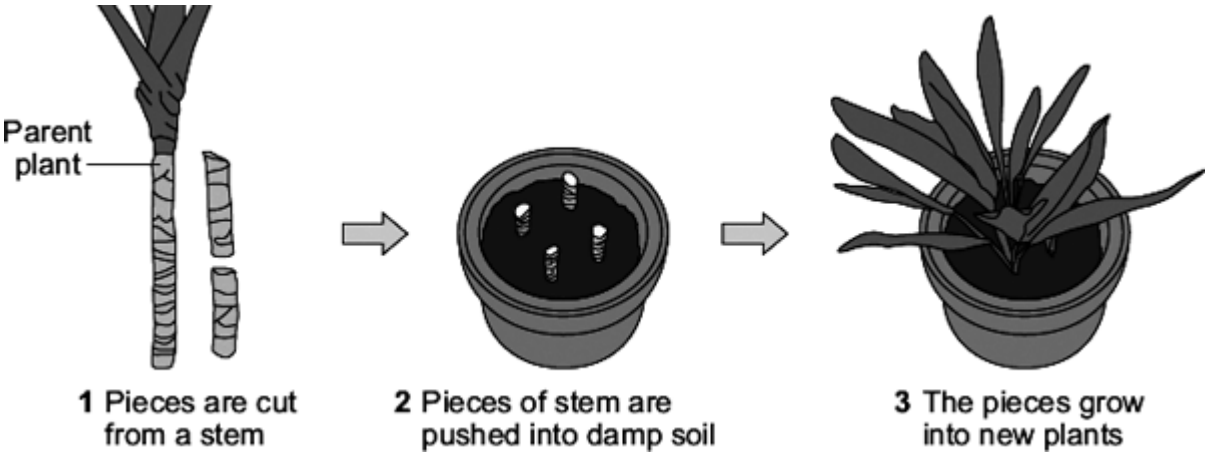
The map on the next page shows a view of the Earth from above the North Pole. The map also shows where these two species are found.

Suggest an explanation for the development of these different species.

(6)
(Total 9 marks)

Q40.

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



Use words from the box to complete the sentences.

asexual	characteristics	clones	engineering	genes	sexual

The colour and shape of the leaves are known as _____

The information for leaf colour is stored in parts of chromosomes

called _____

The new plants are known as _____

The new plants have been produced by _____ reproduction.

(4)

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

_____

(1)

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

_____

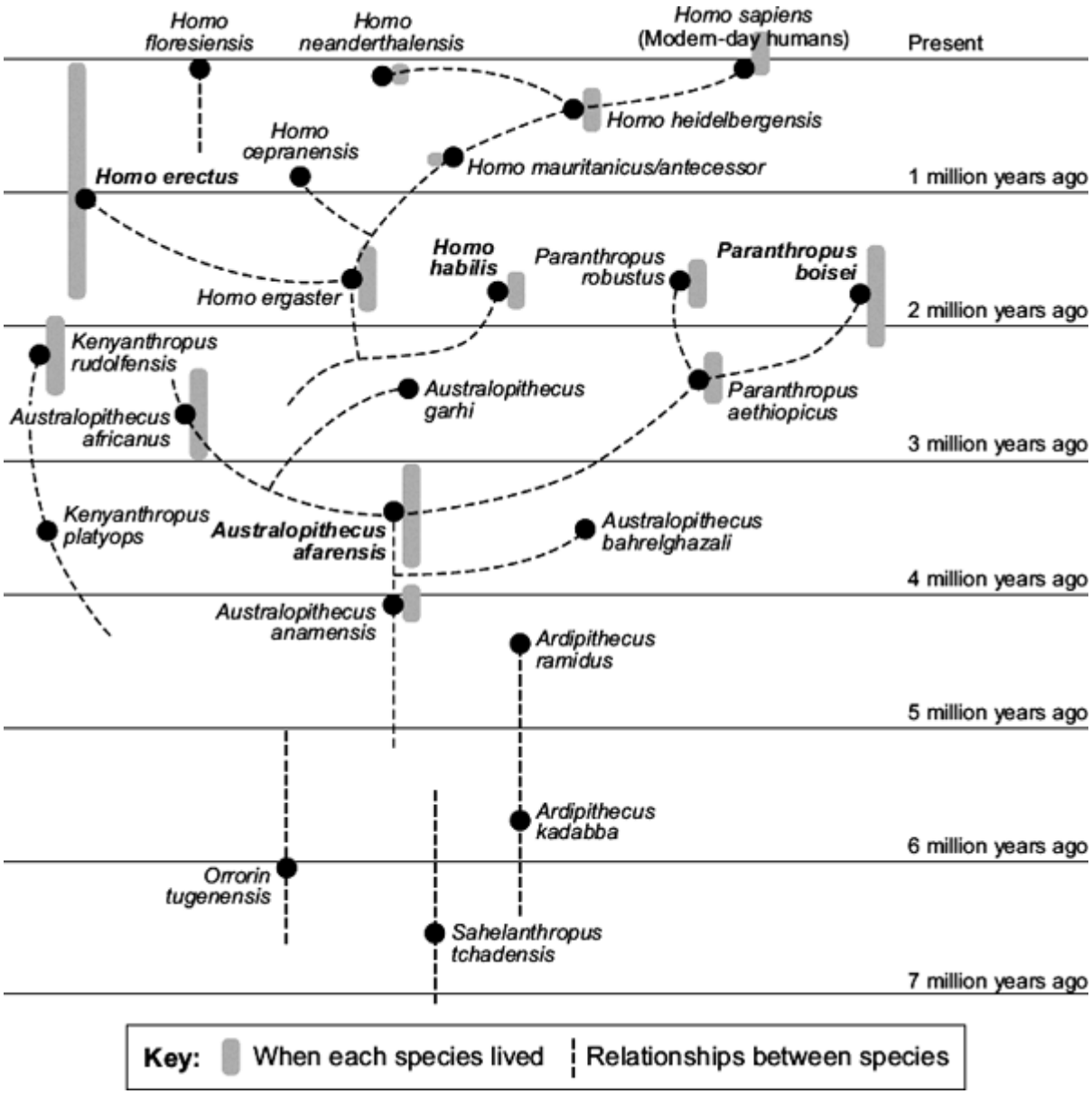
(1)

(Total 6 marks)

Q41.

The diagram shows an evolutionary tree for humans.

The diagram is based on a study of fossils.



(a) When did *Australopithecus afarensis* first appear?

_____ million years ago.

(1)

(b) Which species was the direct ancestor of *Paranthropus boisei*?

_____

(1)

(c) Which species is most closely related to *Homo habilis?*

_____

(1)

(d) About 250 fossils of *Homo erectus* have been found. About 50 of these fossils have been found in China.

A Chinese scientist has suggested the hypothesis that Chinese people evolved from *Homo erectus*.

Most scientists do **not** agree with this hypothesis.

Use the information above and information from the diagram to suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(e) Darwin suggested the theory of natural selection. It was a long time before this theory was accepted by most scientists.

Give **two** reasons why it took a long time.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q42.

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

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

Explain why.

_____

_____

_____

_____

_____

(2)

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

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

_____

_____

(1)

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

_____

_____

_____

_____

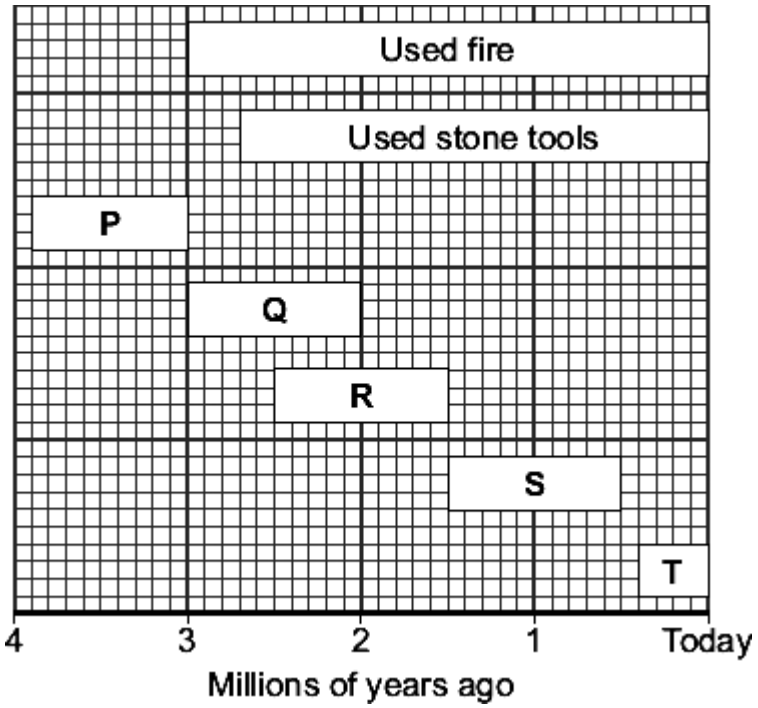
_____

(2)

(Total 5 marks)

Q43.

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)

Q44.

We can now produce organisms with the characteristics we want the organisms to have.

List A gives the names of four ways of producing organisms.

List B gives information about the ways of producing organisms.

Draw **one** line from each way of producing organisms in **List A** to the correct information in **List B**.

List A **Ways of producing organisms**	**List B** **Information**
	Taking part of the stem from a plant, then putting this part of the stem in wet soil in a plant pot.
Embryo transplantation	
	Growing groups of cells from a plant on special jelly.
Genetic engineering	
	Transferring genes from one organism to a different organism.
Taking cuttings	
	Growing plants from seeds in a garden.
Tissue culture	
	Separating groups of cells from

a very young developing animal then putting the groups of cells into host mothers.

(Total 4 marks)

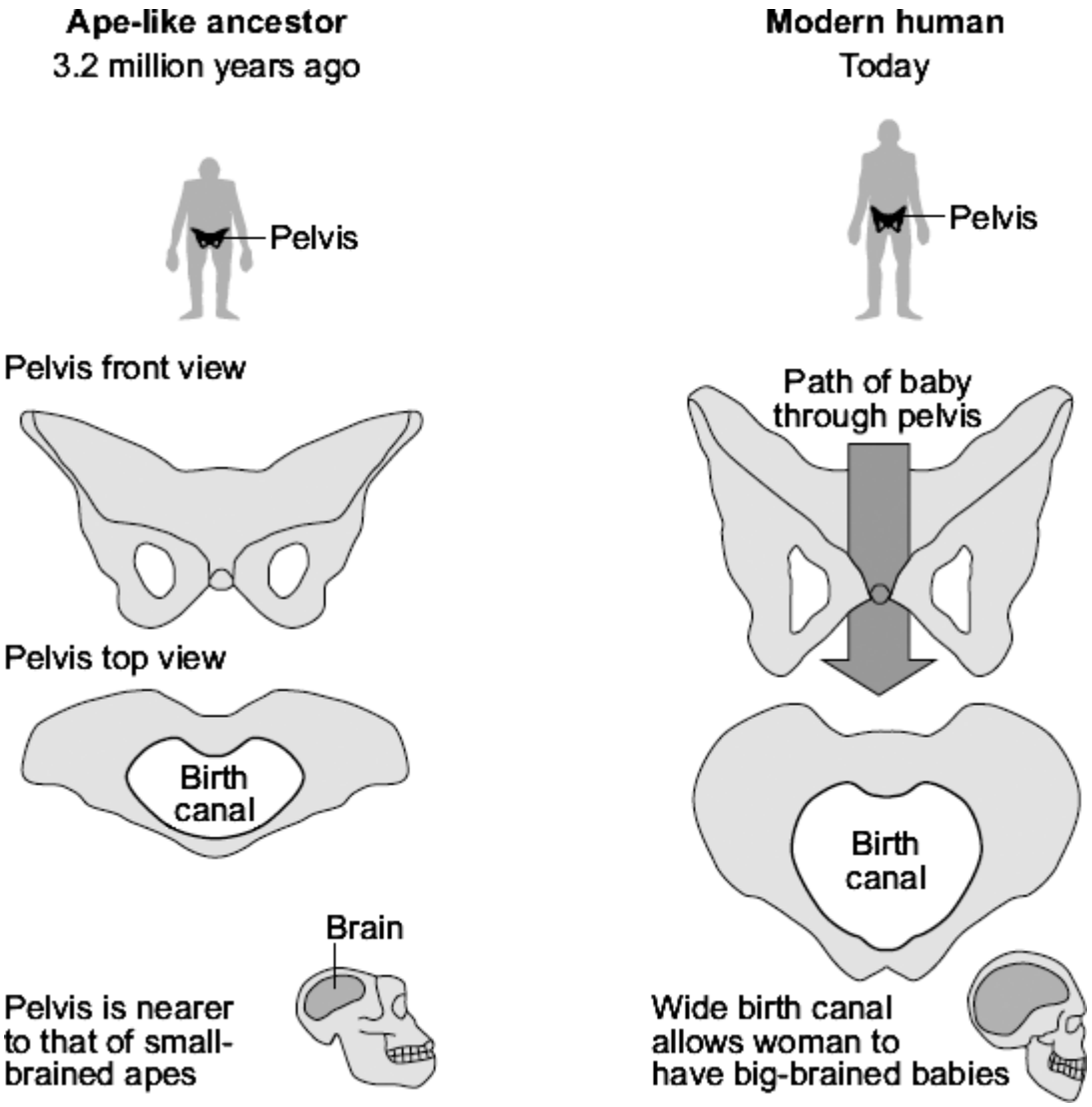
Q45.

Humans have evolved from ape-like ancestors by natural selection.

The drawing shows the pelvis of an ape-like ancestor and a modern human.

The skull and brain of the new born baby are also shown to the same scale.

Modern humans are much more intelligent than their ape-like ancestors.



Suggest an explanation for the evolution of the size and shape of the pelvis of modern humans.

Use information from the drawing to help you.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q46.

Scientists have brought an extinct species of mountain goat, the Pyrenean ibex, 'back to life'. These scientists used skin cells from preserved Pyrenean ibex in cloning experiments.

The Scientists:

- removed the nuclei from domestic goat egg cells
- transferred cell nuclei from the skin cells of the Pyrenean ibex into domestic goat egg cells
- used the domestic goats as surrogate mothers for the embryos that developed.

The scientists made 439 cloned embryos, but only 57 were suitable for transfer into the surrogate goat mothers. Only seven of the goats got pregnant and only one live offspring was born.

Some biologists are very worried about using cloning to preserve endangered animals, because cloned animals often have developmental problems. Some endangered animals are difficult to breed in captivity. For these animals cloning is another way to continue the genetic line.

The biggest threats to endangered animals today are habitat loss, illegal hunting, pollution and climate change. Many scientists say that cloning is not as important as trying to preserve the wild places on Earth. The wild places are being lost very quickly and the animals and plants living in the wild places are dying out.

(a) The Pyrenean ibex was 'brought back to life'.

How is this process different from using adult cell cloning to clone a pet animal?

_____

_____

(1)

(b) Evaluate the use of adult cell cloning to conserve endangered species.

Use the information given and your own knowledge and understanding.

Remember to give a conclusion to your evaluation.

_____

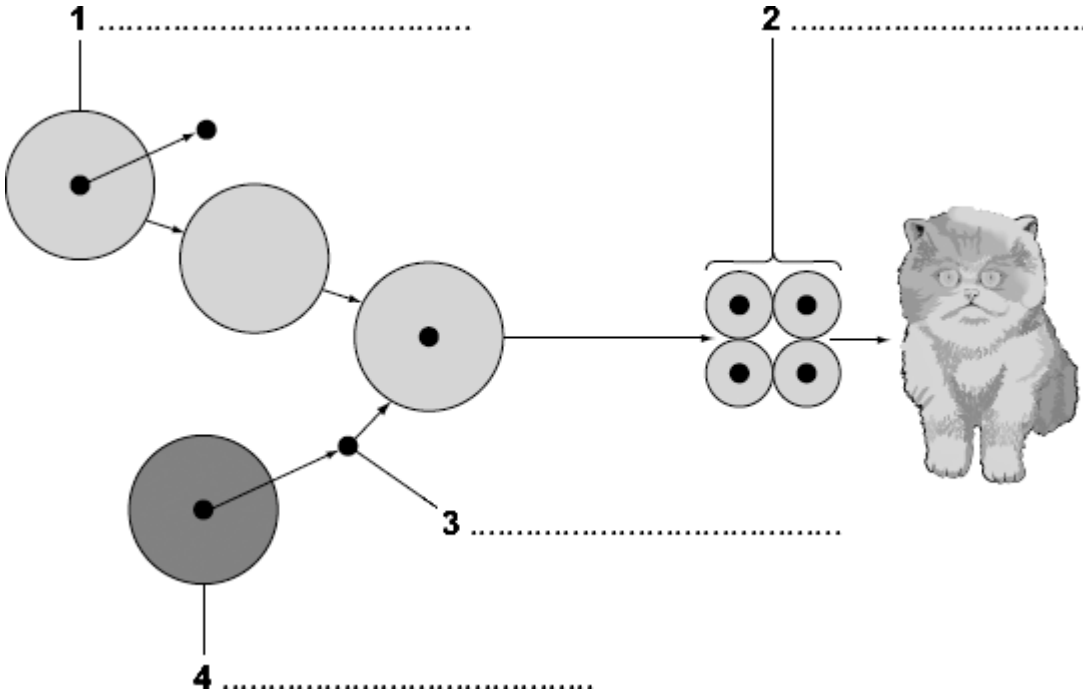
(4)

(Total 5 marks)

Q47.

It is possible to clone pets.

The diagram shows one way of cloning a pet cat, using the nucleus from a cat skin cell.



embryo	**egg**	**nucleus**	**skin cell**	**sperm**

(a) Use words from the box to label structures **1**, **2**, **3** and **4** on the diagram.

(4)

(b) The cloning of humans is not allowed.

Tick (✓) **one** box to complete the sentence.

One **ethical** reason for banning the cloning of humans is that . . .

the method used in animal cloning has not been evaluated. ☐

the method is very expensive. ☐

the child created by cloning would not have been able to give permission. ☐

(1)

(Total 5 marks)

Q48.

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)

Q49.

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.

Suggest an explanation for the evolution of the wild Soay sheep over the last 25 years.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q50.

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

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

1. _____

_____

2. _____

_____

(2)

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

Explain why.

_____

_____

_____

_____

(2)

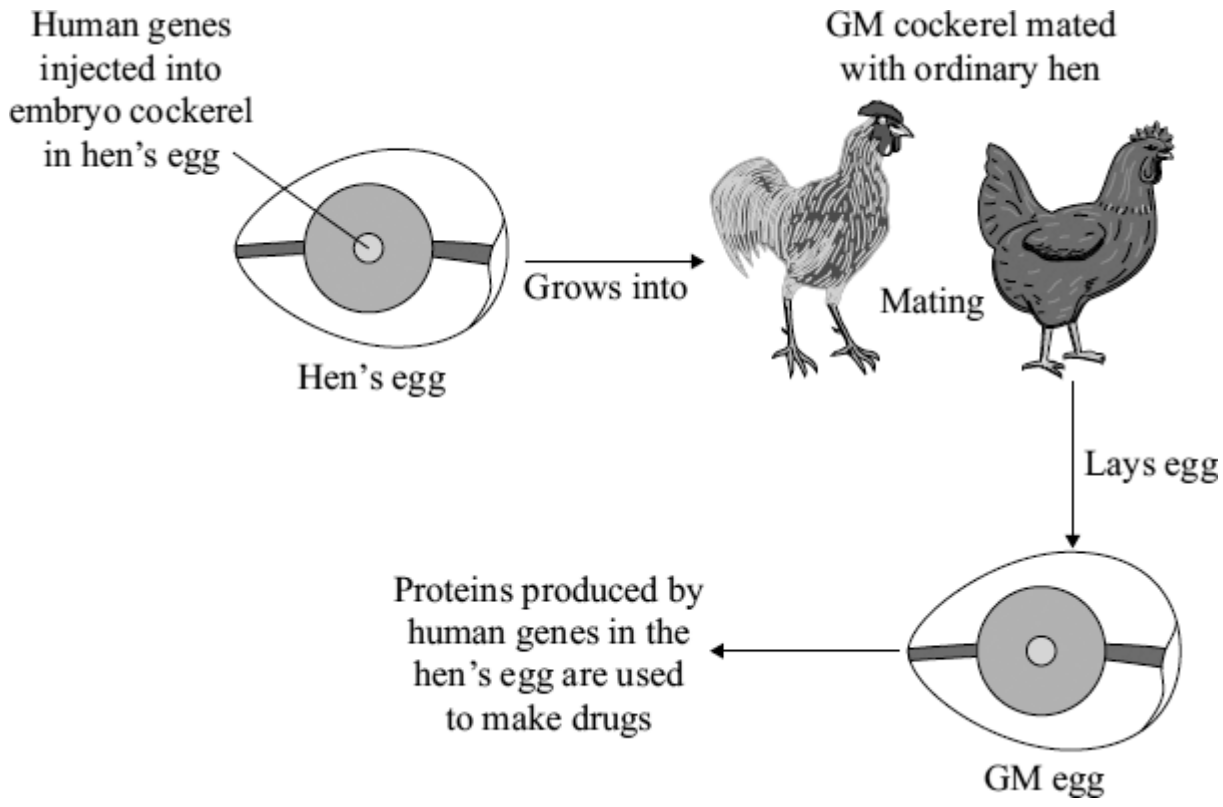
(Total 4 marks)

Q51.

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)

Q52.

Charles Darwin proposed the theory of natural selection.

(a) What is meant by natural selection?

_____

_____

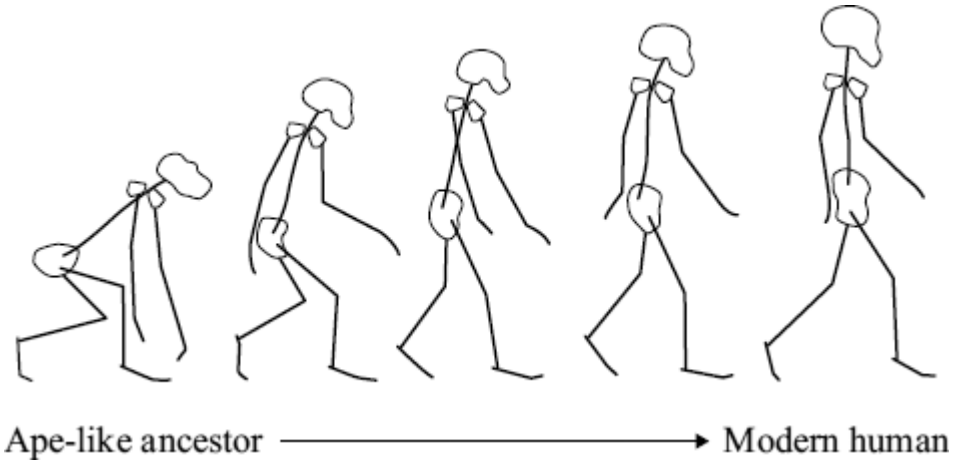
_____

_____

(2)

(b) The drawings show stages in the evolution of the human skeleton.

All the drawings are to the same scale.



Use information from the drawings to describe **two** trends in the evolution of the human skeleton.

1. _____

_____

2. _____

_____

(2)

(c) Darwin said that humans had evolved from ape-like ancestors.

Many people disagreed with him at the time.

Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(d) Lamarck's theory of evolution stated that useful changes which occur in an organism during its lifetime will be inherited by its offspring.

Give **one** way in which Darwin's theory differs from Lamarck's.

_____

_____

(1)

(Total 7 marks)

Q53.

We breed animals with the characteristics that we prefer.

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

Photograph supplied by iStockphoto/Thinkstock

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

characteristic	**chromosome**	**gene**	**gamete**

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

(1)

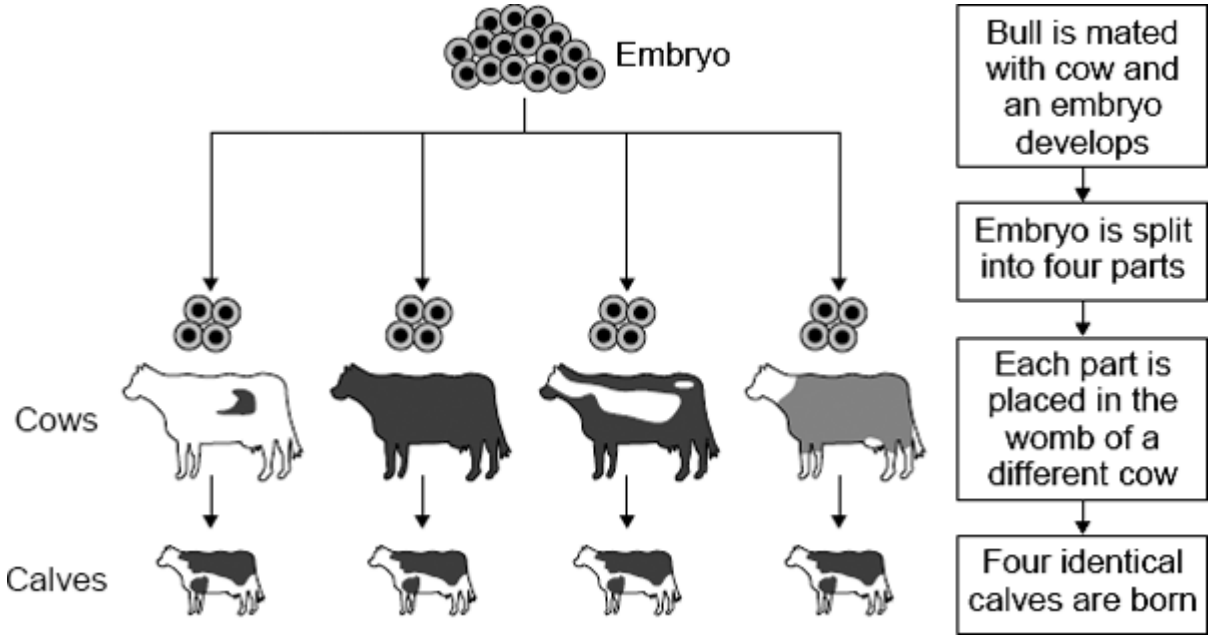
(ii) This colour is controlled by a _____

(1)

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

(1)

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



Use words from the box to complete the sentences.

asexual	clones	cuttings	gametes	genetic	sexual

A bull was mated with a cow.

This is _____ reproduction.

The embryo produced was split into four parts.

The calves in the diagram have identical genetic information.

This is because the calves were produced by _____ reproduction.

The identical calves are known as _____

(3)

(Total 6 marks)

Q54.

The photograph shows an *Anolis* lizard. This lizard lives on a tiny island.

By Paul Hirst (Phirst) (Own work) [CC-BY-SA-2.5], via Wikimedia Commons

Scientists investigated how the leg length of the *Anolis* lizards affected their survival. At the start of the investigation the *Anolis* lizards had a large range of leg lengths.

- The scientists placed six *Curly-tailed* lizards onto the island.
- The *Curly-tail* lizard is a predator of the *Anolis* lizard.
- After one year the population of *Anolis* lizards had halved.
- Nearly all the remaining *Anolis* lizards had long legs.

(a) Why did the population of *Anolis* lizards halve?

_____

_____

(1)

(b) The remaining *Anolis* lizards had long legs.

Suggest an explanation for this.

_____

_____

_____

_____

_____

(2)

(c) Answer each of these questions by placing a tick (✓) in the correct box.

(i) Which theory is supported by evidence from this investigation?

Global warming ☐

Natural selection ☐

Sustainability ☐

(1)

(ii) Which scientist proposed this theory?

Darwin ☐

Lamarck ☐

Semmelweiss ☐

(1)

(Total 5 marks)

Q55.

Scientists have recently cloned a mouse that had died and been frozen for 16 years.

(a) Explain what is meant by a clone.

_____

_____

_____

_____

(2)

(b) The scientists used an egg cell from a living mouse and the genetic material from a brain cell of the frozen mouse.

Describe how the process of adult cell cloning could be used to clone the frozen mouse.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) People could ask scientists to use this technique to clone long-dead relatives, whose bodies have been deep-frozen.

Most people would be opposed to cloning a human from a deep-frozen, long-dead relative.

Give **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q56.

The photograph shows some flamingos.

By Charles J Sharp (Own work) [GFDL, CC-BY-SA-3.0 or CC-BY-2.5], via Wikimedia Commons

- Flamingos feed on organisms that live in mud at the bottom of lakes.

- Leopards prey on flamingos.
- Flamingos find it difficult to fly if their feathers get wet.

Flamingos have evolved very long legs.

How would each of the following theories explain the evolution of these long legs?

(a) Darwin's theory

(3)

(b) Lamarck's theory.

(2)

(Total 5 marks)

Q57.

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.

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)

Q58.

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)

Q59.

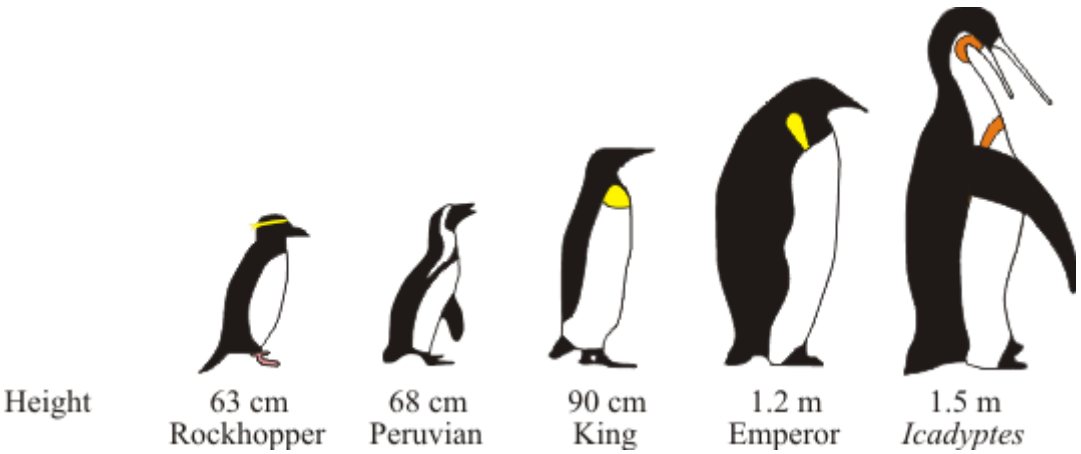
(a) Explain, as fully as you can, how natural selection leads to evolution.

(3)

(b) Most penguins live in cold climates. The modern penguin best adapted for cold conditions is the emperor penguin.

Scientists have found fossils of a 'giant' penguin which they have called *Icadyptes*.

The diagram shows how the size of modern penguins compares with *Icadyptes*.



The scientists were surprised to discover that *Icadyptes* lived in warm seas at a time when the Earth's climate was much warmer than it is now.

Explain why the scientists were surprised that *Icadyptes* lived in warm seas.

(2)

(Total 5 marks)