Variation and Evolution

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

Level: GCSE AQA Biology 8641

Subject: Biology

Exam board: GCSE AQA

Topic: Variation and Evolution

Q1.

Fossils give evidence about organisms that lived a long time ago.

(a) Scientists have found very few fossils of the earliest life forms.

Give **one** reason why.

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(1)

Below is a photograph of a fossilised fish.

(b) Suggest how the fossil in the photograph above was formed.

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(2)

(c) The species of fish shown in the photograph above is now extinct.

Give **two** possible causes of extinction.

1. _____

2. _____

(2)

Modern fish species have evolved from fish that lived a long time ago.

Evolution is caused by mutation and natural selection.

(d) What is a mutation?

Tick **one** box.

A change in a gene	☐
Accidental damage to an organism	☐
An organism with a new characteristic	☐
The loss of a species	☐

(1)

(e) Describe the process of natural selection.

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(3)

(Total 9 marks)

Q2.

Cell division is needed for growth and for reproduction.

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

Complete the table.

Tick **one** box for each statement.

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

(2)

Bluebell plants grow in woodlands in the UK.

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

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

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

1.

_____

_____

_____

_____

2.

(2)

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

(4)

(Total 8 marks)

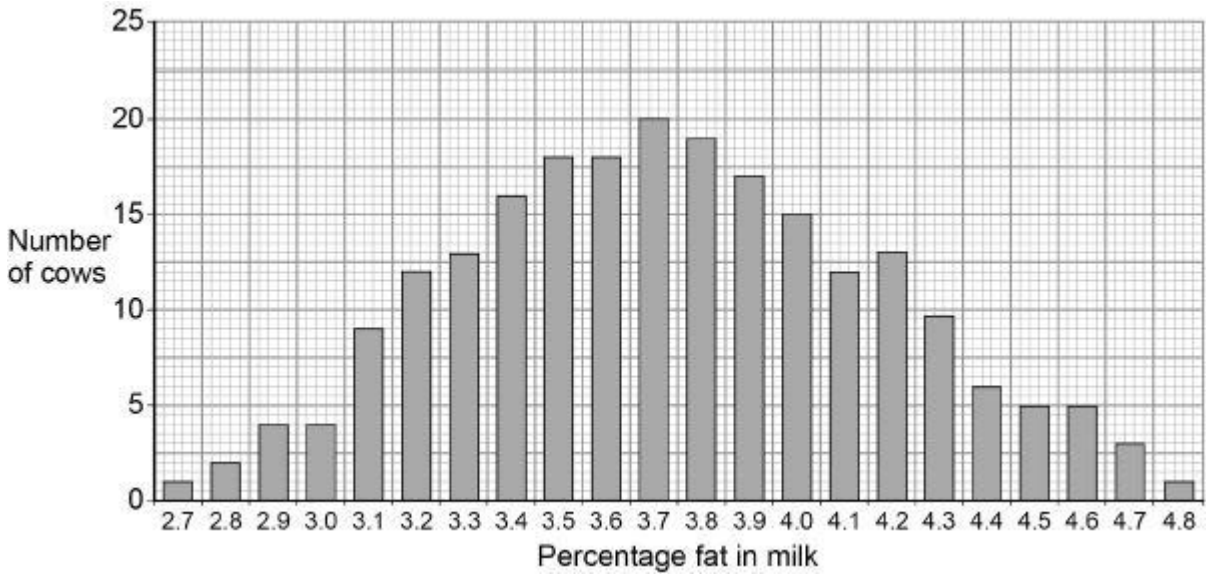
Q3.

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

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

The cows were all the same type.

Figure 1



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

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

Mean percentage = _____

(1)

(b) A student suggested:

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

How many different phenotypes would this produce?

Tick **one** box.

2	☐	3	☐	22	☐	46	☐

(1)

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

_____

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(1)

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

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

The mutation changes one amino acid in the enzyme molecule.

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

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(3)

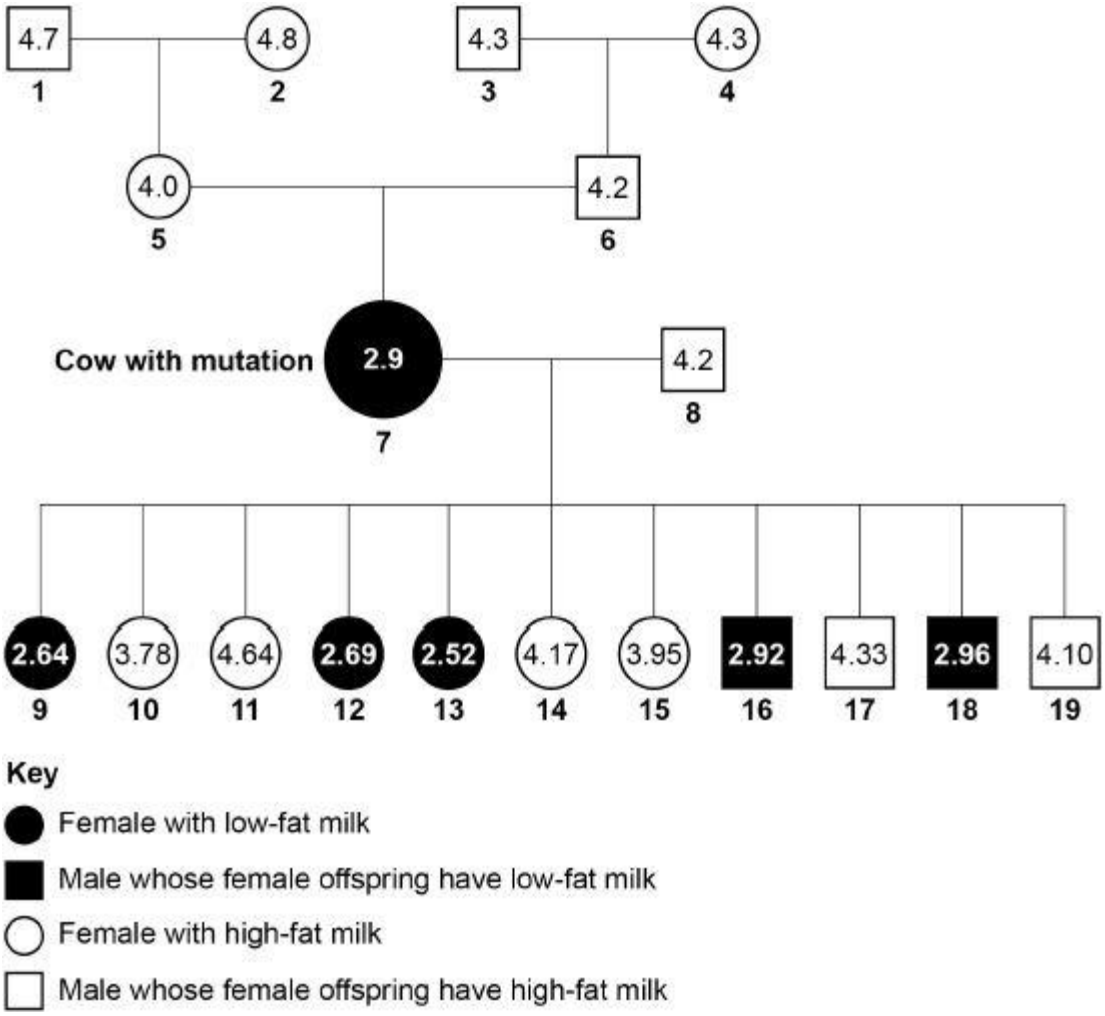
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

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

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

Figure 2



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

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

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

_____

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_____

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(1)

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

The embryos from IVF were transferred into 11 other cows.

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

(1)

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

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

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

(4)

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

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

Describe how the scientists would do this.

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(4)

(Total 16 marks)

Q4.

Figure 1 shows a ring-tailed lemur.

Figure 1

The table below shows part of the classification of the ring-tailed lemur.

Classification group	**Name**
Kingdom	*Animalia*
Phylum	*Chordata*
	Mammalia

	Primates
	Lemuroidea
Genus	*Lemur*
	catta

(a) Complete the table above to give the names of the missing classification groups.

(2)

(b) Give the binomial name of the ring-tailed lemur.

Use information from the table above.

_____

(1)

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

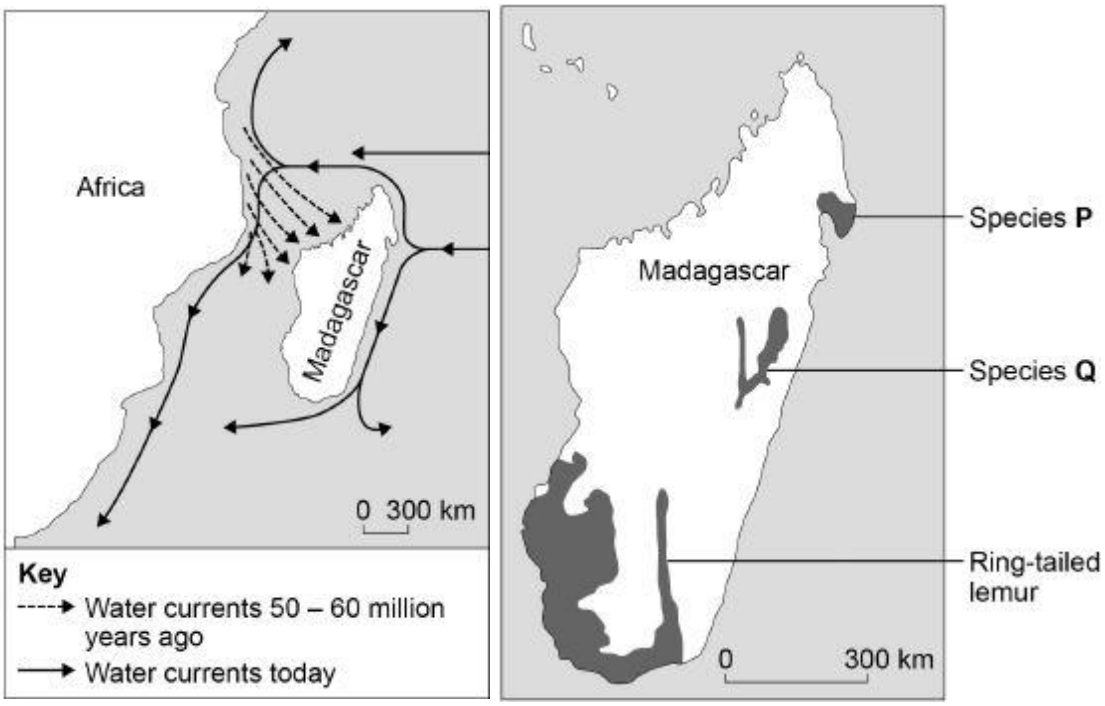
Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 2 shows information about water currents.

Figure 3 shows the distribution of three species of lemur on Madagascar.

Figure 2 **Figure 3**



(c) Suggest how ancestors of modern lemurs reached Madagascar.

_____

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(1)

(d) Describe how the ancestors of modern lemurs may have evolved into the species shown in **Figure 3**.

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(5)

(Total 9 marks)

Q5.

Blood is filtered in the kidneys.

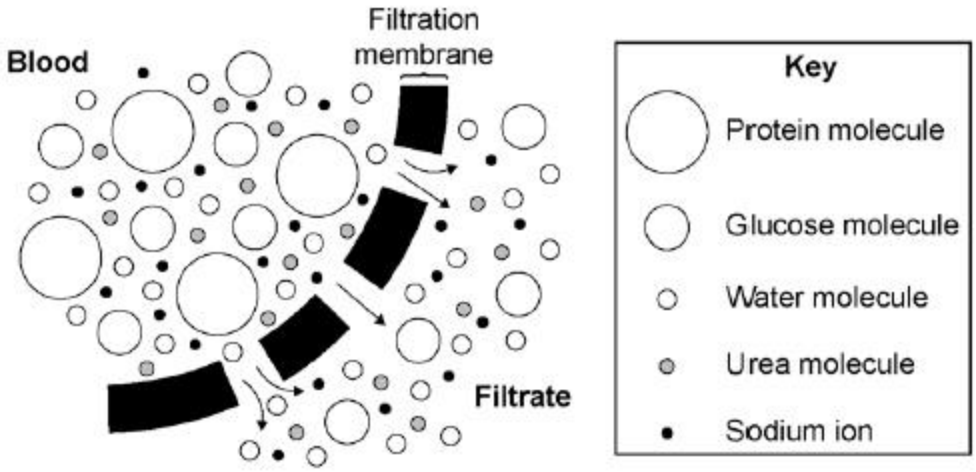
Some substances are then reabsorbed.

The amount of each substance reabsorbed varies.

Each day, a person:

- filters 180 dm^3 of water out of the blood
- produces 2 dm^3 of urine.

The diagram shows the process of filtration in the kidney.



(a) Explain why protein is **not** found in the urine of a healthy person.

(2)

(b) Explain why glucose is **not** found in the urine of a healthy person.

(2)

(c) Explain:

- why urea and sodium ions are found in urine

- why their concentration is higher on a hot day than on a cold day.

(3)

(d) The information below gives some features of two types of treatment for kidney disease.

Dialysis treatment

A dialysis session lasts about 8 hours.

A person needs 3 dialysis sessions every week for the rest of their life.

The person must have a diet low in protein and salt.

Dialysis costs £30 000 per year.

Kidney transplant

A kidney transplant requires surgery using general anaesthetic.

A suitable kidney donor is needed.

Drugs are used to suppress the immune system.

A transplant, and the first year's medical care, costs £51 000.

After the first year, the cost of drugs is £5 000 per year.

Evaluate the use of a kidney transplant instead of dialysis treatment for kidney disease.

(6)

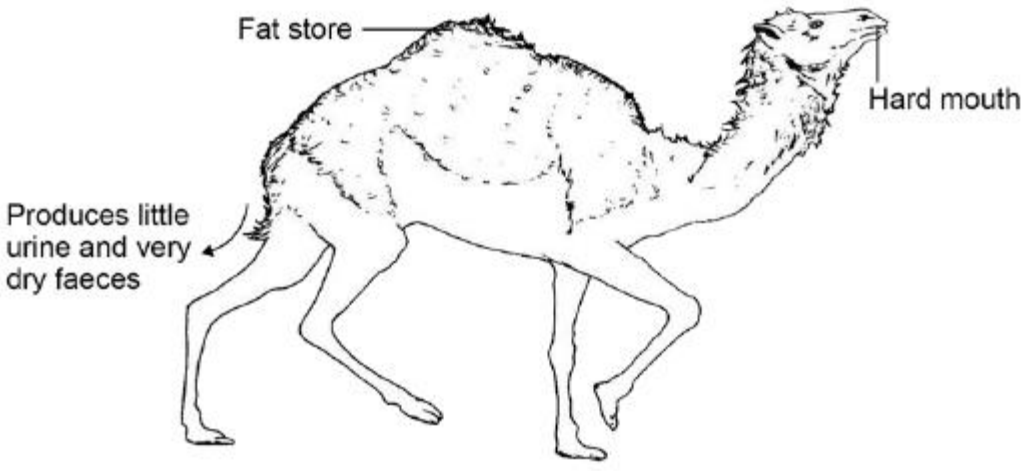
(Total 13 marks)

Q6.

Figure 1 shows a type of camel called a dromedary (*Camelus dromedarius*).

The dromedary lives in hot, dry deserts.

Figure 1



(a) One adaptation of the dromedary is 'temperature tolerance'.

This means that the animal's body temperature can rise by up to 6 °C before it starts to sweat.

Explain how temperature tolerance can help the dromedary to survive in the desert.

_____

_____

_____

_____

(2)

(b) Three more adaptations of the dromedary are given in **Figure 1**.

Give a reason why each adaptation helps the animal survive in the desert.

Fat store

_____

_____

Produces little urine and very dry faeces

_____

_____

Hard mouth

_____

_____

(3)

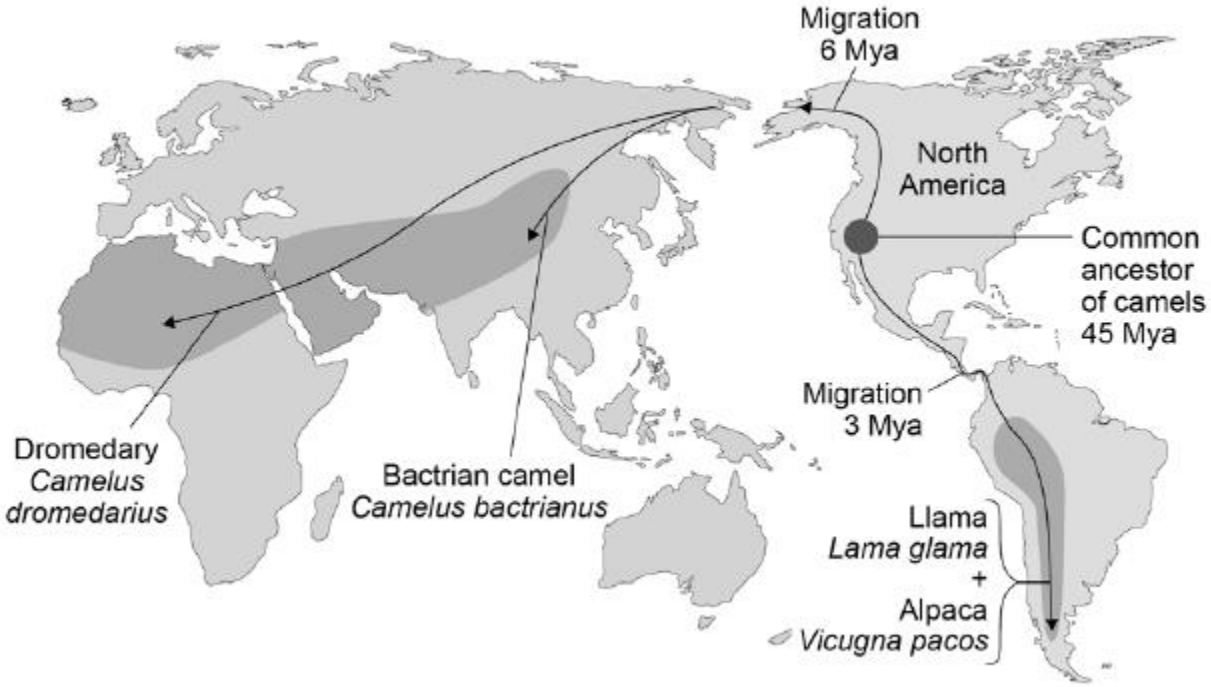
There are several species of the camel family alive today.

Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

Figure 2 shows:

- where four modern species of the camel family live today
- how the ancestors of these camels migrated from North America.

Figure 2



(c) Which **two** of the four modern species of camel do scientists believe to be most closely related to each other?

Give the reason for your answer.

_____ and _____

Reason

_____

_____

_____

(1)

(d) Describe the type of evidence used for developing the theory of camel migration shown in **Figure 2**.

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(2)

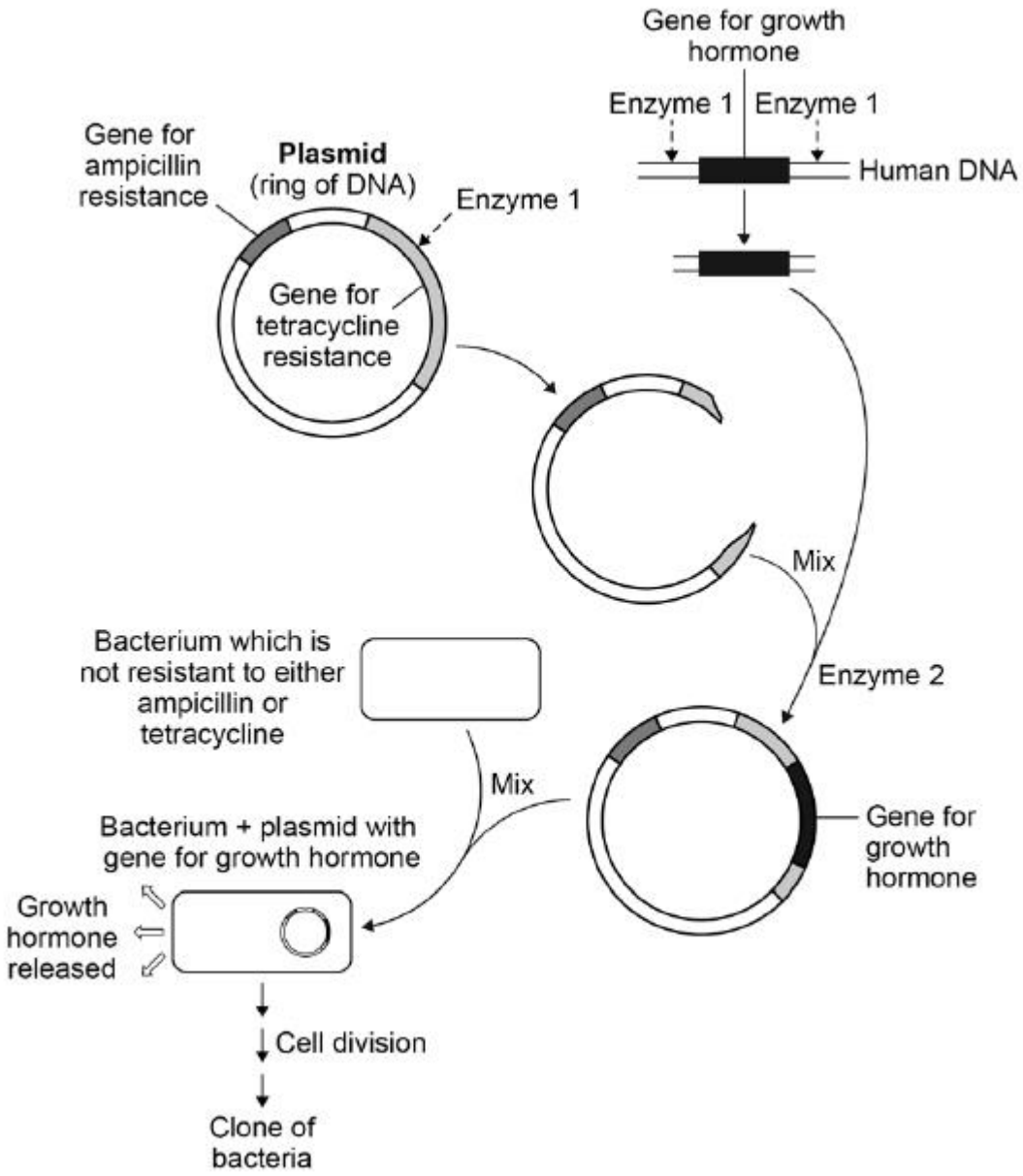
(e) Explain how several different species of camel could have evolved from a common ancestor over 45 million years.

(6)

(Total 14 marks)

Q7.

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



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

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

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

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(1)

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

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

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

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(3)

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

Some bacteria take up an unmodified plasmid.

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

Complete the table below.

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

Bacterium can multiply in the presence of	
Ampicillin	**Tetracycline**

Bacterium + plasmid with growth hormone gene		
Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

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

This produces a clone of bacteria.

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

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(3)

(Total 10 marks)

Q8.

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
	Carried out breeding experiments on pea plants.
Charles Darwin	
	Wrote 'On the origin of species'.

Alfred Russel Wallance	
	Worked on plant defence systems.
Gregor Mendel	
	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?

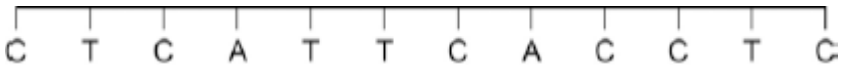
_____

(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)

Q9.

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?

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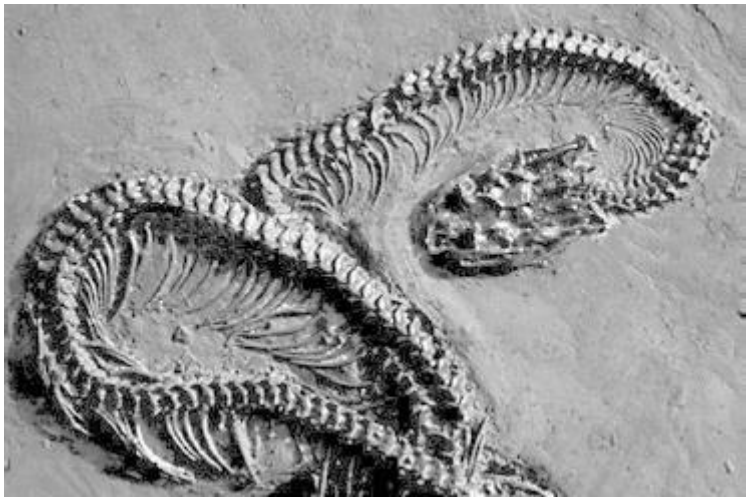
_____

(1)

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

The diagram below shows a fossilised snake.



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

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(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)

Q10.

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.

_____

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_____

_____

(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.

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(4)

(Total 7 marks)

Q11.

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 _____ .

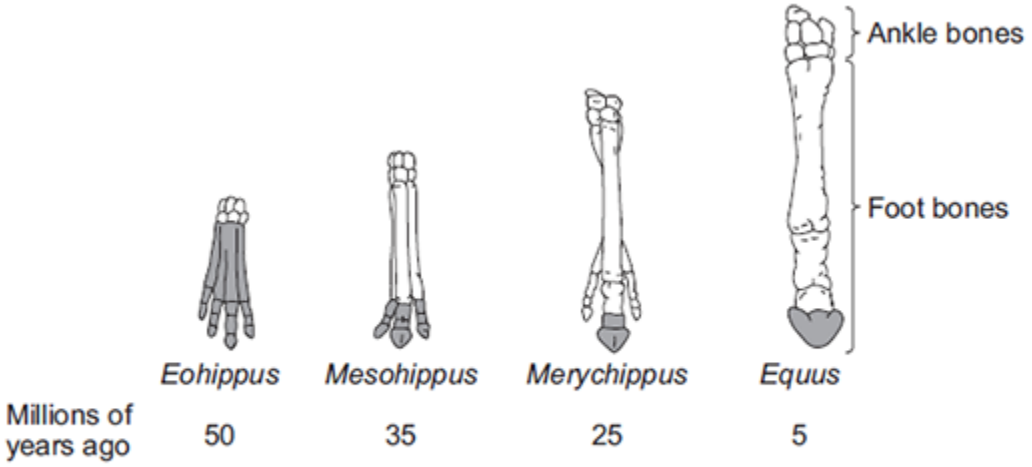
Individuals with characteristics most suited to the environment are more likely to survive and _____ .

(2)

(Total 3 marks)

Q12.

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.

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(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.*

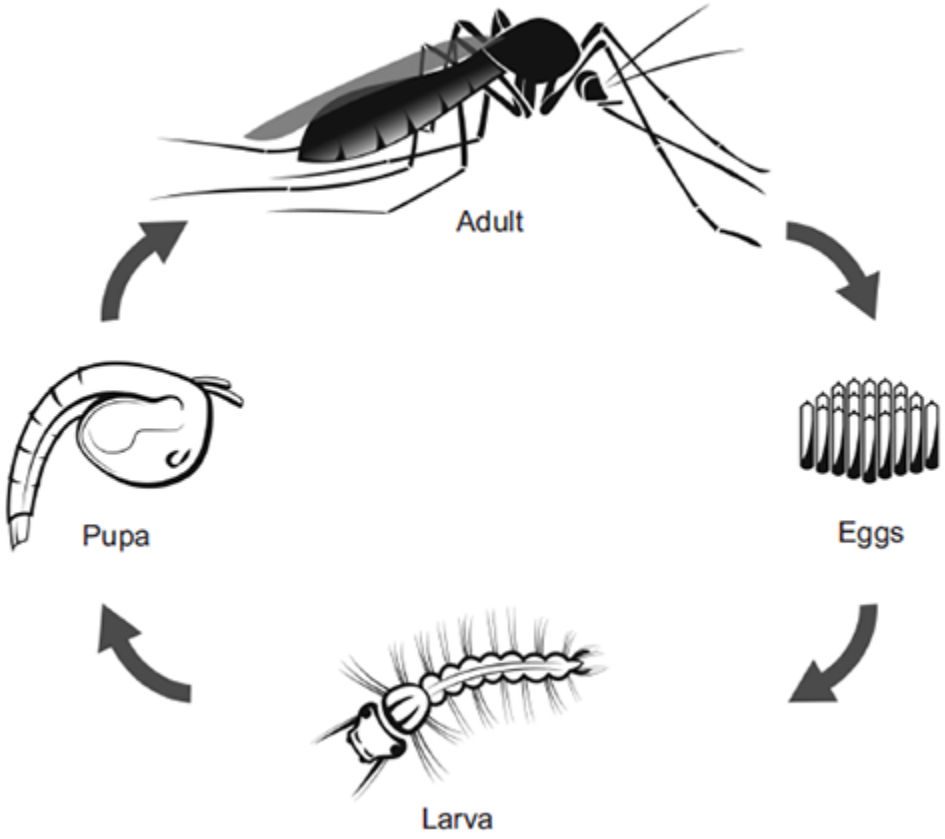
(4)
(Total 8 marks)

Q13.

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)

Q14.

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.

_____

_____

_____

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2.

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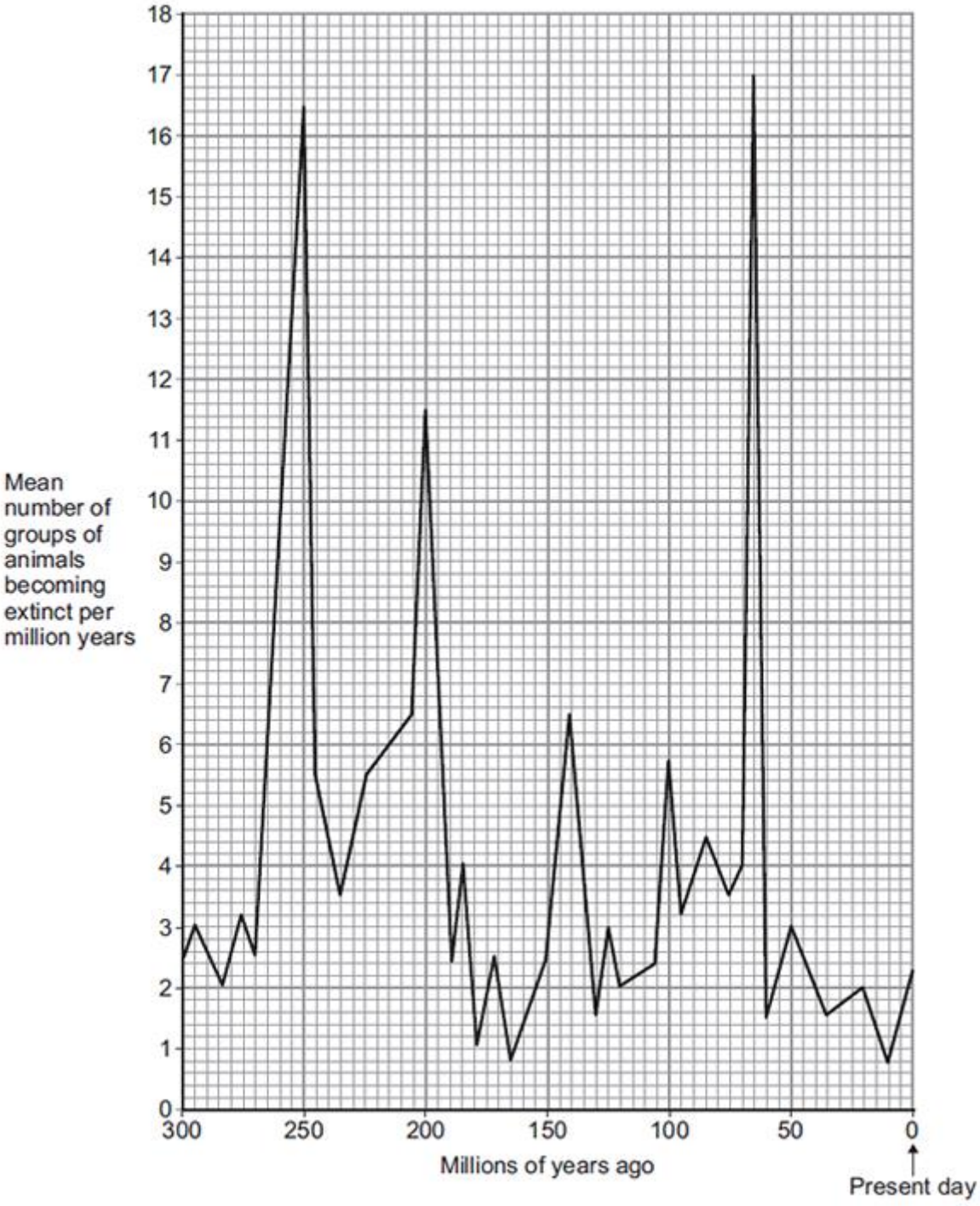
(2)

(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)

Q15.

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

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.

_____

_____

_____

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_____

_____

(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?

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(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)

Q16.

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

Tick (✓) **one** box.

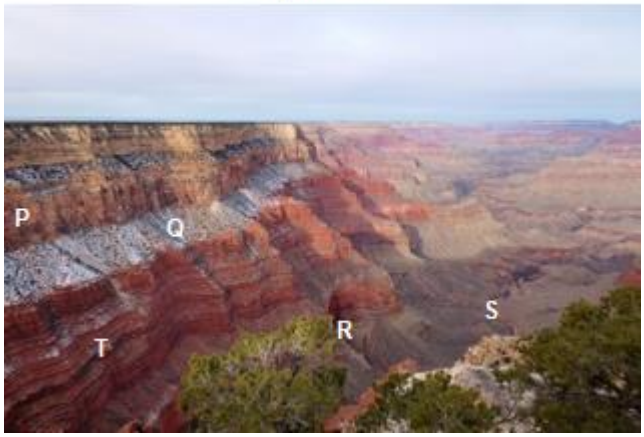
Organisms with many features in common	☐
Organisms that live in the same habitat and eat the same food	☐
Organisms that reproduce together to form fertile offspring	☐

(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

Squirrel X

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.

_____

_____

_____

_____

_____

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_____

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_____

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_____

_____

_____

_____

_____

_____

_____

_____

(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)

Q17.

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?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

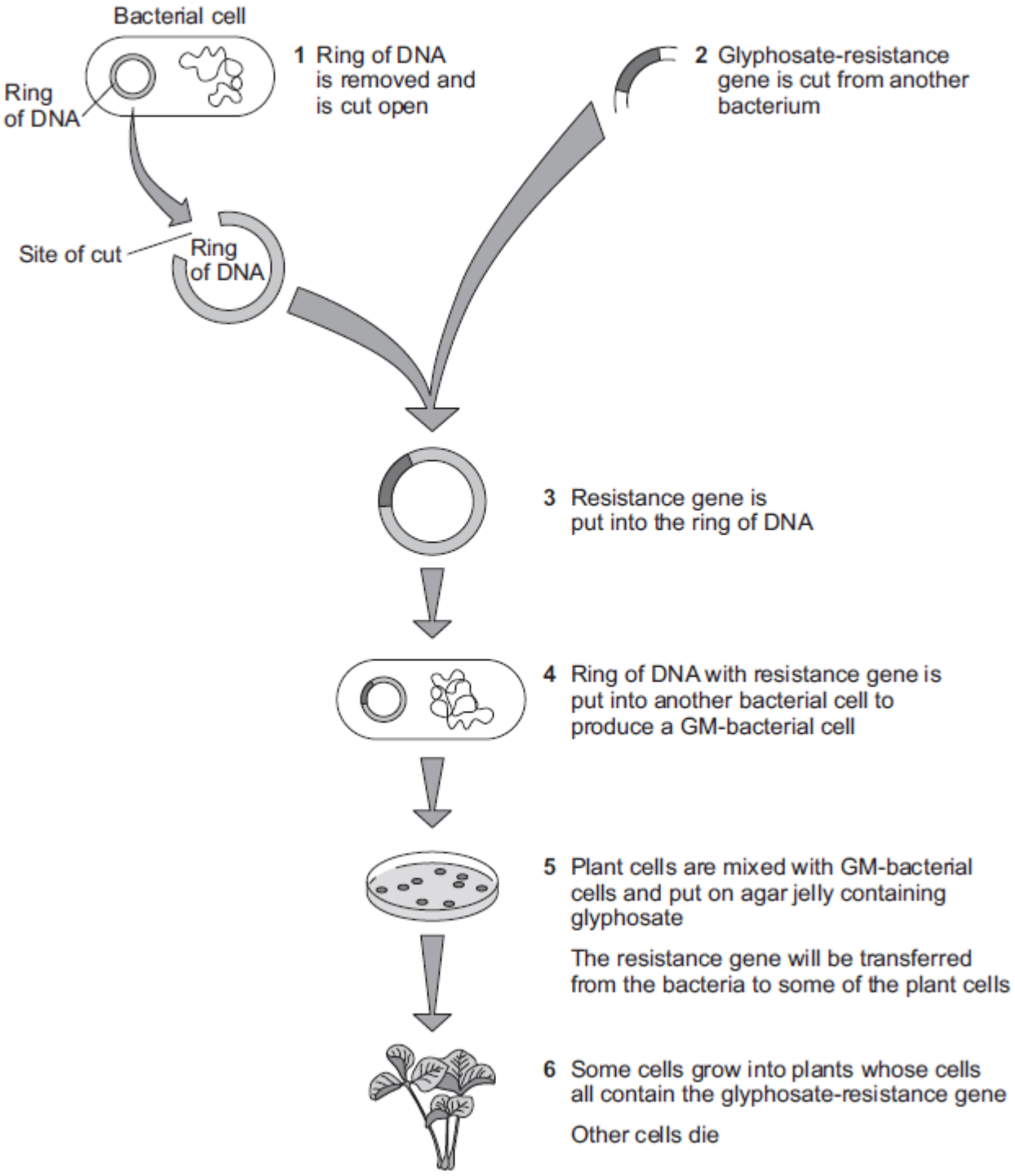
_____

(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.

_____

_____

_____

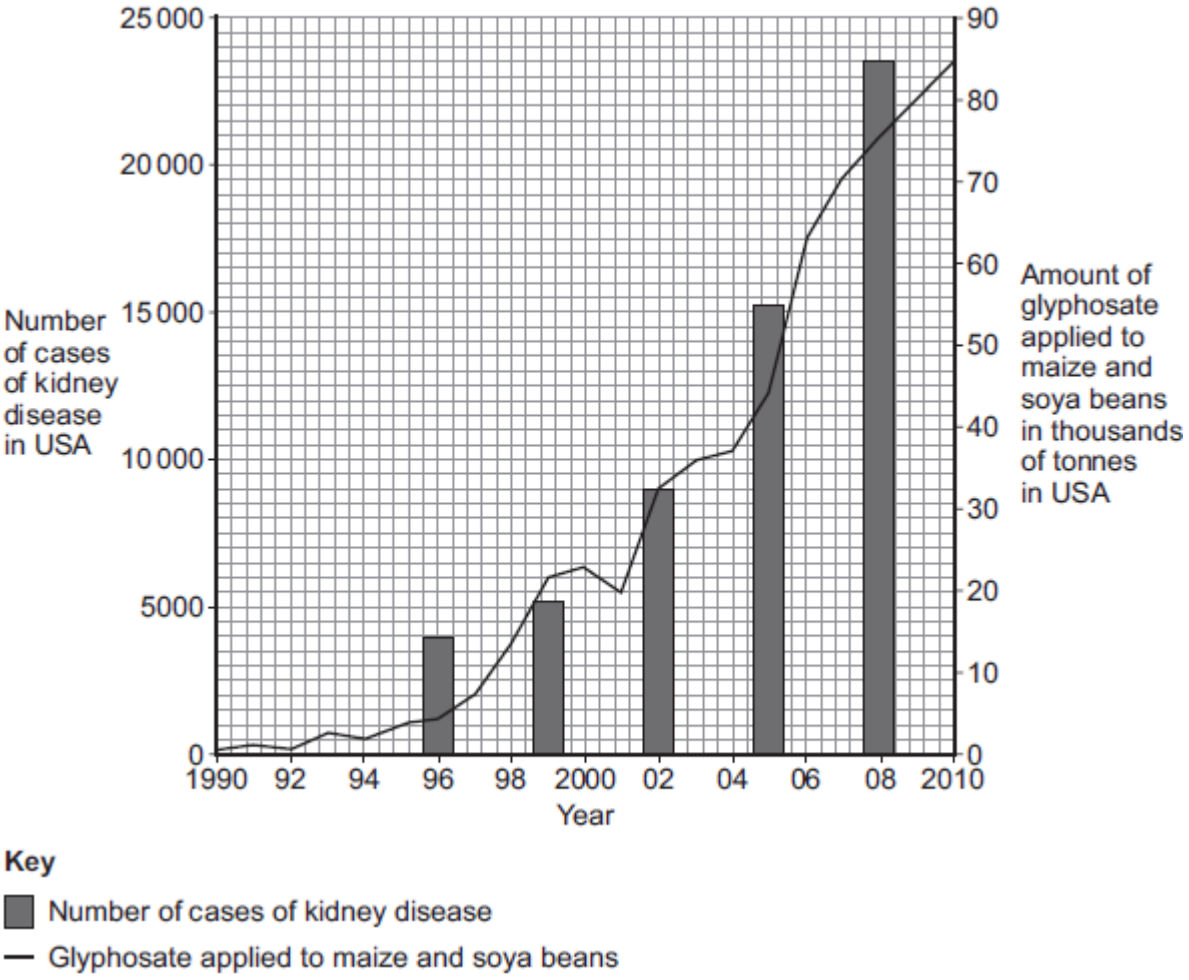
_____

(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)

Q18.

Modern scientists use cloning techniques.

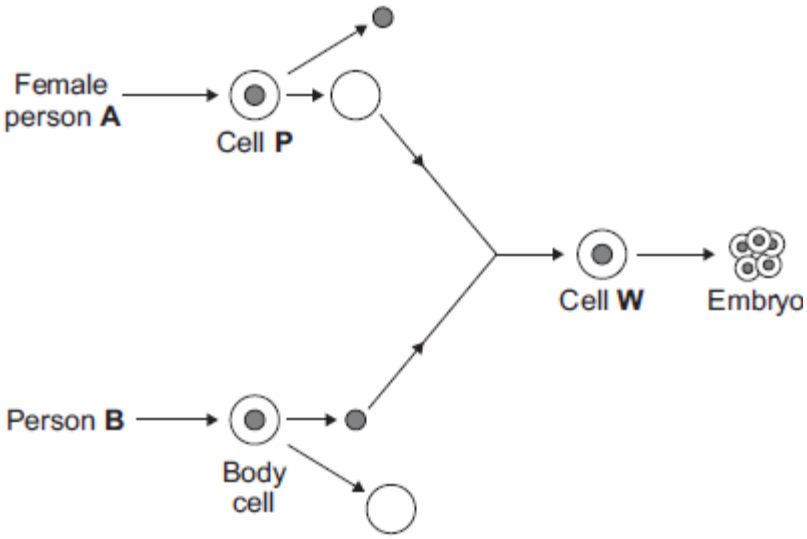
(a) Which **one** of the following is a method of producing cloned plants?

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)

Q19.

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.

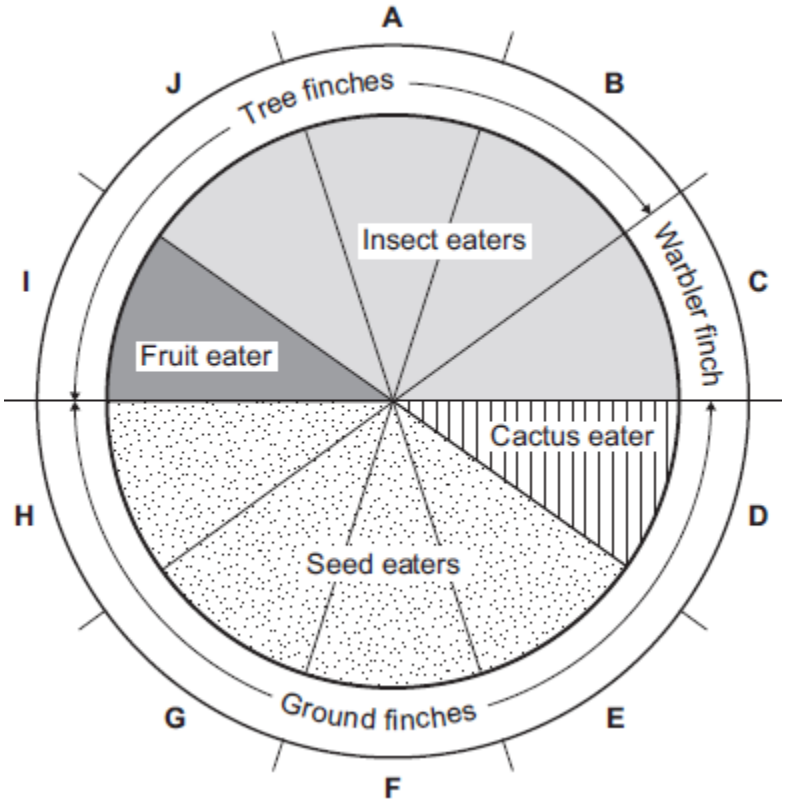
Darwin suggested the theory of evolution by natural

_____

_____

(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)

Q20.

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.

_____

_____

_____

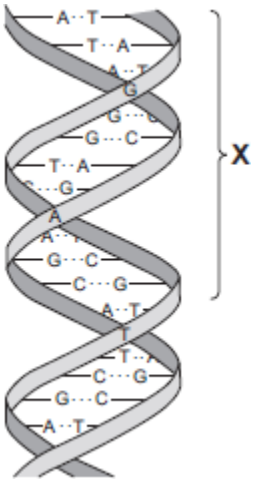
_____

(1)

(Total 7 marks)

Q21.

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)

Q22.

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.

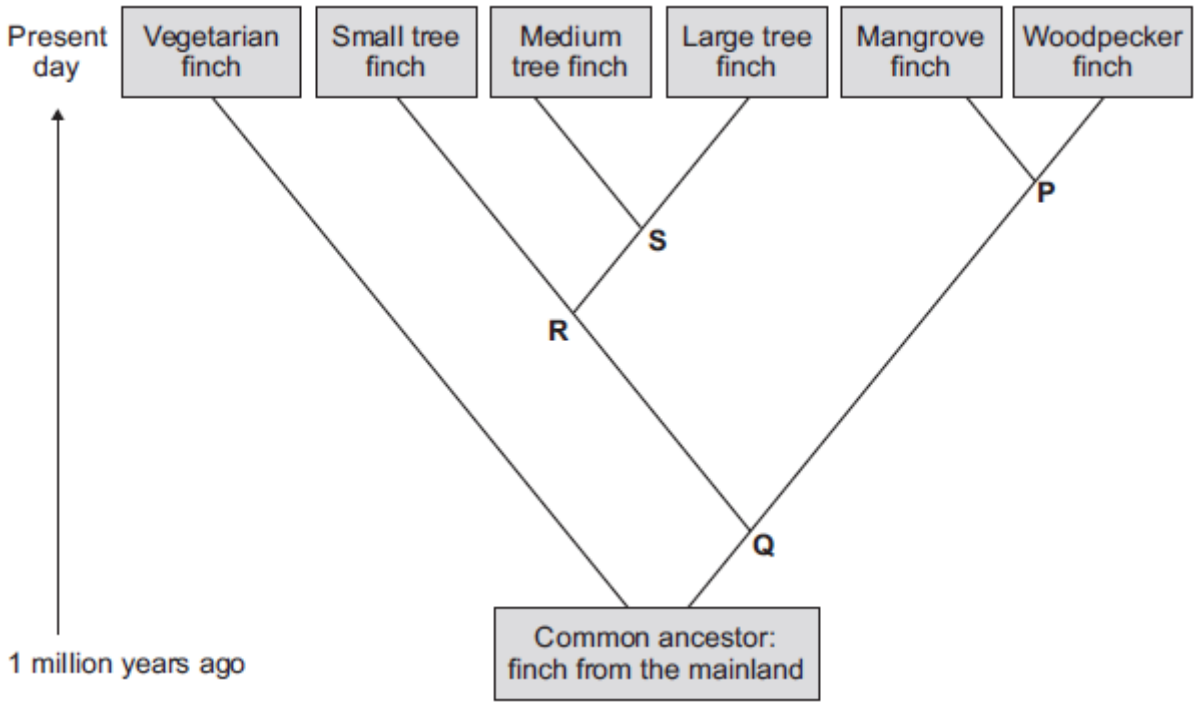
He saw that the birds were similar to, but not the same as, birds he had seen on the mainland of South America.

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)

Q23.

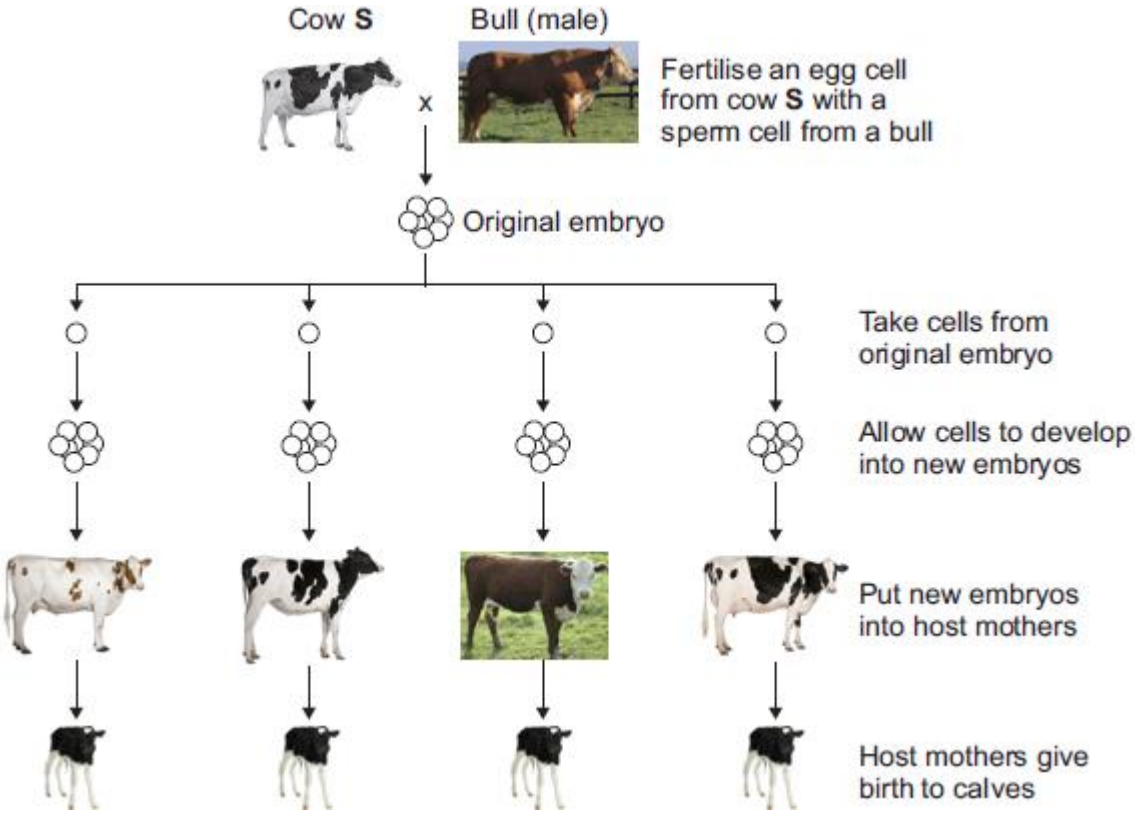
Most cows produce milk with a fat content of 3.4%.

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)

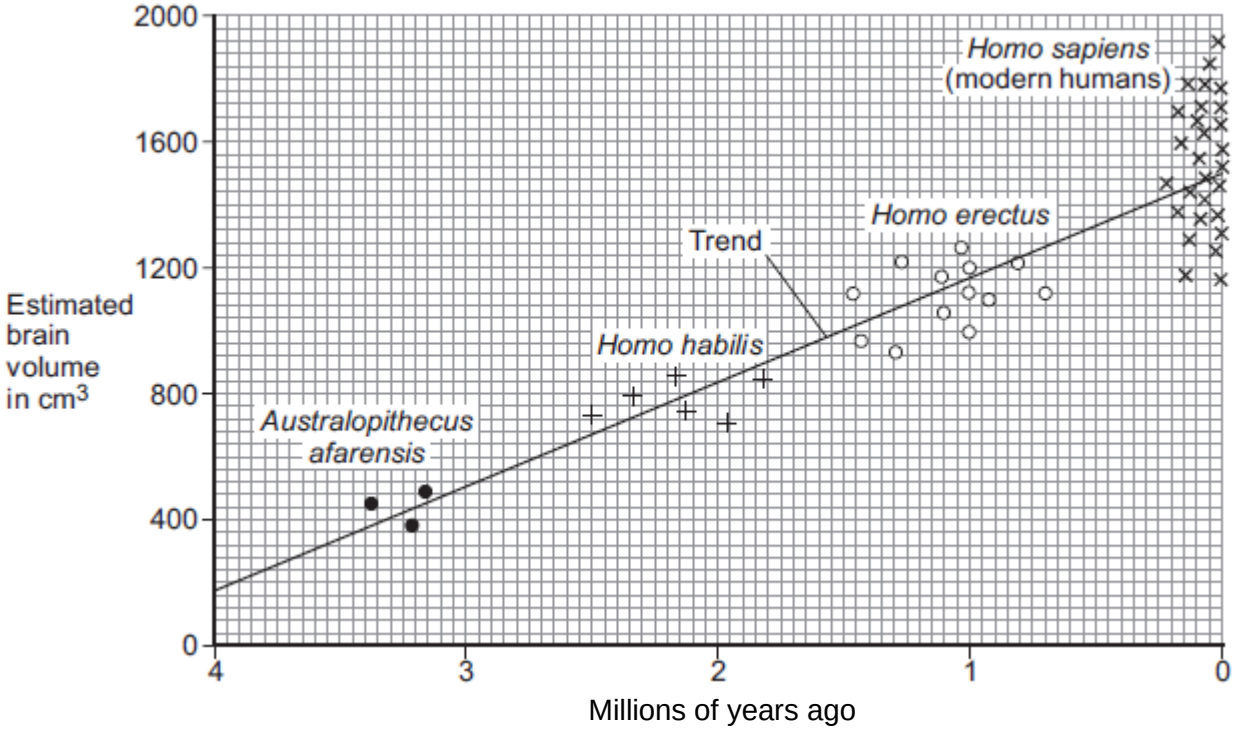
Q24.

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)

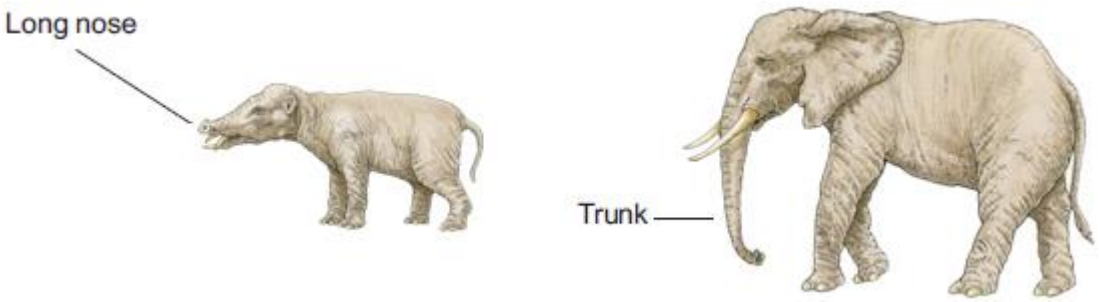
Q25.

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)

Q26.

(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.

_____

_____

_____

_____

_____

_____

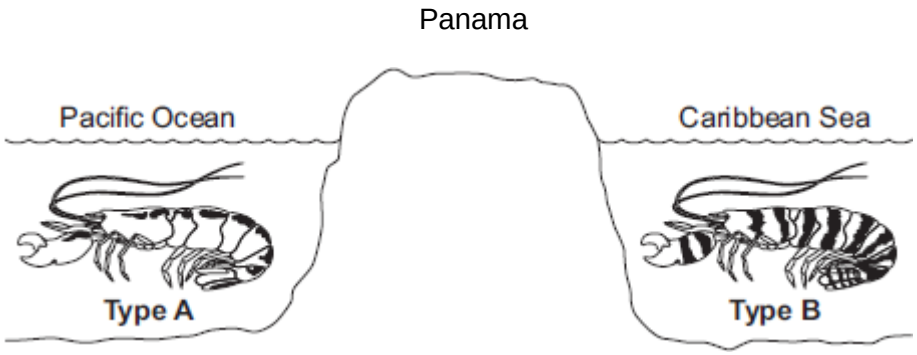
_____

_____

(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)

Q27.

(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 _____

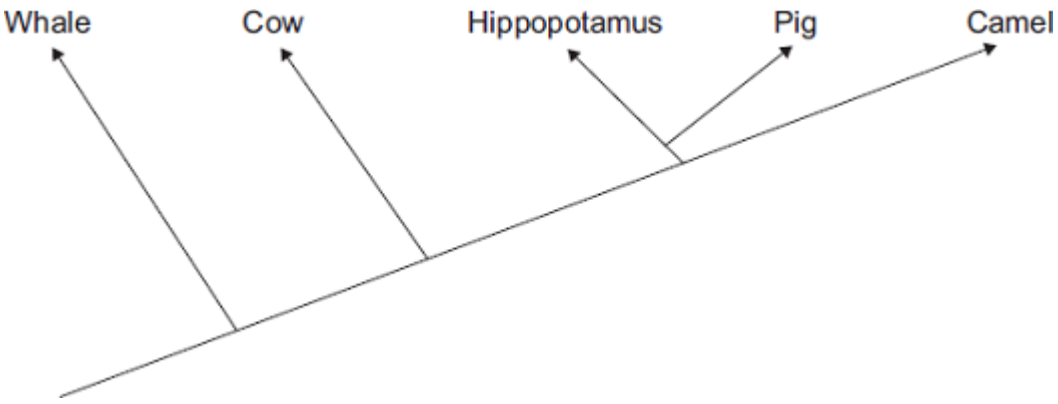
_____

_____

(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?

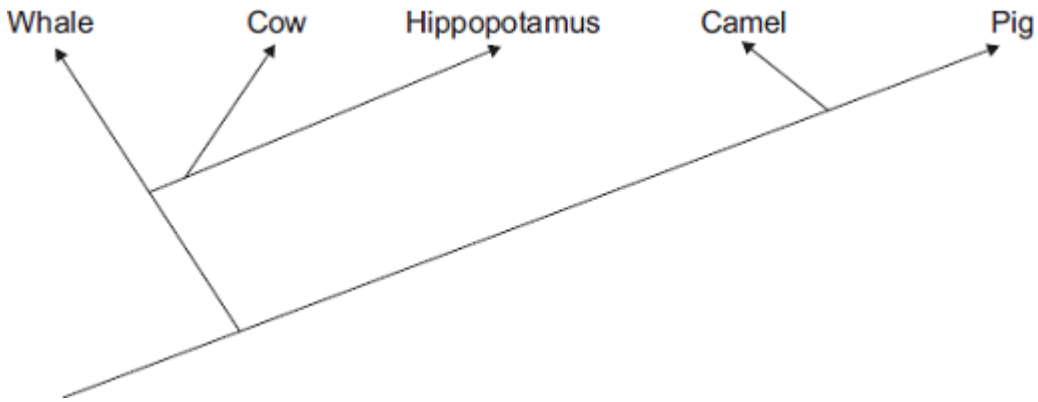
_____ and

_____

(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.

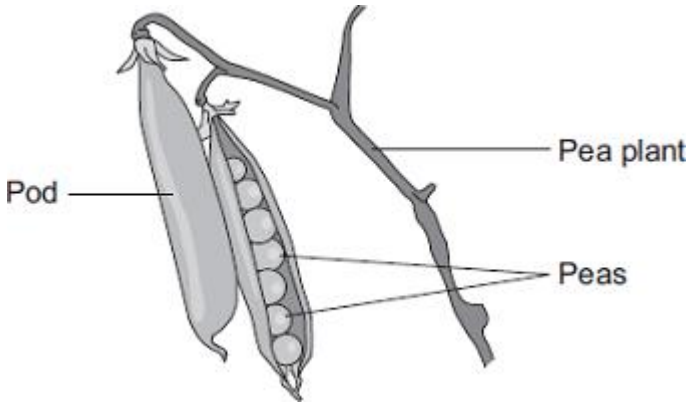
more powerful computers	**new evidence from fossils**	**new species discovered**

(1)

(Total 8 marks)

Q28.

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)

Q29.

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)

Q30.

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. _____

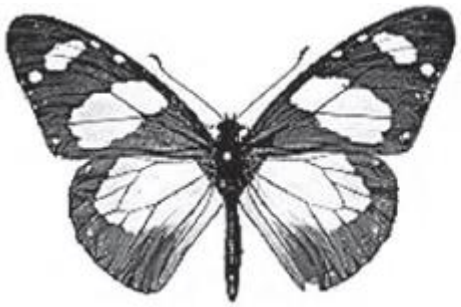
_____

(2)

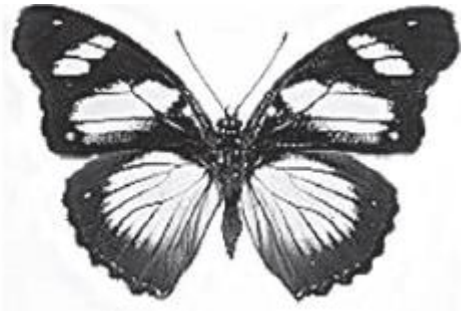
(Total 6 marks)

Q31.

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*.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

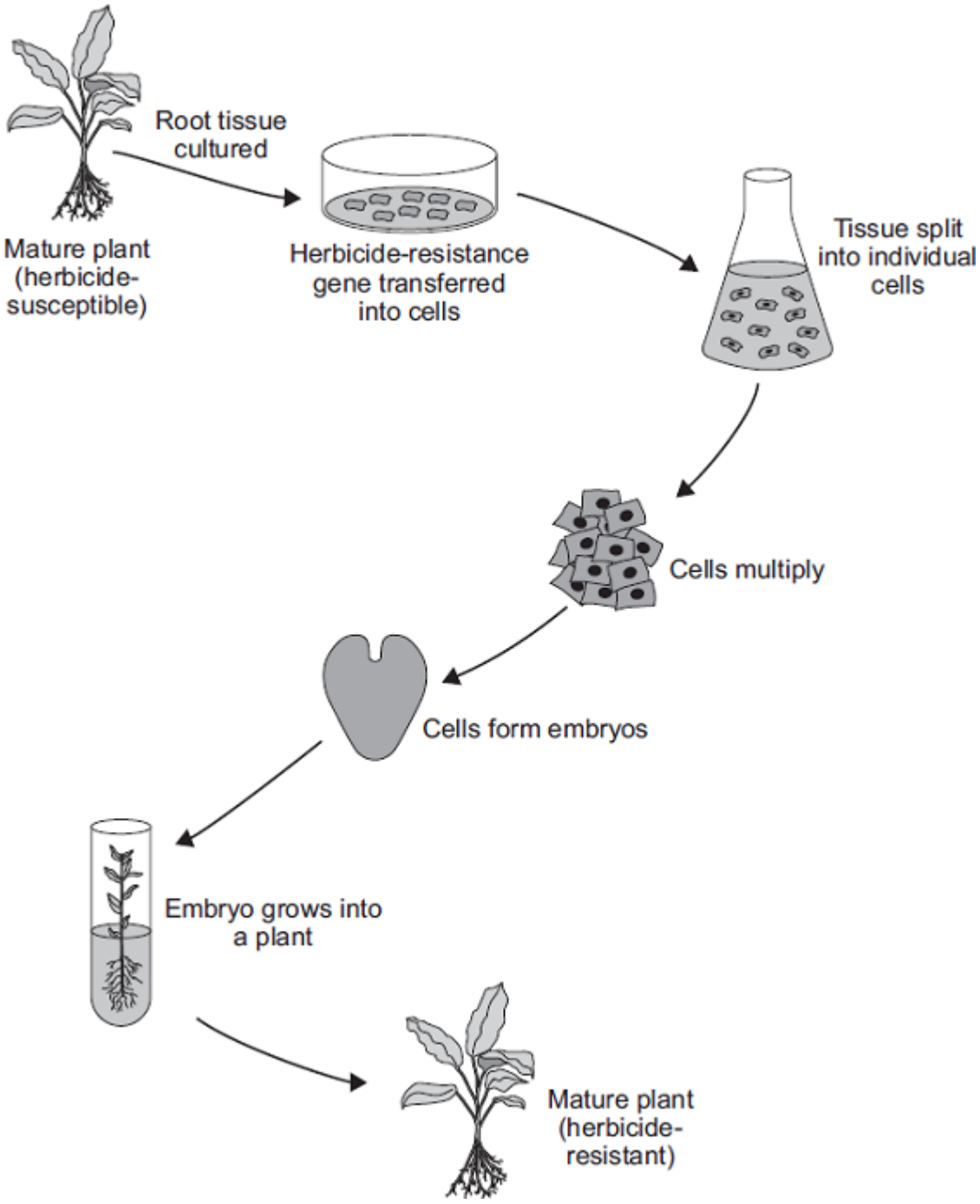
_____

(3)

(Total 5 marks)

Q32.

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)

Q33.

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)

Q34.

The photographs show two breeds of cow.

Friesian cow

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

Jersey cow

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

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

(a) Cows produce their young (calves) by

asexual reproduction.

cloning.

sexual reproduction.

(1)

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

(i) The information for characteristics is carried by

clones.
embryos.
genes

(1)

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

called

body cells.
gametes.
neurones.

(1)

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

The information shows features of Friesian and Jersey cows.

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

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

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

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

1. _____

___

_____

2. _____

_____

_____

(2)

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

1. _____

_____

_____

2. _____

_____

_____

(2)

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

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

(i) What is *genetic engineering* ?

Tick (✓) **one** box.

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

(1)

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

Give **one** reason why.

_____

_____

_____

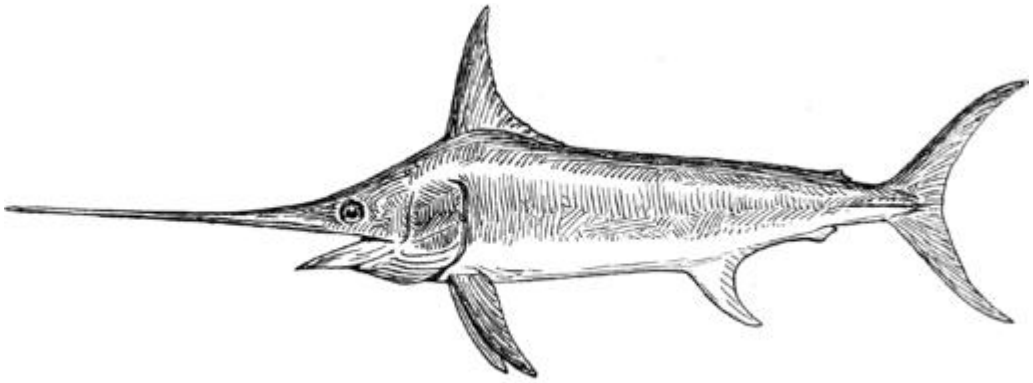
_____

(1)

(Total 9 marks)

Q35.

The picture shows a modern swordfish.

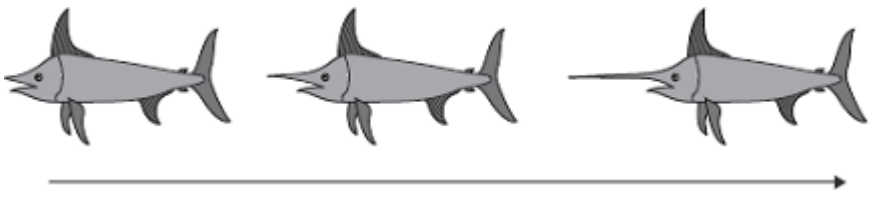


By Pearson Scott Foresman [Public domain], via Wikimedia Commons

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)

Mark schemes

Q1.

(a) (organism) soft-bodied

allow lack hard parts / skeleton / shell

allow (organism) eaten / decayed

or

(fossil) destroyed

allow buried (very) deep
allow they are (very) small

1

(b) any **two** from:

- the fish (dies) buried in sediment / sand / mud

  allow other examples of sediments
  *do **not** accept rock(s)*

- (only) the soft parts decayed / eaten **or** the hard parts / bones did not decay or were not eaten

- mineralisation occurred

  allow description of mineralisation e.g. bones turned to stone
  allow imprinted (in the sediment)

2

(c) any **two** from:

ignore pollution

- drought
- ice age / global warming
- volcanic activity

  allow earthquakes / tsunami

- asteroid / meteor collision
- (new) predators

  allow hunters / poachers
  allow eaten

- (new) disease / named pathogen
- competition for food

  allow lack of food

- competition for mates

  allow isolation or lack of mates

- lack of habitat or habitat change

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

2

(d) a change in a gene

1

(e) there is variation (between members of a species)

allow mutation

1

better adapted survive

allow 'survival of the fittest'

1

(reproduce and) pass on (favourable) allele(s) / gene(s) / mutation(s) / DNA / genetic material

ignore pass on characteristic(s)

1

allow in terms of an example

[9]

Q2.

(a)

	statement is true for		
	mitosis only	**meiosis only**	**both mitosis and meiosis**
all cells produced are genetically identical	✓		
in humans, at the end of cell division each cell contains 23 chromosomes		✓	
involves DNA replication			✓

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

2

(b) any **two** from:

ignore references to one parent only

- many offspring produced
- takes less time

allow asexual is faster

- (more) energy efficient
- genetically identical offspring

allow offspring are clones

- successful traits propagated / maintained / passed on (due to offspring being genetically identical)
- no transfer of gametes or seed dispersal

  allow no vulnerable embryo stage
  allow no need for animals

- not wasteful of flowers / pollen / seeds
- colonisation of local area

  must imply local area

2

(c) genetic variation (in offspring)

1

(so) better adapted survive

allow reference to natural selection or survival of the fittest

1

(and) colonise new areas by seed dispersal
or
can escape adverse event in original area (by living in new area)

must imply new area

1

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

1

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

[8]

Q3.

(a) 3.7

1

(b) 2

1

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

allow continuous variation

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

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

1

(d) different protein made

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

ignore denature

1

active site changed

1

so substrate does not fit / bind

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

1

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

ignore reference to alleles

1

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

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

1

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

1

female gametes correct: D and d

1

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

correct derivation of offspring genotypes from given gametes

*allow 2 × 2 **or** 2 × 1 derivation*

1

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

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

1

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

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

1

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

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

1

or

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

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

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

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

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

1

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

1

[16]

Q4.

(a)

Classification group	Name
Class	*Mammalia*
Order	*Primates*
Family	*Lemuroidea*
Species	*catta*

*all 4 correct = **2** marks*
*2 or 3 correct = **1** mark*
*0 or 1 correct = **0** marks*

2

(b) Lemur catta

ignore capitalisation / non-capitalisation of initial letters

ignore italics / non-italics
ignore underlining / non-underlining

1

(c) carried by (favourable) currents on masses of vegetation

allow description of currents from Figure 2
ignore swimming

1

(d) isolation of different populations

1

habitat variation between lemur populations

allow examples − biotic (e.g. food / predators) or abiotic (e.g. temperature)

1

genetic variation or mutation (in each population)

1

better adapted survive (reproduce) **and** pass on (favourable) allele(s) to offspring

*allow natural selection **or** survival of the fittest*
***and** pass on (favourable) allele(s) to offspring*
allow gene(s) / mutation as an alternative to allele(s)

1

(eventually) cannot produce fertile offspring with other populations

allow cannot reproduce 'successfully' with other populations

ignore cannot reproduce unqualified

1

[9]

Q5.

(a) (molecules are) (too) large

1

cannot pass through (filtration) membrane / (holes in) filter
allow 'is not filtered out of the blood'

1

(b) glucose is reabsorbed

ignore 'is absorbed' unless qualified by 'into blood'

1

all of it

1

(c) (molecules / ions) small so pass through filter
or
not all is reabsorbed

allow the body needs to maintain the right balance of ions and urea in the blood

ignore 'are filtered' unqualified

1

more water reabsorbed on a hot day

1

due to more water lost in sweat

'more' needed at least once to gain both marks

1

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

Level 2 (3-4 marks):
A judgement, supported by some relevant reasons is given.

Level 1 (1-2 marks):
Relevant points are made. If there is a judgement, this is asserted, but not logically

linked to the points made.

No relevant content (0 marks)

Indicative content

pro transplant:
- (dialysis requires repeated treatments to prevent) build-up of toxins
  or
  to prevent raised blood pressure between sessions
- inconvenience of dialysis, e.g. long sessions of immobility **or** repeated hospital visits
- (dialysis requires restricted diet) to prevent build-up of urea / ions
- there is a greater risk of infection with dialysis e.g. repeated puncturing of skin **or** use of non-sterile equipment allows entry of microorganisms
- there is a risk of blood clots with dialysis
- dialysis more expensive in the long term / 2+ years
  or
  examples given e.g. 2 yrs dialysis = £60 000 compared with 2 yrs after transplant
  = (£51 000 + £5 000) = £56 000
- transplant is a long term treatment **or** may remain healthy for many years

con transplant:
- shortage of kidney donors leading to long waiting time
- requires death of another person **or** live donation leaving a person with just one kidney
- exploitation of poor people for donor kidneys (paying for organs)
- need to match tissue type
- rejection – role of wbcs / lymphocytes
- need immunosuppressant drugs – susceptibility to infection
- dangers of surgery – physical damage / infection / brain damage from anaesthetic
- high initial cost – limited funding (either personal or NHS / CCG)

[13]

Q6.

(a) less sweating so less water loss

1

(as) no / little water available in desert

1

(b) (fat store) can be metabolised / respired to water

1

(little urine…) conserve water

1

(hard mouth) not damaged by spines on plants / on food
or
not damaged by hard / dry food

1

(c) dromedary / *C.dromedarius*

and bactrian / *C. bactrianus*

no mark for the names, but must be identified

because

same genus

ignore 'both are Camelus'

1

(d) any **two** from:

- the fossil record
- oldest fossils in N. America

or

- newer fossils in S. America / in Asia / in Africa

*allow numbers for ages (45 Mya **and** 3 Mya / 6 Mya)*

- chemical / DNA analysis of living species

allow radioactive dating of fossils

2

(e) isolation of separate camel populations by sea

or

by mountains

1

habitat variation / described between populations

allow examples – biotic (e.g. food / predators) or abiotic

1

genetic variation / mutation in each population

1

45 million years is sufficient time to accumulate enough mutations

1

natural selection

or

better adapted survive to reproduce

1

pass on favourable allele(s)

allow gene(s)

1

[14]

Q7.

(a) white blood cells have the same DNA / genes / chromosomes

or

have the gene for GH

allow have all the genes

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

1

(b) enzyme has specifically-shaped <u>active site</u>

1

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

1

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

1

(c)

Ampicillin	Tetracycline
✓	×
×	×
✓	✓

1 *mark for each correct row*
if no other mark, allow ***1*** *mark for one correct column*

1
1
1

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

1

all DNA / all genes are copied
allow GH gene copied
allow plasmid copied

1

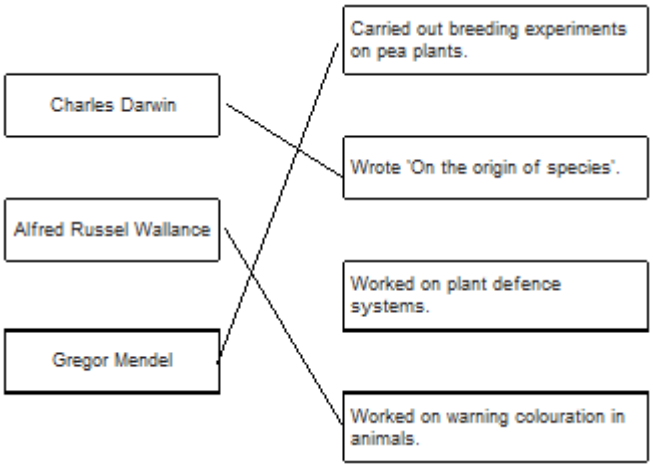
every cell receives a copy
or
receives every gene
or
receives GH gene
or
receives plasmid
or
genetically-identical cells

1

[10]

Q8.

(a)



3

(b) a gene

allow allele

1

(c) 4

1

(d) correct derivation of children's genotypes

1

identification of children with cystic fibrosis (dd)

1

0.25

allow ecf
allow ¼ / 25% / 1 in 4 / 1:3

1

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

(e) heterozygous

1

[9]

Q9.

(a) (Jean Baptiste) Lamarck

allow phonetic spelling

1

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

1

(then) the soft parts decay / are eaten
or
bones / hard parts do not decay

1

(so) minerals enter bones

or
bones are replaced by minerals

1

(c) **Level 3 (3–4 marks):**
A detailed and coherent explanation is provided. Logical links between clearly identified, relevant points explain how the rat snake evolved through the process of natural
selection.

Level 2 (1–2 marks):
Simple statements made, but not precisely. The logic is unclear.

0 marks:
No relevant content.

Indicative content

statements:
- there are lots of different colours of snakes
- some shades of green are closer to the colour of the environment (in Japan) than others
- survivors (in each generation) will breed and produce offspring

explanations:
- different colours are controlled by different genes / alleles / are caused by mutations
- being green means they are best suited to grassy / green environments
- being green means they are camouflaged
- those that are camouflaged best will be able to catch more food
- those that are camouflaged best will be able to avoid being eaten
- survivors' offspring will inherit the genes / alleles / mutation for the shade of green colouration

additional examiner guidance:
- allow converse points relating to the Texas rat snake if they clearly identify the reasons why this snake was at an evolutionary disadvantage, ie more likely to be caught and eaten by a predator
- a good level 2 answer will clearly link survival and breeding to the passing on of the advantageous genes / alleles / mutations and link the idea of colour (AO2) to a
correct explanation of its significance for survival

4

(d) any **one** from:
- changes to the environment
- new predators
- new diseases
- new (more successful) competitors
- catastrophic event / described event

1

[9]

Q10.

(a) any **two** from:

- so that they do not have specific genetic defects
- to produce docile cats or so they are not aggressive

  allow descriptions of aggression such as biting and scratching
- for aesthetic reasons

  allow descriptions of suitable aesthetic reasons

2

(b) (cats) are more likely to pass on (recessive) disorders
or
more likely to be susceptible to diseases

1

(c) **Level 2 (3–4 marks):**
A detailed and coherent explanation is given, which logically links the process of selective breeding with explanations of how this produces cats that do not cause allergic reactions.

Level 1 (1–2 marks):
Simple statements are made relating to process of selective breeding, but no attempt to
link to explanations.

0 marks:
No relevant content.

Indicative content

process:
- parents with the desired characteristic are selected
- the parents are bred together to produce offspring
- offspring with the desired characteristics are selected and bred
- this is repeated over many generations.

explanations:
- parents who produce the least Fel D1 are initially selected
- in their offspring there will be individuals with differing amounts of Fel D1 produced
- care is taken to ensure cats are healthy and avoid possible problems associated
  with selective breeding
- over time the population of (selectively bred) cats will produce less Fel D1

4

[7]

Q11.

(a) three billion

1

(b) mutation(s)

1

breed / reproduce

in this order only

allow pass on their genes

1

[3]

Q12.

(a) any **two** from:

- larger / longer / thicker
  *allow examples eg fewer toes **or** bones fused*
- fewer (bones in total)
  allow smaller surface area touching the ground
- fewer bones touching the ground

2

(b) (i) large(r) surface / area in contact with the ground

or

low / less pressure on ground

1

(so) less likely to sink into mud / ground

or

(so) could run fast(er)
allow easy / easier to escape predators

1

(ii) variation (in size / number / arrangement of bones)
allow mutation(s) (in size / number / arrangement of bones)

1

(and) those with large(r) / few(er) bones more suited to running **or** run faster (on harder / drier ground)

1

these survive **and** breed
allow ref to offspring for breed

1

(so) genes / DNA (for larger / fewer bones) passed on
allow alleles passed on

1

[8]

Q13.

(a) 0.67(%)

allow $0.\dot{6}$ or 0.7
*allow **1** mark for evidence of* $(2 \times 10^6) \div (3 \times 10^8)$
or
*allow **1** mark for 0.0067 or 0.6*

2

(b) (i) idea that food chains start with plants / producers

*allow food chains do not start with animals **or** larvae are consumers*

1

idea that these make food (for other organisms in the chain)

*allow idea that plants / producers photosynthesise **or** plants / producers get energy from the sun*

*allow mosquito larvae do not make food / photosynthesise **or** mosquito larvae do not get energy from the sun*

1

(ii) any **four** from:

- reasoned argument for **or** against release
  *must refer to at least one advantage and one disadvantage. max **3** marks for either only advantages **or** only disadvantages*

advantages:

- fewer mosquitos biting **or** spreading malaria
- fewer people get / die from malaria
  allow people won't get / die from malaria
- lower medical costs (for those infected **or** for treatment) **or** less healthcare needed
- better economically for developing / tropical countries.

disadvantages:

- fewer crops reproduce
  allow fewer crops pollinated
- poorer crop yield
- possible starvation (of people)
- high cost of GM production / mosquito release
- less food for bats / birds **or** bats / birds die
  *allow disruption to food chain / ecosystem **or** reduction of biodiversity*
- gene could 'escape' into other wildlife / species
  ignore into plants

4

(iii) any **three** from:

- gene from bacteria cut out
  allow allele for gene
- ref to enzymes (anywhere in process)
  allow at any point in process, ie in cutting or in splicing
- (gene) transferred to chromosome of mosquito
  allow DNA for chromosome
- at an early stage of development
  allow egg / embryo

3

[11]

Q14.

(a) (i) reduced photosynthesis

ignore growth

*do **not** allow need light for respiration*

1

(ii) less food (for animals) **or** less oxygen (for animals)

allow loss of habitat

1

(iii) any **two** from:

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

examples of physical factors, eg
- flooding
- drought
- ice age / temperature change
  ignore pollution
- volcanic activity

examples of biological factors, eg
- (new) predators (allow hunters / poachers)
- (new) disease / named pathogen
- competition for food
- competition for 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

(b) (i) 3

1

(ii) fossils

ignore bones, remains, fossil fuels

1

(c) (i) 65 million years ago

1

(ii) 17

allow ecf

1

(iii) fossil record incomplete
or
some fossils destroyed

accept not enough evidence

or

cannot perform experiment to test

1

[9]

Q15.

(a) reference to interbreeding

1

successfully between Island types

allow ref. to production of fertile offspring

allow ref. to DNA analysis / comparison for 1 mark

ignore ref. to grey fox

1

(b) (i) (two ancestral populations) separated / isolated (by geographical barrier / sea)

1

and genetic variation (in each population) **or** different / new alleles **or** mutations occur

1

under different environment / conditions

allow abiotic or biotic example

allow different selection pressures

1

natural selection occurs **or** better adapted survived to reproduce

1

so (favourable) alleles / genes / mutations passed on (in each population)

ignore they adapt to their environment

1

(ii) any **one** from:

- continued to mate with one another
- few beneficial mutations (between island varieties)
- similar conditions on each island so similar adaptations/features fit

1

[8]

Q16.

(a) organisms that reproduce together to form fertile offspring

1

(b) (i) fossils of **P** and **Q** in same stratum / layer / level / height

1

(ii) earlier − fossil in deeper layer / further down

1

(iii) the fossils of animals **S** and **T** have many features in common, but **T** is more complex that **S**

1

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

1

(c) (i) **X** has white tail / shorter tail

*allow other points eg **X** has furrier tail / smaller feet / is furrier*

or

***W** has sharper claws / **W** has larger claws*

1

(ii) two (ancestral) populations separated / isolated (by geographical barrier / by canyon / river)

1

genetic variation (in each population) / different alleles / different genotypes / (different) mutation(s)

1

different environmental conditions / example described

allow abiotic or biotic example

1

the better adapted survive / natural selection occurs

allow survival of the fittest
ignore they adapt to the environment

1

so (different / favourable) alleles / genes passed on (in each population)

1

eventually two types cannot interbreed successfully

allow to produce fertile offspring

1

(iii) any **two** from:

- environments similar / described
  allow example, e.g. similar predator(s) / food / climate
- therefore similar adaptations / features / phenotypes suit
  accept suitable named feature
- original ancestor already well adapted
  ignore reference to not enough time for evolution.

2

[14]

Q17.

(a) kills weeds among crops / does not kill crops

1

(kills weeds) so less competition for named factor eg light / water / ions

ignore space

1

crops grow better / higher yield

1

(b) (i) plasmid

1

(ii) use an enzyme

allow correct example

1

(iii) only some cells become GM / take up the plasmid / take up resistance

gene

allow idea of transfer of gene / plasmid to some plant cells from bacteria

1

GM cells survive / non-GM cells are killed

1

(c) Pro:
(positive) correlation between use of glyphosate and number of cases of kidney disease

*allow **1** mark for justified conclusion that the claim is not justified*

1

+ any **three** from:
Con:

- lack of controls / control group
- correlation does not prove a causal link
- some other factor could be the cause

  accept obesity / infection
- no evidence that kidney patients actually consumed GM crops / crops treated with glyphosate / no evidence about amount consumed
  or graph shows amount of herbicide not amount of GM crops grown
  or graph shows data only for maize and soya / not for other (GM) crops
- data have been manipulated by carefully chosen scales to make it look like they coincide
- data from some years is missing
- no data for the dosage of herbicide used

allow kidney disease has been around for much longer than GM crops / better diagnosis of kidney disease.

3

[11]

Q18.

(a) Taking cuttings from plants

1

(b) (i) Adult cell cloning

1

(ii) an egg cell

1

(iii) nucleus

1

(iv) an electric shock

1

(v) uterus / womb

accept phonetic spelling

1

(c) any **two** from:

- unethical / immoral
  allow 'rights' of the cloned child
  allow against religious teachings
- cloned child would have to give up a kidney
- possible operation complications.
  allow illegal
  allow parents may not want another child
  allow a long time to wait (for the kidney)

2

[8]

Q19.

(a) selection

1

(b) (i) 4

1

(ii) ground finch / lives on the ground

1

(only) eats seeds
*allow eg eats seeds on / from the ground for **2** marks*

1

(c) Lamarck

1

[5]

Q20.

(a) part of a chromosome
allow piece of DNA
allow parts of chromosomes

1

controls a characteristic
allow controls characteristics
*allow codes for (**or** controls production of) protein / enzyme*
ignore examples of characteristics

1

(b) (iPS method)
*max **3** similarities or differences*
allow converse if clearly referring to adult cell cloning

similarities

- (both) use of skin / body cell
- (both) ref to (formation of) embryo
- (both) transfer (embryo) into womb / uterus
- (both) use surrogate mothers

differences

- (iPS) uses sexual reproduction
  *allow ref to egg **and** sperm **or** gametes **or** fertilisation*
- (iPS) surrogate mother is different species
- (iPS) no nucleus transfer / removal
- (iPS) offspring genetically different from parent
  allow not a clone
- (iPS) no electric shock

4

(c) any **one** from:

- idea of retaining biodiversity
- may be (economically) useful (in the future)
- idea of maintaining food chain / ecosystem

1

[7]

Q21.

(a) (i) nucleus

correct spelling only

accept mitochondrion

ignore genes / genetic material / chromosomes

1

(ii) base(s)

Accept all four correct names of bases

ignore nucleotides and refs to organic / N-containing

1

(iii) 4

1

(iv) codes for sequence / order of amino acids

ignore references to characteristics

1

codes for a (specific) protein / enzyme

or

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

codes for a specific amino acid

or

the sequence / order of 3 bases / compounds / letters

codes for the order / sequence of amino acids

1

(b) (i) DNA

1

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

1

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

1

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

1

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

ignore ref to asexual reproduction

correct spelling only

1

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

1

(iv) any **two** from:

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

2

[13]

Q22.

(a) any **two** from:

- most people still believed that God made all the animals / plants on Earth

  allow against their 'religion'
- insufficient evidence

  do not allow no proof / evidence

  ignore 'fossil'
- the mechanism of inheritance / genes unknown (at the time)

2

(b) any **four** from:

- finches separated / isolated
- genetic variation / mutation (in finch population(s))
- finches with alleles / genes best suited to their environment survive

  Do not allow 'characteristics'
- advantageous alleles / genes passed on (to offspring)
- after many generations / a long time, the populations can no longer successfully interbreed

  Ignore 'speciation'

4

(c) (i) vegetarian finch

1

(ii) **R**

1

(iii) mangrove **and** woodpecker finches

1

[9]

Q23.

(a) (i) gamete(s)

ignore reproductive cells

1

(ii) womb / uterus

allow phonetic spellings

1

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

1

(ii) embryo transplantation

1

(iii) any **one** from:

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

1

[5]

Q24.

(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]

Q25.

(a) (i) variation (in population) / mutation

1

longer nosed individuals get more food / leaves
allow longer nosed individuals more likely to survive

1

(these) survivors breed (more)

1

pass on genes / alleles / DNA (for long nose)
allow pass on mutation

1

(ii) Phiomia / ancestor stretched its nose (during its lifetime) to reach food / leaves

1

passed on (stretched nose) to offspring
allow offspring inherit (stretched nose)
*do **not** allow ref to genes*

1

(b) (i) insufficient evidence / no proof
ignore other theories, eg religion
*do **not** allow no evidence*

1

mechanism of inheritance not known
allow genes / DNA not discovered

1

(ii) God made all living things / them
allow creationism
ignore religion

1

[9]

Q26.

(a) lack of fossils / fossils destroyed

allow lack of evidence

1

(due to soft parts) decaying / geological activity

allow an example – eg vulcanism or earth movements or erosion

allow converse points re skeletons, shells, hard parts

1

(b) (i) **A** and **B** did not mate successfully

*'**A** and **B** did not mate' insufficient*

allow did not produce fertile offspring

1

(ii) any **two** from:

- may not be mating season
- **A** and **B** may not find each other attractive
- this is just a one-off attempt / an anomaly / need repeats
- may be juvenile / immature
- may be the same sex

allow other sensible suggestion eg were put in unfavourable environment or one / both could be infertile

2

(c) 1. (two ancestral populations) separated (by geographical barrier / by land) / were isolated

1

2. genetic variation (in each population) **or** different / new alleles **or** mutations occur

1

3. different environment / conditions

allow abiotic or biotic example

1

4. natural selection occurs **or** some phenotypes survived **or** some genotypes survived

1

5. (favourable) alleles / genes / mutations passed on (in each population)

1

6. eventually two types cannot interbreed successfully

allow eventually cannot produce fertile offspring

1

[11]

Q27.

(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]

Q28.

(a) any correct named physical environmental condition, e.g. light / water / rain / temperature / minerals / nutrients / space (between plants)
ignore carbon dioxide / climate / weather / sun / pollution

1

genes / inheritance
ignore 'variety'

OR

any correct named biotic factor e.g. predation / disease

1

(b) mass of crop also depends on number of pods (per plant) / size / mass of each pea
ignore number of plants

1

(c) microorganisms / bacteria / fungi / decomposers / detritus feeders / named

1

decompose / rot / break down / decay / digest

ignore feed / eat

1

(these organisms) respire

*do **not** allow respiration by pea (plants)*

1

(decay / respiration / microorganisms etc) releases carbon dioxide

*do **not** allow combustion / fossilisation*

1

[7]

Q29.

(a) organisms that can breed together

accept converse points re. 2 different species

1

successfully

accept produces fertile offspring

1

(b) any **two** from:
(live at)

- different pH of soil
- different height above sea level
- different flowering times

2

AND

genetic variation / mutation / different alleles (produced in isolated populations)

1

natural selection acts differently on the two populations

or different characteristics in the two populations survive

or different alleles passed on in the two groups

1

eventually resulting in interbreeding no longer possible

1

[7]

Q30.

(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]

Q31.

(a) wing pattern similar to *Amauris*

allow looks similar to Amauris

1

birds assume it will have an unpleasant taste

1

(b) mutation / variation produced wing pattern similar to *Amauris*

*do **not** accept breeds with Amauris*

*do **not** accept idea of intentional adaptation*

1

these butterflies not eaten (by birds)

1

these butterflies breed **or** their genes are passed to the next generation

1

[5]

Q32.

(a) (use of) enzymes

1

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

ignore clones

1

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

1

(c) can spray crop with herbicide – only weeds killed

crop survives herbicide insufficient

1

(d) any **one** from:

allow 'think that GM food is bad for health'

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

  ignore not natural or against religion

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

1

[5]

Q33.

(a) sulfur dioxide

1

(b) (i) mutation

1

(ii) pale form now (more) easily seen (by predators) **or** dark form now less easily seen (by predators)

accept ref to camouflage

1

so pale form (more) likely to be eaten **or** dark form less likely to be eaten

1

so dark form (more likely to) breed / pass on genes

or

pale form less likely to breed / pass on genes

1

(c) (i) pyramid of three layers of diminishing size

either way up

1

three labels in food chain order

award 2 marks only if the pyramid is correctly labelled

accept trees / birch

accept (peppered) moth(s) / larvae

1

(ii) some material is lost in waste from the birds

1

peppered moth larvae do not eat all the leaves from the trees

1

[9]

Q34.

(a) sexual reproduction

1

(b) (i) genes

1

(ii) gametes

1

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

answers must be comparative

- more meat (per cow)
  ignore bigger unqualified
- more milk each day
- can be milked for more time after giving birth / greater proportion of time
  *accept '(produce) more 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) more protein

answers must be comparative

1

less 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]

Q35.

(a) Lamarck

ignore any first name(s)

1

(b) (i) variation / range of sword lengths (in ancestors)

accept mutation produced longer sword

1

those with long swords get more food

accept those with short swords get less food

1

swordfish (with long swords) survive **and** breed
allow have offspring for breed

1

(survivors) pass on gene(s) / allele(s) (for long sword)
allow mutation for gene(s) / allele(s)

1

(ii) any **one** from:

- more evidence (now)
  accept examples of evidence, e.g. more fossils
- DNA / genes / mechanism of inheritance discovered
  allow Lamarck's theory has been disproved
  ignore religious arguments
  ignore proof

1

[6]

Q1.

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

Species A

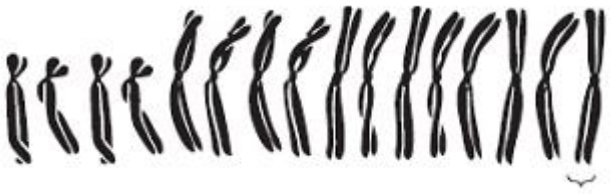
Species B

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.

_____

_____

_____

_____

_____

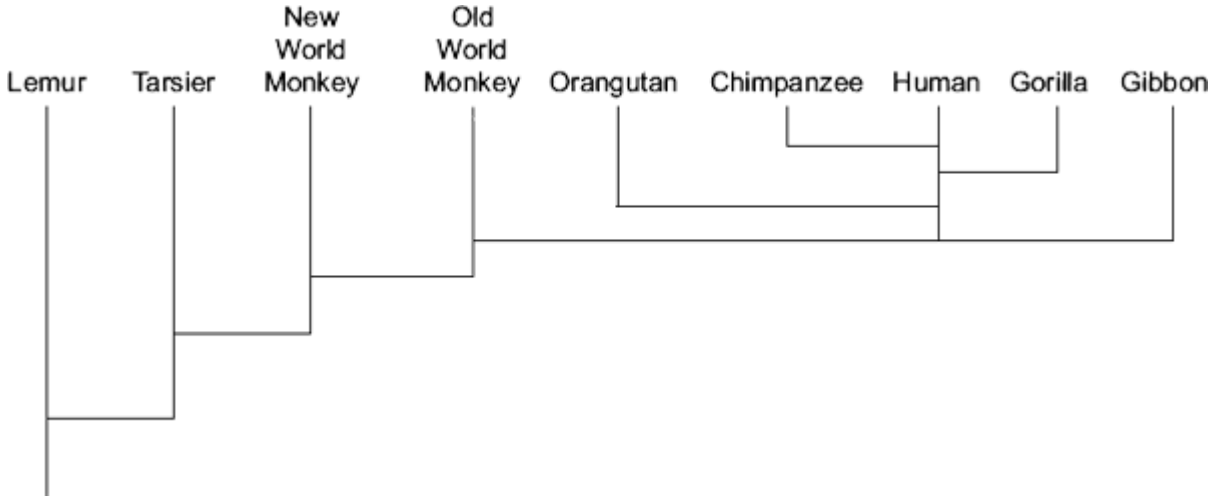
_____

(2)

(Total 10 marks)

Q2.

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)

Q3.

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?

_____

_____

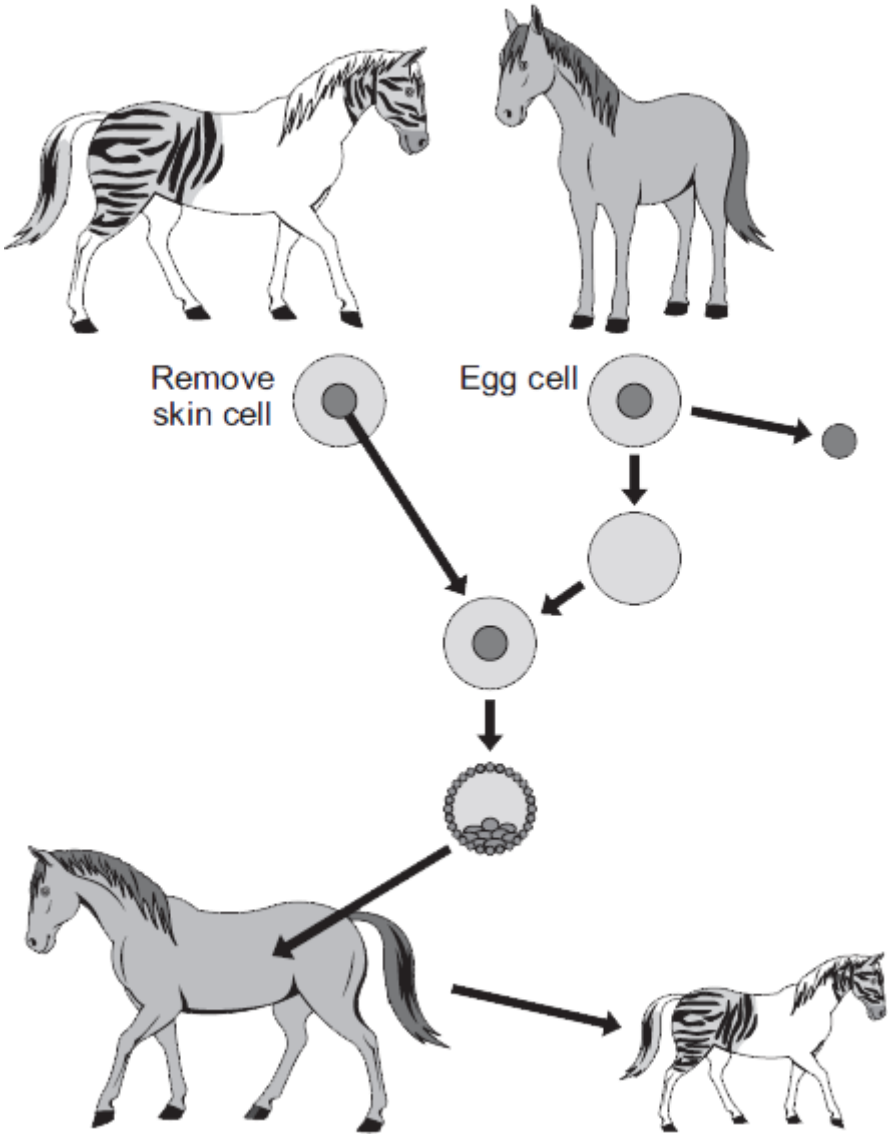
_____

_____

(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)

Q4.

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)

Q5.

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.

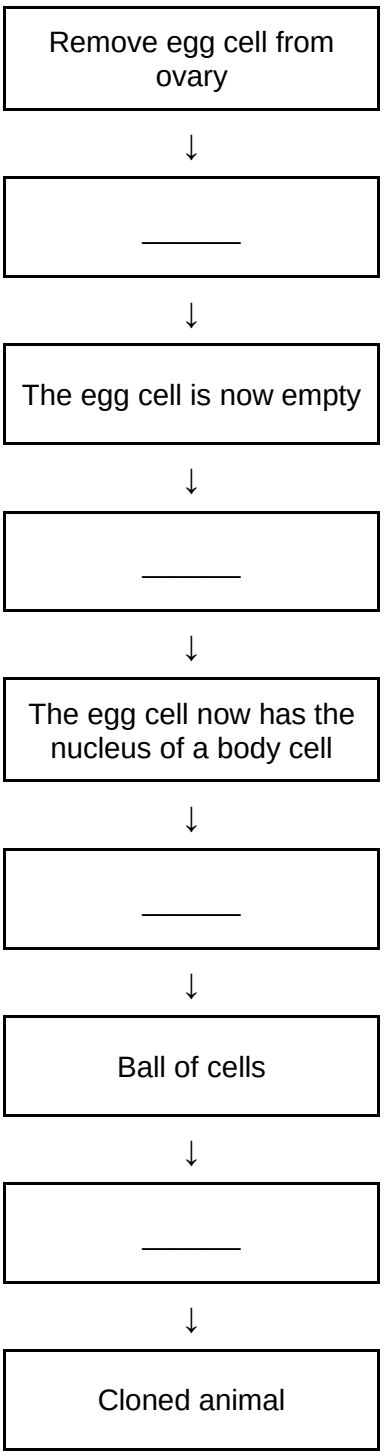
Each number should be used **once** only.

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)

Q6.

(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)

Q7.

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

Modern elephant

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

Commons Wikimedia Commons

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

_____

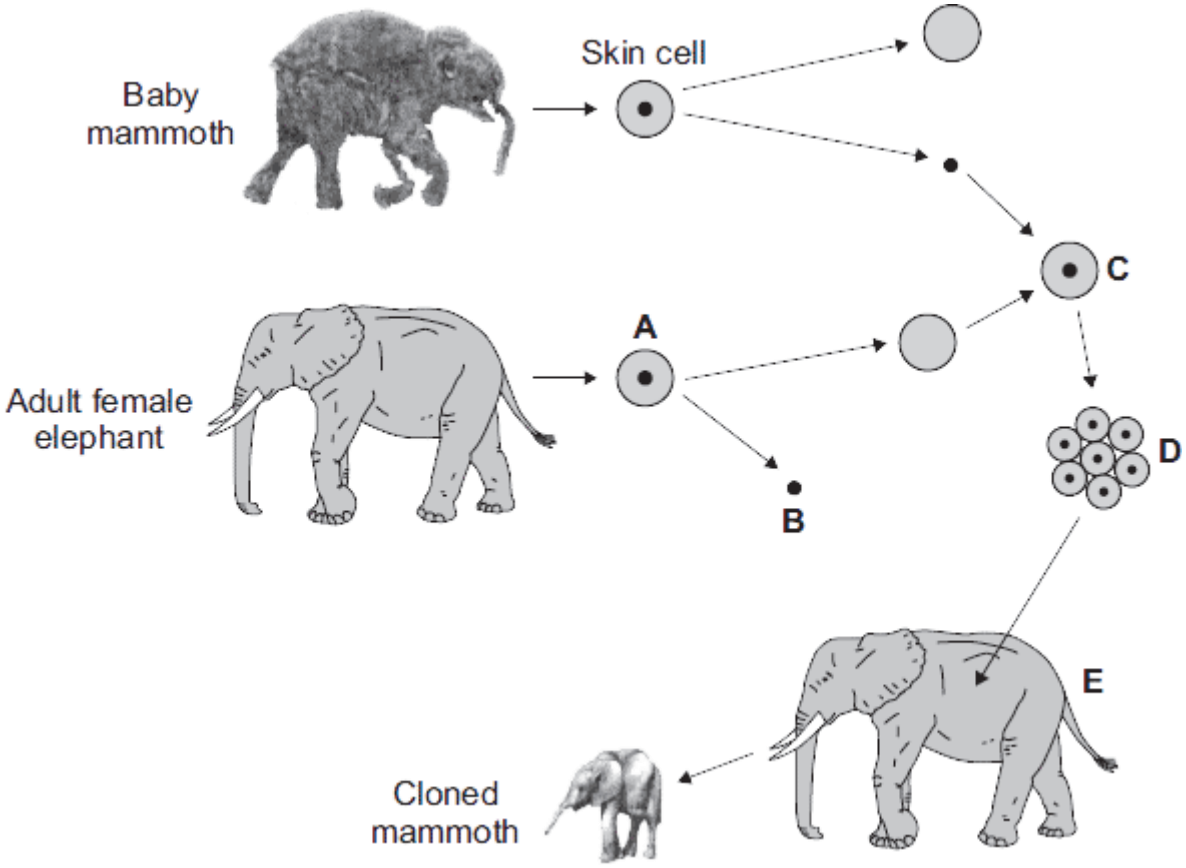
_____

(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?

Cell **C** is

treated with enzymes.
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)

Q8.

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)

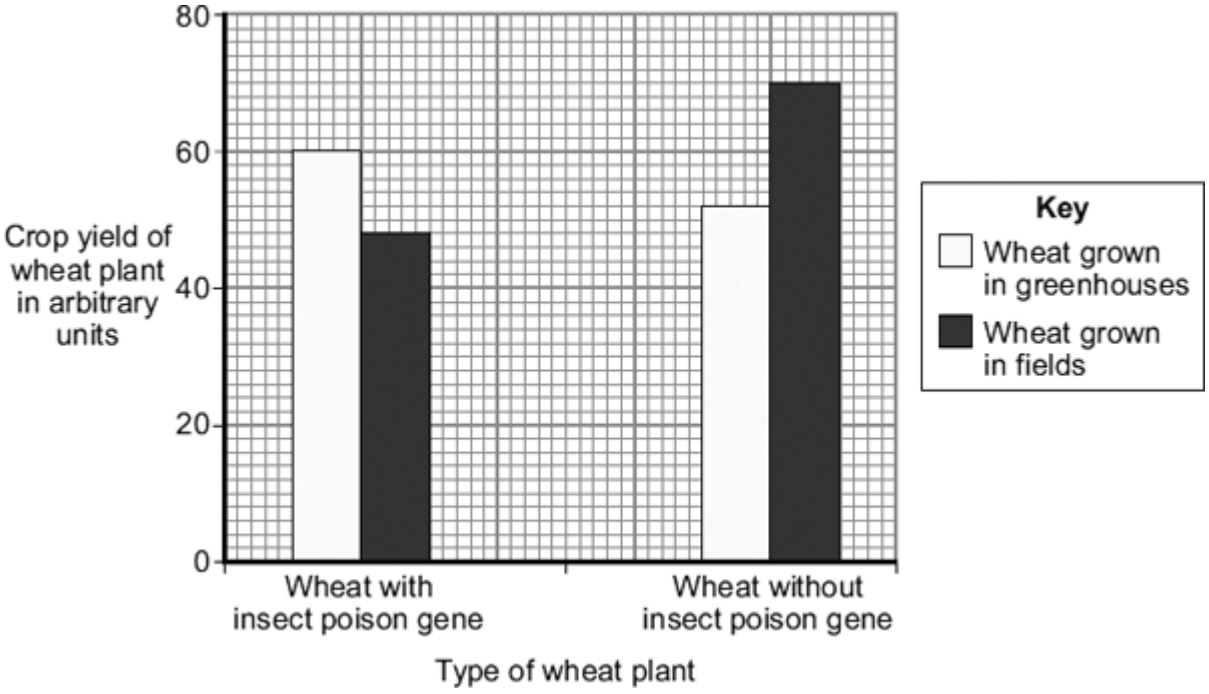
(b) A microorganism contains a gene which causes the production of an insect poison.

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)

Q9.

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)

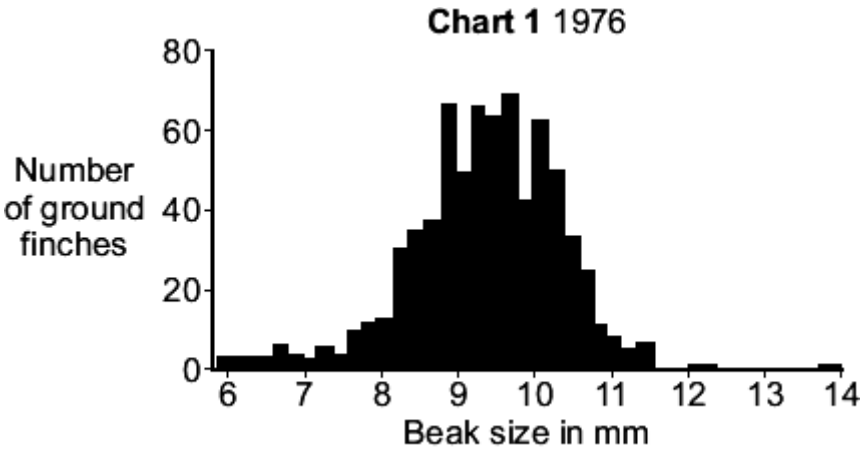
(Total 5 marks)

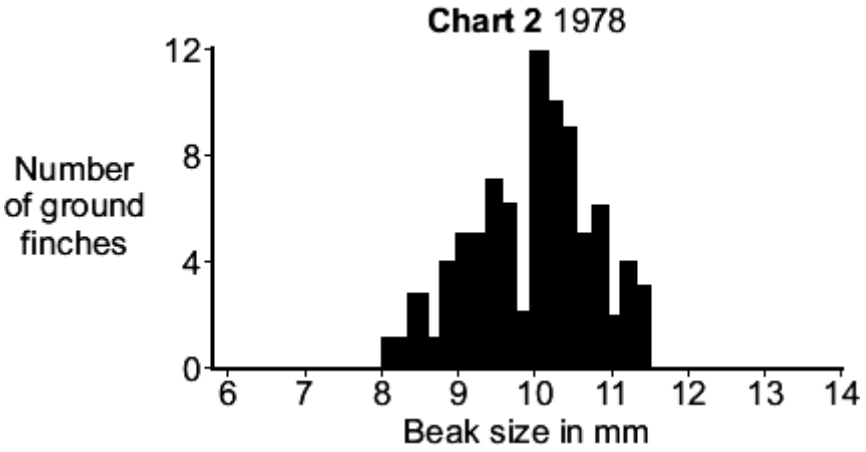
Q10.

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)

Q11.

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

(3)

(b) The photographs show two species of gull.

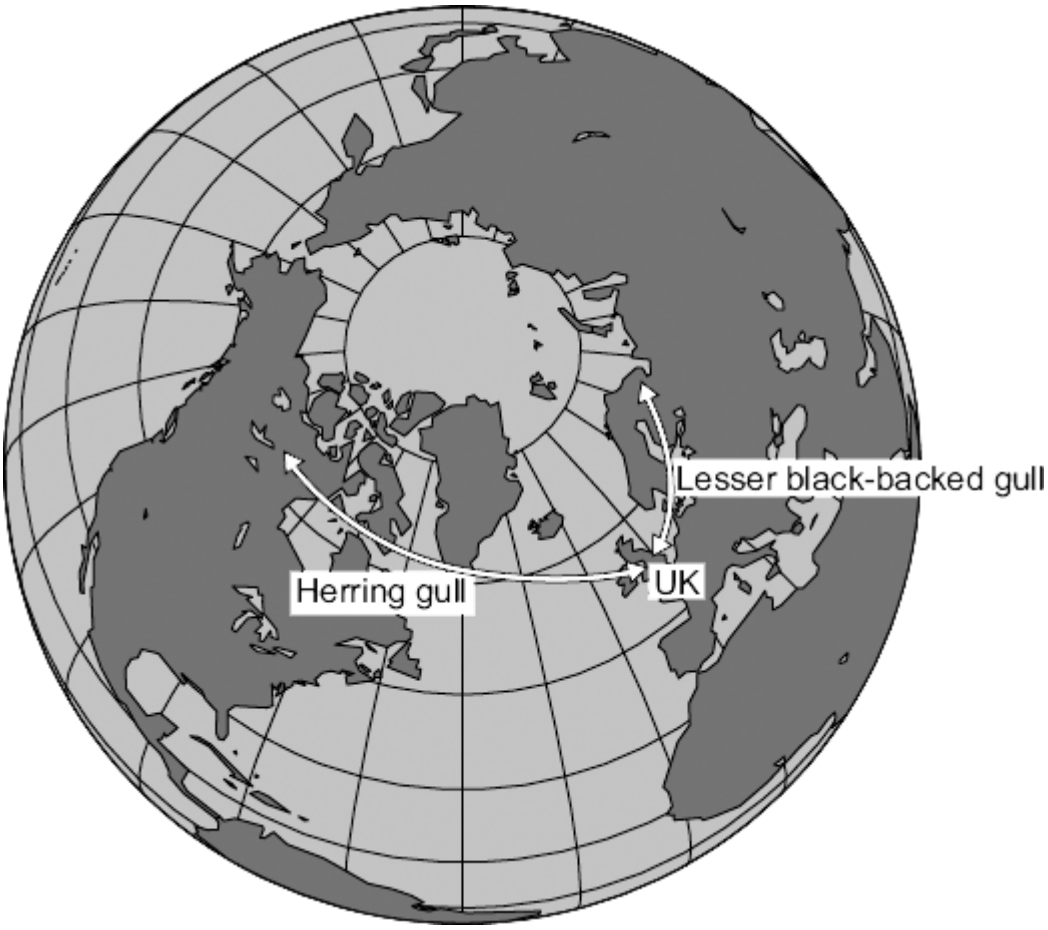
Herring gull (*Larus argentatus*) **Lesser black-backed gull (*Larus fuscus*)**

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

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 below 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)

Q12.

(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.

_____

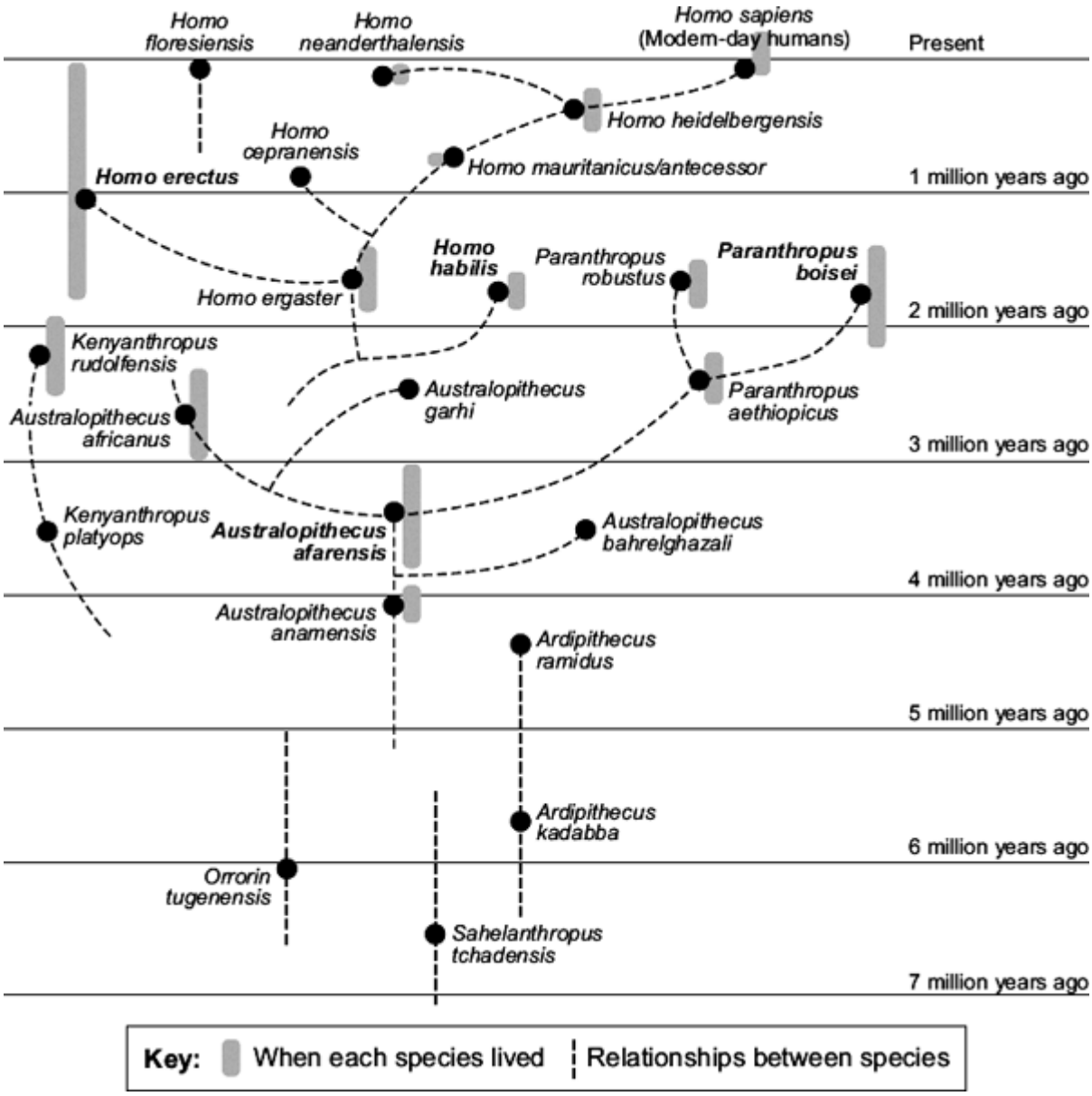
(1)

(Total 6 marks)

Q13.

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)

Q14.

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.

_____

_____

_____

_____

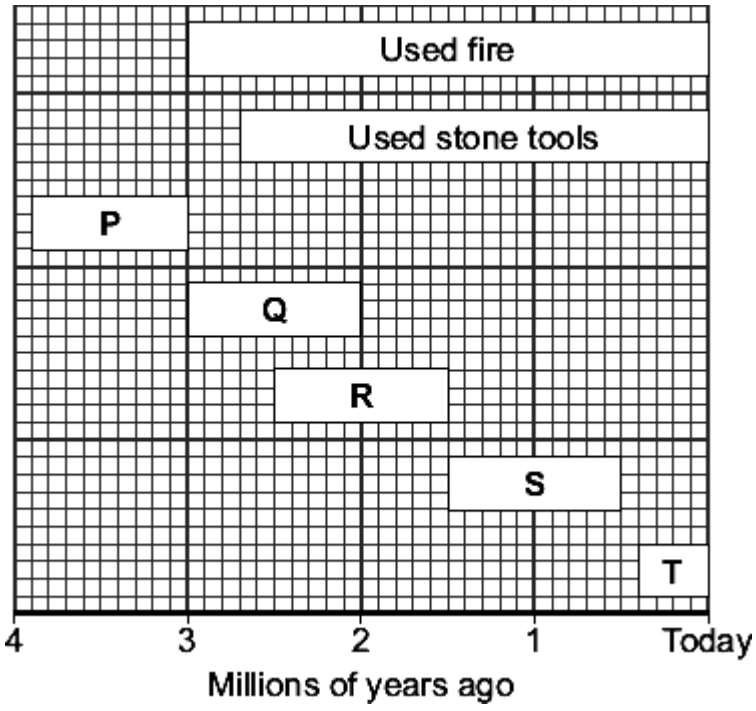
_____

(2)

(Total 5 marks)

Q15.

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)

Q16.

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	

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.
	Growing groups of cells from a plant on special jelly.

(Total 4 marks)

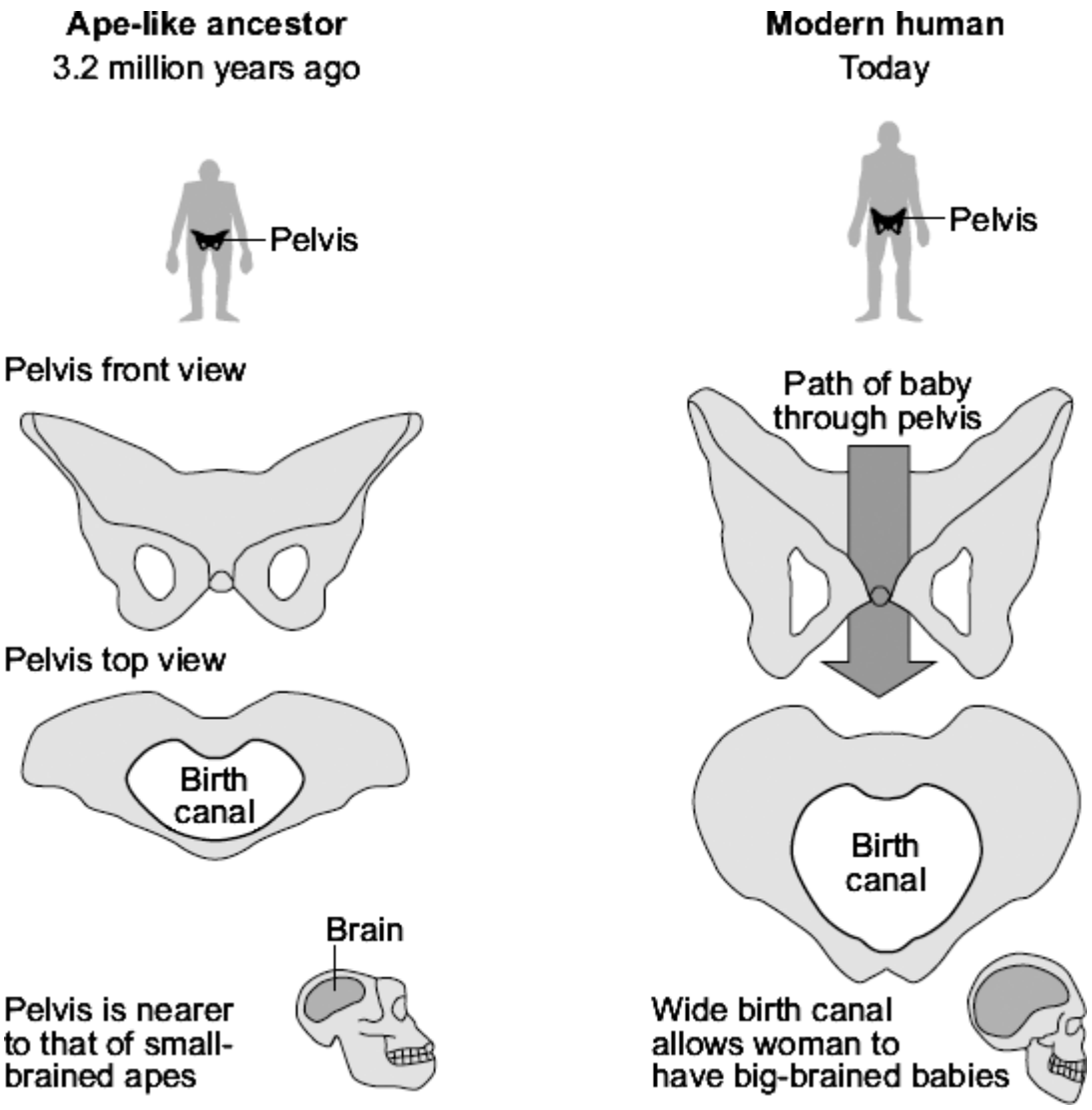
Q17.

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)

Q18.

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.

_____

_____

_____

_____

_____

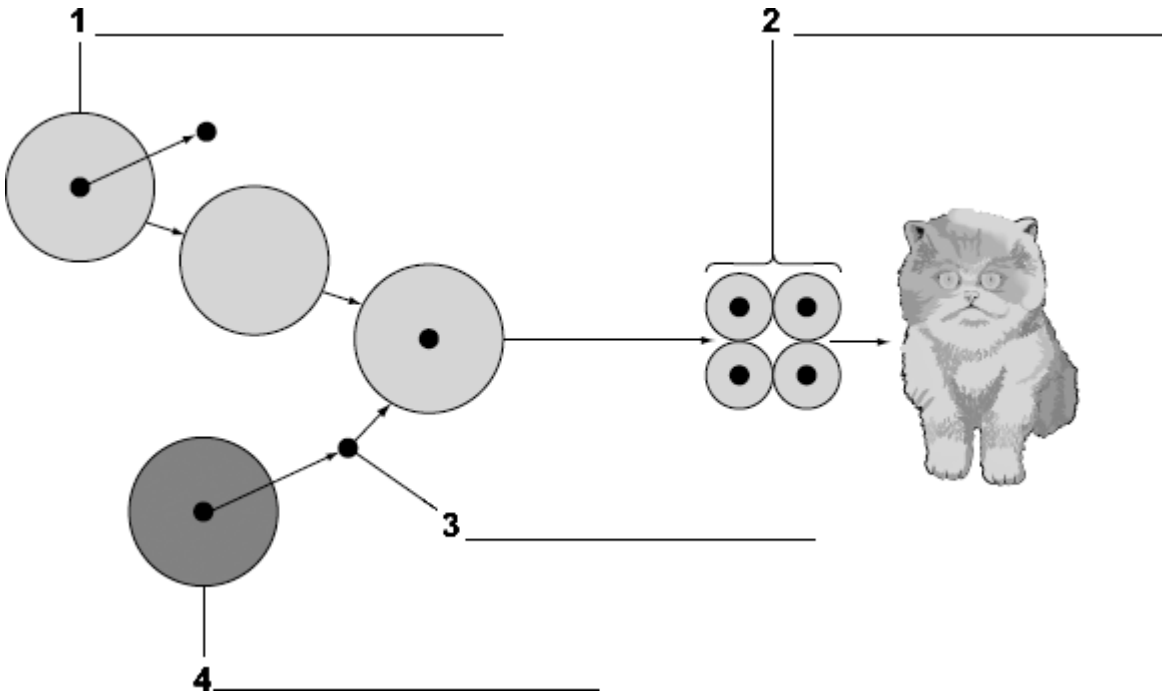
(4)

(Total 5 marks)

Q19.

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)

Q20.

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)

Q21.

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)

Q22.

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)

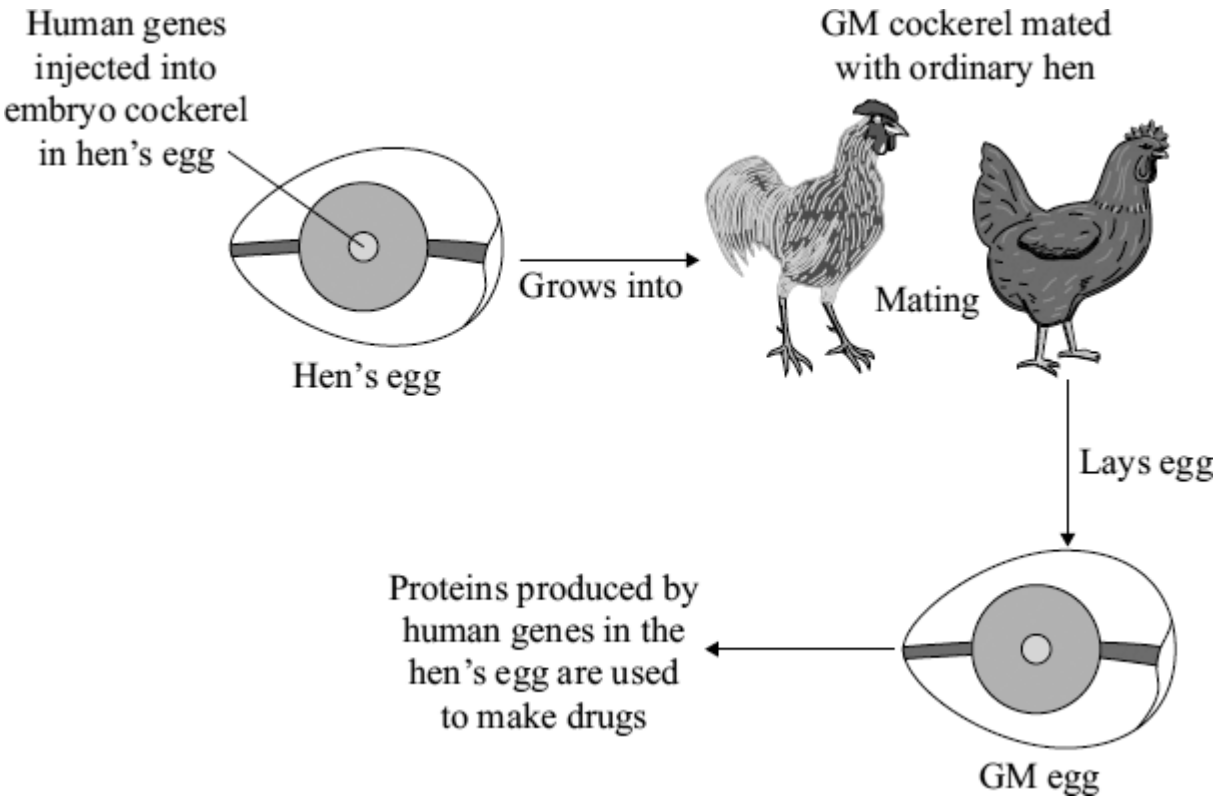
(Total 4 marks)

Q23.

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)

Q24.

Charles Darwin proposed the theory of natural selection.

(a) What is meant by natural selection?

_____

_____

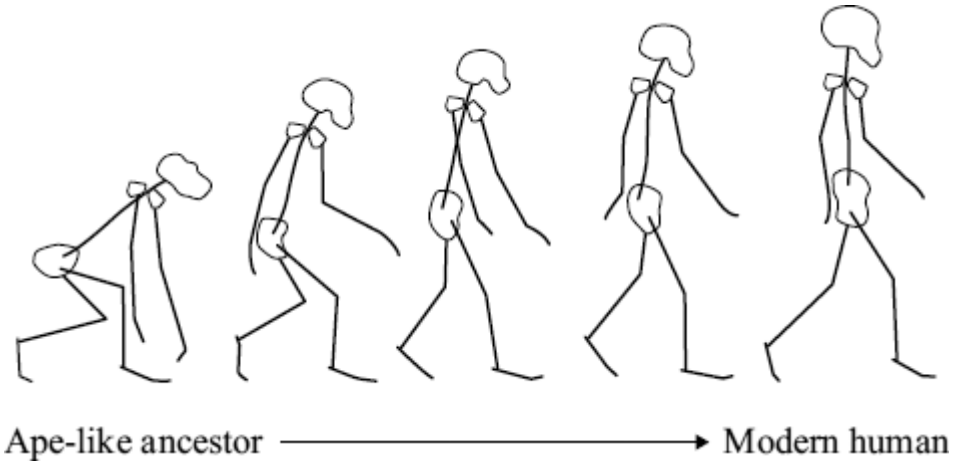
_____

_____

(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)

Q25.

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)

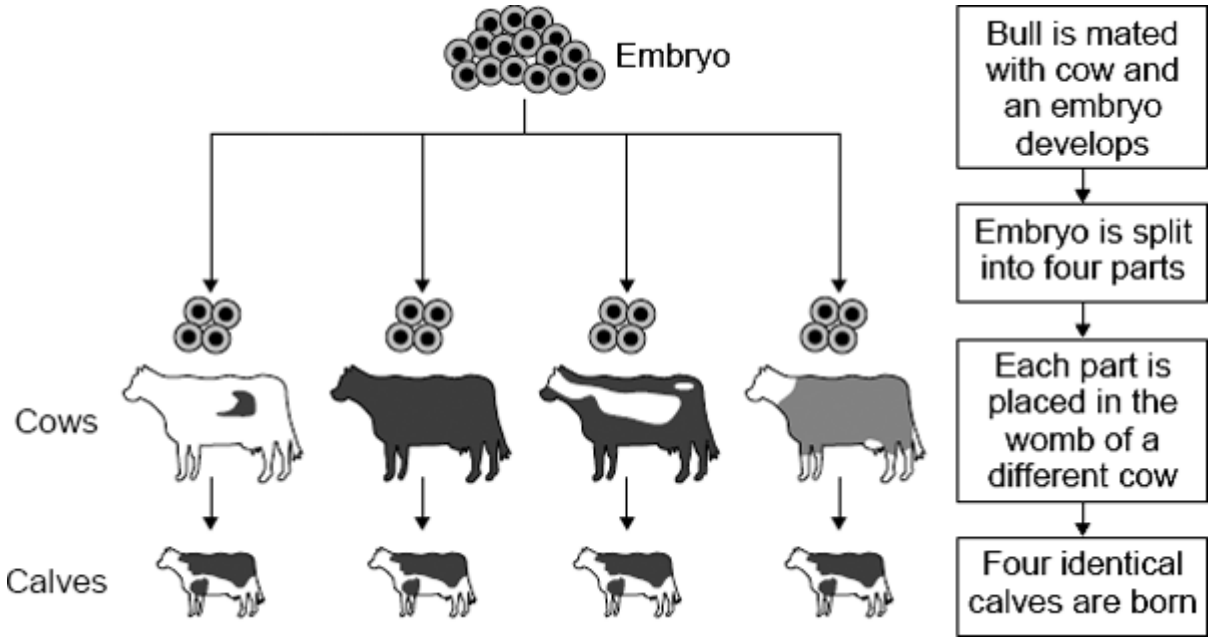
(ii) This colour is controlled by a _____

(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)

Q26.

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)

Q27.

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)

Q28.

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)

Q29.

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)

Q30.

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)

Q31.

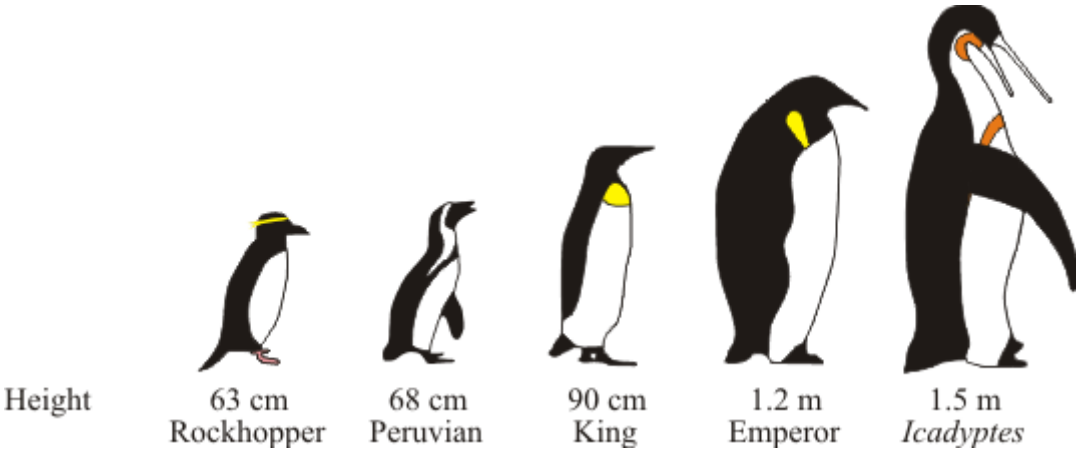
(a) Explain, as fully as you can, how natural selection leads to evolution.

(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)

Q32.

The use of cloned animals in food production is controversial.

It is now possible to clone 'champion' cows.

Champion cows produce large quantities of milk.

(a) Describe how adult cell cloning could be used to produce a clone of a 'champion' cow.

(4)

(b) Read the passage about cloning cattle.

> The Government has been accused of 'inexcusable behaviour' because a calf of a cloned American 'champion' cow has been born on a British farm. Campaigners say it will undermine trust in British food because the cloned cow's milk could enter the human food chain.
>
> But supporters of cloning say that milk from clones and their offspring is as safe as the milk we drink every day.
>
> Those in favour of cloning say that an animal clone is a genetic copy. It is not the same as a genetically engineered animal. Opponents of cloning say that consumers will be uneasy about drinking milk from cloned animals.

Use the information in the passage and your own knowledge and understanding to evaluate whether the government should allow the production of milk from cloned 'champion' cows.

Remember to give a conclusion to your evaluation.

(5)

(Total 9 marks)

Q33.

Some organisms are in danger of extinction.
The photograph shows an African elephant feeding on tree leaves.

(a) Read the information about elephants and humans in Africa.

- The African elephant is the largest land animal.
- The African elephant feeds on lots of leaves.
- Adult African elephants have no natural predators.
- Elephants are killed by poachers for their ivory tusks.
- African elephants live for about 70 years.
- Most African elephants live in large herds.
- Land available to elephants is disappearing rapidly.

The African elephant is now extinct in many parts of Africa.

Use information from the list to give **three** reasons why.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) Organisms that are in danger of extinction can be cloned.

List A gives the names of three different cloning techniques.

List B gives information about these techniques.

Draw a line from each technique in **List A** to the correct information about it in **List B**.

List A Technique	List B Information
	Small groups of cells from parts of a plant are grown on a special jelly.
Adult cell cloning	
	Cells from a developing animal are separated before they become specialised and then placed into host mothers.
Embryo transplanting	
	Genes are cut out from chromosomes and inserted into other organisms.
Tissue culture	
	A nucleus is removed from an unfertilised egg cell. The nucleus from a body cell is inserted into the egg cell. An electric shock causes the egg to start to divide.

(3)

(Total 6 marks)

Q34.

The photograph shows a snake eating a toad.

Cane toads were first introduced into Australia in 1935. The toads contain toxins and most species of Australian snake die after eating the toad.

The cane toad toxin does not affect all snakes the same way. Longer snakes are less affected by toad toxin.

Scientists investigated how red-bellied black snakes had changed in the 70 years since cane toads were introduced into their area. They found that red-bellied black snakes had

become longer by around 3 – 5 %.

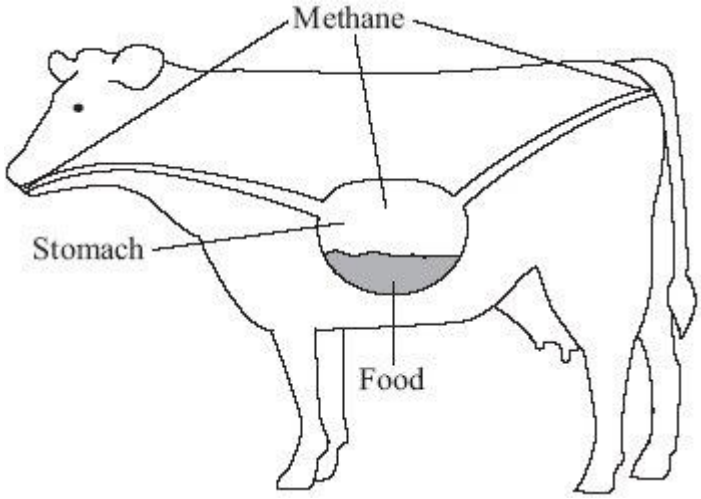
Suggest an explanation for the change in the body length of the red-bellied black snakes since the introduction of the cane toads.

(Total 4 marks)

Q35.

Scientists are investigating how to reduce methane emissions from cattle.

Most of this methane is emitted by the cows belching.



Scientists have found that less methane is belched if the cows eat high-sugar rye grass.

This rye grass has been produced by genetic engineering.

(i) Suggest how the high-sugar rye grass might have been produced by genetic engineering.

_____

_____

_____

(3)

(ii) Some people might object to the growing of genetically-engineered, high-sugar rye grass for feeding cattle.

Give **two** reasons why.

1. _____

_____

_____

2. _____

_____

_____

(2)

(Total 5 marks)

Mark schemes

Q1.

(a) (i) DNA replication / copies of genetic material were made

'it' = a chromosome

allow chromosomes replicate / duplicate / are copied

ignore chromosomes divide / split / double

1

(ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

ignore ref. to gametes and fertilisation

1

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

allow 'so offspring (cells) are identical'

1

(b) (i) meiosis

allow mieosis as the only alternative spelling

1

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

1

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

1

(c) (i) similarities between chromosomes
or
similarities between flowers described

e.g. shape of petals / pattern on petals / colour / stamens

1

can breed / can sexually reproduce

allow can reproduce with each other / they can produce offspring

1

(ii) any **two** from:

- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
- some chromosomes unable to pair (in meiosis)
- (viable) gametes not formed / some gametes with extra / too many genes / chromosomes

or
some gametes with missing genes / chromosomes

2

[10]

Q2.

(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]

Q3.

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

accept fertilisation

allow fusion / joining / combining DNA from two parents

ignore meeting / coming together / mixing of gametes etc

1

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

ignore nucleus / inherited information but allow second mark if given

1

from both parents / horse **and** zebra

dependent on sensible attempt at 1st mark

1

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

0 marks

No relevant content

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

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

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

Examples of Biology points made in the response could include:

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

6

[9]

Q4.

(a) mutation

correct spelling only
ignore other adjectives eg random / spontaneous

1

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

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

1

(individual with advantage) (more) survive / (more) live / (more) don't die
allow immunity rather than resistance throughout

1

(so survivors) breed / reproduce

1

mutation / gene passed (from survivors) to offspring / next generation
allow resistance / characteristic for gene

'gene passed on' is insufficient

1

[5]

Q5.

(a) sexual

1

characteristic

1

mutation

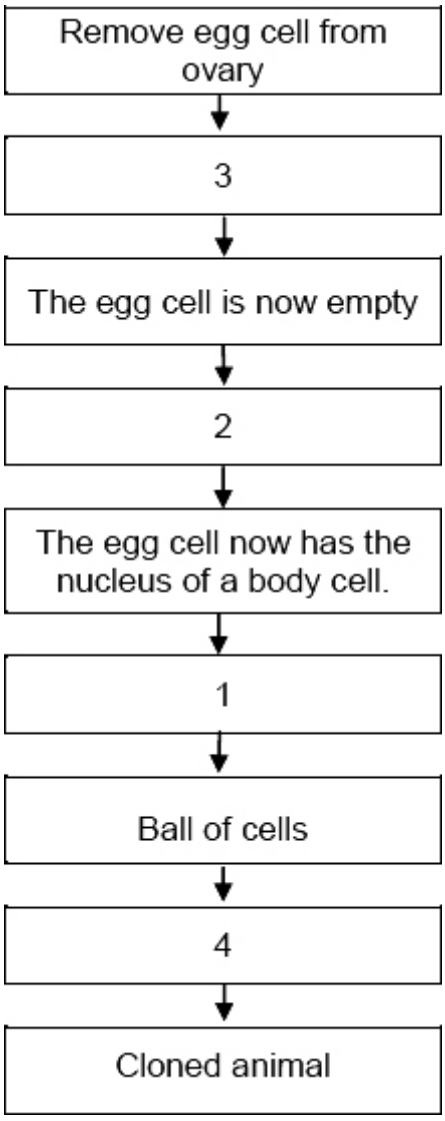
1

chromosome

this order only

1

(b)



*four correct gains **3** marks*
*two or three correct gains **2** marks*
*one correct gains **1** mark*

accept correct connection between statement and box

3

[7]

Q6.

(a) fusion of gametes / named gametes

allow meet / join / fertilise

1

results in mixing of genetic information / DNA / chromosomes

accept genetic information / DNA / chromosomes from two parents

1

(b) (i) use enzyme

1

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

1

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

accept use of plasmid as carrier

ignore salmon / cell

1

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

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

1

[6]

Q7.

(a) too cold / very cold **or** oxygen / microbes cannot reach it

allow not enough energy / heat / warmth
ignore frozen

1

for microorganisms / microbes / bacteria / fungi / enzyme / reaction (to work)

ignore other consumers

1

(b) no longer exist
or no more left
or died out / all died

ignore died unqualified

1

(c) (i) egg cell

1

(ii) nucleus

1

(iii) given an electric shock

1

(iv) womb

1

(d) has mammoth genes / chromosomes

accept genetic information / DNA / alleles / nucleus
accept converse

1

[8]

Q8.

(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]

Q9.

(a) (jellyfish) gene(s) cut out

1

ref to enzymes (at any stage)

1

(gene) transferred to zebra fish at early stage of development / embryo / egg

ignore removal of zebra fish genes

1

(b) any **two** from:

ignore unethical / religious / unnatural

- could transfer gene to other (fish) species
- effects on food chains

accept effects on other species / humans who eat them

- effects on zebra fish themselves, eg may out compete non GM zebra fish

2

[5]

Q10.

(a) in 1978
fewer finches **or** population smaller

1

any **two** from:

- no beaks less than 8mm
- no beaks greater than 11.5 / 12mm

*if these points not given allow smaller range of beak sizes for **1** mark*

- mean / average beak size higher

2

(b) variation or range or mutation of beak sizes

*do **not** accept idea that drought / seed size caused mutation*

1

birds with larg(er) beaks are better adapted for feeding

accept idea of competition for food / seeds amongst finches

1

birds with larg(er) beaks survive

accept (only / more) birds with large beaks were better competitors

1

birds with larg(er) beaks breed **or** gene / allele for large beak passed on

*do **not** accept large beak passed on*

1

[7]

Q11.

(a) fossil is (remains / impression of) organism that lived a long time ago

if numbers, ≥ 1000s years

1

fossils show changes over time **or** older fossils simpler **or** fossils simpler than present-day species

1

fossils have similar features to present-day species

allow fossils allow us to compare old species with present-day species

1

(b) isolation / separation / splitting

1

by geographical barrier / sea

ignore other examples

1

there was variation (in these isolated populations) / different alleles

accept mutation

1

different environmental conditions **or** example eg climate / predators / food

1

natural selection acted on the isolated populations

accept became adapted in each area

1

OR

only certain allele(s) passed on to offspring / different alleles passed on in different environments

allow genes

so differences lead to inability to interbreed

allow differences described – eg mismatch of genitalia / different courtship displays / different breeding seasons

1

[9]

Q12.

(a) characteristics

1

genes

1

clones

1

asexual

1

(b) (i) tissue culture

accept other asexual methods eg runners / plantlets / dividing

accept use of (named) organ e.g. root / leaf

ignore cloning / asexual / stem cuttings / reproduction / genetic engineering

*do **not** accept seeds / sexual reproduction*

1

(ii) embryo transplant / splitting

ignore asexual

or

(adult cell / fusion) cloning

*do **not** accept clones*

*do **not** accept sexual reproduction*

ignore genetic engineering

1

[6]

Q13.

(a) 3.75

accept answers in range 3.6 – 3.9

1

(b) (Paranthropus) aethiopicus

1

(c) (Homo) ergaster

1

(d) any **two** from:

ignore references to H. floresiensis or not enough data

- Homo erectus fossils found in other parts of the world

  *allow **only** 50 fossils found in China*

  ignore the two species were alive at the same time

- (too many) gaps in fossil record

  Homo erectus on different branch of 'tree'

  or no evidence of other 'humans' developing from Homo erectus

  or no link shown between Homo erectus to Homo sapiens / modern humans

  allow diagram shows they are not closely related

or (fossils show that) H. sapiens evolved from H. heidelbergensis / H. mauritanicus / H. ergaster

2

(e) any **two** from:

- ‘religious’ reasons

  allow people did not wish to believe they had evolved from apes

- insufficient evidence at that time

  allow took a long time to get evidence

  or *communications not as good at that time*

  ignore ***no*** *evidence / could not prove it*

- Darwin was not a respected / well known scientist

  ignore references to Lamarck

- mechanism of inheritance / variation not known at that time

  allow (people) did not know about genes / genetics / DNA / chromosomes / mutations

2

[7]

Q14.

(a) seeds produced by sexual reproduction / fusion of gametes / fertilisation

allow produced by pollination / crossing

1

mixture of genes / genetic information / chromosomes / DNA
or from two parents / apple trees

if no other mark obtained allow ***1*** *mark for apples had different genes / genetic information / chromosomes / DNA*

or

mutation occurred

ignore environmental effects / cloned

1

(b) (i) cuttings / tissue culture

accept grafting

allow adult cell cloning

ignore cloning unqualified

ignore genetic engineering

ignore asexual reproduction

1

(ii) asexual reproduction

allow produced by cloning / mitosis

1

have identical genes / genetic information / chromosomes / DNA

or no mixing of genes / genetic information /chromosomes /DNA

1

[5]

Q15.

(a) (i) 3

1

(ii) Q

1

(iii) 1

1

(b) from fossils / bones

allow artefacts / named artefacts / drawings / evidence of fires

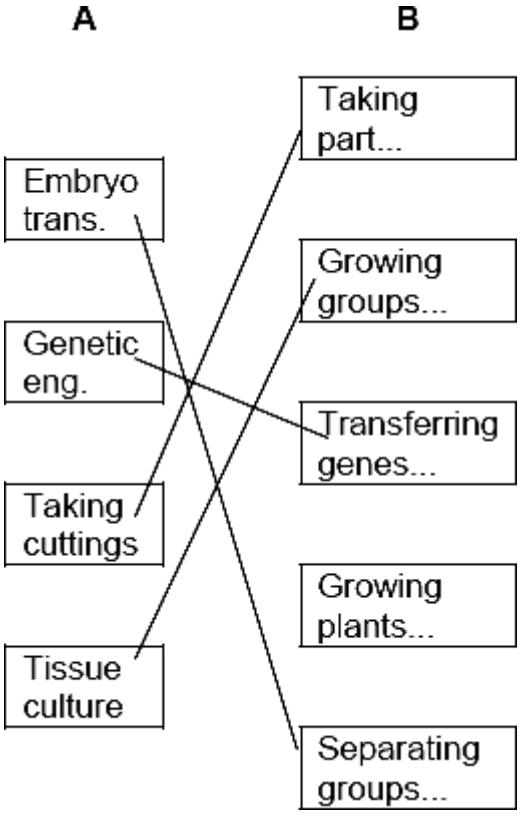
1

(c) Darwin

1

[5]

Q16.



1 *mark for each correct line*

mark each line from left hand box

two lines from left hand box cancels mark for that box

[4]

Q17.

a mutation occurs **or** variation in size / shape of pelvis

allow idea that walking upright needs larger pelvis to bear weight

1

large / wide birth canal / pelvis allowed passage of wide skull / brain

*do **not** allow pelvis became larger to enable birth of larger-skulled babies*

1

link between brain size and intelligence

1

those with larger pelvis / brain more likely to survive / reproduce

1

[4]

Q18.

(a) two species / types involved

1

(b) *full marks only if at least **one** pro, **one** con and an attempt at a conclusion*

any **three** from:

pros (max **two** pros)

- useful if species difficult to breed
- prevents extinction / continues genetic line

cons (max **two** cons)

ignore reference to ethical issues / cruelty

- low success rate **or** figures given
- development problems
- diverts attention from habitat conservation / poaching / pollution / climate change
- cloning reduces gene pool

3

conclusion

argued conclusion

*must include references to **both** pros and cons and must be at end of answer*

1

[5]

Q19.

(a) **1** egg

1

2 embryo

1

3 nucleus

1

4 skin cell

1

(b) the child created by cloning would not have been able to give permission

extra boxes ticked cancels the mark

1

[5]

Q20.

(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]

Q21.

mutation **or** <u>variation</u> **or** <u>range</u> of sizes

*do **not** accept deliberate mutation **or** factor caused mutation*

1

warm(er) / dry(er) now

allow global warming

1

if warmer more smaller lambs / sheep survive winter

award 'survival' point only if linked to warmer / dryer conditions

1

or if warmer sheep do not need fat / wool / fur to keep warm
or if warmer smaller sheep can lose heat more readily / do not overheat / keep cool (so survive)

*do **not** accept smaller sheep retain more heat*

or if warmer smaller sheep have larger SA / V ratio (so survive)

*do **not** accept smaller sheep have smaller SA / V ratio*

or if dryer smaller lambs / sheep need less grass (to survive)

ignore small sheep feed easier on grass

small sheep breed / pass genes / mutations / characteristics to next generation

*do **not** accept if Lamarckian*

ignore competition / predation / human influence

1

[4]

Q22.

(a) any **two** from:

assume it refers to asexual

- no fusion in asexual **or** sexual involves fusion

  *accept no fertilisation in asexual **or** fertilisation in sexual*

  or no mixing of genetic information in asexual **or** mixing of genetic information in sexual

  accept genes / alleles / chromosomes / genetics for genetic information

  or asexual involves splitting (of one individual)

- no gametes in asexual **or**
  sexual involves gametes

  accept named gametes

- only one parent in asexual **or**
  sexual involves two parents

- no variation in asexual
  or asexual produces clones
  or sexual leads to variations

  allow offspring of sexual have characteristics of both parents for this point

  ignore sexual intercourse

  ignore external / internal

  ignore plants / animals

  ignore mitosis / meiosis

2

(b) nucleus of egg removed **or**
involves empty egg cell

1

so only one nucleus **or** one set of genetic information / genes / chromosomes
or

so genetic information / genes / chromosomes from one parent only

1

[4]

Q23.

(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]

Q24.

(a) any **two** from:

- survival of fittest

  allow examples
- amplification of fittest ie has adaptations to survive

  allow examples
- go on to breed **or** genes / characteristics passed on to next generation

  *NB best adapted organisms survive gains **2** marks*

2

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

ignore unqualified change eg 'the skull changes shape'

- increased height
- increased erectness

  allow description of modern human characteristic eg 'modern humans stand up straight'

- shorter arms
- legs straighter
- larger skull

  allow description of ape-like characteristics eg ape-like ancestor walked on four legs

- larger pelvis **or** changing shape described
- humans walk on two legs / feet

2

(c) any **two** from:

- religious objections
- insufficient evidence

  *ignore **no** evidence*

  accept could not prove

- mechanism of heredity not known

  did not know about genes /chromosomes / DNA / mutations

- did not like the thought of being descended from apes

2

(d) Darwin's theory depends on differences in genes at birth / inborn variation / mutation

allow Darwin's theory depends on genetics

ignore reference to time

1

[7]

Q25.

(a) (i) characteristic

1

(ii) gene

1

(iii) gamete

1

(b) sexual

1

asexual

1

clones

1

[6]

Q26.

(a) predation / eaten

ignore competition

1

(b) could run faster / jump higher /climb better

1

to escape / or escape describe

1

(c) (i) natural selection

1

(ii) Darwin

1

[5]

Q27.

(a) genetically identical / same DNA / same chromosomes

gains 2 marks

*accept identical without reference to genetic material for **1** mark*

2

(b) remove nucleus from egg

allow use empty egg cell

1

insert genetic material / nucleus /DNA / chromosomes from frozen mouse

*do **not** allow if reference to sperm*

1

electric shock **or** allow to divide **or** insert into womb / uterus

1

(c) ethical / religious / emotional reasons

or

not known if it is safe / long term effects not known

ignore playing God / unnatural / immoral

1

[6]

Q28.

(a) variation / range of leg sizes /mutation

*do **not** allow intention to mutate*

1

ones with longer legs could feed in deeper water / get more food
or
long legged ones less likely to get feathers wet
or

long-legged ones could escape from leopards

allow reverse argument

1

survive / breed / pass on genes

allow characteristics passed onto next generation

1

(b) flamingos stretched their legs (to be able to feed in deeper water/ keep feathers dry / escape from leopards)

It must be clear that the characteristic develops during the organism's lifetime ie it is not inherited from parents

accept long legs are an acquired characteristic

1

longer legs / acquired characteristic inherited by offspring

accept (acquired) genes for long legs passed on

1

[5]

Q29.

(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]

Q30.

(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]

Q31.

(a) variation / mutation

1

individuals with characteristics most suited to environment survive

allow survival of the fittest

1

genes passed to next generation **or** these individuals reproduce

1

(b) any **two** from:

- similar in size to Emperor penguin **or** bigger than all penguins
- large size is adaptation to cold climate
- since less heat loss per unit of body volume **or** smaller surface area / volume ratio

2

[5]

Q32.

(a) any **four** from:

- nucleus / DNA / chromosomes / genetic material removed (from egg)
- from (unfertilised) egg / ovum

  linked to second point

  *allow 'empty egg cell' for first **two** marks*

  *do **not** allow fertilised egg*

  allow egg from champion cow
- nucleus from body cell of champion (cow)

- inserted into egg / ovum
- electric shock
- to make cell divide **or** develop into embryo
- (embryo) inserted into womb / host / another cow

allow this point if wrong method eg embryo splitting

4

(b) any **four** from:

Pros: Max 3 marks

- economic benefit eg increased yield / more profit
- clone calf not genetically engineered
- genetic material not altered
- milk safe to drink / same as ordinary milk

Cons: Max 3 marks

- consumer resistance
- caused by misunderstanding process
- not proved that milk is safe

*ignore 'God would not like it' **or** 'it's not natural'*

- ethical / religious argument
- reduce gene pool / eg

4

Conclusion:

sensible conclusion for or against, substantiated by information from the passage and / or own knowledge

conclusion at end

1

[9]

Q33.

(a) killed by poachers / killed for tusks

1

less trees / leaves to eat

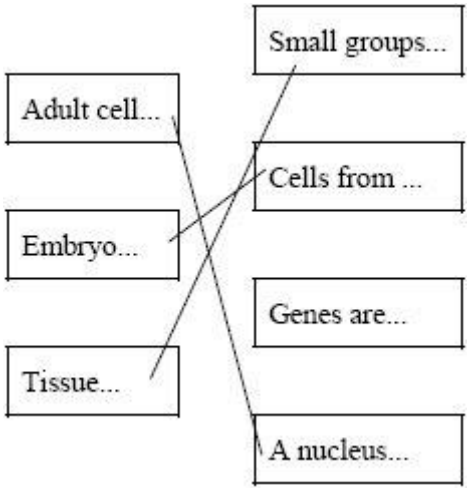
ignore feed on lots of leaves

1

land available disappearing

1

(b)



*all three correct = **3** marks*
*two correct = **2** marks*
*one correct = **1** mark*
extra line from a statement cancels the mark

max 3

[6]

Q34.

any **four** from

- mutation
  *do **not** accept 'had to mutate / decided to mutate'*
- produces longer snake **or** there is variation in snake length
  *do **not** accept 'had to adapt and became longer'*
- longer snake less susceptible to toxin **or** longer snake survives
- survivors reproduce
- gene passed to next generation
  allow characteristic passed to next generation

[4]

Q35.

(i) any **three** from:

ignore references to other methods eg tissue culture and embryo transplantation

- remove gene
- use of enzymes

- from plant with high sugar production

allow from bacteria

- insert gene into rye grass

3

(ii) any **two** from eg

- concern about effect on (health) of cow
- concern about effects on human (health)
- concern about food chain effects **or** effects on ecosystem
- effect on gene pool

*ignore not natural **or** cost*
ignore ethical / religious arguments
if no other marks awarded
'we don't know the long term effects' = 1 mark

2

[5]

Q1.

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. _____

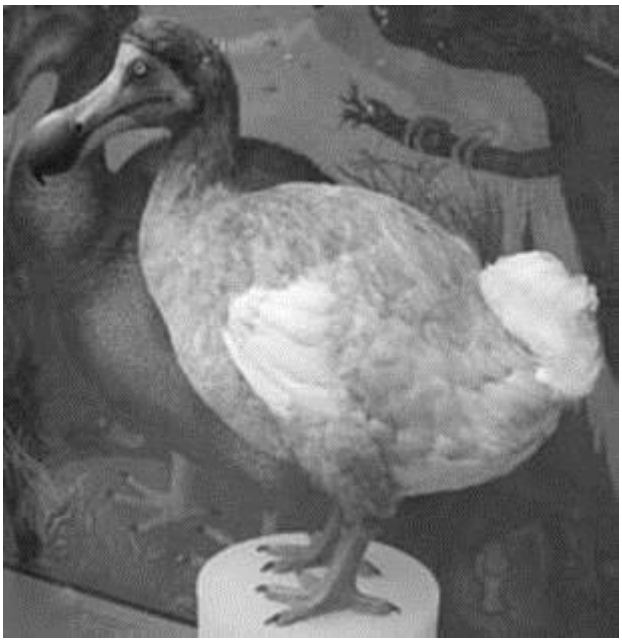
_____

(2)

(Total 6 marks)

Q2.

The dodo is an extinct bird. The drawing shows an artist's impression of the bird.



The dodo lived on a small island in the middle of the Indian Ocean. Its ancestors were pigeon-like birds which flew to the island millions of years ago. There were no predators on the island. There was a lot of fruit on the ground. This fruit became the main diet of the birds. Gradually, the birds became much heavier, lost their ability to fly and evolved into the dodo.

(a) Suggest an explanation for the evolution of the pigeon-like ancestor into the flightless dodo.

(4)

(b) The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

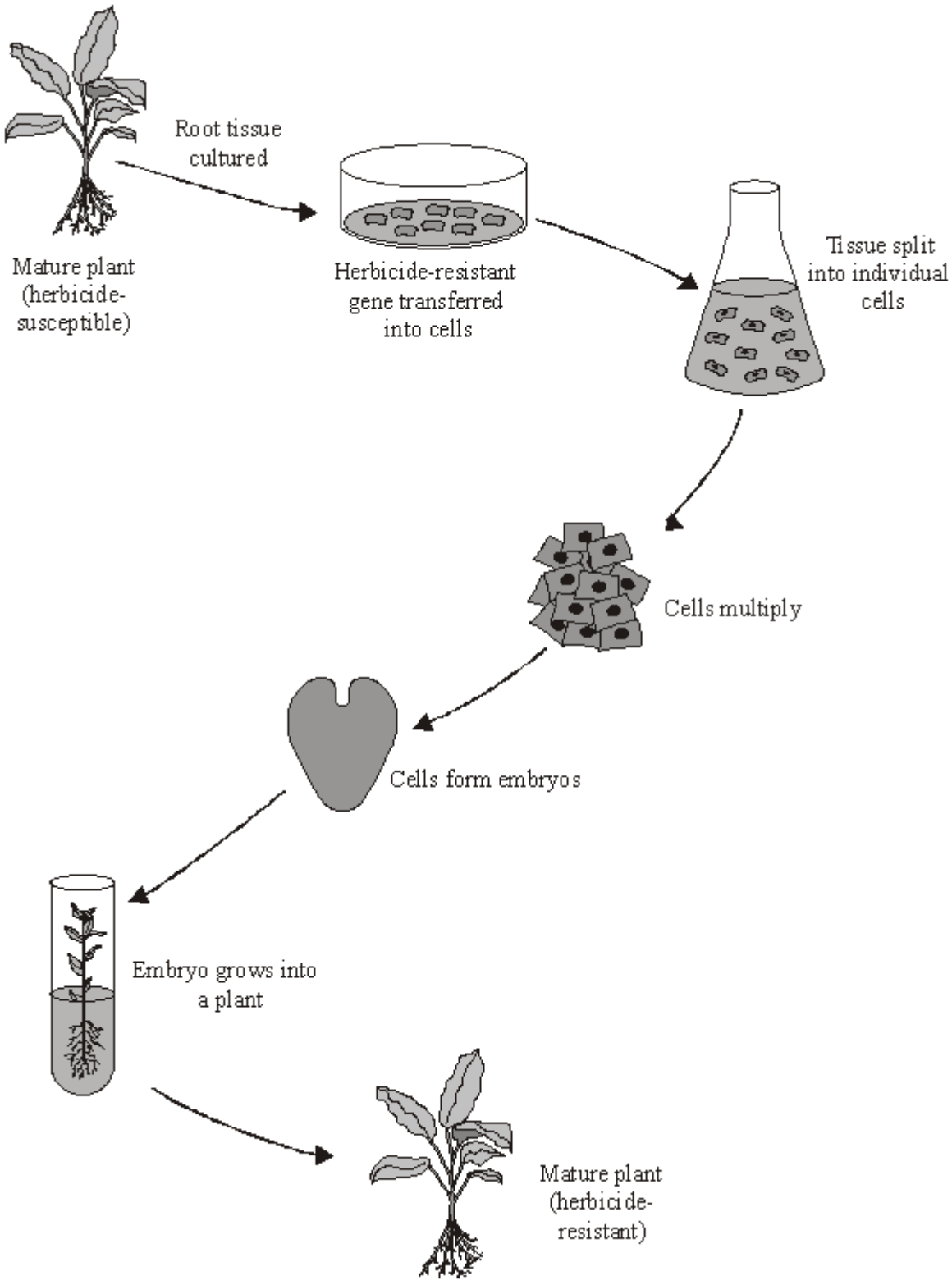
Suggest an explanation for this uncertainty.

(1)

(Total 5 marks)

Q3.

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



(a) (i) The herbicide-resistance gene is obtained from a herbicide-resistant plant.

Which structure in a cell carries the genes?

_____

(1)

(ii) How is the herbicide-resistance gene cut out of this structure?

_____

_____

(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 6 marks)

Q4.

In the 1850s, Gregor Mendel carried out breeding experiments using peas.

(a) The importance of Mendel's work was not recognised until the early 1900s.

Explain why.

_____

_____

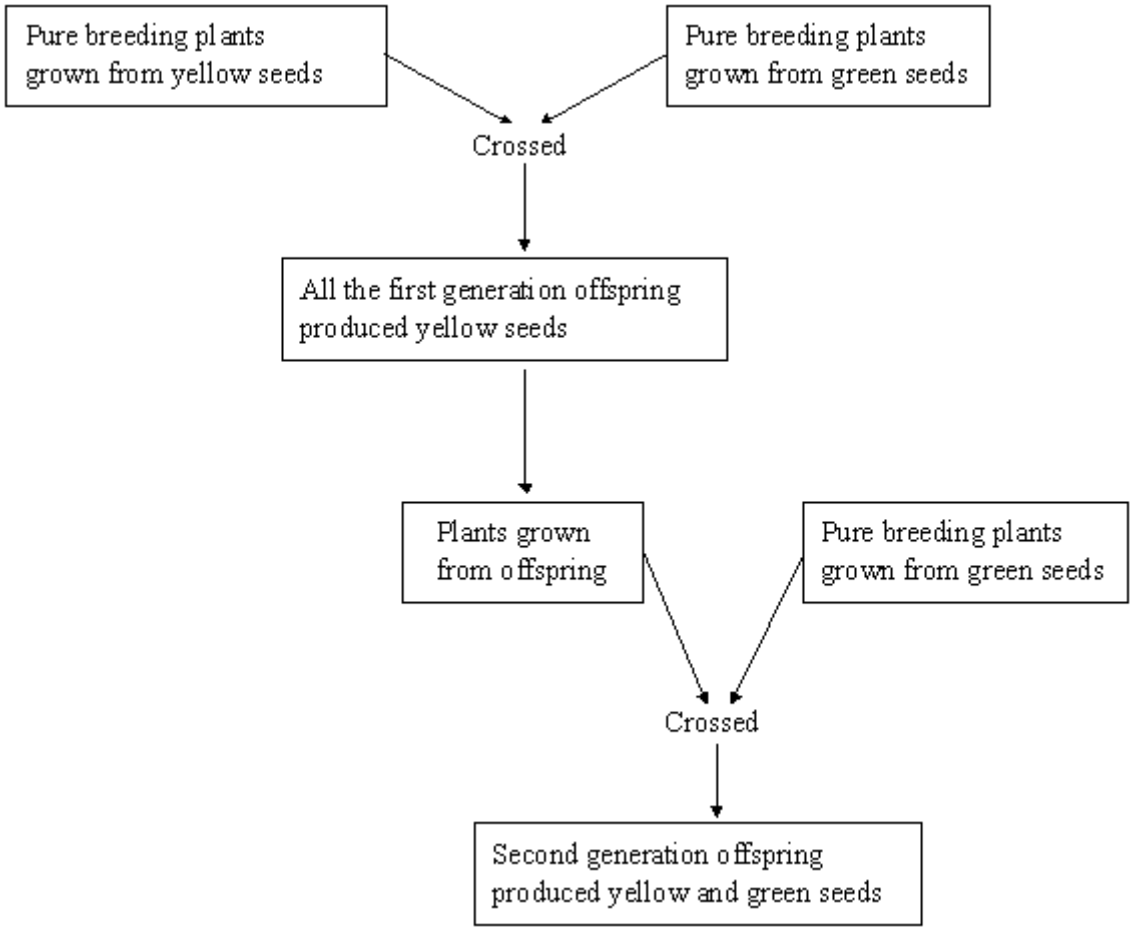
_____

_____

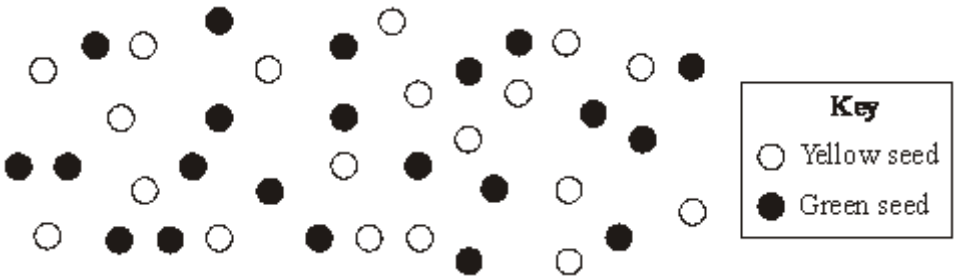
(2)

(b) A student repeated one of Mendel's experiments.

The flow chart shows her procedure.



The diagram shows a representative sample of seeds produced by second generation plants.



(i) Describe how the student could obtain a sample that is representative of seeds produced by the second generation.

_____

_____

(1)

(ii) What was the approximate ratio of yellow seeds to green seeds in the seeds produced by the second generation?

_____

(1)

(iii) Seed colour in peas is controlled by a single gene which has two alleles.

Use a genetic diagram to show why this ratio of yellow seeds to green seeds was produced by the second generation.

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

(4)

(Total 8 marks)

Q5.

The diagram shows an evolutionary tree for a group of animals called primates.

The names of extinct animals are printed in italics *e.g. Nycticeboides*.

The drawings show animals that are alive today.

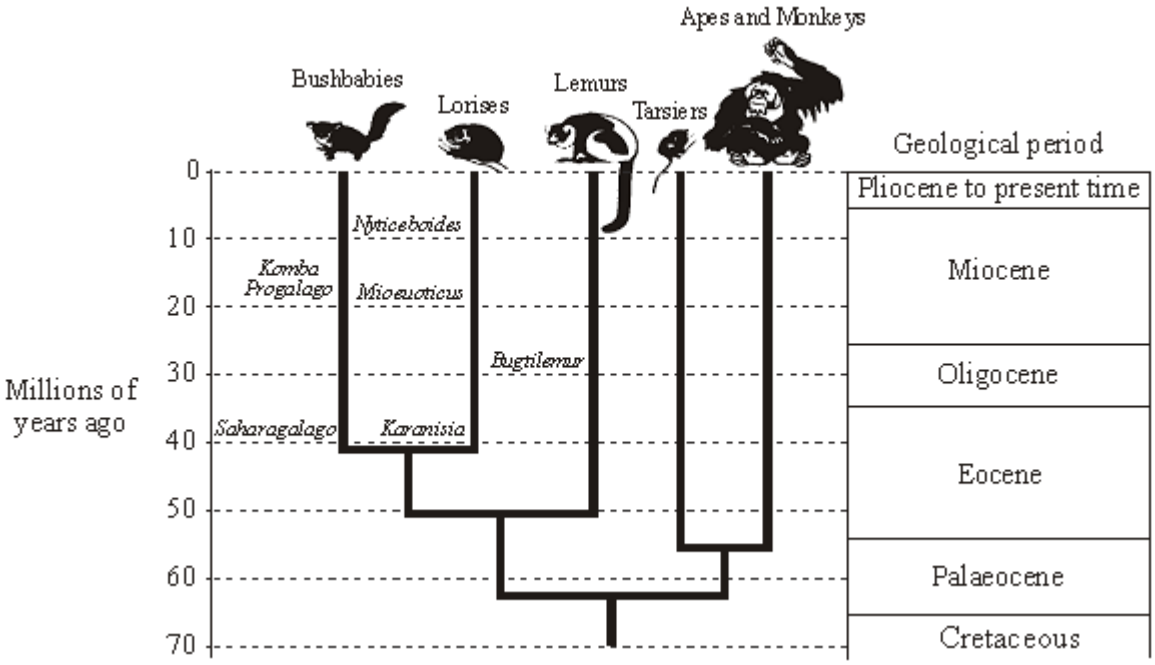


Illustration by Lucrezia Beerli-Bieler

(a) (i) How many million years ago did *Karanisia* first appear?

_____ millions of years ago.

(1)

(ii) During which geological period did the Apes and Monkeys begin to evolve?

_____

(1)

(iii) Which group of primates alive today are the closest relatives of the Lorises?

_____

(1)

(b) Darwin was the first scientist to state that humans and other primates had common ancestors.

Many people were against Darwin's ideas at that time.

Give **two** reasons why they were against his ideas.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

Q6.

The photograph shows a Crossbill.

A Crossbill feeds by using its bill (beak) to force apart the scales on conifer cones. It then uses its tongue to extract the seeds. If the bill is clipped it grows back again.

Scientists were interested in the evolution of the bill of the Crossbill.

In an investigation, they clipped the bills of several Crossbills so that their bills no longer crossed.

They observed that Crossbills with clipped bills took much longer to get seeds.

Use information from the investigation to suggest an explanation for the evolution of the bill in the Crossbill.

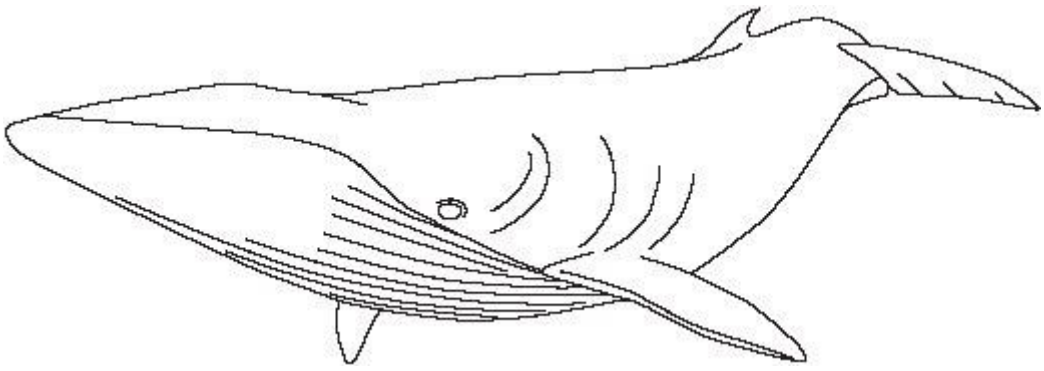
In your explanation, use the ideas of *selection*, *competition* and *mutation*.

(Total 4 marks)

Q7.

(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

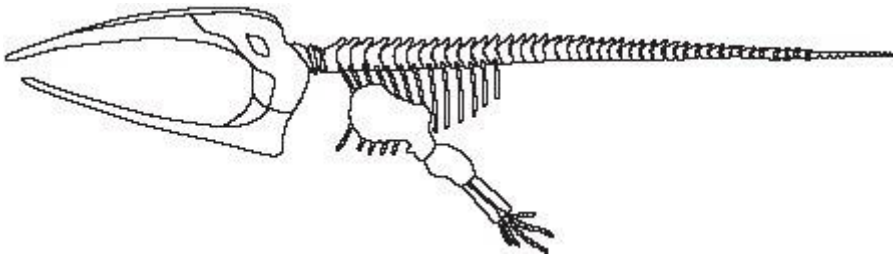
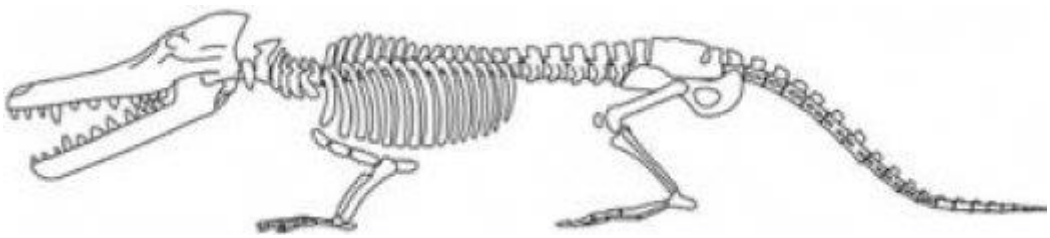


Figure 3 shows the fossil skeleton of an extinct whale.

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.

disprove

Fossils	give evidence for prove	the theory of evolution.

(2)

(Total 6 marks)

Q8.

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

antibiotics	**antibodies**	**antitoxins**	**painkillers**	**statins**

The substances made by white blood cells to kill pathogens are called _____

The substances made by white blood cells to counteract poisons produced by pathogens are called _____

Medicines which kill bacteria are called _____

(3)

(b) The MMR vaccine protects people against three diseases.

Write down the names of **two** of these diseases.

1. _____

2. _____

(2)

(c) All vaccinations involve some risk.

The table shows the risk of developing harmful effects:

- from the disease if a child is **not** given the MMR vaccine;
- if a child **is** given the MMR vaccine.

Harmful effect	Risk of getting the harmful effect from the disease (if not vaccinated)	Risk of getting the harmful effect from MMR vaccine
Convulsions	1 in 200	1 in 1000
Meningitis	1 in 3000	Less than 1 in 1 000 000
Brain damage	1 in 8000	0

A mother is considering if she should have her child vaccinated with the MMR

vaccine.

Use information from the table to persuade the mother that she should have her child vaccinated.

_____

_____

_____

_____

(2)

(d) The vaccine used to protect us from the Hepatitis B virus is produced by genetic engineering.

Yeast cells are used to produce the vaccine.

Use words from the box to complete the sentence.

chromosomes	**drugs**	**enzymes**	**genes**	**hormones**

To produce the vaccine _____ are used to cut out _____

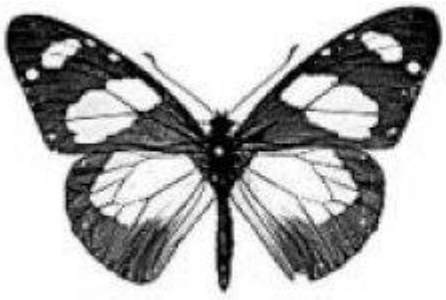
from the Hepatitis B virus which are then inserted into the yeast cells.

(2)

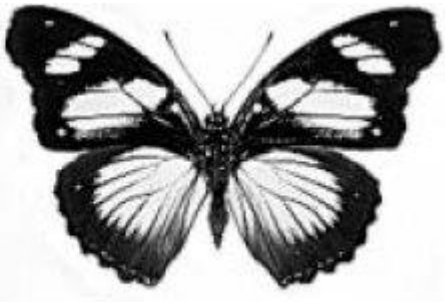
(Total 9 marks)

Q9.

The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.
- *Amauris* has a foul taste which birds do not like, so birds have learned not to prey on it.
- *Hypolimnas* does **not** have a foul 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)

Q10.

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

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

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

(2)

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

_____

_____

_____

_____

(2)

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

Suggest an explanation for this.

_____

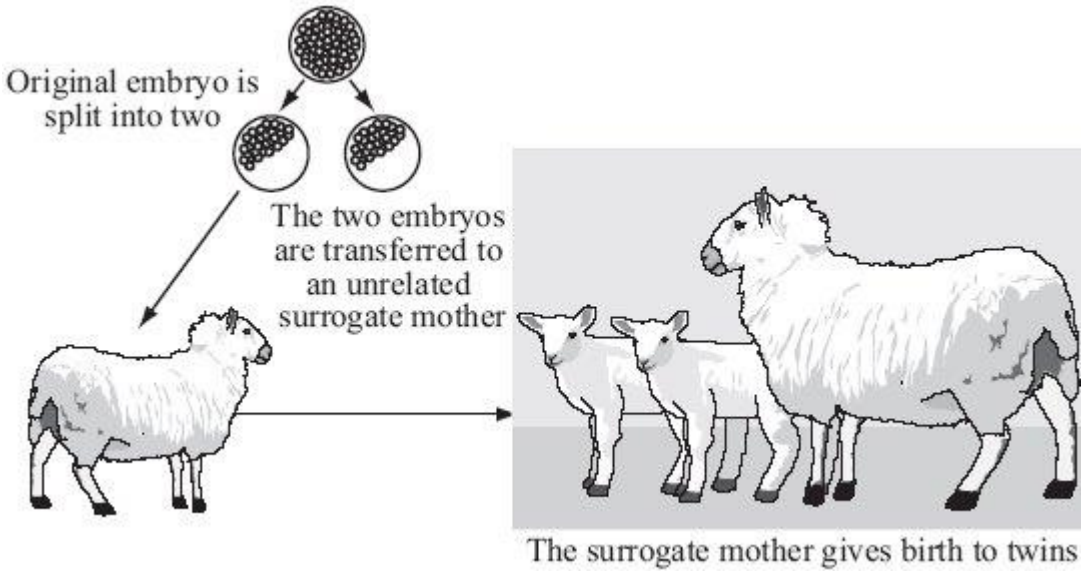
_____

(1)

(Total 5 marks)

Q11.

The diagram shows one way of cloning sheep.



Use words from the box to complete the sentences.

asexual	**clones**	**different**	**gametes**
identical	**joining**	**sexual**	**splitting**

The original embryo in the diagram developed following the _____ of an egg and a sperm. This is called _____ reproduction. The twins in the

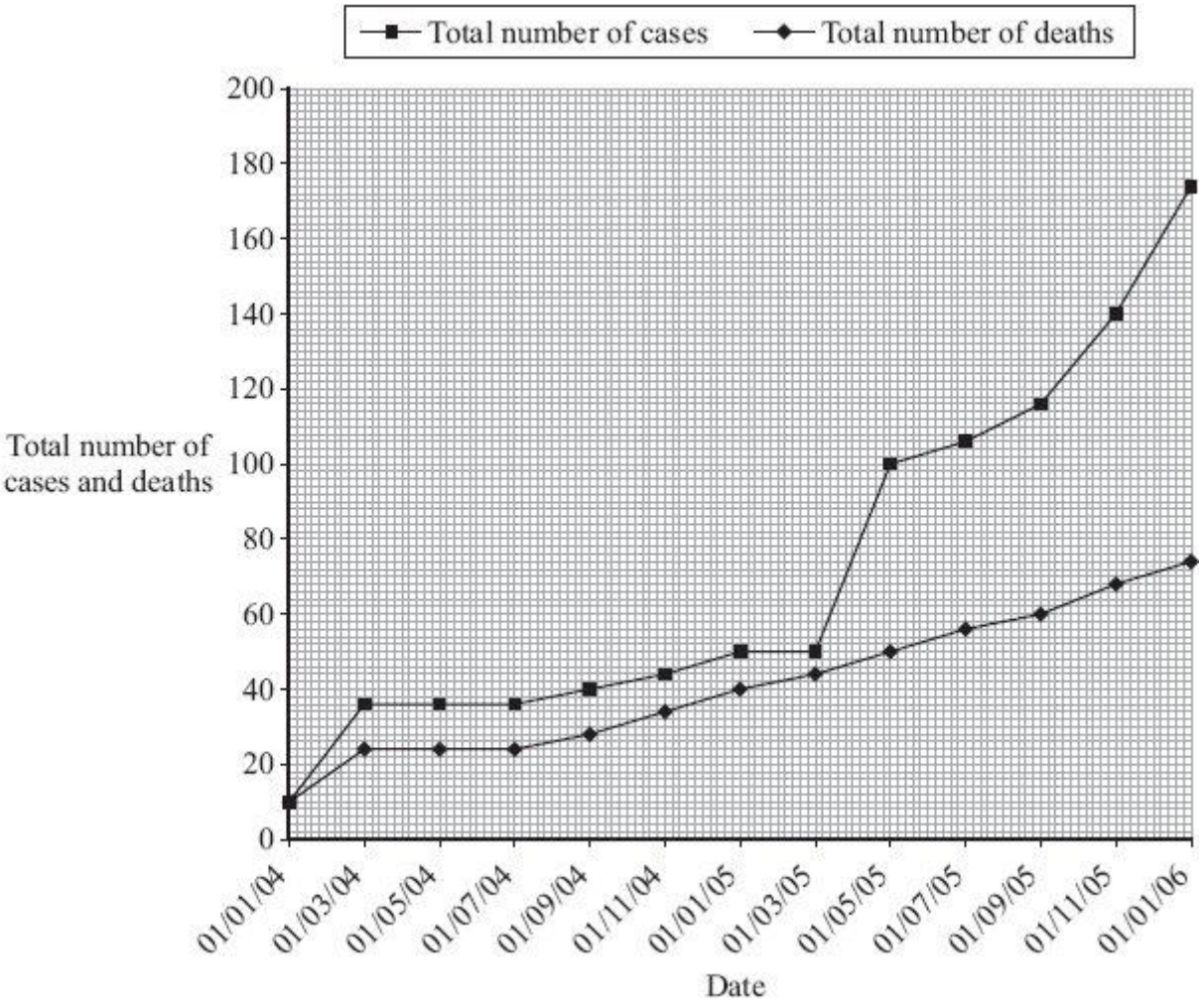
diagram have _____ genetic information. This is because the two embryos were produced by _____ reproduction. Because of this they are known as _____

(Total 5 marks)

Q12.

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)

Q13.

Tetra is the first monkey to be cloned.

The method is described below.

- A sperm and an egg were combined and the resulting embryo was allowed to split into two cells, then four, then eight cells.
- At the eight-cell stage, the embryo itself was split by scientists to produce four two-cell embryos.
- The four embryos were then implanted into surrogate mothers. Three of the

embryos did not survive. The fourth, Tetra, was born 157 days later. Her name means 'one of four'.

(a) Explain why this method could produce several identical monkeys.

_____

_____

_____

_____

(2)

(b) Suggest **two** reasons why these monkeys would be valuable in trials of new treatments for human diseases.

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q14.

(a) What does the theory of evolution state?

_____

_____

_____

_____

(2)

(b) *Daphnia* are microscopic water fleas. Midge larvae prey on *Daphnia*. The midge larvae release a hormone into the water. *Daphnia* respond to these hormones by growing larger protective 'helmet'-like structures

Scientists were surprised to observe that the offspring of *Daphnia* females who had been exposed to these hormones always had larger helmets than offspring whose mothers had never been exposed to the hormones. The offspring with the large helmets went on to produce offspring with large helmets.

Explain why the scientists' observations seem to contradict the theory of natural selection.

_____

_____

_____

_____

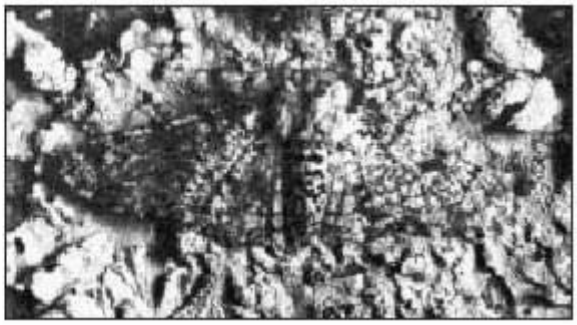
(2)

(Total 4 marks)

Q15.

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 _____

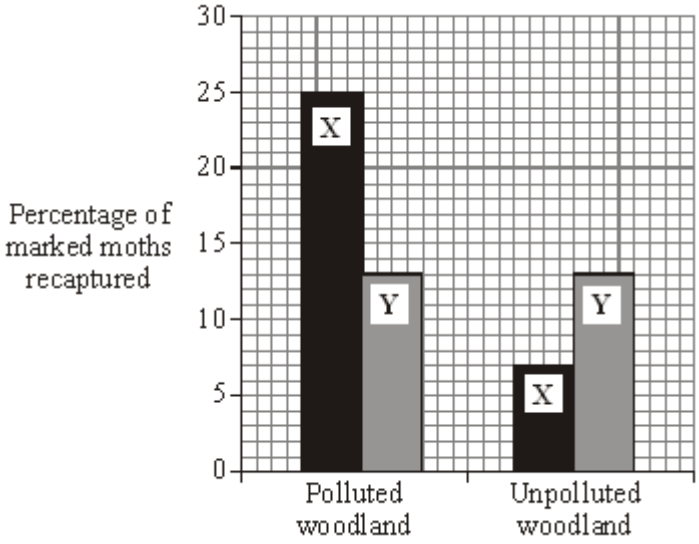
_____

(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)

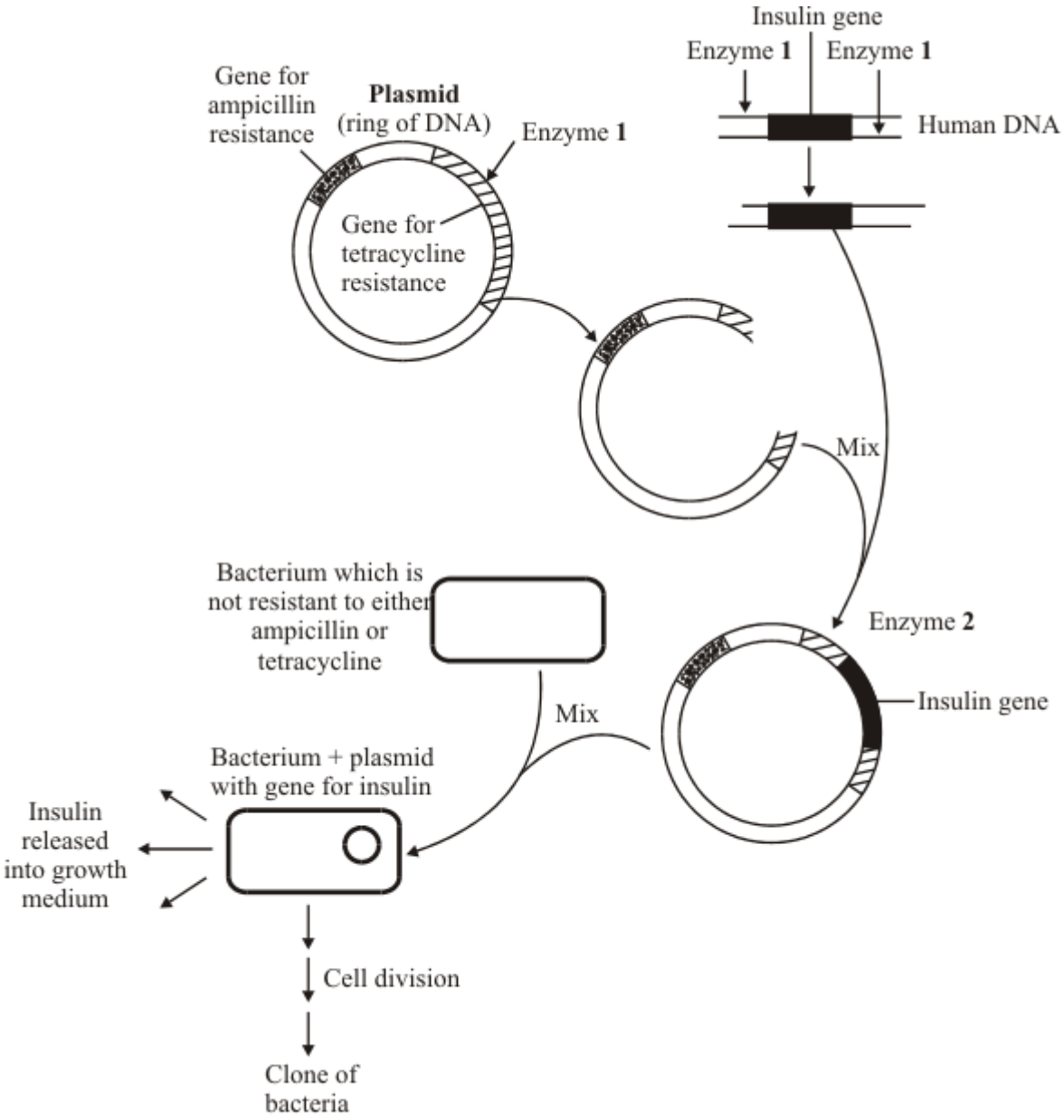
Q16.

The vole is a small, mouse-like animal. Voles found on some cold islands to the north of Scotland are much larger than voles found in warmer areas such as southern France. Explain how natural selection may have caused the northern voles to be larger in size.

(Total 5 marks)

Q17.

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



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

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

	Bacterium can multiply in the presence of	
	Ampicillin	**Tetracycline**
Bacterium + plasmid with the insulin gene		

Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

(3)

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

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

_____

_____

_____

_____

_____

_____

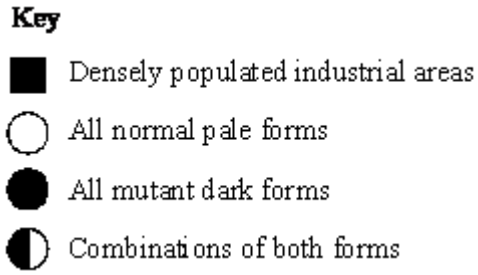
(3)

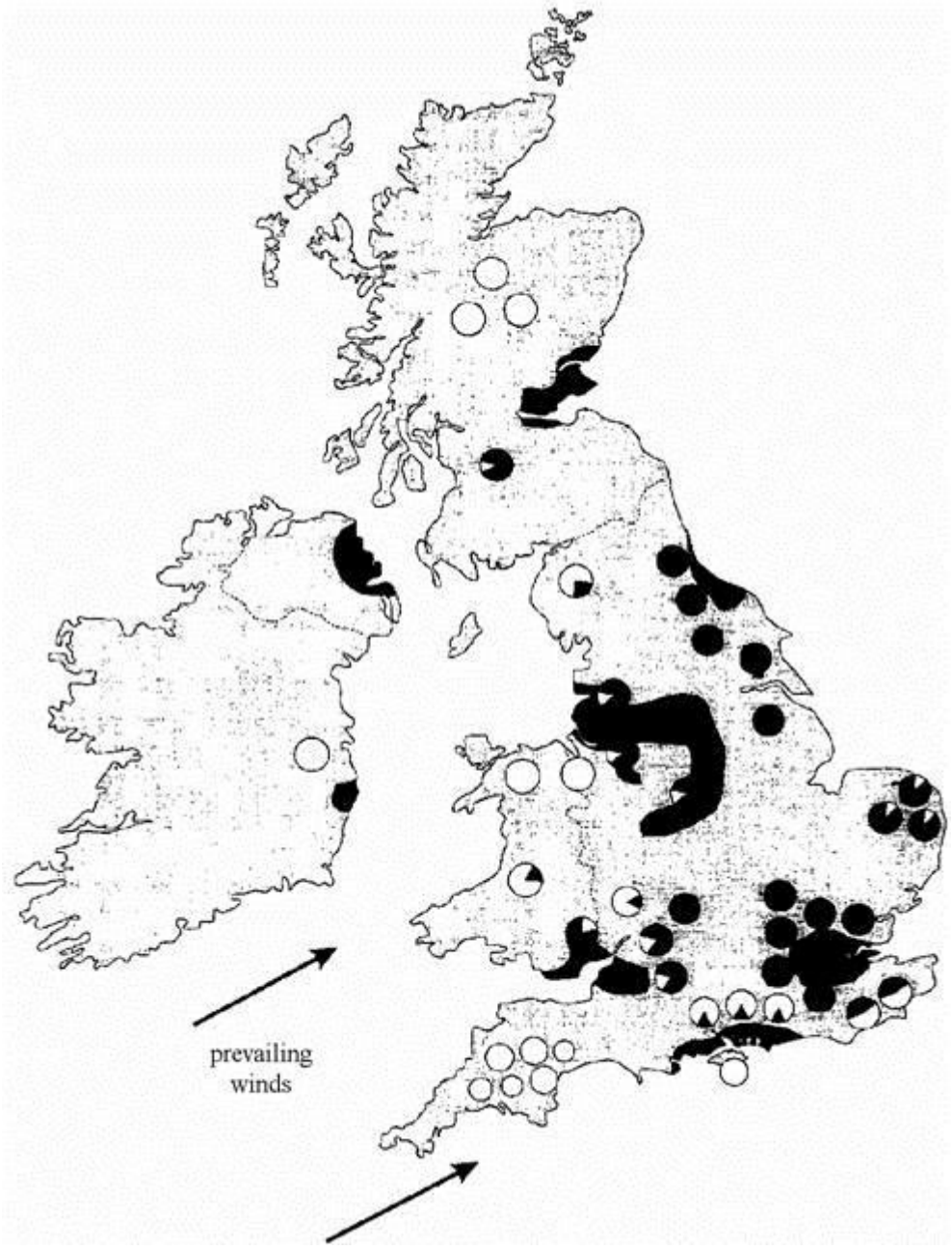
(Total 6 marks)

Q18.

The map shows:

the most densely populated industrial areas;
the frequency of pale and dark forms of the peppered moth;
the direction of the prevailing winds in the British Isles.





Peppered moths usually rest on trees covered with lichen, and they are preyed upon by many birds. In areas of low air pollution the lichen on trees is usually pale in colour. In areas of high air pollution the lichen turns black.

(a) (i) State a pattern of the distribution of the mutant dark form shown on the map.

_____

_____

(1)

(ii) Suggest a reason for your pattern.

_____

_____

(1)

(b) The dark form of peppered moth developed after a *mutation* in the pale form. What is a *mutation?*

_____

_____

(1)

(c) Using the idea of Natural Selection explain why the dark form of the moth is restricted to the areas shown.

_____

_____

_____

_____

_____

_____

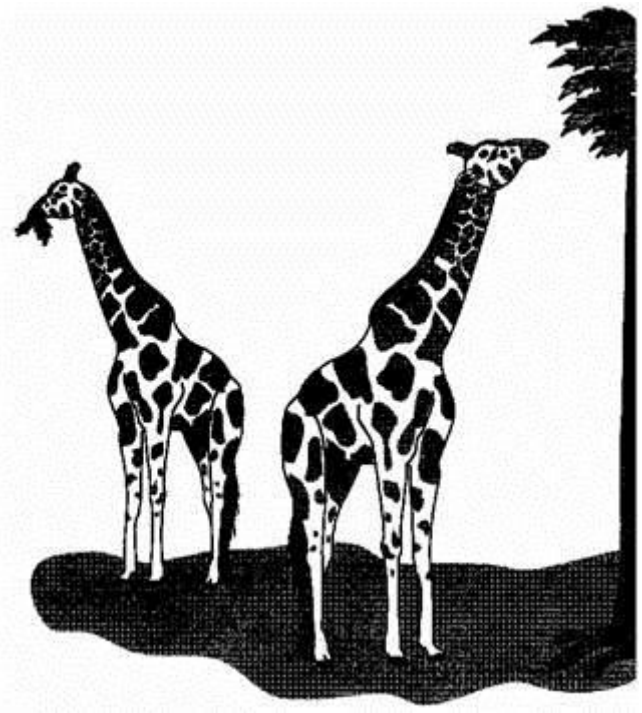
_____

(4)

(Total 7 marks)

Q19.

Giraffes feed on the leaves of trees and other plants in areas of Africa. They are adapted, through evolution, to survive in their environment.



(a) Use the information in the picture to give **one** way in which the giraffe is adapted to its environment.

(1)

(b) Explain how Jean-Baptiste Lamarck (1744–1829) accounted for the evolution of the long neck in giraffes.

(3)

(c) Another scientist, August Weismann (1834 -1914) wanted to check Lamarck's explanation. To do this he cut off the tails of a number of generations of mice and looked at the offspring.

His results did not support Lamarck's theory. Explain why.

(2)

(d) Explain how Charles Darwin (1809–1882) accounted for the evolution of the long neck in giraffes.

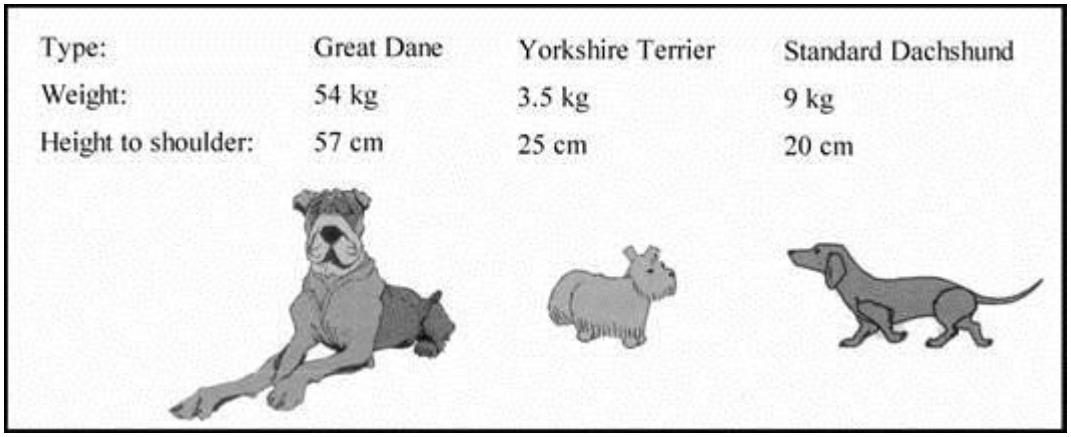
_____

(4)

(Total 10 marks)

Q20.

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)

Q21.

Penicillin is an antibiotic which stops bacteria from reproducing. It was used a lot in the past to treat bacterial infections in humans and other animals. In many hospitals there are now strains of penicillin resistant bacteria.

Explain how natural selection could have produced these strains of penicillin resistant bacteria.

(Total 5 marks)

Q22.

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

Thanks to the test tube banana

Specially bred resistant varieties may

save African crops from disease

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

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

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

The issue goes well beyond our high streets and supermarkets. The banana has a larger relative called a plantain, which is starchy rather

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

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

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

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

(2)

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

(4)

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

(3)

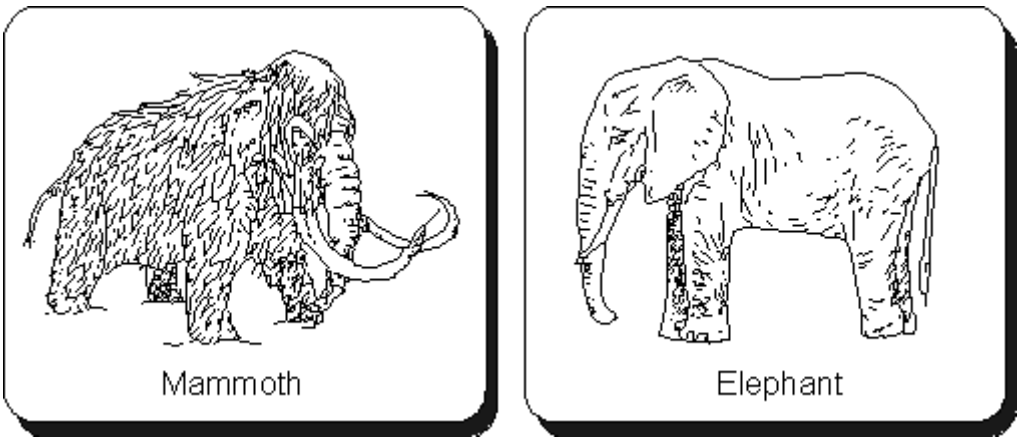
(d) Explain, as fully as you can, how IATA scientists may use genetic engineering to produce varieties of banana resistant to Black Sigatoka disease.

(4)

(Total 13 marks)

Q23.

The drawings below show a mammoth, an extinct relation of the elephant which lived in arctic regions, and a modern elephant which lives in tropical areas.



The mammoth, which was very hairy, and the elephant, are both thought to have evolved from a scantily haired ancestor. Explain, as fully as you can, how the **mammoth** evolved from the common ancestor.

(Total 5 marks)

Q24.

The article below appeared in the Daily Mail on February 24 1993.

March of the mutant tomatoes as Frankenfood hits the menu

Just when you thought it was safe to go back to the dinner table, 'Frankenfoods' are heading for the menu.

Rainbow trout with human genes and tomatoes grown with traits of flounder fish are the latest products of food scientists.

It is good news for producers – the trout grow bigger and more quickly, while the tomatoes have a lower freezing point, preventing them becoming damaged.

But consumer groups fear a whole breed of these 'genetically modified organisms' (GMOs) may be introduced without proper trials.

David King, director of the pressure group Genetic Forum, said: 'The march of scientists who want to genetically alter food has very serious implications both for animal welfare and the environment.'

'You run the risk of introducing triffid-like creatures – plants which have the capacity to overtake landscapes and force out other plant life.'

Genetic forum is to join groups including the RSPCA and World Wide Fund for Nature to debate a number of GMOs awaiting licenses in the United States.

They have called for proper labelling so shoppers can decide for themselves whether they want to buy modified foods.

Two genetic compounds – certain brands of cheddar cheese and bakers' yeast are already approved for use in British food manufacture, said Mr. King.

British multi-national ICI also has a company, Zeneca seeds, working on genetically altering food and is planning to sell tomatoes in which the ripening gene has been 'blocked' to increase shelf life.

An ICI spokesperson said 'Extensive trials are carried out on all these modified foods and we are required by the Ministry of Agriculture to provide full information on all our trials.'

Growers were able to pick the new tomato when it was ripe and red instead of green and it was wrong to label such an advance 'Frankenfood', she said.

'It has very negative connotations which are not at all correct. The entire drive behind this work is to produce positive benefits to the consumer.'

ICI had helped to produce crops able to resist pests and diseases, bringing food to people who otherwise would go hungry, she added.

(a) The foods described in the article have been produced by genetic engineering. Explain, as fully as you can, how this technique is used to produce 'genetically modified organisms'.

(4)

(b) Having produced the desired type of tomato by genetic engineering, how might scientists quickly produce large numbers of the new plants to supply to horticulturists?

(2)

(c) Using information from the article and your own knowledge, assess the advantages and disadvantages of producing new types of food by genetic engineering.

(6)

(Total 12 marks)

Q25.

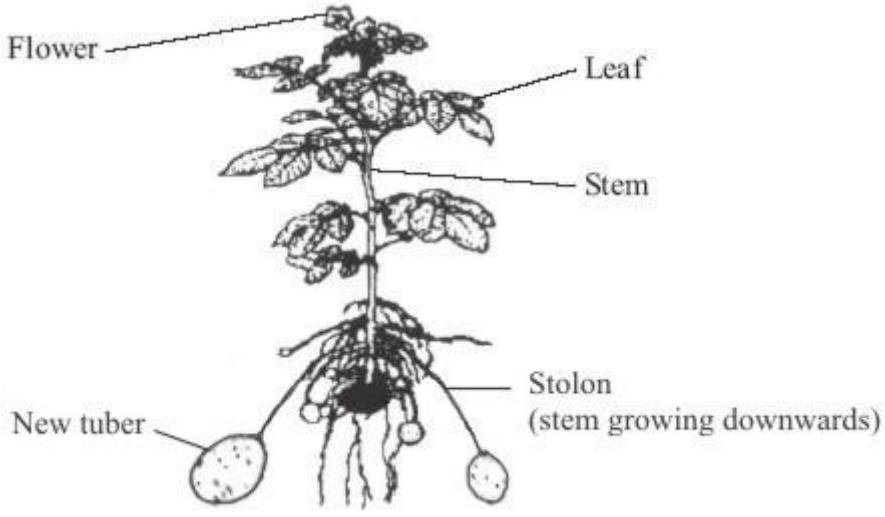
Cotton crops may become infested with weeds. Scientists are developing genetically-engineered strains of cotton which resist the action of herbicides. This means that when the crop is sprayed with herbicide, only the weeds are killed. However, there are potential dangers with this procedure. Cotton plants can interbreed with some other species of plants.

Evaluate the possible advantages and disadvantages of developing genetically-engineered herbicide-resistant crops.

(Total 5 marks)

Q26.

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



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

_____

_____

(2)

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

Give **one** reason why.

_____

_____

(1)

(Total 3 marks)

Q27.

Read the extract.

Super-bug may hit the price of coffee

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

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

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

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

_____

_____

(1)

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

_____

(ii) Explain why this change will take place.

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

_____

_____

_____

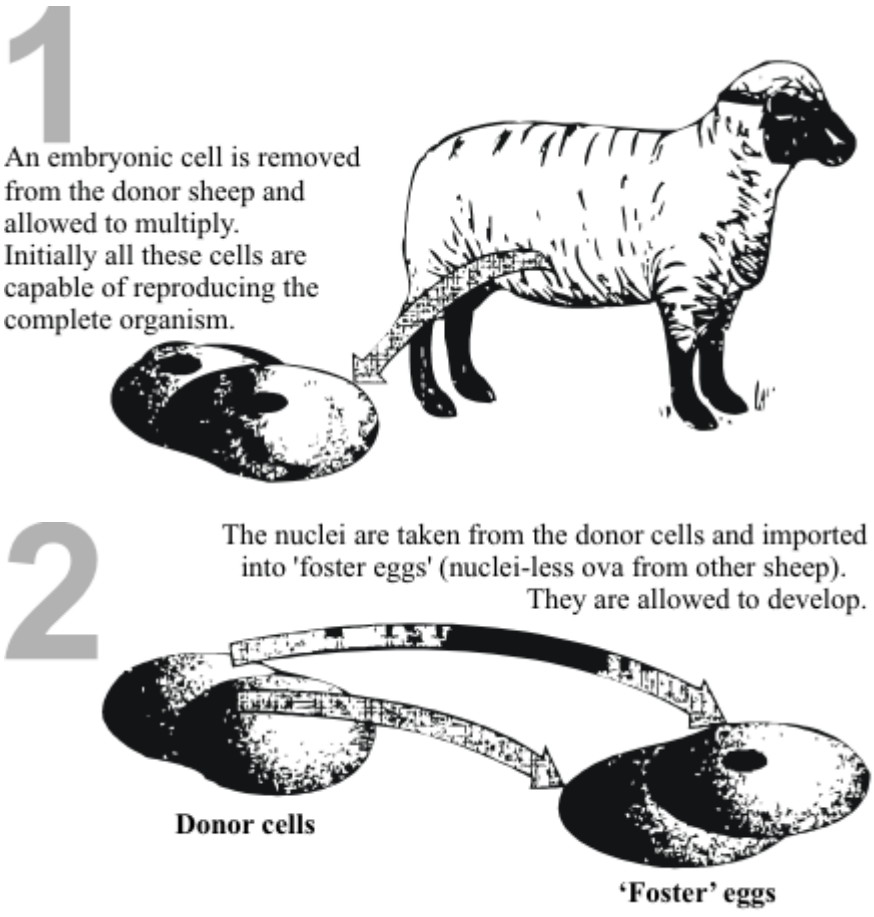
_____

(3)

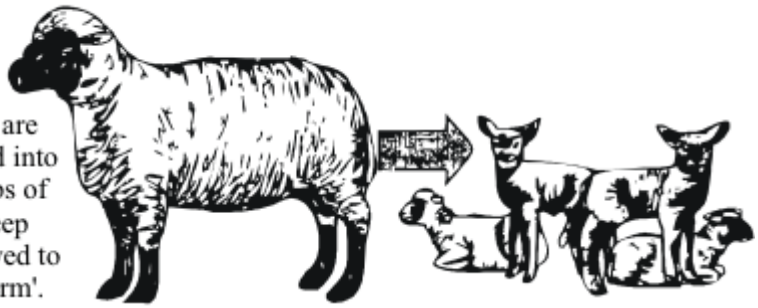
(Total 7 marks)

Q28.

The diagram shows one method of cloning sheep.



3



The eggs are implanted into the wombs of foster sheep and allowed to 'go full term'.

(a) Explain why the lambs produced by this technique are identical to each other.

(2)

(b) Explain why the lambs are **not** genetically identical to the sheep which produced the 'foster' eggs.

(2)

(c) Explain the drawback of widespread use of just a few clones of sheep.

(3)

(Total 7 marks)

Q29.

A market gardener produces large numbers of attractive, large flowered geranium plants.

(a) Give two advantages to the gardener of producing geraniums from cuttings rather than from seeds.

1. _____

_____

2. _____

_____

(2)

(b) Gardeners often cover trays of cuttings with large polythene bags.

Suggest **one** advantage of this.

_____

_____

(1)

(Total 3 marks)

Q30.

The drawings show two forms of the peppered moth.

Pale form

Dark form

In an investigation, pale and dark moths were placed in different positions on trees in two woods. One wood was in an industrial area where the bark was blackened by pollution. The other wood was unpolluted, and the tree bark was covered in pale mosses and lichen. After three days, the surviving moths were counted. The results are shown in the table.

WOOD	POSITION OF MOTH ON TREE	PERCENTAGE OF MOTHS EATEN BY BIRDS	
		PALE	DARK
Polluted	On main trunk	58	40
	Underside of branch	50	28
Unpolluted	On main trunk	32	62
	Underside of branch	26	40

(a) What can you tell from these results about the survival of the two types of moth in polluted and unpolluted woods, and in different positions on the tree?

(3)

(b) Explain how the results provide evidence for **one** theory of evolution.

(3)

(Total 6 marks)

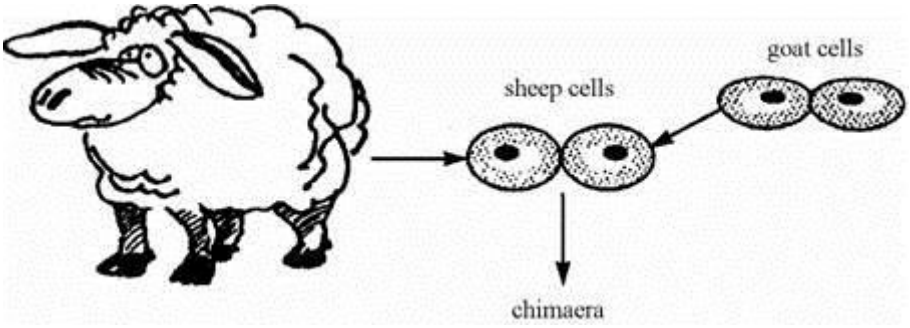
Q31.

Read the passage.

One reason for cloning animals is to prevent rare breeds from becoming extinct. Early

embryos can be divided into four to produce identical quads. Dividing a young embryo into more than four parts is a problem because each part may not have enough cells to create both an embryo and a placenta.

The problem can be overcome by adding cells from another embryo, to make a mixture of cells called a chimaera. The two sets of cells may be from two different breeds of animals, or even two different species, such as sheep and goats.



The aim is not to create freaks but chimaeras in which the added cells form the placenta only. The sheep embryos are given cells to make goat placentas and are carried to full term in the uteri of goats. They are born as pure sheep.

(a) Explain why the sheep embryos with added goat placental cells develop into sheep, not goats.

(2)

(b) Use information from the passage and your own knowledge and understanding to evaluate the use of cloning techniques in agriculture.

(6)

(Total 8 marks)

Q32.

Busy lizzie plants produce flowers with many different colours.

A gardener wants to produce busy lizzie plants to fill a flower bed in her garden.
She decides to grow them from cuttings rather than seeds.

(a) Give **one** condition that she should supply to the new cuttings so that they grow well.

_____

(1)

Busy Lizzie plants can produce flowers which are white, pink or red.
A gardener wants to grow a display containing all three colours of flowers.

(b) Give **one** advantage and **one** disadvantage to the gardener of growing Busy Lizzie plants from cuttings rather than seeds.

Advantage _____

Disadvantage _____

(2)

(Total 3 marks)

Q33.

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

alleles **chromosomes** **gametes** **genes** **mutations**

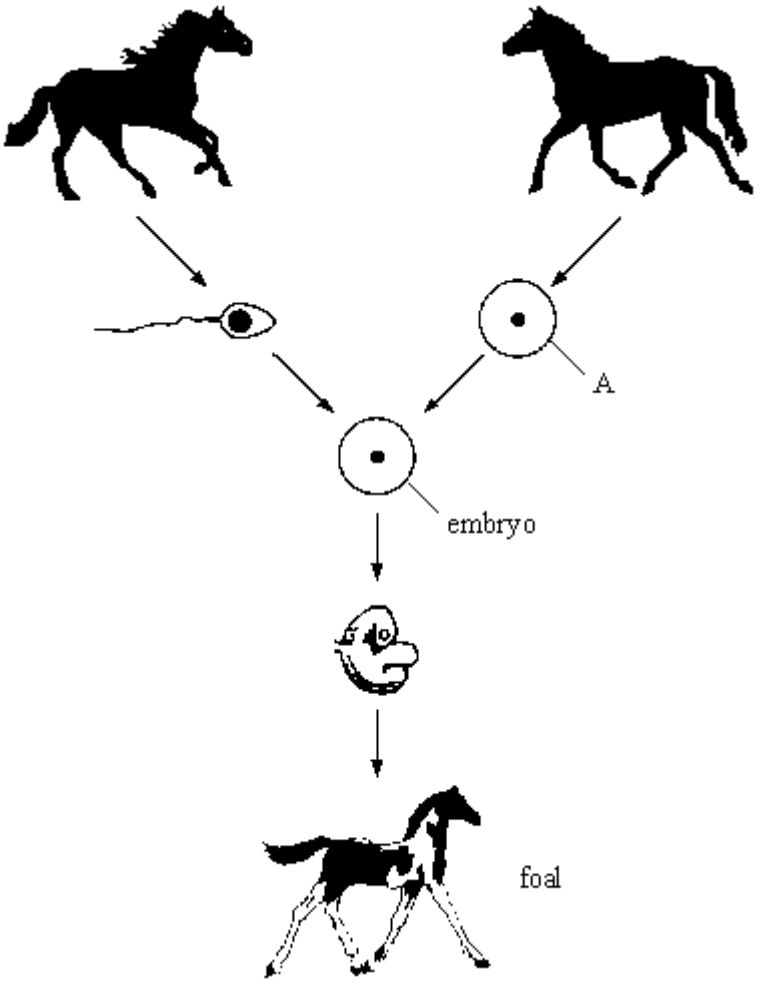
The nucleus of a cell contains thread-like structures called _____ .

The characteristics of a person are controlled by _____

which may exist in different forms called _____ .

(3)

(b) The drawing shows some of the stages of reproduction in horses.



(i) Name this type of reproduction _____

(1)

(ii) Name the type of cell labelled **A** _____

(1)

(c) When the foal grows up it will look similar to its parents but it will **not** be identical to either parent.

(i) Explain why it will look similar to its parents.

_____

_____

(1)

(ii) Explain why it will **not** be identical to either of its parents.

_____

_____

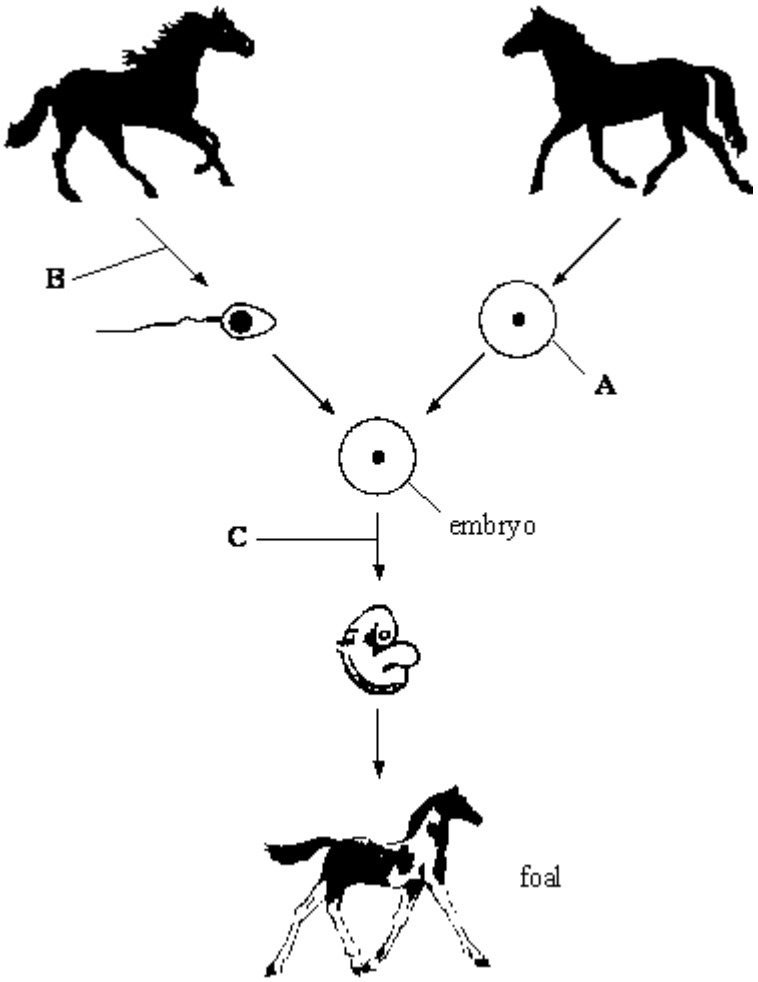
_____

_____

(2)
(Total 8 marks)

Q34.

The drawing shows some of the stages of reproduction in horses.



(a) (i) Name this type of reproduction _____

(1)

(ii) Name the type of cell labelled **A** _____

(1)

(b) Name the type of cell division taking place at the stage labelled:

(i) **B** _____

(ii) **C** _____

(2)

(c) How does the number of chromosomes in each cell of the embryo compare with the number of chromosomes in cell **A**?

_____

(1)

(d) When the foal grows up it will look similar to its parents but it will **not** be identical to either parent.

(i) Explain why it will look similar to its parents.

_____

_____

(1)

(ii) Explain why it will **not** be identical to either of its parents.

_____

_____

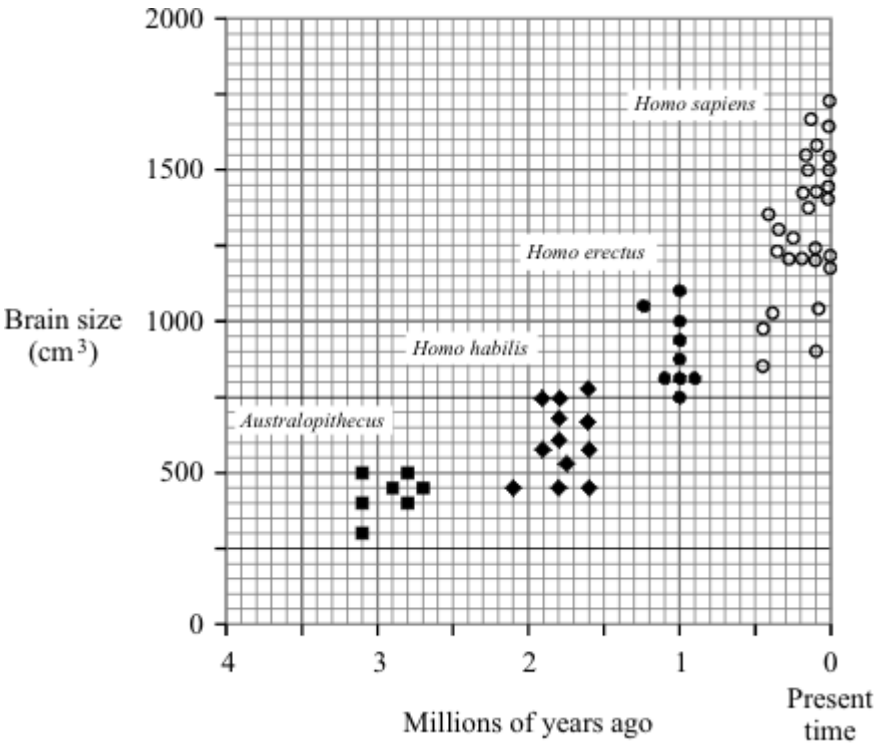
_____

(2)

(Total 8 marks)

Q35.

Modern humans belong to the species *Homo sapiens*. Many people think that modern humans evolved from more primitive species. Three of these primitive species were *Australopithecus*, *Homo habilis* and *Homo erectus*. These three species are now extinct. The graph shows the brain size of several specimens from each of the species.



(a) Estimate the mean brain size of *Homo habilis*.

_____ cm^3

(1)

(b) Suggest how we know about the brain size of *Australopithecus*.

(2)

(c) Suggest an explanation, in terms of natural selection, for the change in brain size during the evolution of *Homo sapiens*.

(3)

(Total 6 marks)

Mark schemes

Q1.

(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]

Q2.

(a) any **four** from:

- mutation / variation
- produces smaller wings / fatter body
  must be linked to mutation / variation
- wings no longer an advantage since no predators
  allow wings / flight not needed as no predators
- wings no longer an advantage since food on ground
  allow wings / flight not needed as food on ground
- fatter body can store more energy when fruit scarce
- successful birds breed / pass on genes

4

(b) any **one** from:

- evidence has all gone
- no scientists on island at time to record evidence
- no records (from sailors)

1

[5]

Q3.

(a) (i) chromosomes

allow DNA

ignore nucleus

1

(ii) enzymes

1

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

ignore clones

1

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

1

(c) can spray crop with herbicide – only weeds killed

crop survives herbicide insufficient

1

(d) any **one** from:

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

  allow 'think that GM food is bad for health'

  *ignore not natural **or** against religion*

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

1

[6]

Q4.

(a) any **two** from:

accept other logical / reasonable ideas

- other scientists not aware of his work
- chromosomes / DNA / genes not seen / discovered / known

  *do **not** accept there was no interest in genetics*

- other theories accepted at the time
- not considered to be a scientist / not eminent / respected

  allow 'he was just / only a monk'

2

(b) (i) random selection

accept a method of achieving random selection

eg "take a handful"
if number given, minimum 20

1

(ii) any **one** from:

- 1:1 / one to one
- 19:21
  accept any ratio to give correct answer, eg "50:50"
  *do **not** accept 21:19 unqualified*

1

(iii) A + a as gametes from 1st parent

1

a + a as gametes from 2nd parent
allow a alone

1

(offspring / 2nd generation) Aa aa
offspring must be derived from correct gametes

correct identification of yellow (Aa)
other symbols correctly used can gain full marks

1

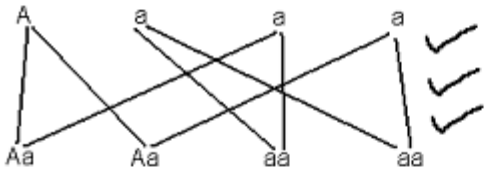
or

green (aa) (if both given, both must be correct)
ignore references to previous generations
*if no other marks awarded, both correct parental genotypes given gains **1** mark*

examples of award of first three marks

	a	a
A	Aa	Aa
a	aa	aa

	A	a
A	AA	Aa
a	Aa	aa



	B	b
b	Bb	bb
b	Bb	bb

1

[8]

Q5.

(a) (i) 40 – 42

1

(ii) Palaeocene

1

(iii) bush babies

1

(b) any **two** from:

- religious objections
- insufficient evidence

  allow 'could not prove'
  ignore 'no evidence'

- mechanism of heredity not known

2

[5]

Q6.

any **four** from:

*max **two** marks for a Lamarck explanation*

- mutation produced a bird whose bill was crossed
  *do **not** allow birds decide to mutate*
- birds compete for <u>food</u> / <u>seeds</u>
- mutant crossbill able to obtain food faster / easier / more successfully
- selected for **or** more likely to survive
- reproduce / mate / breed / produce offspring

[4]

Q7.

(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]

Q8.

(a) antibodies

1

antitoxins

1

antibiotics

1

(b) any **two** from:

- measles
- mumps
- rubella / German measles

2

(c) less / low / no chance of getting named / all condition(s) if vaccinated

1

quantitative figure(s) e.g. 5 times less likely to get convulsions
must be comparative

1

(d) enzymes

1

genes

1

[9]

Q9.

(a) wing pattern similar to *Amauris*

1

birds assume it will have foul taste

1

(b) mutation / variation produced wing pattern similar to *Amauris*
*do **not** accept breeds with Amauris*
*do **not** accept idea of intentional adaptation*

1

these butterflies survived

1

breed / genes passed to next generation

1

[5]

Q10.

(a) have identical genes / chromosomes / genetic material

1

since asexual reproduction
accept mitosis

1

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

1

sexual reproduction / fusion of gametes

1

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

*do **not** allow mark for embryos lost*

1

[5]

Q11.

joining

1

sexual

1

identical

1

asexual

1

clones

1

[5]

Q12.

(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]

Q13.

(a) asexual reproduction / mitosis

ignore cloning

or

no fusion of gametes

or

division after fusion

or

from fertilised egg

or

from same embryo

or

from same egg **and** sperm

1

each embryo has identical genetic information / genes / DNA / chromosomes

1

(b) any **two** from:

- experimental subject and control are identical
  or
  fair test since monkeys identical
- monkeys similar to humans, so effect of drugs likely to be similar
  allow closely related so…
  ignore evolved from
- all identical so will have same reaction to drugs / disease
- it's better than catching wild ones

2

[4]

Q14.

(a) present day organisms have evolved from simpler organisms

ignore answers in terms of natural selection

1

over long periods of time
or
millions / billions of years

1

(b) (natural selection operates on successful)

characteristics produced by chance / (random) mutation

1

in this experiment caused by hormones / environment

*allow this example indicates inheritance of acquired characteristics for **2** marks*

*allow this is Lamarckism only for **1** mark*

1

[4]

Q15.

(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]

Q16.

any **five** from:

- genetic variation exists in a population **or** variation caused by mutation / change in gene / in DNA
- larger voles have smaller $\frac{\text{S.A.}}{\text{Vol.}}$ **or** have more fat

  'they' accept as larger voles
- larger voles lose less heat / are better insulated **or** more energy stored

- larger voles survive
- larger voles breed
- larger voles pass on (beneficial) gene / allele / mutation / DNA

ignore characteristic

[5]

Q17.

(a)

Ampicillin	Tetracycline
✓	–
–	–
✓	✓

*accept blank **or** cross **or** –*

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

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

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

3

(b) 1st: Yes (no mark)

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

2nd: all formed from same original cell

must be <u>one</u> cell i.e. bacterium

1

by asexual reproduction / no fusion / not sexual

allow reference to 'mitosis'

1

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

1

[6]

Q18.

(a) (i) dark form lives in the industrialised/ densely populated areas
or
dark form lives to the East/downwind/North East of industrialised are

1

(ii) more pollution/discolouration in those areas
or
pollution blown by prevailing winds

1

(b) a **change** to the genetic material/DNA/chromosomes/genes in an organism

*do **not** accept fault. error*

1

(c) survival in polluted areas:

one mark for each mark point to a maximum of 4

(pollution) lichen/trees/buildings become(s) blackened

credit an answer given in terms of survival in polluted areas or non-survival in other areas

(camouflage) black formed camouflaged / more difficult to see

(predation) not preyed upon eaten by thrushes

(survival) survive to breed

or non survival

(no pollution) lichen/trees/buildings remain(s)pale/non-blackened

(no camouflage) black formed not camouflaged / easier to see

(predation) preyed upon/eaten by thrushes

(survival) do not survive to breed

4

[7]

Q19.

(a) long neck or legs

1

(b) change in environment **or** reaching for food **or** stretching led to **more use** of neck (and legs) [1]

use led to **increased** size **or** characteristic acquired during lifetime [1]

this characteristic was passed to offspring [1]

3

(c) phenotypic changes do not affect genotype **or** genes [1]

acquired characteristics are not passed to offspring **or** the offspring were bom with tails **or** inheritance has to be genetic [1]

2

(d) **one** mark awarded for each of the following general points:

variation exists in all populations **or** mutation occurred [1]

or if written specific to giraffes:

*all giraffes are different **or** reference to short necked giraffes[1]*

4

some individuals will have an advantage in certain areas **or** will be better adapted **or** there is survival of fittest [1]

*taller giraffes **or** those with longer necks will have an advantage in being able to reach high vegetation **or** there is survival of fittest [1]*

advantaged individuals breed more **or** are more successful [1]

*these giraffes will breed more **or** will be more successful [1]*

the genes **or** units of heredity **or** DNA of these individuals are passed on [1] (look for idea of genetic information being passed on)

*the genes **or** units of heredity **or** DNA of these giraffes are passed on [1]*

[10]

Q20.

(a) breed (together)

accept have same number of chromosomes

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

1

to produce fertile offspring

1

(b) male **or** testes

accept dog

1

testes **or** male

accept testis

*do **not** accept testicles*

1

ovary **or** ovaries

1

gametes

1

fertilisation

*do **not** accept conception*

1

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

*do **not** accept baby **or** puppy*

1

(c) genetic information **or** genes **or**

chromosomes **or** DNA

*do **not** accept characteristics by itself*

1

(comes) **from** two parents

*accept **from** both parents*

1

[10]

Q21.

mutation or description of mutation (gives resistance to penicillin)

1

some survive (penicillin)

1

(survivors) reproduce **or** multiply

1

asexual reproduction **or** binary fission **or** cloning

accept mitosis

1

gene for resistance **or** the mutation is passed on (to offspring)

allow reference to bacteria being immune

ignore reference to survival of fittest

1

[5]

Q22.

(a) select for breeding;
the plants with the sweetest taste

each for 1 mark

2

(b) natural population has a wide range of variations;
because it has a large number of alleles;
selective breeding reduces the number of alleles;
cloning perpetuates this reduced number of alleles

each for 1 mark

4

(c) 3 of:
reference to cuttings;
reference to tissue culture;
reference to hormones;
cloning

each for 1 mark

3

(d) 4 of:

cut genes for disease resistance;
from chromosomes of 'cooking banana';
introduce into chromosomes of 'ordinary banana';
tissue culture to produce disease resistant plants/clone;
enzymes cut chromosomes

each for 1 mark

4

[13]

Q23.

natural variation in amount of body hair;
in cold environment, (having genes) which produce long hair is an advantage;
because hair insulates; OWTTE
such animals more likely to survive;
and pass these genes onto succeeding generations

each for 1 mark

[5]

Q24.

(a) genes
cut from plant chromosomes
transferred to cells of other plants
at early stage of development

each for 1 mark

4

(b) use of cuttings
use of tissue culture

each for 1 mark

2

(c) 6 of: pros e.g.:
faster growing tomatoes with longer shelf life
disease-resistant crops
cons e.g.:
lack of proper field trials may have disastrous environmental consequences
example
possible effects of the altered genes on humans

each for 1 mark

6

[12]

Q25.

advantages 2 of:
kills weeds but not cotton
higher yields of cotton
increased profits

any 2 for 1 mark each

2

disadvantages 2 of:

reduced genetic variability in ecosystem
other species of plants may become resistant to herbicide
possible devastating effect on future crop growth
effects on ecosystem on spread of herbicide resistant plants

2

any 2 for 1 mark each

evaluation anywhere = 1

for 1 mark

1

[5]

Q26.

(a) grow from parents,
by vegetative reproduction/asexual reproduction/
no sexual reproduction

for 1 mark each

2

(b) e.g. different environmental conditions/named condition

for 1 mark

1

[3]

Q27.

(a) mutation

for 1 mark

1

(b) fall,
idea that resistant beetles more likely to survive to breed,
∴ their offspring more likely to appear in the next generation

for 1 mark each

3

(c) inbreeding between resistant brothers and sister,
will produce some individuals with 2 copies of the resistance allele,
if 2 of these individuals breed all their offspring will be resistant

for 1 mark each

3

[7]

Q28.

(a) contain the same genes, because they are formed by division
of identical nucleus

for 1 mark each

2

(b) genes located in nucleus, nucleus comes from donor cells

for 1 mark each

2

(c) number of alleles in population reduced, therefore less chance of successfully breeding, to cope with changed conditions

for 1 mark each

3

[7]

Q29.

(a) quick
cheap / many can be produced from one plant
cuttings produce plants identical (to parents) / outcome known

any two for 1 mark each

2

(b) *idea that* provides damp atmosphere / less likely to wilt
reduces or stops transpiration or water loss / keeps it warmer
(*reject prevents animals eating it*)

for 1 mark

1

[3]

Q30.

(a) greater proportion of dark moths survive in polluted woods
Greater proportion of pale moths survive in unpolluted woods
% survival on underside of branch is greater in both situations

each for 1 mark

3

(b) *ideas that (please indicate in body of answer by √1, √2, √3)*
1. different sorts of moths / pale and dark moths
2. ideal of differential survival in different habitats
3. this is evidence for natural selection / survival of the fittest
or idea that feature likely to be passed on

each for 1 mark

3

[6]

Q31.

(a) *ideas that*
embryos develop from cells with sheep nuclei / chromosomes / DNA
which contains genetic information / information for development
OR placental cells (from goat) provide only e.g. nutrition

any two for mark each

2

(b) *Max. 3 pros e.g. ideas that* avoids extinction of rare breeds
rapid method for plants large numbers with same features can be produced
preserves features produced by genetic engineering *e.g. Tracey*
maintains particular genetic strains *e.g. produced by extensive selective breeding*
reject simple idea of identical offspring unless qualified as above

any three each for one mark

3

Max. 3 cons e.g. ideas that moral / ethical objections animal 'rights'
identical individuals less adaptable to change or changing needs
reduced gene pool

any three each for one mark

3

[8]

Q32.

(a) water / damp / wet
or
suitable temperature / warm / heat / hot
or
light / sun
(*accept* rooting powder / soil qualified e.g. fine / nutrients / fertiliser / minerals)
(*do NOT allow* oxygen / carbon dioxide / food)

for 1 mark

1

(b) *advantage*
quick / cheap / several from one plant / known outcome / same as parent
(*reject* all the same)
disadvantage
all the same / all get same disease

for 1 mark each

2

[3]

Q33.

(a) chromosomes
genes (*reject* alleles)
alleles

for 1 mark each

3

(b) (i) sexual / sex

for one mark

1

(ii) egg / gamete / sex cell / ovum (*reject* ovule)

for one mark

1

(c) (i) information / genes / DNA passed from parents (*reject* chromosomes)

for one mark

1

(ii) genes / genetic information / chromosomes from two parents
alleles may be different
environmental effect / named may have been mutation

any two for 1 mark each

2

[8]

Q34.

(a) (i) sexual / sex

(ii) egg / gamete / sex cell / ovum (*reject* ovule)
for 1 mark each

2

(b) (i) meiosis / reduction

(ii) mitosis / somatic
for 1 mark each

2

(c) twice as many (*reject* answers based on 23 / 46 chromosomes)
for one mark

1

(d) (i) information / genes / DNA passed from parents
(chromosomes neutral)
for one mark

1

(ii) genes / genetic information / chromosomes from two parents
alleles may be different
environmental effect / named may have been mutation
any two for 1 mark each

2

[8]

Q35.

(a) 550 – 650
for one mark

1

(b) skulls
preserved as fossils / measure skull volume
for 1 mark each

2

(c) range of brain size / bigger brains arose by mutation
more with large brains more likely to survive
because more intelligent / survival advantage described
their genes passed to next generation / offspring inherited large brains
any three for 1 mark each

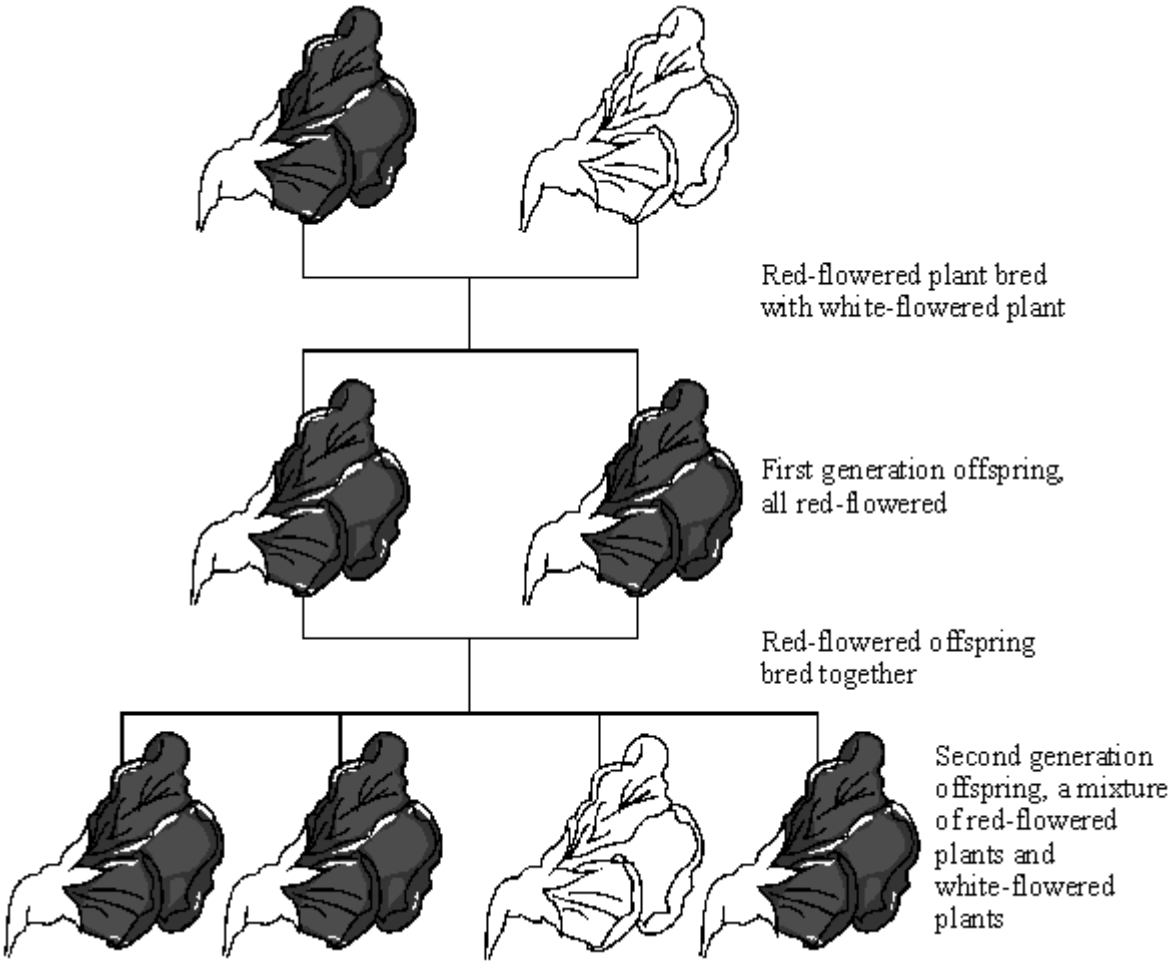
3

[6]

Q1.

The diagrams show one of the experiments performed by a scientist called Mendel.

He bred sweet pea plants.



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

Mendel proposed that flower colour was controlled by inherited factors.

The first generation plants show that the red factor is

dominant
environmental
recessive

The second generation plants show that the white factor is

dominant
environmental
recessive

We now call inherited factors

chromosomes
gametes
genes

These factors are passed from generation to generation in

gametes
glands
organs

The red-flowered sweet pea plants did not all grow to the same height.

This was due to

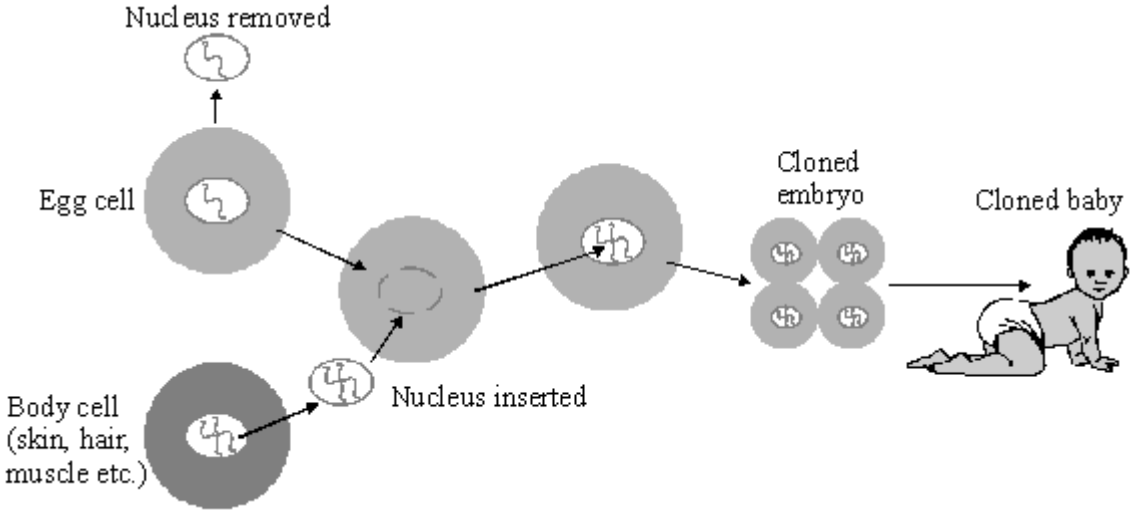
dominant
environmental
recessive

factors.

(Total 5 marks)

Q2.

It is now possible to clone humans. The diagram shows one way in which this can be done.



(a) What type of reproduction is this?

_____

(1)

(b) Will the baby have the characteristics of the egg cell or the body cell?

_____

Explain the reason for your answer.

_____

_____

_____

_____

(2)

(c) The procedure in the diagram could be used to produce several cloned embryos.

Suggest how this might be done.

_____

_____

(1)

(Total 4 marks)

Q3.

Genetic engineering is being used to help sufferers of cystic fibrosis.

In the sentence below, cross out the **two** lines which are wrong in each box.

In genetic engineering, genes are cut out of	cell membranes chromosomes cytoplasm	using	drugs enzymes hormones	

(Total 2 marks)

Q4.

In some methods of reproduction, clones are made.

(a) Explain what is meant by a clone.

_____

_____

_____

_____

(2)

(b) *To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Describe, in as much detail as you can, **one** way in which an embryo can be cloned.

_____

_____

_____

_____

_____

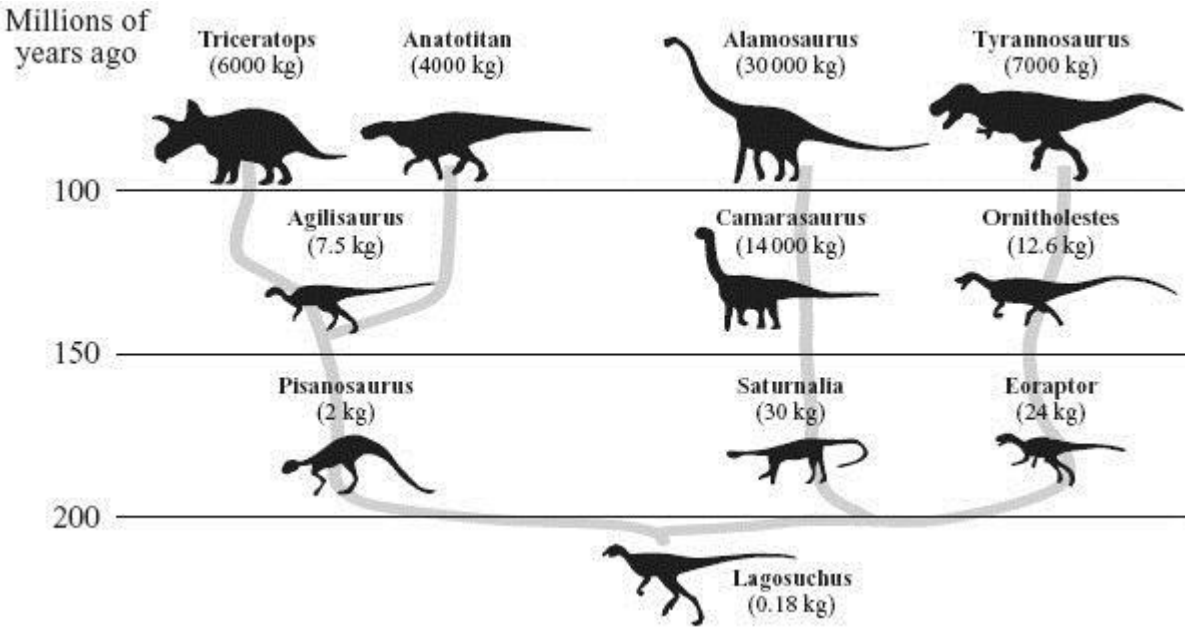
_____

(3)
(Total 5 marks)

Q5.

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**

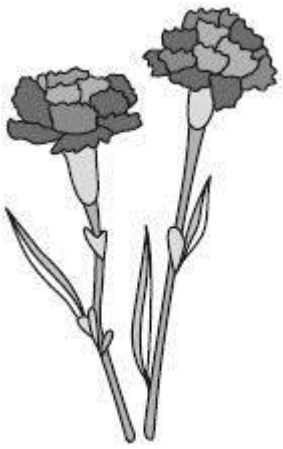
The theory of evolution states that all species of living things have evolved from _____ life forms which first developed more than three _____ years ago.

(2)

(Total 8 marks)

Q6.

Carnation plants have attractive flowers.



(a) Carnation plants are grown from cuttings.

Complete the sentences by using the correct words from the box.

asexual	**clones**	**genes**	**mutation**	**sexual**

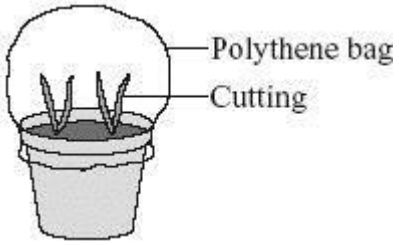
Carnations grown from cuttings have the same _____ as their parents.

This type of reproduction is _____ .

The new plants are known as _____ .

(3)

(b) Gardeners usually cover the cuttings with a polythene bag as shown in the diagram below.



Why do the cuttings grow better if gardeners do this?

_____

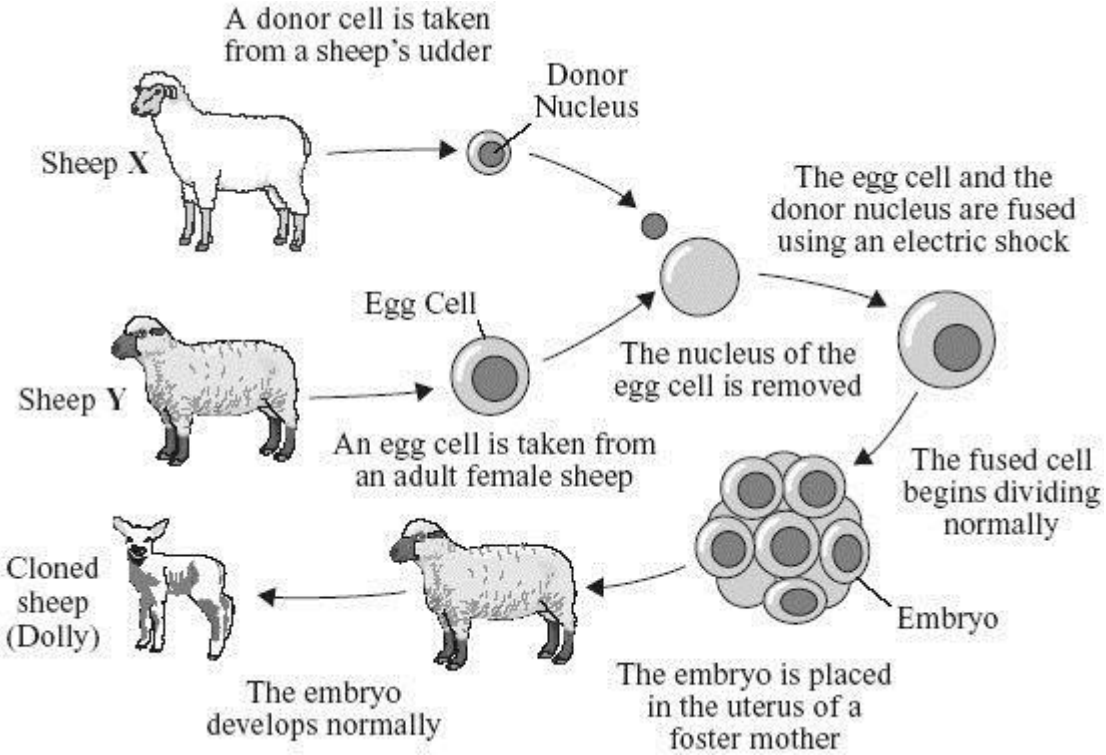
_____

(1)

(Total 4 marks)

Q7.

The diagram shows how Dolly the sheep was cloned.



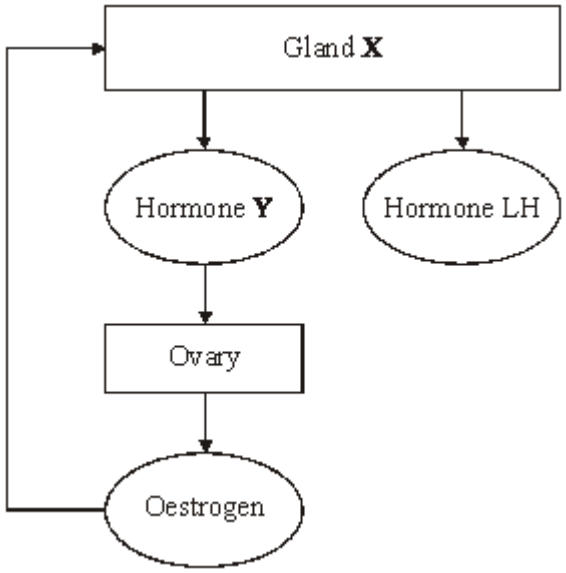
(a) Name the type of cell division that occurs:

(i) as the egg cell is produced; _____

(ii) as the fused cell begins to divide normally. _____

(2)

(c) The diagram below shows the relationships between the glands and hormones that control the menstrual cycle of a woman.



(i) Name:

gland **X**; _____

hormone **Y**. _____

(2)

(ii) Give **two** effects of the hormone oestrogen on gland **X**.

1. _____

_____

2. _____

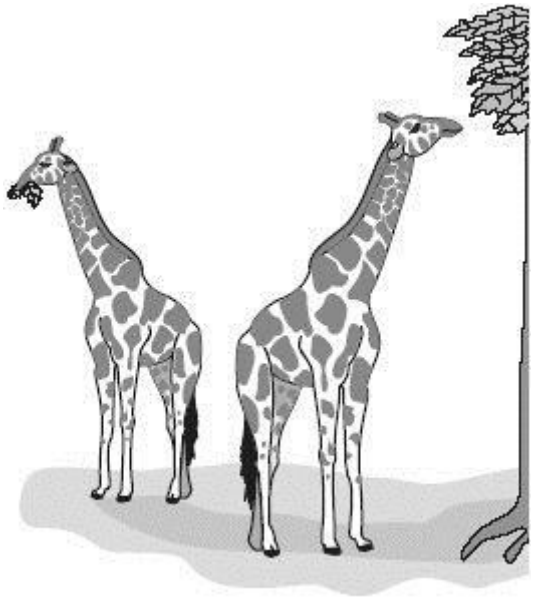
_____

(2)

(Total 6 marks)

Q8.

Giraffes feed on the leaves of trees and other plants in areas of Africa.



Lamarck explained the evolution of the long neck of the giraffe in terms of the animals stretching their necks to eat leaves from tall trees.

Darwin also explained the evolution of the long neck in terms of getting leaves from tall trees.

Neither scientist used any evidence to support their explanation.

Recently, scientists have tried to explain how the long neck of the giraffe might have evolved.

These are some of their observations.

- Giraffes spend almost all of the dry season, when food is scarce, feeding from low bushes.
- Only in the wet season do they feed from tall trees when new leaves are plentiful.
- Females spend over 50 % of their time feeding with their necks horizontal. Both sexes feed faster and most often with their necks bent.
- Long giraffe necks are very important in male-to-male combat. Males fight each other with their long, powerful necks!
- Female giraffes prefer male giraffes with longer necks.

(a) Do the observations support or reject the explanation that the long neck of the giraffe evolved to get leaves from tall trees? Explain the reasons for your answer.

_____

_____

_____

_____

(2)

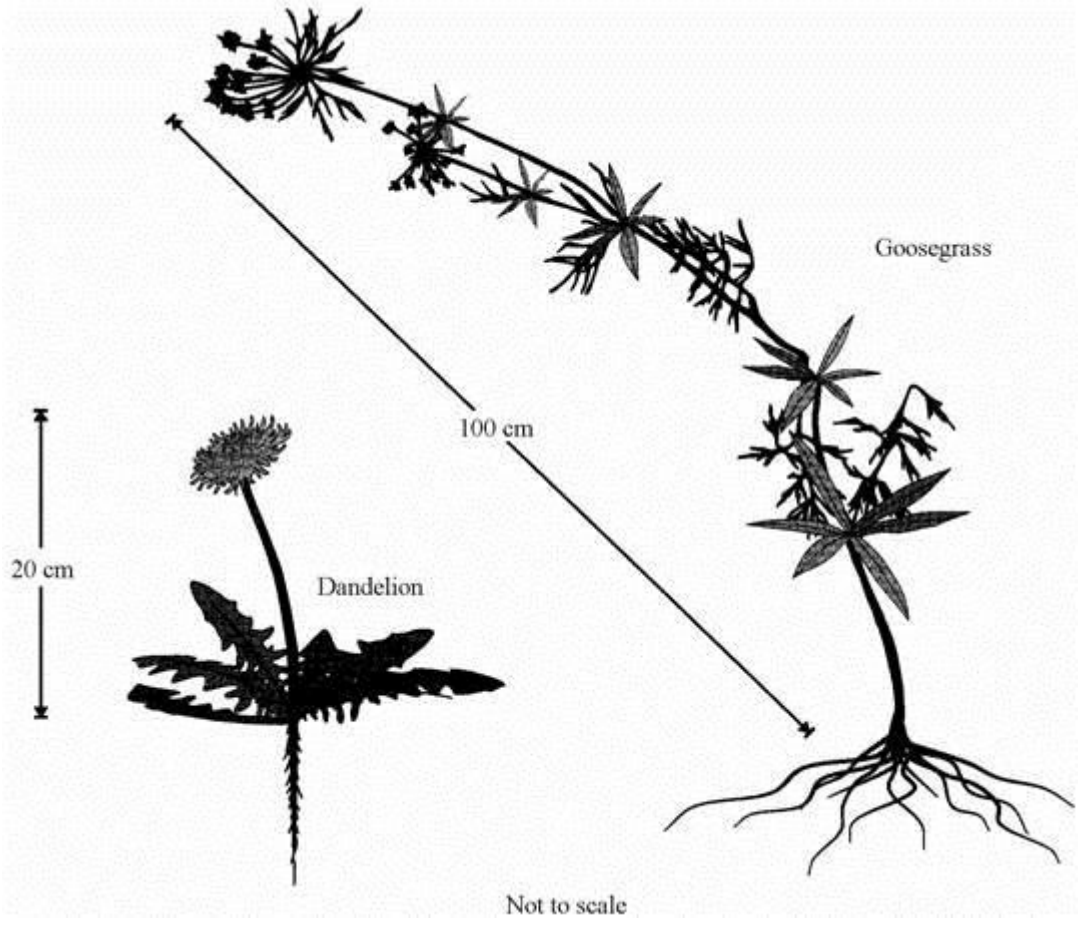
(b) Use the recent observations to give another explanation for the evolution of the long neck of the male giraffe.

(2)

(Total 4 marks)

Q9.

Dandelions have become adapted to live in lawns and grass areas where animals graze. Goosegrass, however, has become adapted to live alongside hedgerows and cannot survive being mown.



(a) Use the information in the drawings to suggest **one** advantage of each of the following adaptations.

(i) Dandelion leaves lie flat on the ground.

_____

_____

(1)

(ii) A dandelion has a thick tapered root.

_____

_____

(1)

(iii) Goosegrass stems are long.

_____

_____

(1)

(iv) Goosegrass roots are thin and very long.

_____

_____

(1)

(b) Dandelions and goosegrass are different species of plants.

(i) What name is given to the unit of inheritance which controls one particular characteristic of a plant or animal?

_____

(1)

(ii) Why would you be unlikely to succeed if you tried to breed a new species of plant by crossing a dandelion with goosegrass?

_____

_____

(1)

(c) Animals as well as plants have become adapted to live in different environments.

State **one** way a polar bear has become adapted to living in the Arctic, and the reason for the adaptation.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q10.

The peppered moth is an example of a mutation which gives the mutant variety an advantage in certain environmental conditions.

Normally the peppered moth is light coloured.

In 1848 the first dark form of the peppered moth was caught in the Manchester area. By 1895, 98% of the population was the dark form. In an area where a smokeless zone was established in 1972 the percentage of light-coloured peppered moths changed. In 1961 it was 5.2% but in 1974 it had risen to 10.5%.

Use the information above to explain the term *natural selection.*

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q11.

Insulin is now made by a biotechnological process. A description of the process is given below. Complete the gaps in the sentences.

(a) The first step in the biotechnological process is that a special enzyme is used to cut the insulin _____ out from a human _____ .

In a separate operation, a ring of bacterial _____ is cut open using a special enzyme.

These two pieces of genetic material are combined together to form a new plasmid ring which is inserted into a bacterium.

(3)

(b) Explain why large quantities of insulin are produced when this bacterium is put into a culture medium.

_____

_____

_____

(2)

(c) Before insulin was made in this way, it could only be obtained from sheep and pigs. Suggest **two** reasons, other than preventing the exploitation of animals, why it is better to obtain insulin by genetic engineering than from animals.

1. _____

_____

2. _____

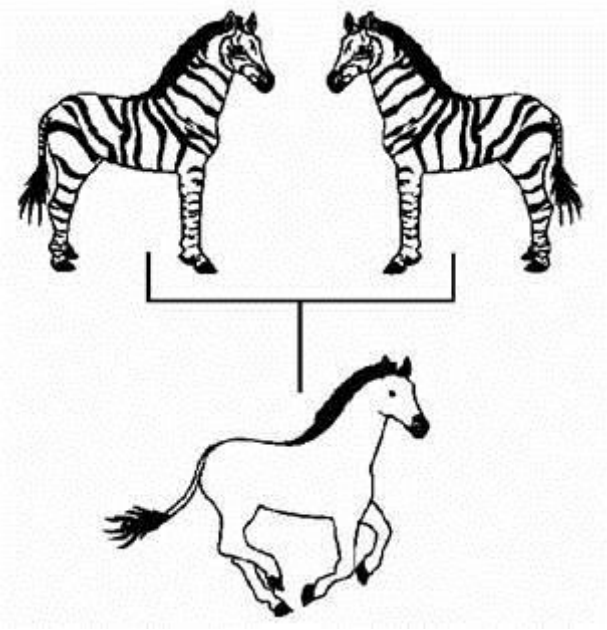
_____

(2)

(Total 7 marks)

Q12.

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)

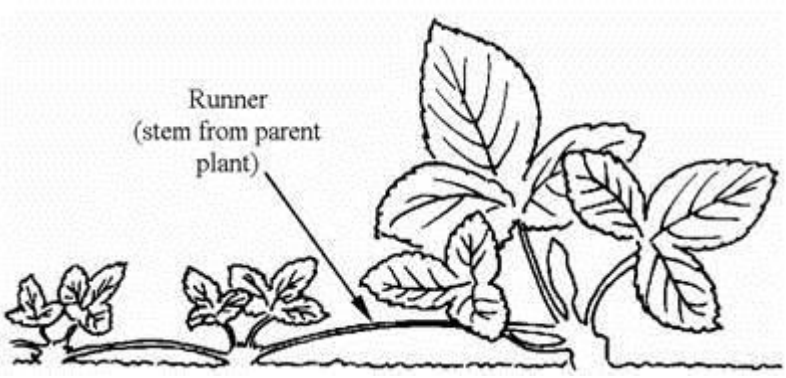
(Total 5 marks)

Q13.

A grower found some small strawberries with a nice taste, growing on a strawberry plant.

The grower then developed plants with strawberries which were larger but had the same nice taste.

Once the grower had developed his new plants, he could use runners to produce more plants which had the new large and tasty strawberries.



(i) What type of reproduction is this called?

_____

(1)

(ii) Why would he use this type of reproduction to produce more new plants?

_____

(1)

(Total 2 marks)

Q14.

A particular species of snail has a shell which may be pink, yellow or brown. It may also be plain or have bands running round it.

The snails are eaten by song thrushes.

Explain why snails with plain brown shells are the most common in hedgerows.

_____

_____

_____

_____

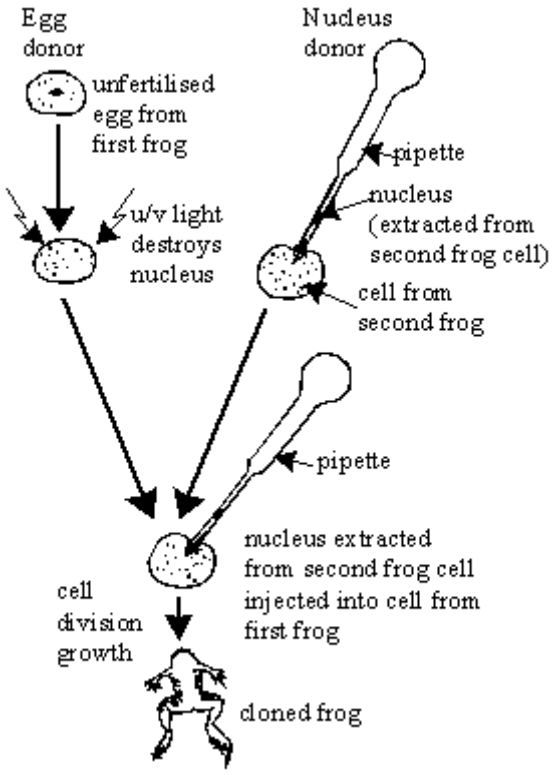
_____

_____

(Total 4 marks)

Q15.

The diagram shows how a frog can be cloned.



(a) In the example shown, will the cells of the cloned frog be the same as those of frog

1 or frog 2?

Explain your answer as fully as possible.

(4)

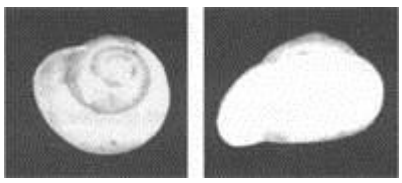
(b) Discuss the advantages and disadvantages of cloning compared to sexual reproduction.

(5)

(Total 9 marks)

Q16.

Cepaea nemoralis is a snail which is found on sand dunes. It may have a plain or banded shell. The snails are found on grass stalks and leaves.



Plain

Banded

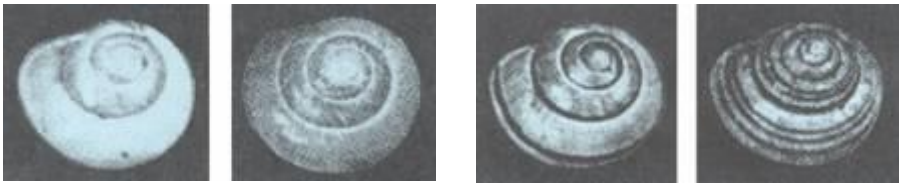
A scientist collected young unbanded snails and kept them until they were fully grown and mated them.

The eggs laid produced 35 unbanded and 12 banded snails.

(a) Explain these figures as fully as you can. You may use a genetic diagram if you

wish to make your answer clearer.

(7)



Variation in colour

Variation in banding

(b) The snail shells show a lot of variation in colour. They are yellowy/green, brown, pink or cream. The banding varies from a single wide band to a mixture of thick and thin bands.

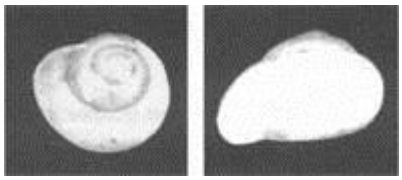
Describe briefly the factors which have produced this variation and explain how these factors may themselves have arisen.

(4)

(Total 11 marks)

Q17.

Cepaea nemoralis is a snail which is found on sand dunes. It may have a plain or banded shell. The snails are found on grass stalks and leaves.



Plain

Banded

When a scientist collected snails on the sand dunes he got 450 banded
280 unbanded.

Snails are eaten by birds. Sand dunes have clumps of grasses growing on them.

Suggest why there were more banded than unbanded snails on the sand dunes.

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q18.

Many insecticides contain “active” ingredients called pyrethrins. These are extracted from pyrethrum daisies. These plants are grown in Kenya, a developing country in Africa. They provide income for farmers and valuable exports.

An American biotechnology company has now transferred the gene for making a specific pyrethrin to brewers’ yeast. This can be grown easily, so this pyrethrin can be produced cheaply. However, insect populations can build up resistance to specific pyrethrins.

(a) What are the advantages and disadvantages of using brewers’ yeast to produce pyrethrins?

_____

_____

_____

_____

(6)

(b) Describe, as fully as you can, how a gene for making pyrethrins is transferred from daisy to yeast.

(3)

(Total 9 marks)

Q19.

Many islands in the Indian and Pacific oceans have or used to have large flightless birds like the dodo on Mauritius and the kiwi on New Zealand.

* Scientists think that birds on these islands came from elsewhere.
* Birds were able to fly to the islands.
* Birds living on islands may get blown out to sea and drown.
* Flying uses up lots of energy.
* Large birds find it difficult to fly.
* Islands in the middle of oceans had no mammal predators.

(a) Use this information to suggest how flightless birds evolved on different islands.

_____

_____

_____

_____

_____

_____

_____

(6)

(b) This evolution of the kiwi could not have occurred unless there was some variation between the birds.

Suggest **two** factors which could produce this range of variation.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q20.

Spiders produce a protein thread which is extremely strong compared to man-made fibres of the same diameter.

Spider's web

Scientists can now use bacteria to produce the **same** protein.
How can they do this?

_____

_____

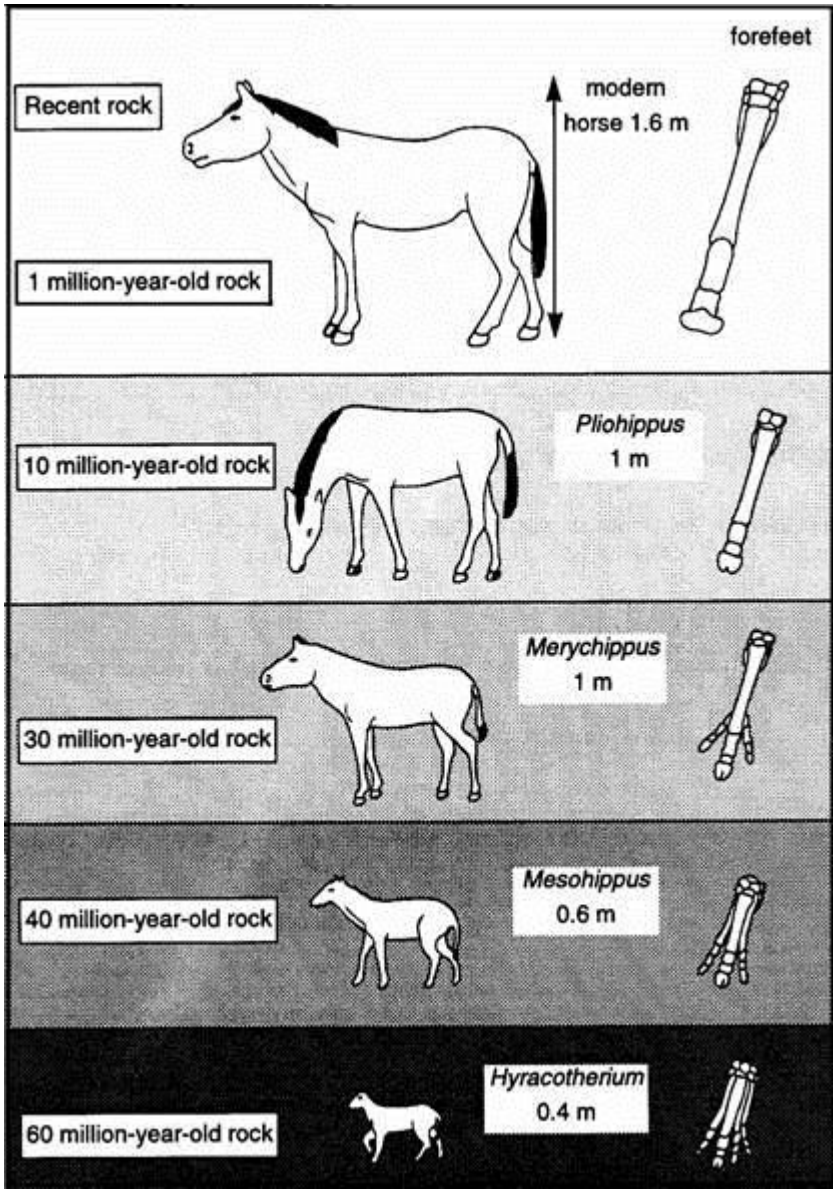
_____

_____

(Total 3 marks)

Q21.

The diagrams show fossil animals found in rocks of different ages. Scientists have used this information to work out how the modern horse evolved.



(a) *Mesohippus* became extinct over thirty million years ago. Use information from the diagrams to suggest **two** reasons why this happened.

1. _____

_____

2. _____

_____

(2)

(b) (i) How do scientists know how big these early horses were?

_____

_____

(1)

(ii) How do scientists know when they lived?

_____

_____

(1)

(c) Explain how the information in the diagrams supports the theory of evolution.

_____

_____

_____

(3)

(Total 7 marks)

Q22.

For many years scientists studied the organisms in an area of grassland.

One of the animals was a species of black fly. In this population only one allele **B** existed for colour. All the flies were homozygous **BB**.

A mutation occurred which produced a new recessive allele **b** which could produce a green colour.

(a) Draw **two** genetic diagrams to show how the single **b** allele in just one fly was able to produce homozygous **bb** green flies in two generations.

First generation

Second generation

(4)

(b) Although this new allele was recessive and the mutation only occurred once, a large proportion of the fly population was soon green.

Suggest in terms of natural selection why the recessive **b** allele was able to spread through the population.

(3)

(Total 7 marks)

Q23.

Insect pests can be controlled without using chemical insecticides.

For example, the bacterium *Bacillus thuringiensis* produces a toxin extremely poisonous to certain species of insects. The gene which produces this toxin has been introduced into tomato plants.
It gives them built-in resistance to a range of insect pests, but is not poisonous to humans.

(a) Explain, step-by-step, how the tomato plant is made resistant to some insect pests.

(4)

(b) Give **two** arguments for and **two separate** arguments against controlling insect pests in this way.

For:

1. _____

2. _____

Against:

1. _____

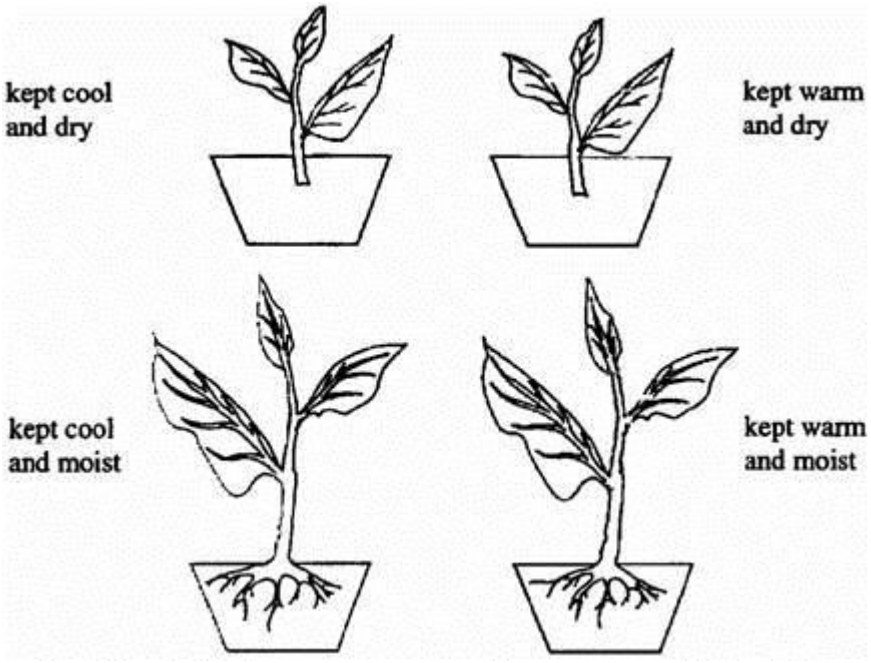
2. _____

(4)

(Total 8 marks)

Q24.

A gardener took four cuttings from the same plant and put them in compost.
He kept them in different conditions.
The diagrams show each cutting some time later.



(a) Use information from the diagrams to answer this part.

(i) The most important condition needed for cuttings to develop is that they should be kept _____

(1)

(ii) Explain why you chose this condition.

_____

(2)

(b) Gardeners often grow new plants from cuttings instead of from seeds.
Give a reason for this.

_____

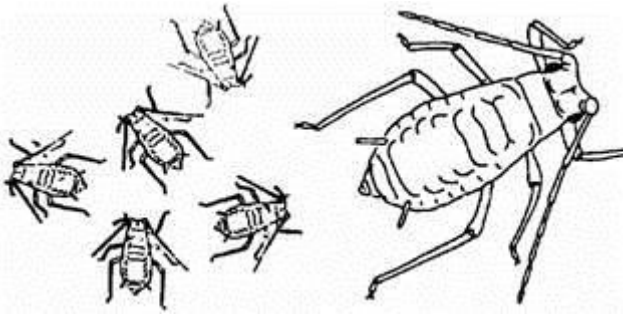
(1)

(Total 4 marks)

Q25.

The bean aphid is a type of black-fly which lives on broad bean plants in summer.

In the autumn, males and females mate and produce eggs.



(a) Name the type of reproduction which produces the eggs.

_____

(1)

(b) In spring these eggs hatch. The young aphids are all female.
Explain why they are all similar but not identical to each other.

_____

(1)

(c) These females are then able to produce offspring without needing any males.

(i) Name the type of reproduction where females do **not** need males to produce offspring.

_____

(1)

(ii) How will the offspring from one of these females:

A compare with each other

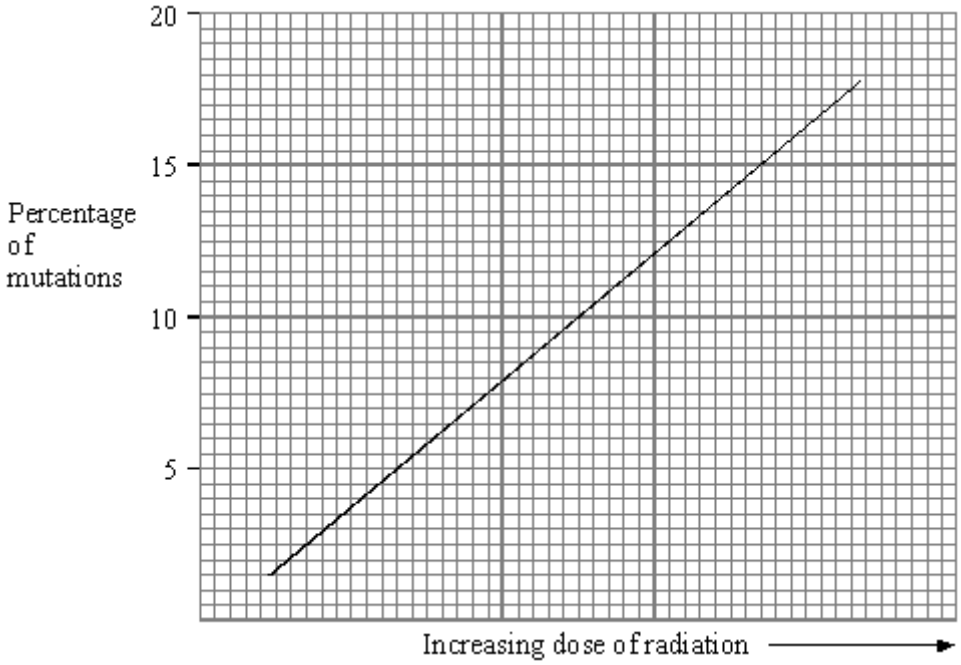
_____

B compare with the offspring from other females?

_____

(2)

(d) Some scientists investigated mutations in these aphids. They exposed the aphids to X-rays.
They plotted their results.



(i) What was the connection between the dose of X-rays and the percentage of mutations?

_____

(1)

(ii) Name **one** other possible cause of mutations.

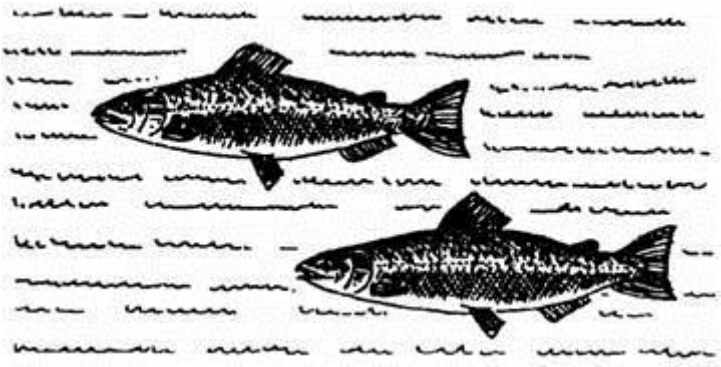
_____

(1)

(Total 7 marks)

Q26.

Wild salmon hatch from eggs laid in rivers. The small salmon then swim downstream to the sea. After 3-4 years they return to breed, usually in the same river in which they were hatched. If fish return to a different river they do not breed as successfully as those returning to the same one. This means that each river has its own breeding population of salmon. Each breeding population is slightly different from all the others.



Use the idea of natural selection to explain how each river has its own breeding population.

_____

_____

_____

_____

_____

(Total 4 marks)

Mark schemes

Q1.

dominant

1

recessive

1

genes

1

gametes

1

environmental

1

[5]

Q2.

(a) asexual

mitosis is neutral

1

(b) (body cell)
nucleus *is* from body cell

no mark for just body cell – mark the explanation
allow converse nucleus from egg cell is removed

1

nucleus contains (genetic) information / instructions / chromosomes / genes / DNA / allele

*do **not** credit 'contains characteristics'*

1

(c) splitting apart (cells from clonal) embryo

*do **not** credit 'repeat process'*

1

[4]

Q3.

chromosomes

1

enzymes

1

[2]

Q4.

(a) genetically identical / same genetic information / same DNA

accept identical / same chromosomes / alleles / genes

allow 1 mark for identical same characteristics

2

(b) Quality of written communication:
Correct sequence
split → transfer

1

any **two** from

- split apart cells (from embryo)
- before specialised

  allow early stage
- implant / transplant
- into host / mother / uterus / womb

2

[5]

Q5.

(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]

Q6.

(a) genes

1

asexual

1

clones

1

(b) keeps cuttings damp / prevents wilting

allow keeps warm / acts like a greenhouse
allow keeps pests off

1

[4]

Q7.

(a) (i) meiosis

1

(ii) mitosis

1

(c) (i) **X** pituitary

1

Y FSH

1

(ii) stimulates LH production

1

inhibits FSH production / production of **Y**

1

[6]

Q8.

(a) (reject)

if support then zero marks

any **two** from:

giraffe spend almost all of the dry season feeding from low bushes

only in the wet season do they feed from tall trees, when new leaves are plentiful

females spend over 50% of their time feeding with their necks horizontal

both sexes feed faster and most often with their necks bent

2

(b) any **two** from:

<u>mutations</u> produce male giraffes with longer necks

either

male giraffes with longer neck more likely to win fight / more likely to mate with female

or

females prefer long necks / more likely to mate with long necked male

their genes more likely to pass to next generation

accept long necks inherited or offspring have long necks

2

[4]

Q9.

(a) (i) to go under teeth **or** mower

accept not damaged by grazing animals

accept do not get cut or bitten

accept reduces competition by other plants

do not credit maximum surface of leaves facing Sun

1

(ii) any **one** from

it can force its way through grass roots

accept in competition with grass roots

it is a store of food (to help the plant recover)

do not credit a good store of water

to reach down to water

to give good anchorage

accept it is hard to pull up

1

(iii) any **one** from

to reach more light

*accept to get out of the shadow of the hedge **or** tall grass*

to let seeds be caught on animals' coats (more easily)

*accept improves access **or** visibility **or** ease for pollination*

do not credit to help it grow up the hedge

1

(iv) any one from

(they reach out from hedge) to find water

accept increase surface area

*accept to find nutrients **or** minerals*

do not award mark if food mentioned

to give good anchorage

1

(b) (i) gene **or** allele

do not credit chromosome

1

(ii) any **one** from

they do not crossbreed **or** interbreed

*accept different species do not breed together **or** do not fertilise each other*

do not produce fertile offspring

have different numbers or types of chromosomes

accept genes are incompatible

*do not credit have different genes **or** are genetically different*

do not credit do not pollinate each other

1

(c) one mark is for the adaptation and one is for an appropriate reason

have white fur

for camouflage

are huge

for large volume to surfae area

thick layer of fat

*for insulation or to reduce heat loss **or** retain heat*

*do not credit to stop it losing heat **or** withstand the cold **or** keep it warm*

have thick fur

*for insulation **or** to reduce heat loss **or** retain heat*

hibernate

to avoid the coldest part of year

is a carnivore

because animals provide high energy food

has big paws **or** claws

to be able to walk on snow

have small ears

to reduce heat loss

have furry feet

for insulation from the snow

2

[8]

Q10.

any **four** from

dark were better adapted to survive **or** dark ones can hide in dirty environment

*dark is the survival of the fittest **or** they are better camouflaged*

those which survive breed

they are able to pass on their genes

light ones more easy to see on smoky surfaces (so get eaten)

birds can see light ones more easily

as environment becomes cleaner or less smoky light ones hide easier

those which survive breed **or** increase the population

accept the converse argument

[4]

Q11.

(a) gene or allele

1

chromosome

*do not credit cell **or** pancreatic cell **or** genome*

1

DNA

accept plasmid

1

(b) any **two** from

bacteria grow **or** reproduce

a growth related point

DNA ring **or** plasmid **or** insulin gene produced each time

***a** genetic related point*

insulin gene (in ring instructs bacteria to) make insulin

2

(c) any **two** from

same match to human insulin

*accept animal insulin may be rejected **or** may not suit humans*

no crossing species risk

accept no risk of BSE type species crossing

more easy to obtain **or** can be made in large quantities

*accept it is cheaper to make in the long term **or** it's quicker*

do not credit it's cheap

an ethical answer such as no religious **or** cultural concerns

accept it is cheaper so can be made available to many more people

2

[7]

Q12.

(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]

Q13.

(i) vegetative/asexual/cloning

for 1 mark

(ii) clones/identical copies/all same

for 1 mark

not clones if cloning in b(i)

[2]

Q14.

idea brown colour/plain shell inconspicuous

for 1 mark

less likely to be eaten

gains 1 mark

but

less likely to be eaten before breeding

gains 2 marks

so alleles (genes) passed on

for 1 mark

(N.B accept inverse of any of the above)

[4]

Q15.

(a) *ideas:*

frog 2

nucleus comes from this frog

DNA/genes/information in nucleus

this controls development

for 1 mark each

4

(b) *advantages:*

large number of identical offspring

guaranteed desired features

quick

economic

disadvantages:

may all succumb to unexpected disease/change in conditions

cut adaptation/reduce gene pool/limits variation

any 5 for 1 mark each

5

[9]

Q16.

(a) idea

- unbanded dominant/plain **or** banded recessive
- because banded appears in young/
- parents heterozygous/Bb
- offspring BB } Bb } Bb } bb } credit response consistent with parents even if not both heterozygous

  Accept any clear and consistently used notation
- identify BB, Bb as plain
- identify bb as banded
- ratio 3:1 unbanded/banded (stated or clearly implied
- matches 35:12 results e.g. <u>all</u> the outcomes clearly identified as banded/unbanded)

  for 1 mark each

7

(b) *idea*

- many genes control [accept “continuous variation”]
- many alleles for a gene/large genepool
- snails can inherit lots of different combinations
- mutation (gives rise to many alleles)
  allow selection allows alleles to be passed on unless [very]disadvantageous or if advantageous

  any 4 for 1 mark each

  [Also credit, for 1 mark each, up to <u>2</u> causes of mutation, e.g. mistakes in cell division, radiation]

4

[11]

Q17.

idea

- banded snails camouflaged/less easily seen
- fewer banded eaten [by birds]

- more banded survive to breed

- more genes for banded passed on
  or more banded snails in population

  for 1 mark each

N.B.
Accept reverse of all above for plain snails
*All 4 marks may be gained by a relatively short response

[4]

Q18.

(a) *idea*
advantages

- large scale
- cheaper
- easy to grow/produce or quick to produce
- non-seasonal

disadvantages

- loss of farmers' income
- loss of foreign exchange
- less work in Kenya/developing country
- mass use of a of particular pyrethin
- can allow insect populations to become resistant

  any 6 for1 mark each
  maximum of 4 in
  advantages/disadvantages

6

(b) *idea*
chromosomes /DNA carry genes
cut off gene/part of chromosome/DNA
insert into yeast chromosome/DNA/plasmid/nuclear
Accept DNA answers

for 1 mark each

3

[9]

Q19.

(a) *ideas that*

- birds reached islands by flying

- some variation between these birds
- flight not needed to escape predators
- flight uses energy
- flight could result in death by drowning
- so non-flying birds favoured by natural selection or better chance to survive and breed
- so larger birds at an advantage
- any six for 1 mark each

6

(b) *idea*

- large number of genes per characteristic
- large range of alleles/large gene pool

(credit for these points not to be given if they are made in (a))

- mutation(s)

(credit idea of inheritance and environment as the two factors with 1 mark)

any two for 1 mark each

2

[8]

Q20.

idea

- gene cut out/taken
- put in bacterial (cell) do not allow “nucleus”)
- cells cultured / grown in bulk

1 mark each

(allow 1 mark for “genetic engineering” if no other marks gained)

[3]

Q21.

(a) *idea about*

- environment change / habitat drier / climate change
- couldn’t escape from predators / ref to predators / killed / eaten

[Do not allow "died"]

- because feet not adapted to run on dry ground

- couldn't compete (with Merychippus) / more difficult to get food

[Use v + x = x principle]
any two for 1 mark each

2

(b) (i) fossil remains / from the bones
for 1 mark

1

(ii) (known) age of rock **or** any reason for knowing the age of the rock
eg by the rock layers by RA dating (not C-dating)
for 1 mark

1

(c) *idea that*
(present day) horses / species evolved / adapted / developed from earlier species/ horses

- over a long period of time / millions of years
- via many / gradual changes
- which gave a survival advantage /passed on genes / characteristics
any three for 1 mark each

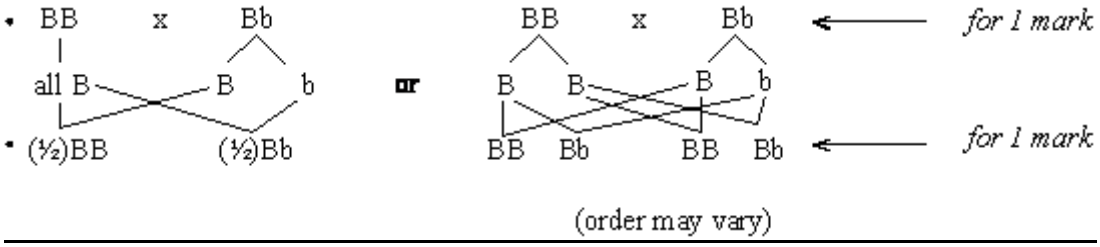
[First bullet point answer is required before marks can be awarded for others]

3

[7]

Q22.

(a) First Generation



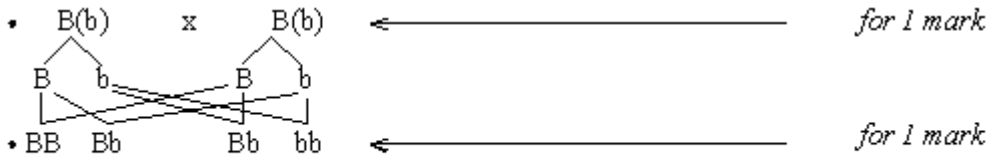
or as matrix

	B	B
B	BB	BB
b	Bb	Bb

1 mark for correct column and row headings
1 mark for correct outcomes

allow one mark for being able to produce a correct genetic cross
(even if from an incorrect starting point)

Second generation



( ) = picking out this idea gets both marks

or as a matrix

	B	b
B	BB	Bb
b	Bb	bb

1 mark for correct column and row headings
1 mark for correct outcomes

4

(b)
- green colour gives an advantage/camouflage
- more green flies dm black flies survive to breed*
- pass on their genes to the next generation
- (* but implied by 3rd bullet point)

for 1 mark each

3

[7]

Q23.

(a) *ideas that*

- (toxin) gene cut out (from bacterium)
- of bacterial chromosome/DNA / plasmid (not nucleus)
- transferred to tomato chromosomes / cells/DNA/nucleus
- makes the toxin in the tomato plant

each for 1 mark

4

(b) **For:**

- good if we are sure that it only kills tomato pests, not bees etc
- humans will not be eating toxic insecticide
- don't have to buy insecticides
- less use of 'chemical' insecticides/less pollution
- reduce labour costs
- no hit or miss spraying

- spray washed off / needs respraying

(not to ensure better crop/better quality tomatoes ∴ Q asks.... in <u>this</u> way)

any two for 1 mark each

2

<u>Against:</u>

- not sure how the gene will affect other tomato genes/characteristics/named
- characteristic
- toxin might affect other organisms that feed on plant eg useful insects
- genetic engineering unethical/unnatural
- can't predict the effect of mutations
- could mutate to form a human toxin

(not 'insects may develop resistance ∴ also applies to chemical insecticides)

NB Credit other sensible responses for/against

any two for 1 mark each

2

[8]

Q24.

(a) (i) moist (warm and cold are neutral)

for 1 mark

1

(ii) *idea that* roots / plants (only) grow with <u>moisture</u> (second condition negates answer)
idea that same (amount of growth) whether warm or cool

for 1 mark each

2

(b) *idea that* quicker / cheaper / more successful / same as the parent plant

for 1 mark

1

[4]

Q25.

(a) sexual / sex

for 1 mark

1

(b) *idea that*
sexual reproduction brings about a mixture of genes
or similar / different genes / parents / gametes / DNA / characteristics / chromosomes (*not* features)

for 1 mark

1

(c) (i) asexual / cloning (*allow* vegetative)

for 1 mark

1

(ii) (A) *idea that* (they are exactly the same). *Do not allow* similar or just <u>one</u> named feature.

for 1 mark

2

(B) different (*allow* similar but *do not allow* same).
Allow any one named difference

for 1 mark

(d) (i) greater the X-ray dose, greater the % of mutations
or % of mutations increases steadily / in proportion to X-ray dose

for 1 mark

1

(ii) ionising radiations / ultra-violet light / alpha particles / beta particles / gamma rays / radio activity / chemicals / drugs / smoking / natural in meiosis / spontaneous / cell replication / toxic waste / pollution

1

Accept radioactivity but not radiations alone.

for 1 mark

[7]

Q26.

idea that

- variations / mutations / differences in genes / alleles (in wild salmon population)
- adapted to own river
- any appropriate difference between rivers

  e.g. flow rate, waterfalls, pH, temperature, food supply, disease predators, competitors

- homing instinct

for 1 mark each

survive to breed

gains 1 mark

but
pass on genes to offspring

gains 2 marks

[4]