Dev Understanding Genetics + 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: Dev Understanding Genetics + 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.

_____

_____

_____

_____

(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.

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

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

(a) What is the name of this scientist?

Tick **one** box.

Alfred Russel Wallace ☐

Charles Darwin ☐

Gregor Mendel ☐

Jean-Baptiste Lamarck ☐

(1)

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

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

Tick **one** box.

Carbohydrate ☐

DNA ☐

Lipid ☐

Protein ☐

(1)

(c) A gene often has two alleles.

One allele is dominant and the other allele is recessive.

When is a recessive allele expressed as a characteristic?

Tick **one** box.

When the dominant allele is not present ☐

When the recessive allele is inherited from the female parent ☐

When the recessive allele is inherited from the male parent ☐

When the recessive allele is present on only one of the chromosomes ☐

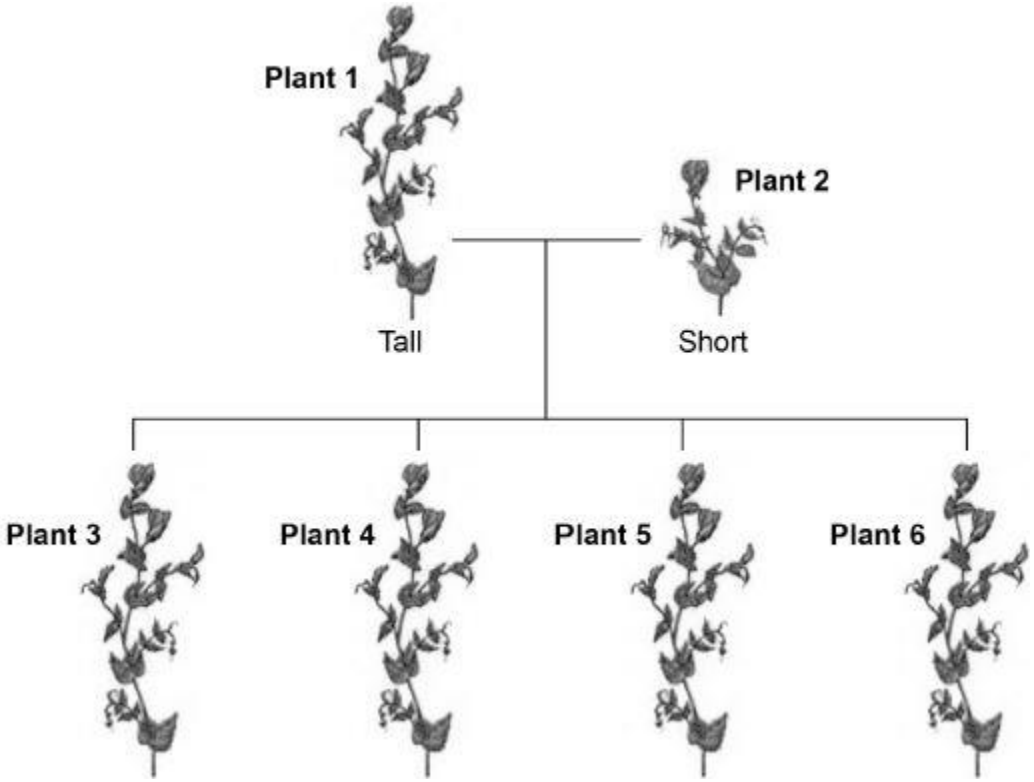
(1)

A scientist investigated the inheritance of height in pea plants.

The scientist crossed tall pea plants with short pea plants.

Figure 1 shows the scientist's results.

Figure 1



All tall offspring

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

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

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

Give the genotype of plant **2**.

_____

(1)

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

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

Figure 2

		Male gametes: T	Male gametes: t
Female gametes	T	TT	
	t		

(2)

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

(1)

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

Ratio of tall plants : short plants = _____ : _____

(1)

(Total 8 marks)

Q3.

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.

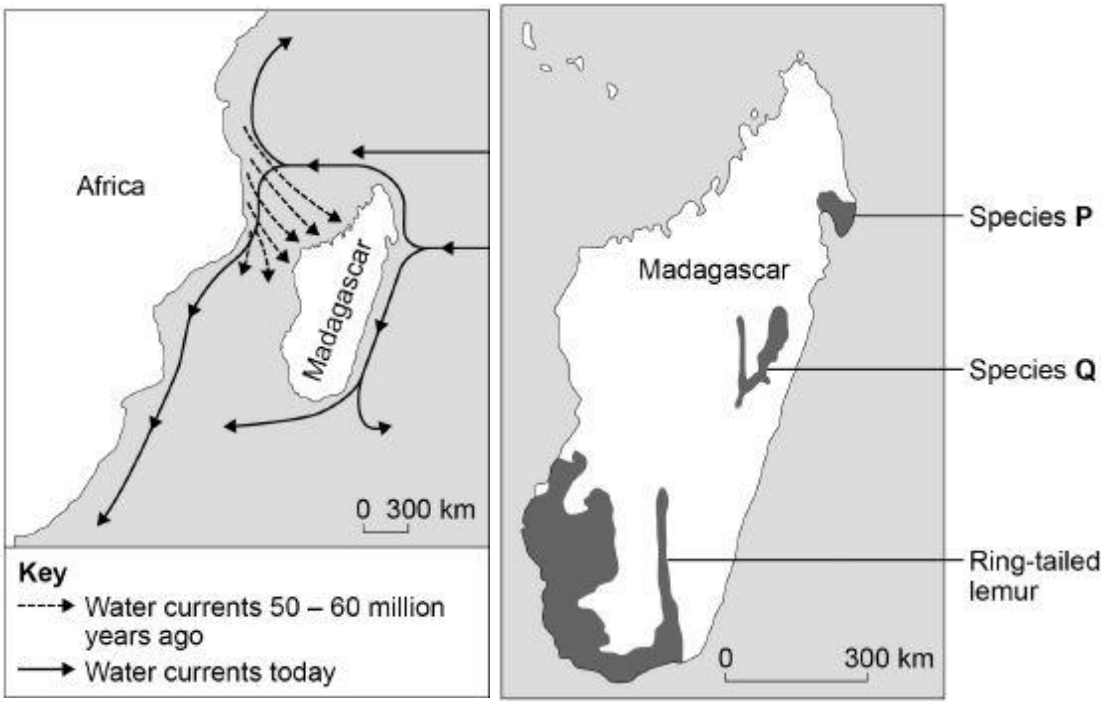
Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

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.

_____

_____

_____

_____

(1)

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

_____

_____

_____

_____

_____

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_____

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_____

_____

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_____

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_____

_____

(5)
(Total 9 marks)

Q4.

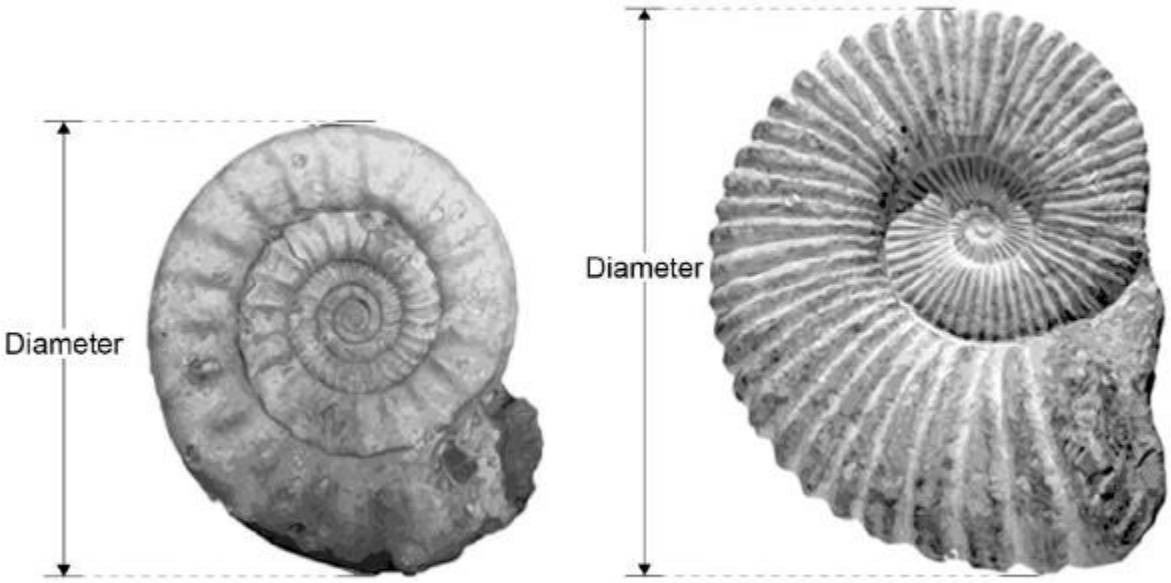
Fossils provide evidence about organisms that lived a long time ago.

(a) Give **one** way a fossil may be formed.

(1)

Figure 1 shows the fossils of two species of ammonite.

Figure 1



Ammonite **P** (scale: x 1)

Ammonite **Q** (scale: x ½)

(b) Use a ruler to measure the diameter of **P** and the diameter of **Q** in millimetres.

Diameter of **P** = _____ mm

Diameter of **Q** = _____ mm

(1)

(c) Calculate the diameter of the real fossil of ammonite **Q**.

Use your answer to part (b) and the scale factor given in **Figure 1**.

_____

_____

_____

_____

Diameter of the real fossil of ammonite **Q** = _____ mm

(1)

(d) How many times larger is ammonite **Q** compared to ammonite **P**?

Tick **one** box.

0.4 ☐ 0.8 ☐ 1.25 ☐ 2.5 ☐

(1)

(e) Describe **two** ways the fossil of ammonite **Q** is different from the fossil of ammonite **P**.

Do **not** give answers referring to size.

1.

_____

_____

2.

_____

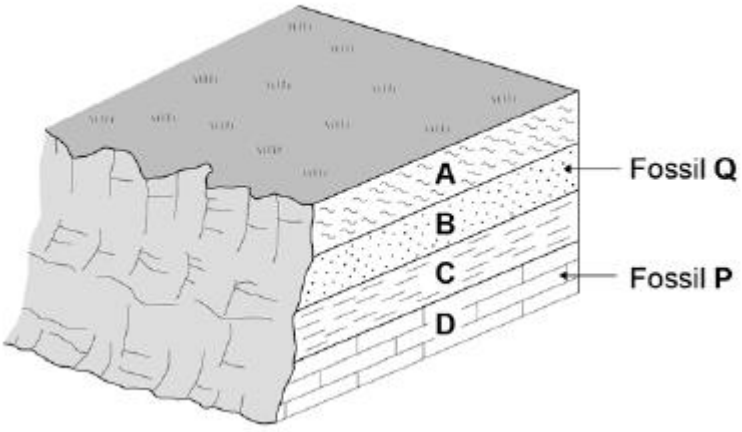
_____

(2)

(f) **Figure 2** shows:

- four layers of rock, **A**, **B**, **C** and **D**
- where the fossils of ammonites **P** and **Q** were found.

Figure 2



Which statement is evidence that ammonite **Q** may have evolved from ammonite **P**?

Tick **one** box.

P and **Q** are both found in limestone. ☐

Q was found in newer rocks than **P**. ☐

P is a darker colour than **Q**. ☐

Q has a smaller mass than **P**. ☐

(1)

(g) Suggest how long ago ammonites **P** and **Q** were alive.

Tick **one** box.

100 years ☐

1000 years ☐

100 million years ☐

100 billion years ☐

(1)

(h) Ammonites are now extinct.

Suggest **three** possible causes of extinction.

1. _____

2. _____

_____

_____

3.

_____

_____

_____

_____

(3)

(i) Give **one** reason why scientists cannot be sure about what caused the ammonites to become extinct.

_____

_____

_____

_____

(1)

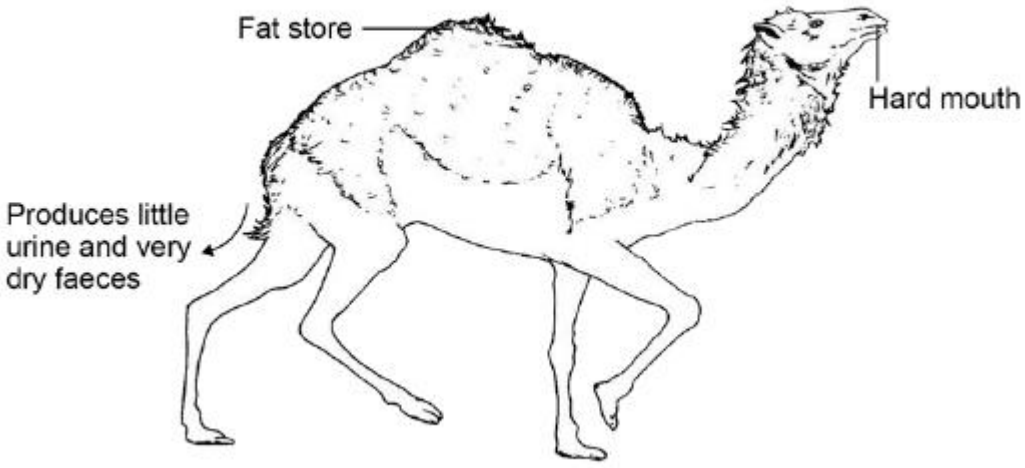
(Total 12 marks)

Q5.

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.

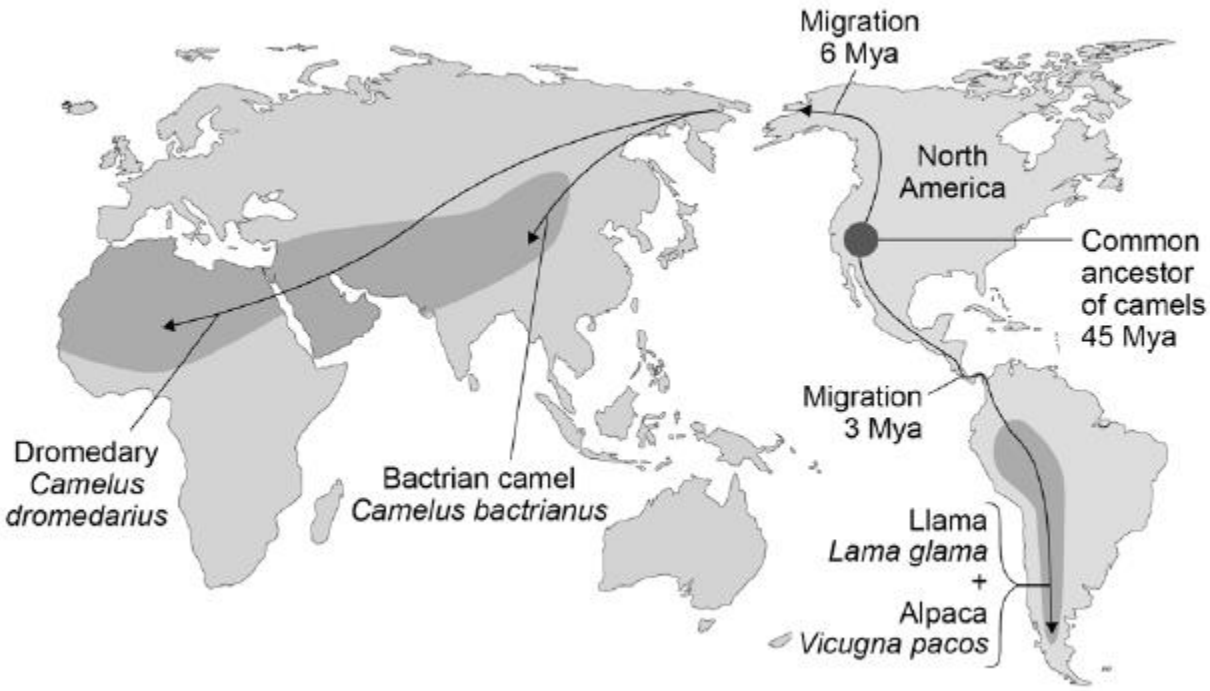
Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

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**.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

(6)

(Total 14 marks)

Q6.

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?

_____

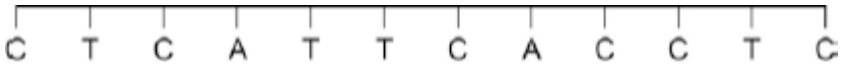
_____

(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)

Q7.

Charles Darwin proposed the theory of natural selection.

Many people at the time did not accept his theory.

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

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

Who proposed this theory?

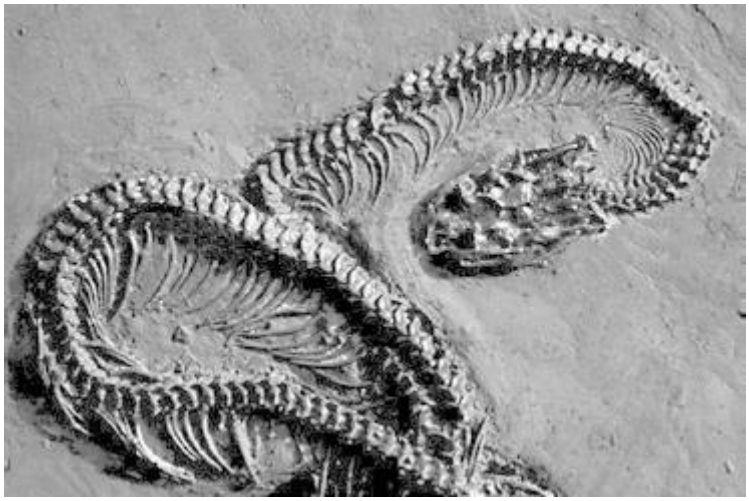
_____

_____

(1)

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

The diagram below shows a fossilised snake.



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

_____

_____

_____

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_____

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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.

_____

_____

_____

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_____

(4)

(d) Many species of snake have become extinct.

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

_____

_____

_____

_____

(1)

(Total 9 marks)

Q8.

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 _____ .

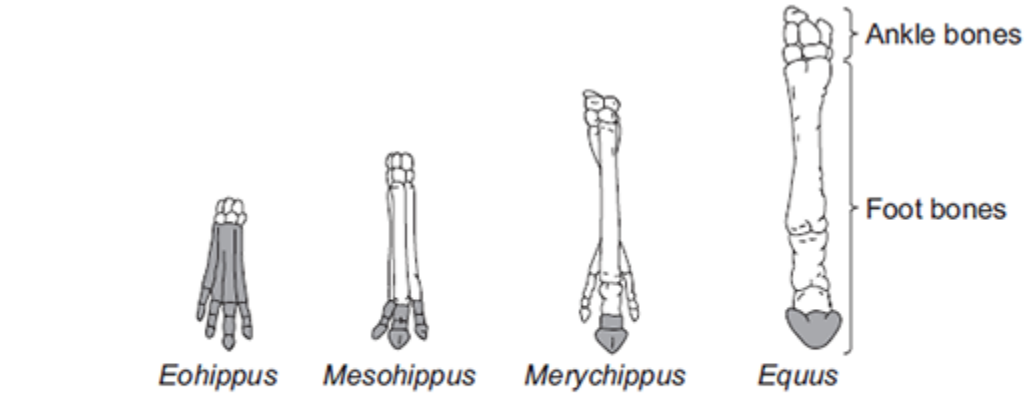
Individuals with characteristics most suited to the environment are more likely to survive and _____ .

(2)

(Total 3 marks)

Q9.

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



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

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

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

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

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

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

_____

_____

_____

_____

_____

(2)

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

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

(4)

(Total 8 marks)

Q10.

Over millions of years:

- new groups of organisms have evolved
- other groups of organisms have become extinct.

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

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

Suggest how.

_____

_____

_____

_____

(1)

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

_____

_____

_____

_____

(1)

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

1.

_____

_____

_____

_____

2.

_____

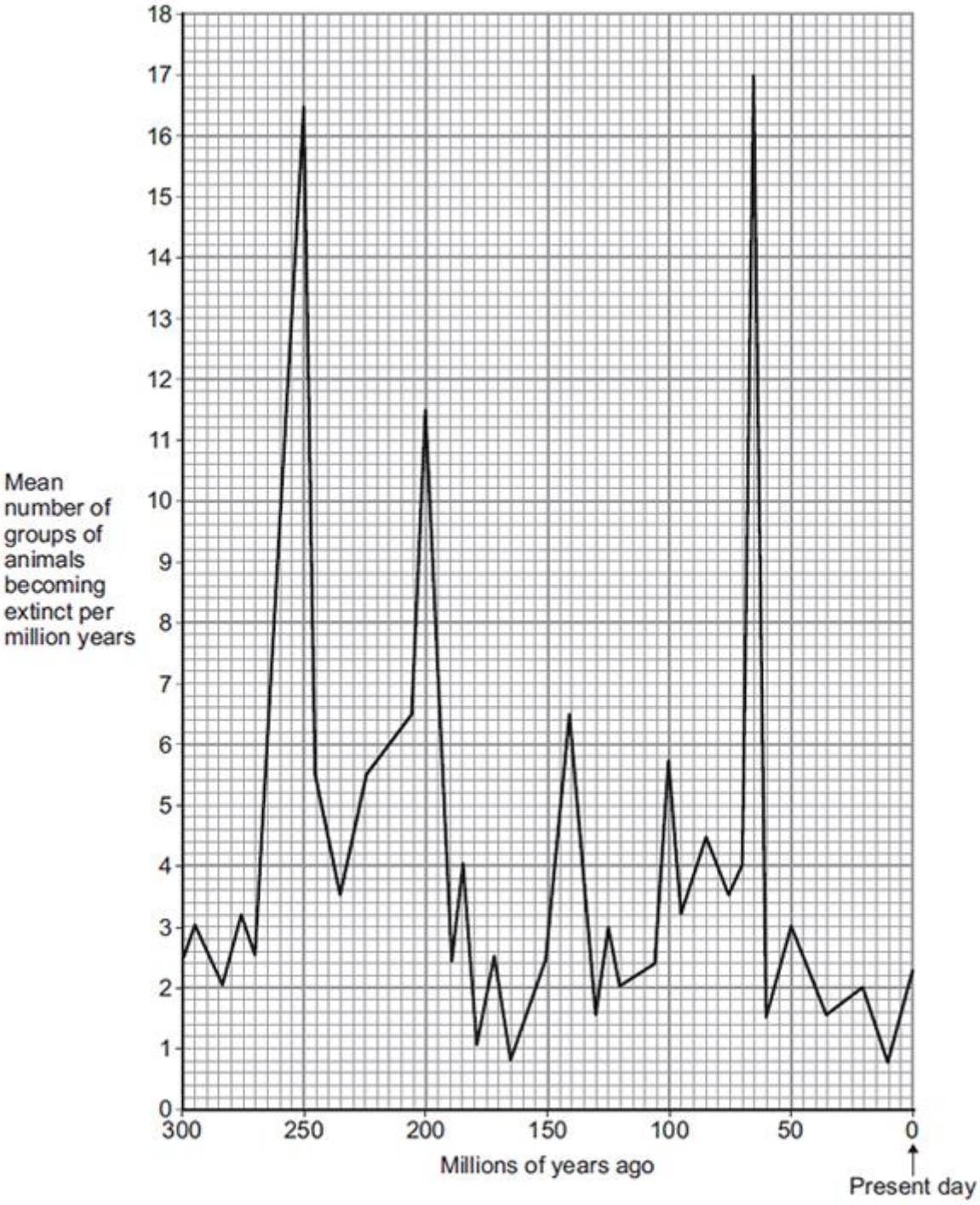
_____

_____

_____

(2)

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



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

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

_____

(1)

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

_____

_____

(1)

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

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

Tick (✓) **one** box.

50 million years ago ☐

65 million years ago ☐

250 million years ago ☐

(1)

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

_____ groups per million years

(1)

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

_____

_____

(1)

(Total 9 marks)

Q11.

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

Figure 1

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

Figure 2 shows an Island Fox.

Figure 2

© GaryKavanagh/iStock

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

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

The Grey Fox lives in mainland California.

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

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

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

_____

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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)

Q12.

(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 ☐

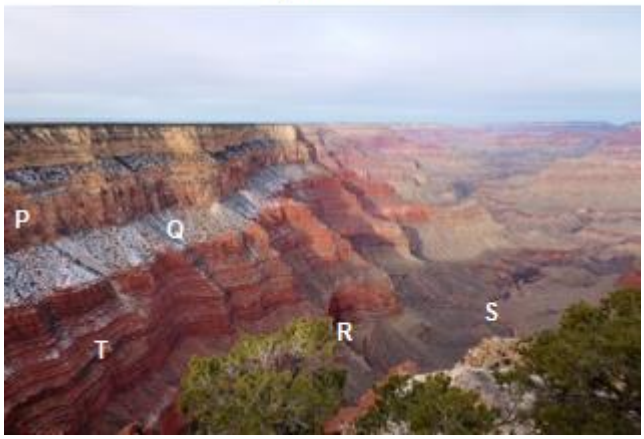
Organisms that reproduce together to form fertile offspring ☐

(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.

(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)

Q13.

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.

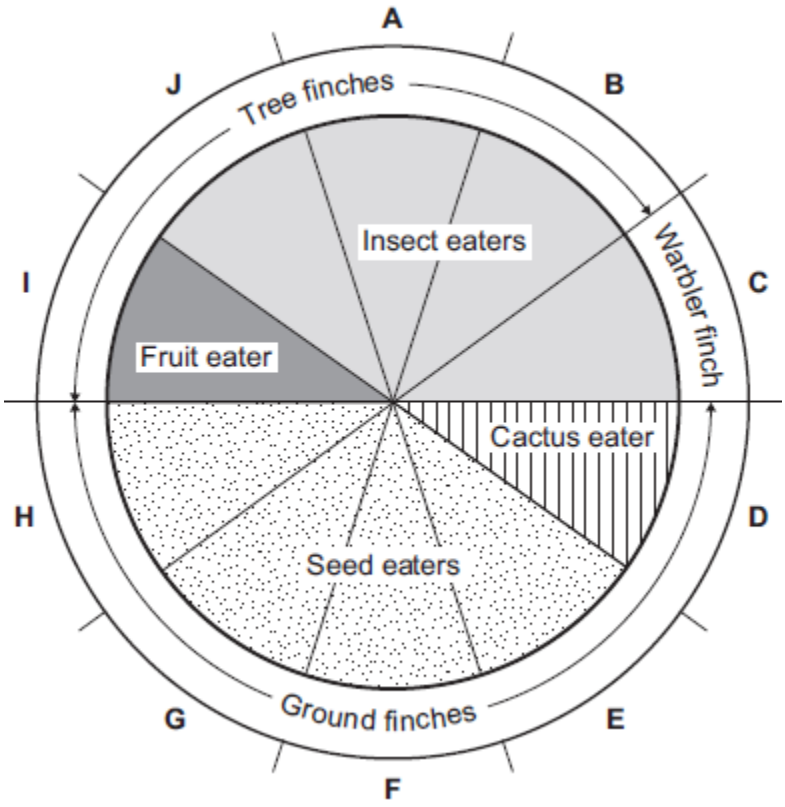
Darwin suggested the theory of evolution by natural

_____

_____

(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)

Q14.

Antibiotics can be used to protect our bodies from pathogens.

(a) What is a pathogen?

_____

_____

_____

_____

(1)

(b) Bacteria may become resistant to antibiotics.

How can doctors reduce the number of bacteria that become resistant to antibiotics?

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(c) Scientists grow microorganisms in industrial conditions at a higher temperature than is used in school laboratories.

(i) Which temperature would be most suitable for growing bacteria in industrial conditions?

Draw a ring around the correct answer.

25 °C **40 °C** **100 °C**

(1)

(ii) What is the advantage of using the temperature you gave in part (c)(i)?

_____

_____

_____

_____

(1)

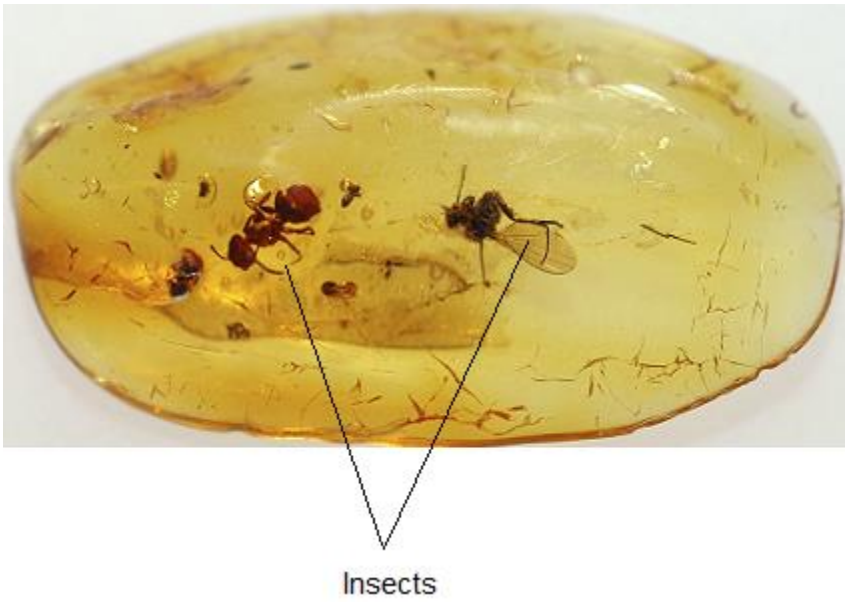
(Total 5 marks)

Q15.

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

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

The image shows two fossil insects in amber.



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

_____

_____

_____

_____

_____

_____

_____

_____

(2)

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

1. _____

_____

2.

_____

_____

_____

_____

(2)

(b) The fossil record shows that many organisms, including the dinosaurs, became extinct 65 million years ago.

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

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

Why might this happen?

Tick (✓) **one** box.

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

(1)

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

1.

_____

_____

_____

2.

_____

_____

_____

3. _____

_____

_____

_____

(3)

(Total 8 marks)

Q16.

(a) Evidence about extinct species of animals and plants comes from fossils.

Below is a photograph of a fossil of a bird-like animal called *Archaeopteryx.* *Archaeopteryx* lived about 150 million years ago.

(i) Suggest how the fossil of *Archaeopteryx* was formed.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) Scientists have found other fossils of the ancestors of modern birds, but the fossil record is very incomplete.

Suggest **two** reasons why there are gaps in the fossil record.

1. _____

_____

2. _____

_____

(2)

(b) There are many different species of bird on the Earth today.

Describe how these different species may have evolved from an ancestor such as *Archaeopteryx*.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

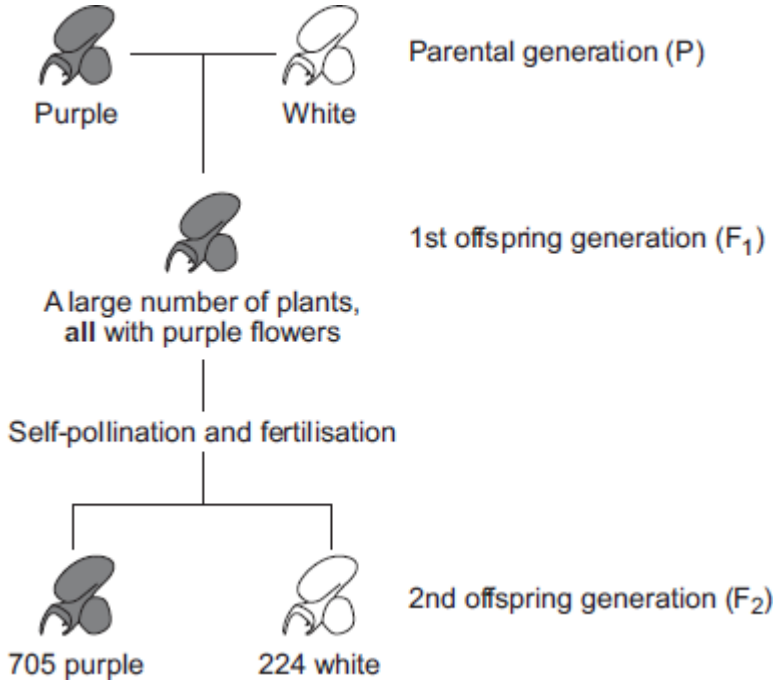
(4)

(Total 8 marks)

Q17.

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

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



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

Ratio of purple : white = _____

(1)

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

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

Explain why.

_____

_____

_____

_____

(2)

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

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

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

(2)

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

Use the following symbols:

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

(3)

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

Suggest **two** reasons why.

1.

_____

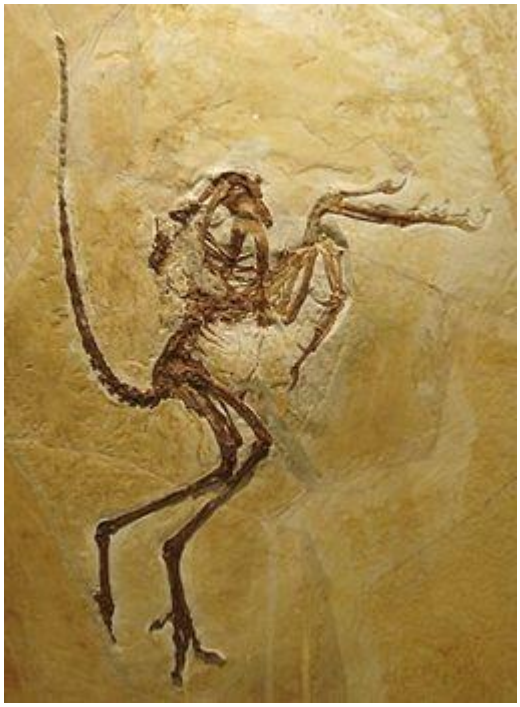
___

2.

(2)
(Total 10 marks)

Q18.

The photograph shows a fossil of a prehistoric bird called *Archaeopteryx*.



By Ghedoghedo (own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/BY-SA-3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via Wikimedia Commons; By Steenbergs from Ripon, United Kingdom (Small Fishing Boat In North Sea) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons.

(a) Describe **three** ways fossils can be made.

_____

_____

_____

_____

_____

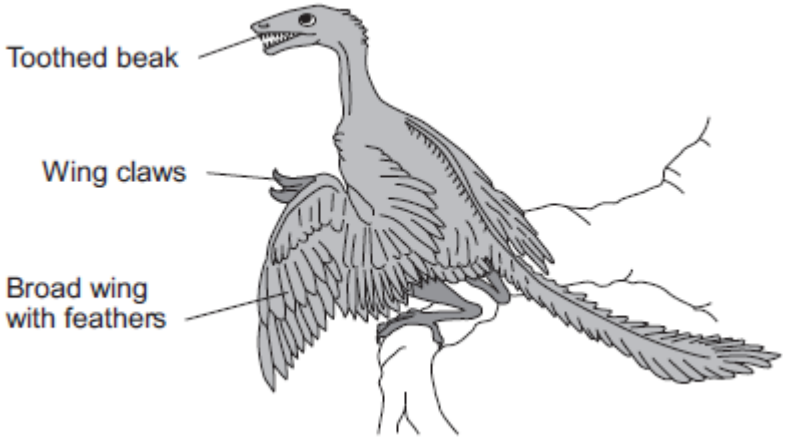
_____

_____

(3)

(b) The drawing shows what an *Archaeopteryx* might have looked like when it was alive.

Scientists think that *Archaeopteryx* was a predator.



(i) Look at the drawing.

Write down **three** adaptations that might have helped *Archaeopteryx* to catch prey.

How would **each** adaptation have helped *Archaeopteryx* to catch prey?

Adaptation 1

_____

How it helps

_____

_____

_____

Adaptation 2

_____

How it helps

_____

_____

_____

Adaptation 3

_____

How it helps

_____

_____

_____

(3)

(ii) *Archaeopteryx* is now extinct.

Give **two** reasons why animals may become extinct.

1.

_____

_____

_____

2.

_____

_____

_____

(2)

(Total 8 marks)

Q19.

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.

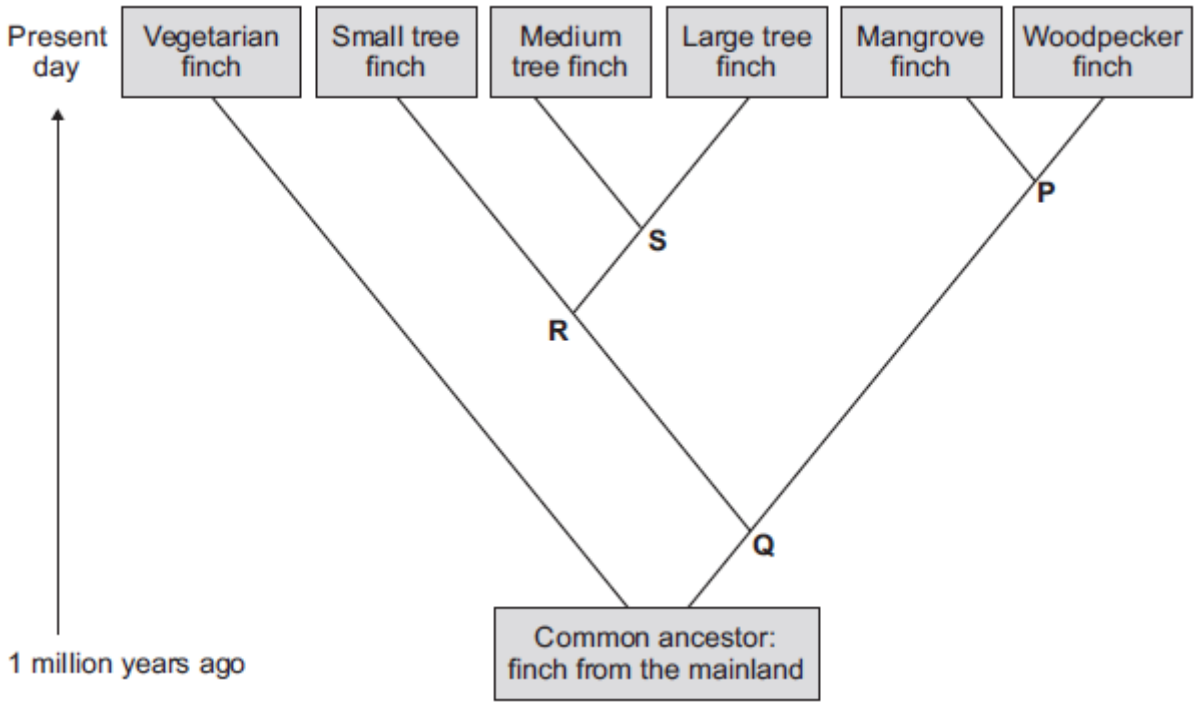
Describe how a new finch species may have evolved from the original species of finch that arrived from the mainland.

_____

_____

(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)

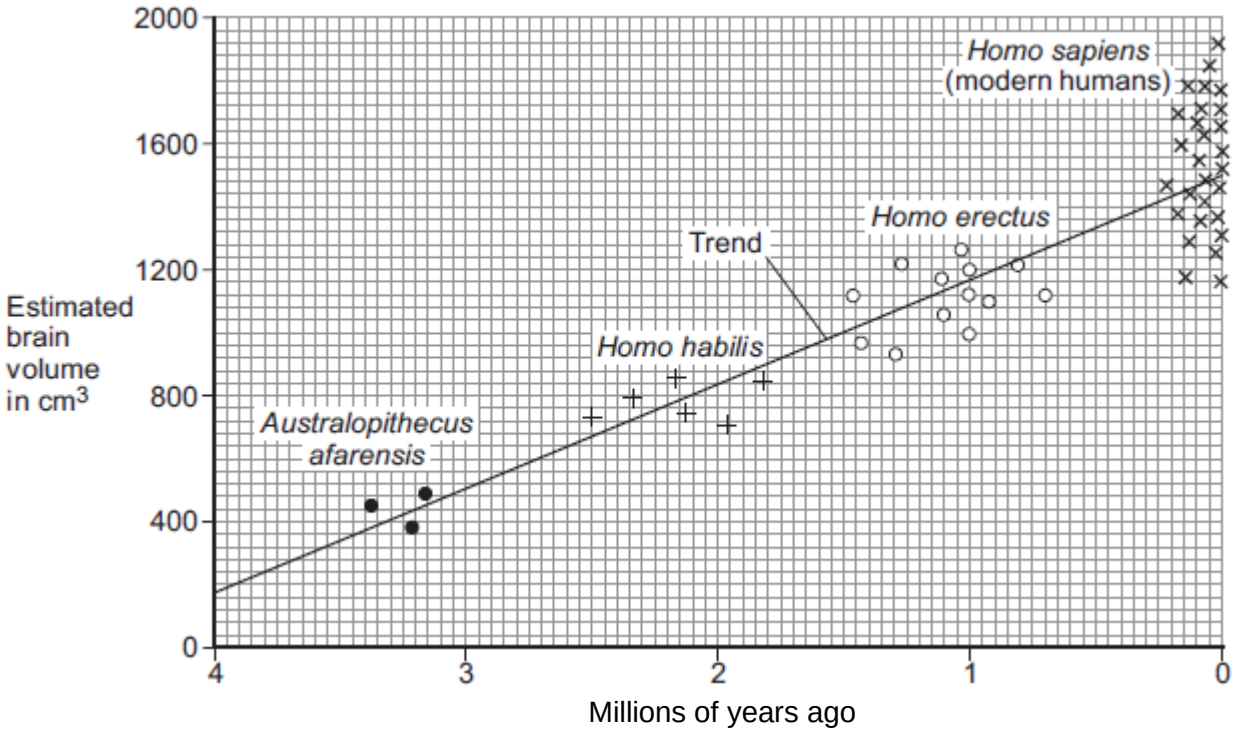
Q20.

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)

Q21.

The MMR vaccine is used to protect against measles.

(a) Apart from measles, which **two** other diseases does the MMR vaccine protect against?

_____ and _____

(1)

(b) Read the information.

> Measles is a dangerous disease caused by a virus.
> Normally, MMR vaccinations are given at 1 year old and again at 4 years old.
> Each vaccination is 90% effective in protecting against the measles virus.
>
> In April 2013, there were 630 cases of measles in children aged 4 and over in a small area of the UK. Of these cases, 504 children had not been vaccinated against MMR at all and only a few had been given a second vaccination.

(i) Calculate the percentage of the children who caught measles in April 2013 who had **not** been vaccinated against MMR.

_____

_____

_____

Percentage = _____

(2)

(ii) Suggest **one** advantage to the population as a whole of children having the second MMR vaccination.

_____

_____

(1)

(c) (i) What does a vaccine contain?

_____

_____

_____

_____

(1)

(ii) Explain how a vaccination prevents infection.

(3)

(d) (i) Antibiotics can only be used to treat some infections.

Explain why antibiotics **cannot** be used to treat measles.

(2)

(ii) Why do antibiotics become less useful at treating an infection if the antibiotic is overused?

_____

(1)

(Total 11 marks)

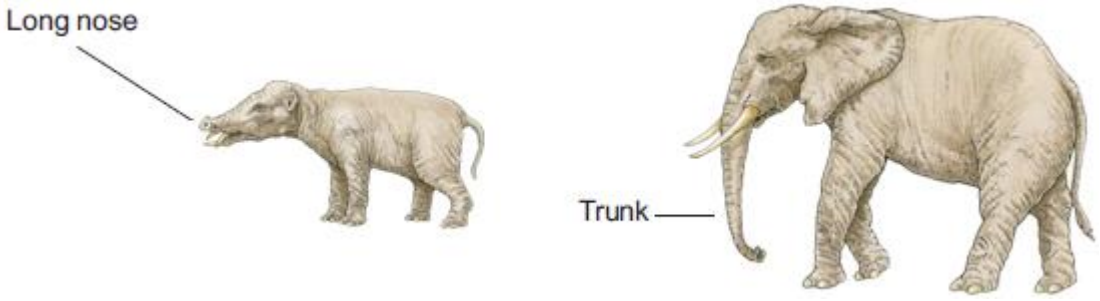
Q22.

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)

Q23.

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

Figure 1

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

(a) How can fossils give evidence for evolution?

Tick (✓) **one** box.

Newer fossils are simpler than older fossils. ☐

Fossils show change over time. ☐

All fossils show the bones of animals. ☐

(1)

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

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

animal died.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

Figure 2

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

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

_____

_____

_____

_____

(1)

(d) Plesiosaurs are now extinct.

Give **two** possible reasons why.

1. _____

2. _____

(2)

(Total 7 marks)

Q24.

(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.

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)

Q25.

Viruses and bacteria cause diseases in humans.

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

Organisms that cause disease are called	algae. pathogens. vaccines.

(1)

(b) In August 2011 the United Nations gave a warning that there was a new strain of the bird flu virus in China.

Bird flu may kill humans. The new strain of the bird flu virus could cause a *pandemic* very quickly.

(i) What is a *pandemic*?

Tick (✓) **one** box.

A disease affecting the people all over one country.	☐
A disease affecting hundreds of people	☐
A disease affecting people in many countries.	☐

(1)

(ii) The swine flu virus is carried by pigs.

The bird flu virus is likely to spread much more quickly than the swine flu virus.

Suggest **one** reason why.

_____

_____

_____

(1)

This notice is from a doctor's surgery.

Unfortunately, antibiotics will NOT get rid of your flu.

(c) (i) Why will antibiotics **not** get rid of flu?

_____

_____

(1)

(ii) The symptoms of flu include a sore throat and aching muscles.

What would a doctor give to a patient to relieve the symptoms of flu?

_____

(1)

(iii) It is important that antibiotics are **not** overused.

Explain why.

Use words from the box to complete the sentence.

antibody	**bacteria**	**immune**	**resistant**	**viruses**

Overuse of antibiotics might speed up the development

of _____ strains of

_____ .

(2)

(Total 7 marks)

Q26.

(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 _____

_____

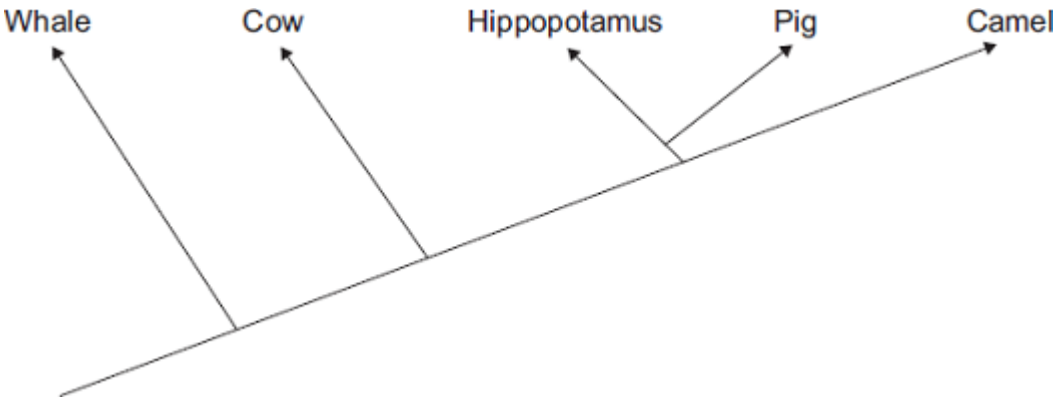
2 _____

_____

(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)

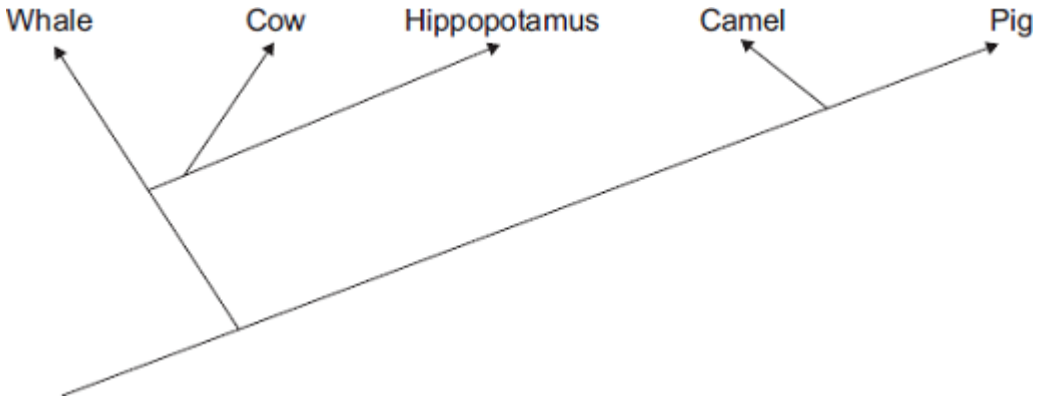
(ii) Which **two** of the animals in **Diagram 1** are most closely related?

_____ 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)

Q27.

Darwin suggested the theory of natural selection.

(a) Explain how natural selection occurs.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Latitude is a measure of distance from the Earth's equator.

Scientists investigated the effect of latitude on:

- the time taken for new species to evolve
- the number of living species.

The table shows the scientists' results.

Latitude in degrees North of equator	Time taken for new species to evolve in millions of years	Relative number of living species

0 (at the equator)	3–4	100
25	2	80
50	1	30
75 (in the Arctic)	0.5	20

As latitude increases environmental conditions become more severe.

(i) Describe the patterns shown by the data.

(2)

(ii) Suggest explanations for the patterns you have described in part (b)(i).

_____

(2)

(Total 7 marks)

Q28.

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

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

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

_____

_____

_____

_____

(1)

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

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

_____

_____

_____

_____

(1)

(b) Dinosaurs are now extinct.

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

1. _____

2. _____

(2)

(c) How can fossils give evidence for evolution?

_____

_____

(1)

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

Why?

_____

_____

(1)

(Total 6 marks)

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.

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.

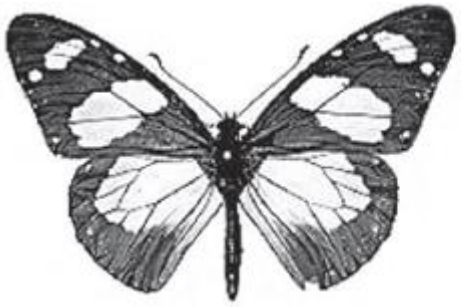
1.

2.

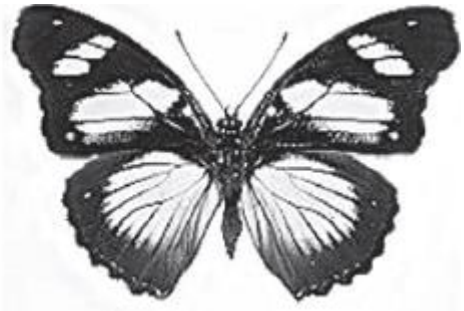
(Total 2 marks)

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*.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

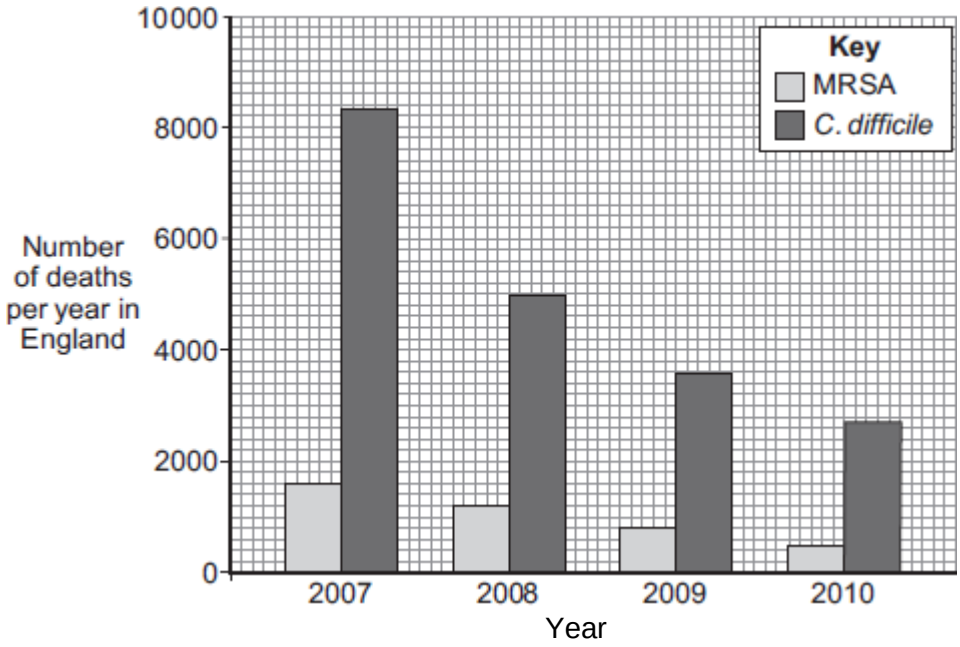
(3)

(Total 5 marks)

Q32.

Infections by antibiotic resistant bacteria cause many deaths.

The bar chart below shows information about the number of deaths per year in England from *Methicillin-resistant Staphylococcus aureus* (MRSA) and from *Clostridium difficile* (*C.difficile*) over 4 years.



(a) (i) Describe the trend for deaths caused by *C. difficile*.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) Suggest a reason for the trend you have described in part **(a)(i)**.

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(iii) Calculate the percentage change in deaths caused by MRSA from 2009 to 2010.

_____

_____

_____

_____

_____

_____

Percentage change in deaths caused by MRSA = _____ %

(2)

(iv) Numbers have not yet been published for 2011.

When the numbers are published, scientists do **not** expect to see such a large percentage change from 2010 to 2011 as the one you have calculated for 2009 to 2010.

Suggest **one** reason why.

_____

_____

_____

_____

(1)

(b) Before 2007 there was a rapid increase in the number of deaths caused by MRSA.

Describe how the overuse of the antibiotic methicillin led to this increase.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 10 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	☐

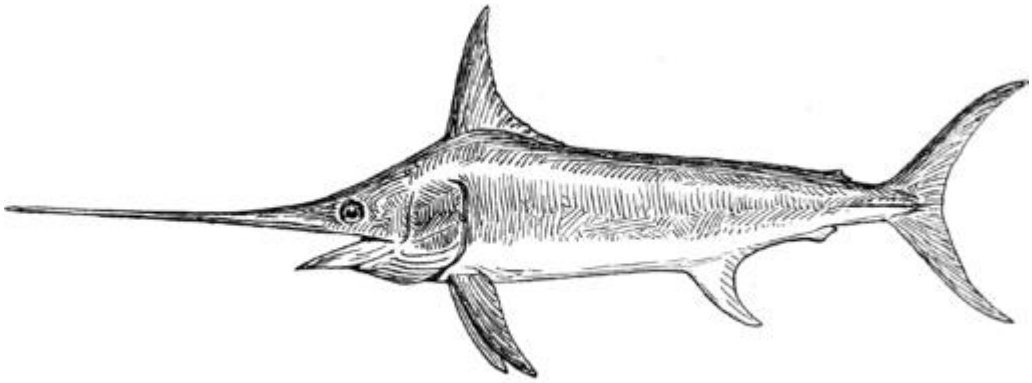
The trees do not use all of the Sun's energy ☐

(2)

(Total 9 marks)

Q34.

The picture shows a modern swordfish.

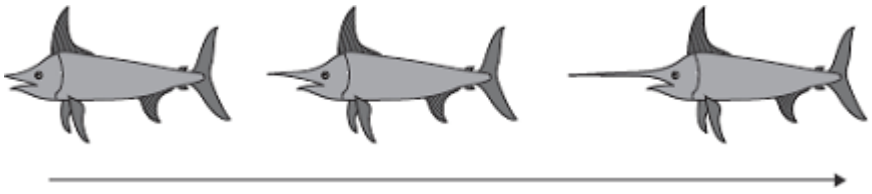


By Pearson Scott Foresman [Public domain], via Wikimedia Commons

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.



(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)

Q35.

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

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

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) How can fossils give evidence for evolution?

_____

_____

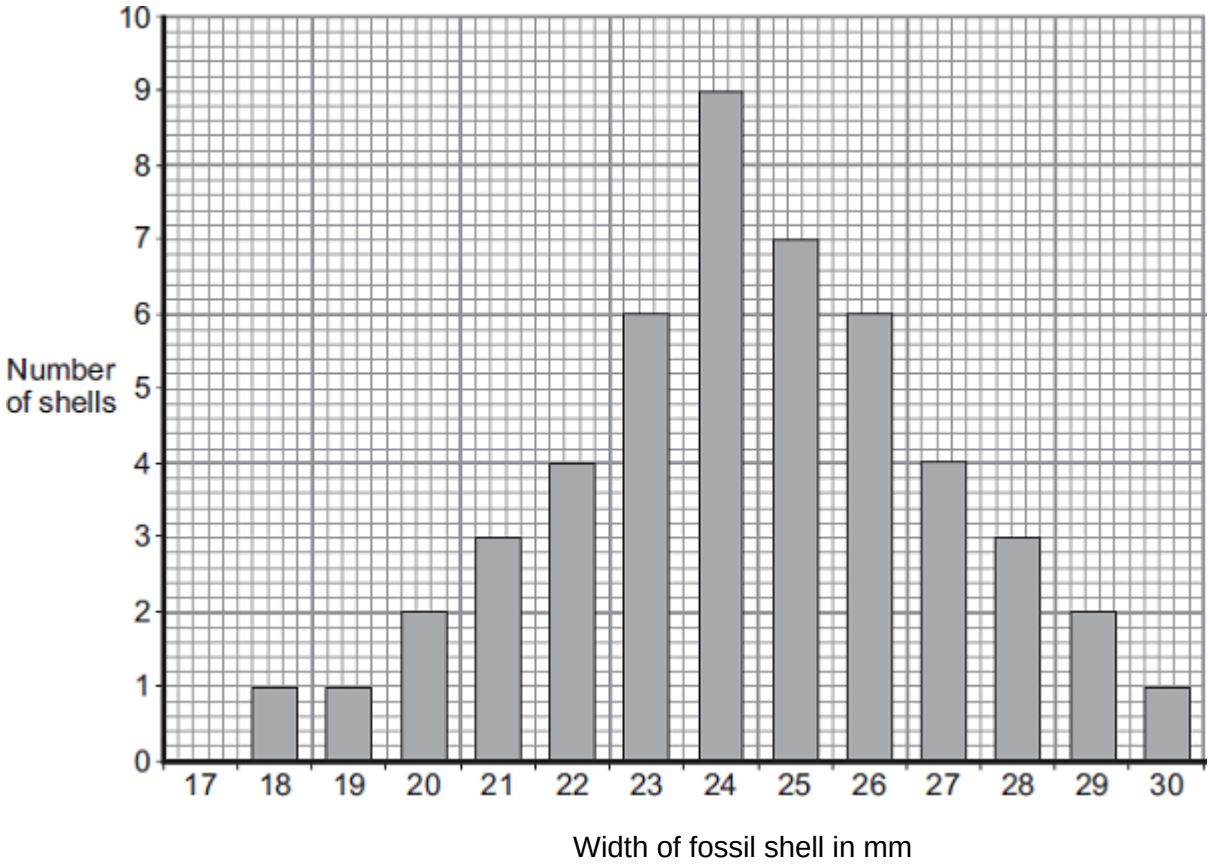
_____

_____

(1)

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

The bar chart shows the scientists' results.



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

From _____ to _____

(1)

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

Why?

_____

_____

_____

_____

(1)

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

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

_____

_____

_____

_____

(1)

(Total 6 marks)

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) Gregor Mendel

1

(b) DNA

1

(c) when the dominant allele is not present

1

(d) tt

allow homozygous recessive

1

(e)

	T	t
T	TT	Tt
t	Tt	tt

*all 3 correct = **2** marks*
*2 correct = **1** mark*
*0 or 1 correct = **0** marks*
allow tT for Tt

2

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

allow circles drawn round both

1

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

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

1

[8]

Q3.

(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]

Q4.

(a) any **one** from:

- animal / plant (dies and) body covered in sediment / mud
- bones / shells / hard parts do not decay
- minerals enter bones / parts are replaced by other materials / mineralisation
- preserved traces / footprints / burrows / rootlet traces / impressions / casts

allow covered in tar / ice

1

(b) (diameter **P** =) 60
and
(diameter **Q** =) 75

allow ***±*** *1 mm*

1

(c) 150

allow ecf from (b)

1

(d) 2.5

1

(e) any **two** from:

- **Q** has fewer spirals
- **Q** has more (radial) ridges

  allow stripes / etc
- **Q**'s ridges are more pronounced
- **Q** has more elongated shape

  accept ***Q*** *is less circular / round*

  allow other correct descriptions

2

(f) **Q** was found in newer rocks than **P**

1

(g) 100 million years

1

(h) any **three** from:

- flooding
- drought
- ice age

ignore pollution

*if none of these points given allow climate change / global warming / weather change / environmental change for **1** mark*

- volcanic activity
- asteroid collision

ignore pollution

*if none of these points given allow natural disaster / catastrophic event for **1** mark*

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

lack of habitat
or
habitat change

3

(i) lack of evidence
or
cannot perform experiment to find out

*do **not** accept no evidence*

allow no proof

allow no one was there to observe

1

[12]

Q5.

(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)

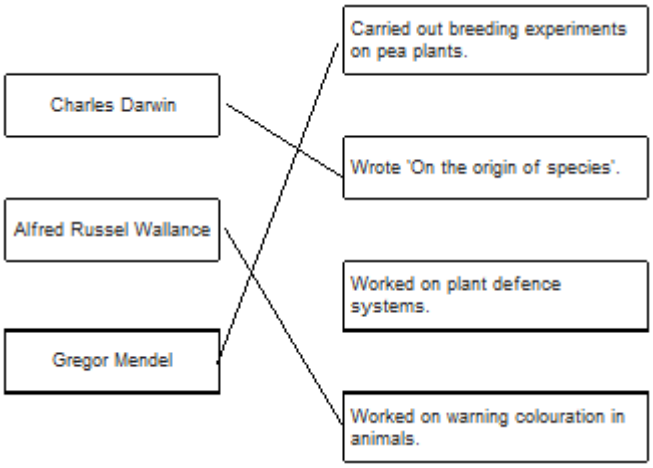
allow gene(s)

1

[14]

Q6.

(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]

Q7.

(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]

Q8.

(a) three billion

1

(b) mutation(s)

1

breed / reproduce

in this order only

allow pass on their genes

1

[3]

Q9.

(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]

Q10.

(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]

Q11.

(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]

Q12.

(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]

Q13.

(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]

Q14.

(a) microorganism / bacteria / virus / fungus that causes (infectious) disease

1

(b) reduce / stop use of (current) antibiotics

1

(reduce / stop use) for non-serious / mild / viral infections

allow ensure course is completed

allow use of variety of antibiotics

1

(c) (i) 40 °C

1

(ii) any **one** from:

- microorganisms grow / reproduce / work / act faster
- results / product acquired sooner

1

[5]

Q15.

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

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

allow engulfed / covered by amber

- prevented decay.

2

(ii) any **two** from:

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

ignore ref to rock

allow covered in tar / ice

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

2

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

1

(ii) any **three** from:

examples of physical factors, e.g.

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

- flooding
- drought
- ice age / temperature change.

ignore pollution

examples of biological factors, e.g.
- (new) predators (allow hunters)
- (new) disease / named pathogen
- competition for food
- competition for mates

competition must be qualified
- cyclical nature of speciation
- isolation
- lack of habitat or habitat change.

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

3

[8]

Q16.

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

- (dead) animal buried in sediment

  allow imprint in mud
- hard parts / bones do not decay **or** soft parts do decay

  allow (one of) the conditions for decay is missing − accept example, eg oxygen / water / correct temperature / bacteria
- mineralisation (of hard parts / bones)

  allow replacement by other materials

2

(ii) any **two** from:

- conditions not right for fossilisation

  ignore references to soft-bodied
- geological activity has destroyed fossils / has destroyed evidence

  allow a named / described example − eg vulcanism / earth movements / erosion
- fossils not yet found

  allow description of why not yet found

2

(b) any **four** from:

- separation / isolation (of different populations)
- different environmental conditions (between locations)
- mutation(s) occur **or** genetic variation (within each population)
- better adapted survive **or** natural selection occurs

  allow 'survival of the fittest'

  ignore animals adapt to their environment

ignore reference to stronger survive

- favourable alleles passed on (in each population)

  allow genes for alleles
- eventually different populations unable to breed successfully with each other

  allow unable to produce fertile offspring

4

[8]

Q17.

(a) (i) 3.15 : 1

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

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

Ignore 705:224

1

(ii) any **two** from:

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

  allow ref. to more representative / reliable

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

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

  accept example of an anomaly

2

(b) (i) in sequence:

Homozygous
Homozygous
Heterozygous

All 3 correct = 2 marks

2 correct = 1 mark

1 or 0 correct = 0 marks

2

(ii) genetic diagram including:

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

allow other characters / symbols only if clearly defined

1

or

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

allow genotypes correctly derived from candidate's P gametes

1

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

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

1

(c) any **two** from:

- did not know about chromosomes / genes / DNA
  or did not know chromosomes occurred in pairs

  ignore genetics
- had pre-conceived theories

  eg blending of inherited characters

  ignore religious ideas unless qualified
- Mendel's (mathematical) approach was novel concept

  allow his work was not understood or no other scientist had similar ideas
- Mendel was not part of academic establishment

  allow he was not considered to be a scientist / not well known / he was only a monk
- work published in obscure journal / work lost for many years
- peas gave unusual results cf other species

  allow he only worked on pea plants
- Mendel's results were not corroborated until later / 1900

2

[10]

Q18.

(a) any **three** from:

- parts of organisms have not decayed

  accept in amber / resin

  allow bones are preserved
- conditions needed for decay are absent

  accept appropriate examples, eg acidic in bogs / lack of oxygen
- parts of the organism are replaced by other materials as they decay

  accept mineralised
- or other preserved traces of organisms, eg footprints, burrows and rootlet traces

  allow imprint or marking of organism

3

(b) (i) teeth for biting (prey)

must give structure + explanation

1

claws to grip (prey)

accept sensible uses

1

wing / tail for flight to find (prey)

1

(ii) any **two** from:

- new predators
- new diseases
- better competitors
- catastrophe eg volcanic eruption, meteor
- changes to environment over geological time

  accept climate change

  allow change in weather
- prey dies out **or** lack of food

  allow hunted to extinction

2

[8]

Q19.

(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]

Q20.

(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]

Q21.

(a) mumps

in either order rubella / German measles

both needed for the mark

ignore measles unqualified

1

(b) (i) 80(.0)

*allow **1** mark for* $\frac{504}{630}$ ***or** 0.8*

2

(ii) less chance of epidemic / pandemic

or

less chance of spread of disease / measles / mumps / rubella

allow idea of herd immunity (increased protection for those who are not vaccinated)

*ignore less chance of getting the disease **or** to eradicate the disease*

1

(c) (i) dead / inactive pathogens / viruses / bacteria

allow antigens / proteins from pathogens / viruses / bacteria

ignore microorganisms

1

(ii) white blood cells produce antibodies

1

antibodies produced rapidly (on re-infection) **or** response rapid (on re-infection)

allow ecf if antibodies incorrectly identified in first marking point

1

these antibodies kill pathogens / viruses / bacteria

*do **not** accept idea that original antibodies remain in blood and kill pathogens*

1

(d) (i) antibiotics don't kill viruses

allow antibiotics only kill bacteria

1

(because measles) virus / pathogen lives inside cells

*allow antibiotics do not work inside cells **or** killing virus / pathogen would kill / damage cell*

1

(ii) (bacteria / pathogens) develop resistance (to antibiotic)

ignore reference to immunity

ignore viruses develop resistance

1

[11]

Q22.

(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]

Q23.

(a) fossils show change over time.

1

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

1

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

1

minerals enter bones / parts are replaced by minerals / mineralisation

accept turns to rock

allow 'is an impression' / 'imprint' / 'cast'

1

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

accept not enough / no evidence / no-one has seen one

allow 'this fossil is only bones'

1

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

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

physical factors such as volcanic activity (allow volcanoes) / earthquakes / asteroid (collision) / ice age / temperature change

ignore pollution

and / or

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

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

2

[7]

Q24.

(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]

Q25.

(a) pathogens

1

(b) (i) A disease affecting people in many countries

1

(ii) birds fly / migrate

accept converse

OR

human contact with birds more likely

birds not contained / difficult to control movement

OR

there are more birds (than pigs)

1

(c) (i) antibiotics (only) kill bacteria

ignore flu is caused by a virus unqualified

OR

antibiotics don't kill viruses

ignore virus resistant / immune

1

(ii) painkillers

accept any correct named painkiller, eg aspirin or paracetamol

allow antivirals / Tamiflu

ignore medicine / tablets

1

(iii) resistant

1

bacteria

1

in this order

[7]

Q26.

(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]

Q27.

(a) variation (between organisms within species)
allow described example
*allow mutation – but **not** if caused by change in conditions*

1

those most suited / fittest survive

1

genes / alleles passed on (to offspring / next generation)
allow mutation passed on

1

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

- increase in latitude reduces number of (living) species

ignore references to severity of conditions

- increase in latitude reduces time for evolution (of new species)
- the less the time to evolve the fewer the number of (living) species

2

(ii) any **two** from:

*do **not** accept intention or need to evolve*

- (increase in latitude reduces number of (living) species because) less food / habitats / more competition <u>at high latitude</u>
  allow only extremophiles / well-adapted species can survive
- (increase in latitude reduces time for evolution (of new species) because) severe conditions act more quickly / to a greater extent on the weakest
- (the less the time to evolve the fewer the number of (living) species because) species that evolve slowly don't survive

2

[7]

Q28.

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

or

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

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

1

(ii) any **one** from:

- (from) bones / shells / hard parts **or** from parts that do not decay / rot or are preserved
  ignore imprint / impression
- animal trapped in resin / amber / ice / peat
  allow frozen
- infiltration with minerals / named

1

(b) any **two** from:

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

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

ignore pollution

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

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

2

(c) older fossils simpler

to gain the mark there must be implication of change

or

change (with time)

ignore evolve
ignore extinction

1

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

ignore no people were there
allow no proof

1

[6]

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 <u>different</u> alleles passed on in the two groups

1

eventually resulting in interbreeding no longer possible

1

[7]

Q30.

any **two** from:

- religious objections
- insufficient evidence

  allow 'could not prove'
  *ignore '**no** evidence'*
- mechanism of heredity not known

[2]

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) (i) decrease

1

rate of decrease slows

1

(ii) any **one** from:

- <u>more</u> use of disinfectant

  allow any reasonable increase in hygiene or sterilisation precautions
- <u>more</u> use of hand washing

- more careful / more often cleaning of patient facilities
- raised awareness / education about hygiene

1

Explanation:
stops / reduces the bacteria being transferred / spreading

1

(iii) 800 – 500 / 800 × 100 =

1

37.5 (%)

*correct answer with or without working gains **2** marks*

1

(iv) any **one** from:

- numbers quite low now so hard to reduce further
- was a big campaign / much publicity (in 2009) so more people already doing it
- hygiene / cleaning now good so hard to improve
- hospitals short of money so less staff to clean

1

(b) mutation occurred giving resistance (to methicillin)

*do **not** accept overuse caused mutation*

1

resistant bacteria not able to be treated / not killed

1

these bacteria multiplied / reproduced / spread quickly

1

[10]

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) 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]

Q35.

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

1

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

or

from a long time ago / many years ago

if number, > 1000 years

ignore hundreds

1

(ii) older fossils are simple(r)

must make ref to change and time

allow deeper fossils are simple(r)

or

fossils show change / adaptation with time

1

(b) (i) 18 to 30

allow 30 to 18

allow 12

ignore units

1

(ii) small sample

allow only 49 shells / not representative / not enough evidence

allow not all fossils found

1

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

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

or

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

ignore human factors eg hunting / pollution

1

[6]

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

One chromosome

Species B

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.

_____

_____

_____

_____

_____

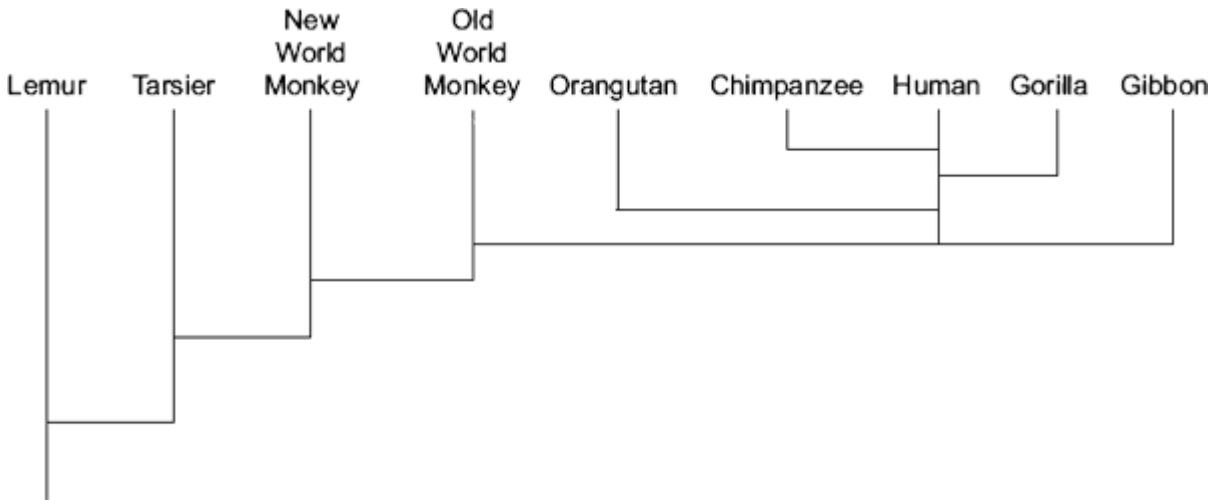
_____

(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 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)

Q4.

An animal called *Tiktaalik* became extinct about 360 million years ago.

The photograph shows the fossilised skeleton of *Tiktaalik* and a model of what scientists think *Tiktaalik* looked like.

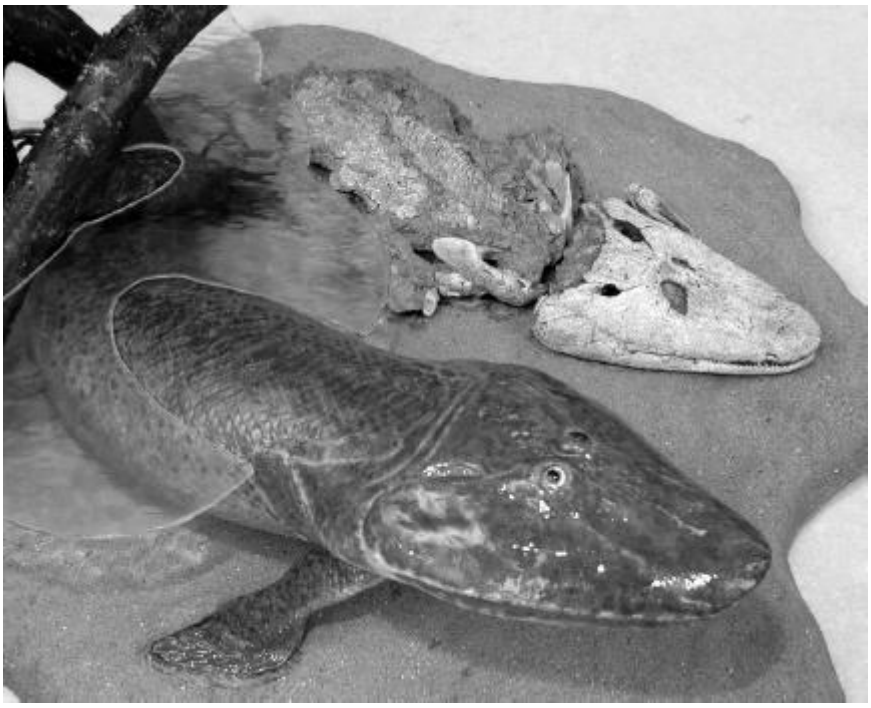


Image © University of Chicago, Shubin Lab. Model by Tyler Keillor

(a) Scientists found only the fossilised skeleton of *Tiktaalik*.

Explain why.

_____

_____

_____

_____

(2)

(b) Scientists think that *Tiktaalik* lived mostly in water, but that it was one of the first animals to be able to move onto land.

Use evidence from the photograph to suggest why.

_____

_____

_____

_____

(2)

(Total 4 marks)

Q5.

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

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

The picture shows the mammoth.

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

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

_____

_____

_____

_____

(2)

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

What scientists think a mammoth looked like

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

Modern elephant

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

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

_____

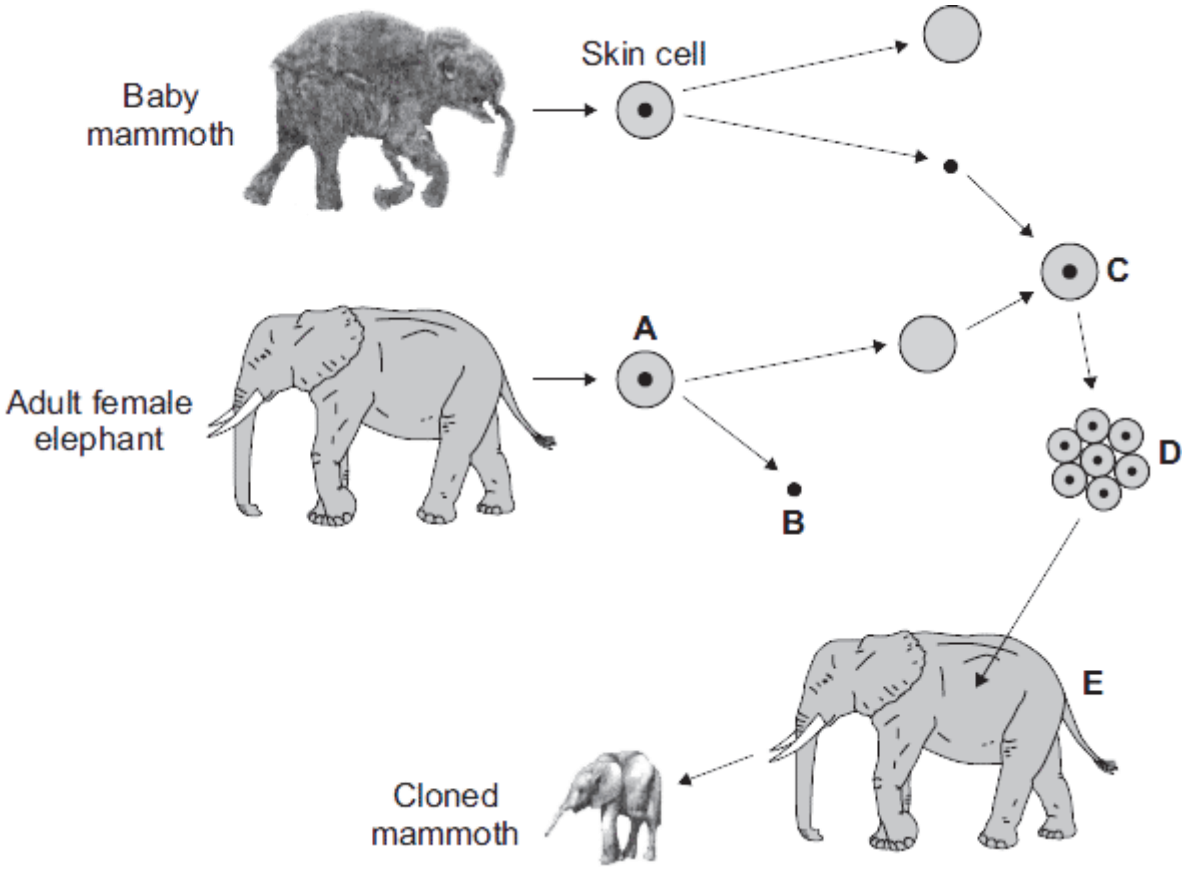
_____

(1)

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

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

The diagrams show how the skin cell will be used.



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

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

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

(1)

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

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

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

(1)

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

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

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)

Q6.

People may be immunised against diseases using vaccines.

(a) (i) Which part of the vaccine stimulates the body's defence system?

_____

_____

_____

_____

(2)

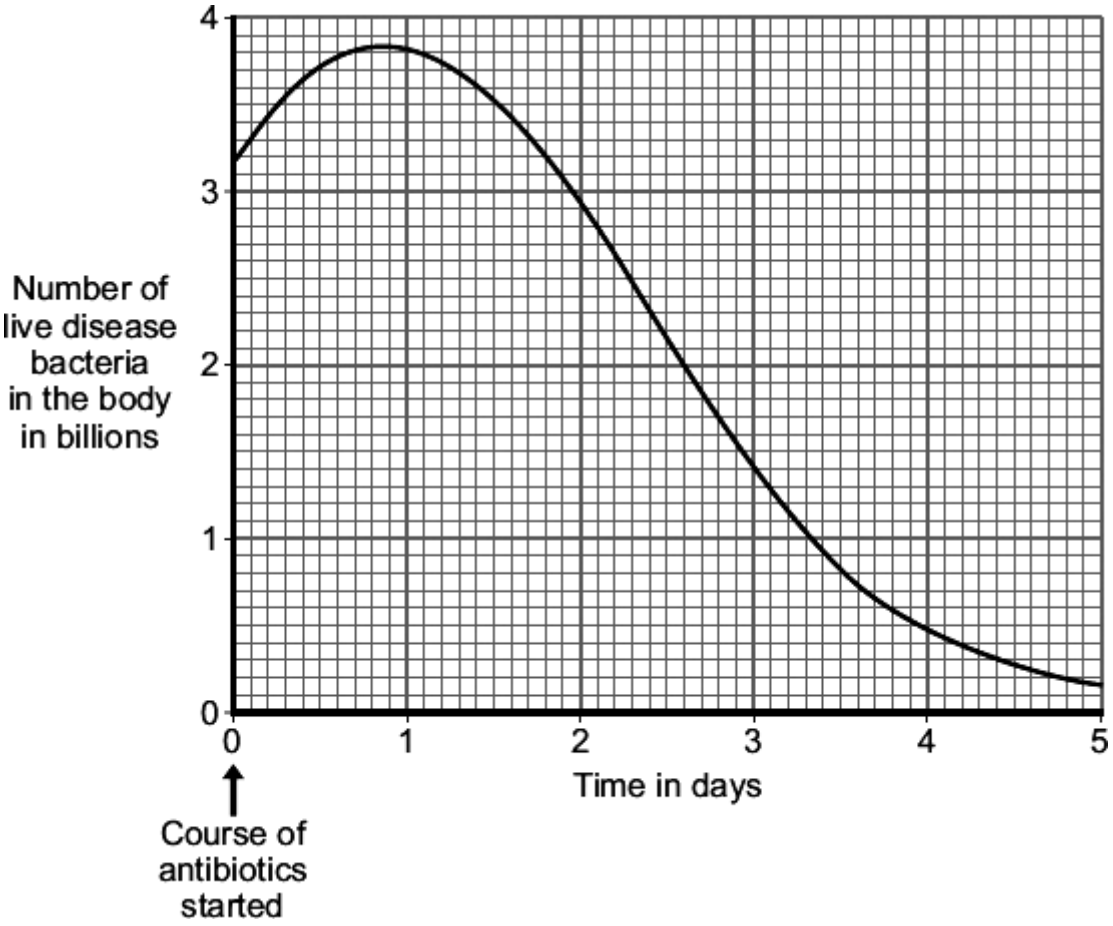
(ii) A person has been vaccinated against measles. The person comes in contact with the measles pathogen. The person does **not** catch measles.

Explain why.

(3)

(b) A man catches a disease. The man has **not** been immunised against this disease. A doctor gives the man a course of antibiotics.

The graph shows how the number of live disease bacteria in the body changes when the man is taking the antibiotics.



(i) Four days after starting the course of antibiotics the man feels well again. It is important that the man does **not** stop taking the antibiotics.

Explain why.

Use information from the graph.

_____

_____

_____

_____

(2)

(ii) Occasionally a new, resistant strain of a pathogen appears.

The new strain may spread rapidly.

Explain why.

_____

_____

_____

_____

_____

_____

(3)

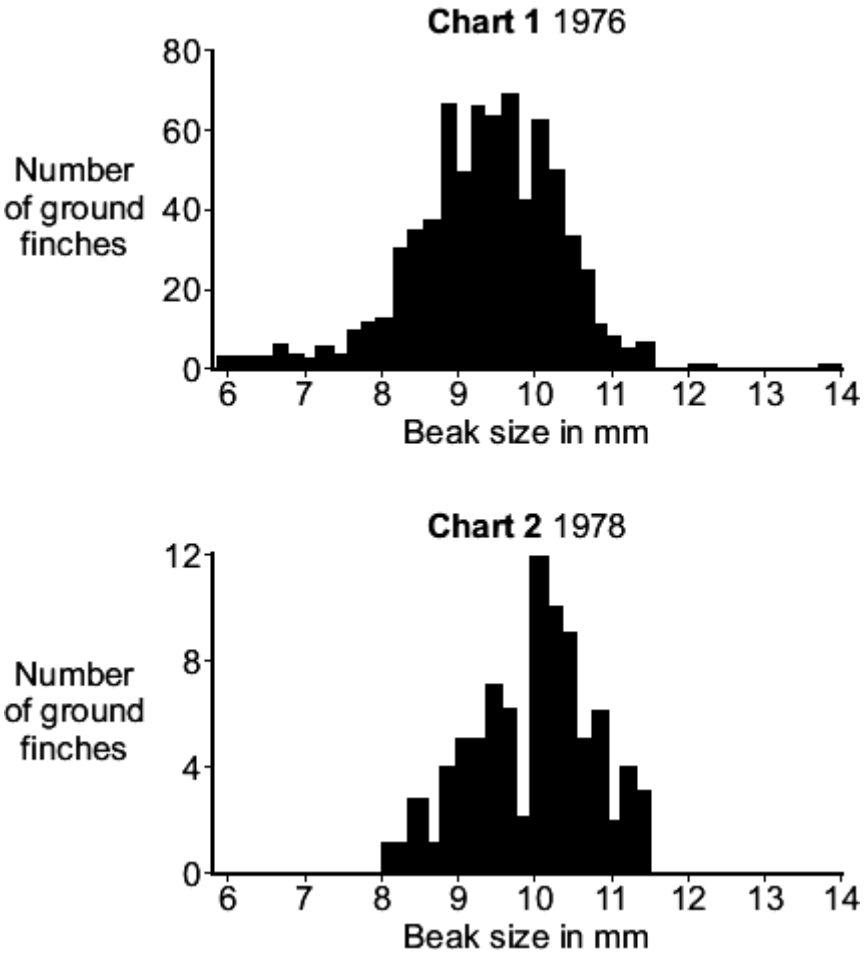
(Total 10 marks)

Q7.

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

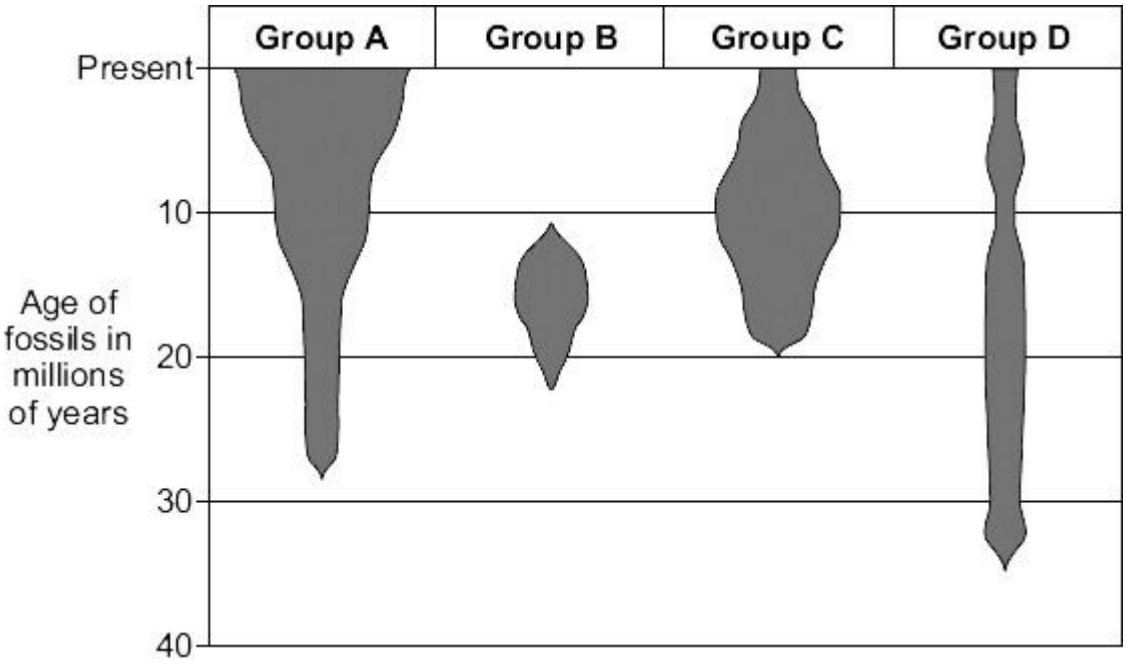
Suggest an explanation for the changes in beak sizes between 1976 and 1978.

(4)

(Total 7 marks)

Q8.

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



(a) What is a fossil?

_____

_____

_____

_____

(2)

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

(1)

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

(1)

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

_____

_____

(1)

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

What is the evidence for this in the diagram?

_____

_____

(1)

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

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

Tick (✓) **one** box.

Statement	Tick (✓)
All the groups lived in the same area.	
Fossils from each group were found in the same rock layer.	
Members of the groups have similar physical structures.	

(1)

(Total 7 marks)

Q9.

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

_____

_____

_____

_____

_____

_____

(3)

(b) The photographs show two species of gull.

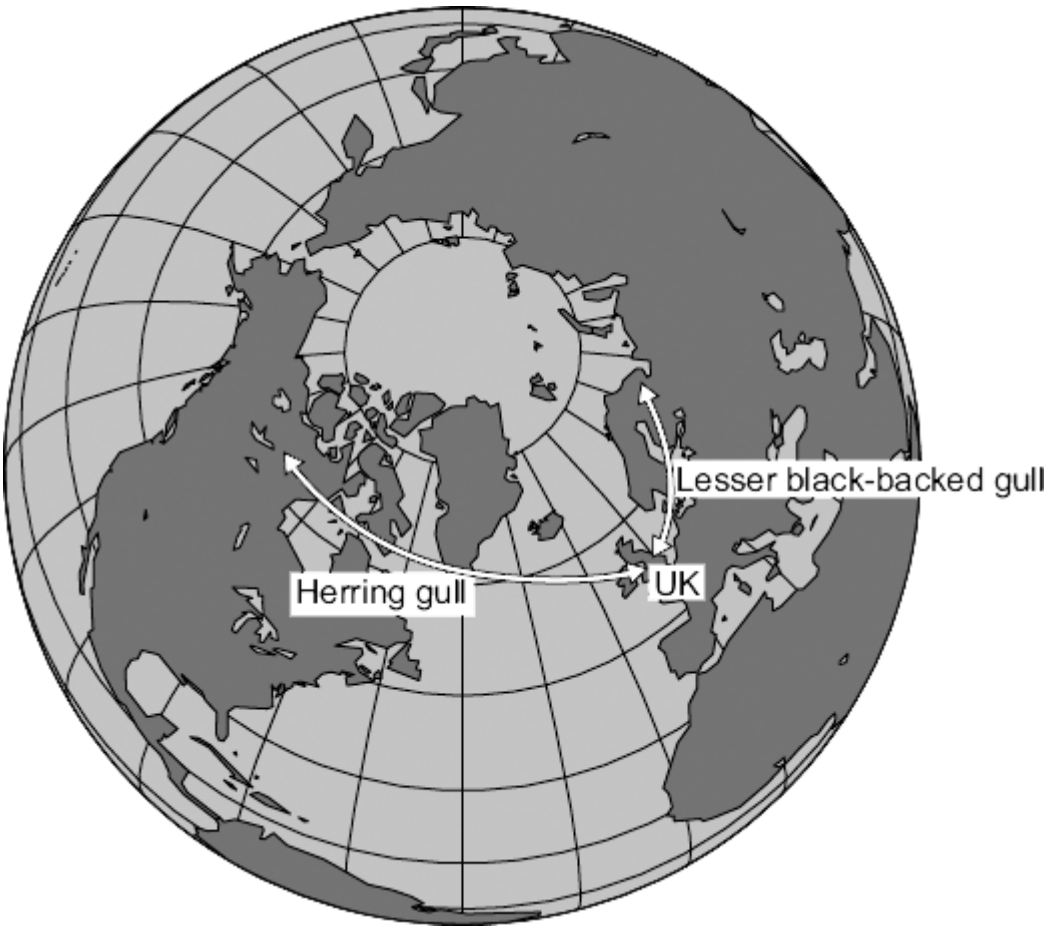
Herring gull (*Larus argentatus*) **Lesser black-backed gull (*Larus fuscus*)**

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.

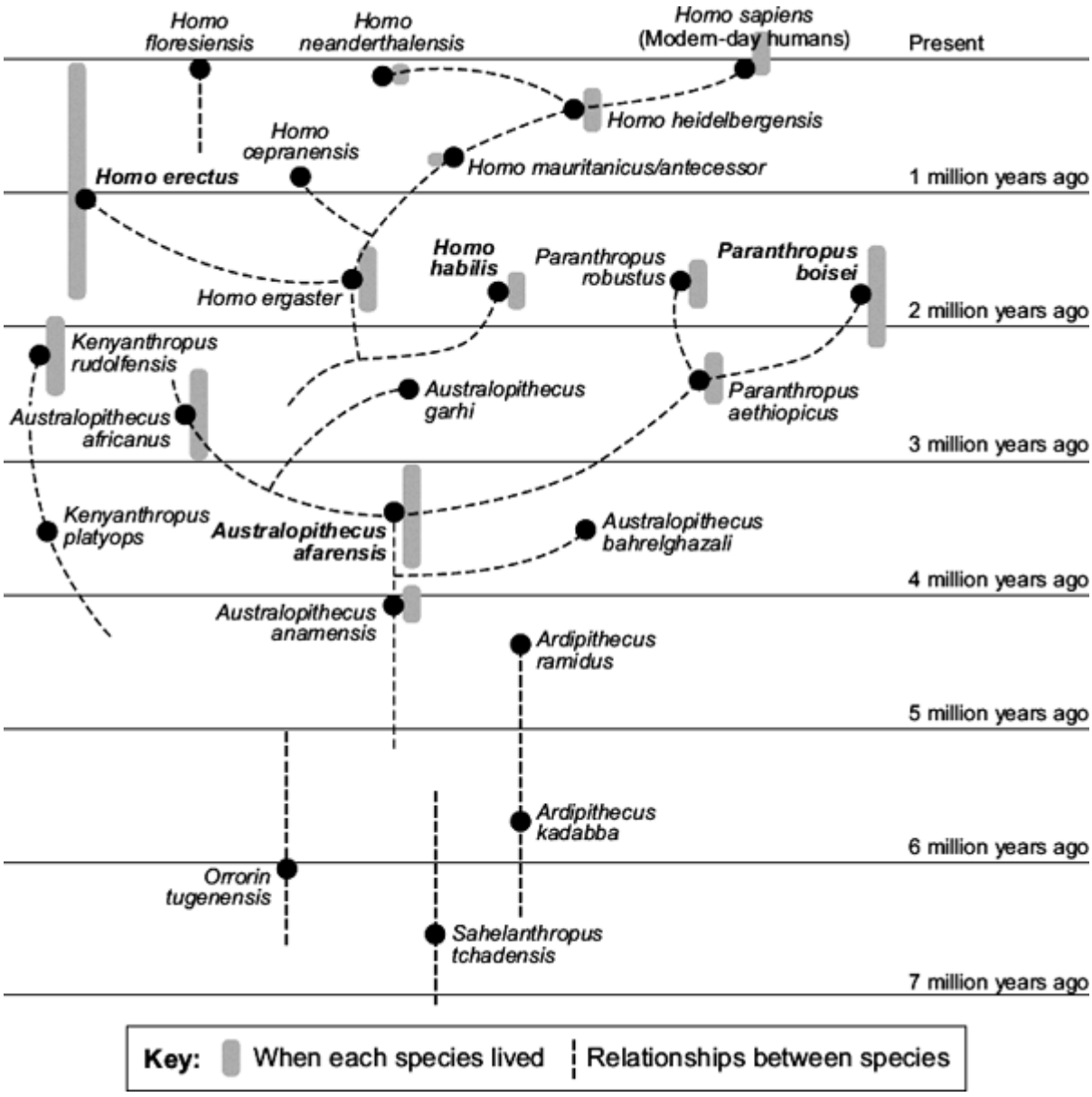
(6)

(Total 9 marks)

Q10.

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)

Q11.

Many strains of bacteria have developed resistance to antibiotics.

The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008.

Show clearly how you work out your answer.

_____

_____

Percentage increase = _____

(2)

(b) Explain, in terms of natural selection, why the number of people infected with the resistant strain of the bacterium is increasing.

_____

_____

_____

_____

_____

_____

_____

_____

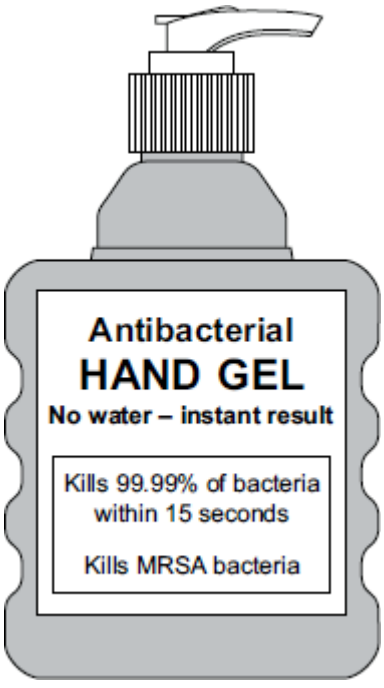
(3)

(Total 5 marks)

Q12.

MRSA strains of bacteria are causing problems in many hospitals.

(a) The diagram shows a hand-gel dispenser.



Hand-gel dispensers are now placed at the entrance of most hospital wards.

Explain why.

(2)

(b) Explain, as fully as you can, how MRSA strains of bacteria became difficult to treat.

(3)

(Total 5 marks)

Q13.

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.

_____

_____

_____

_____

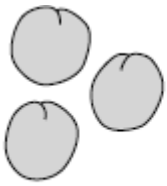
_____

_____

(Total 4 marks)

Q14.

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



Round pea seeds

Wrinkled pea seeds

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

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

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

Which alleles did the seeds from the cross have?

_____

(1)

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

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

Explain why Mendel's crosses gave him these results.

In your answer you should use:

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

(3)

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

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

Suggest why.

_____

_____

(1)

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

Give **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q15.

Charles Darwin proposed the theory of natural selection.

(a) What is meant by natural selection?

_____

_____

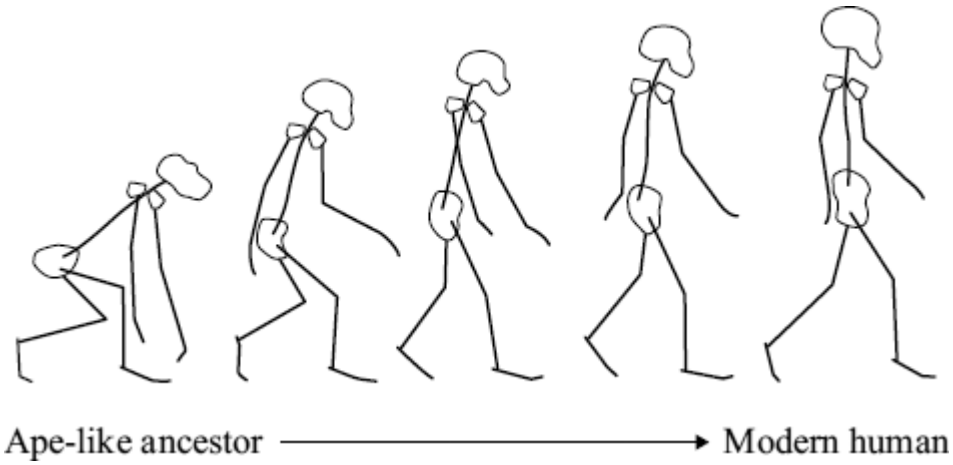
_____

_____

(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)

Q16.

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)

Q17.

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)

Q18.

Animals have adaptations that enable them to survive.

(a) The photograph shows an echidna.

The echidna has pointed spines on its back.

Explain how these spines might help the echidna to survive.

(2)

(b) The photograph shows a caterpillar.

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

_____

_____

_____

_____

_____

(2)

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

(i) Evolution can be explained by a theory called

genetic engineering
mutation
natural selection

.

(1)

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

Darwin
Lamarck
Semmelweiss

.

(1)

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

monkeys
dinosaurs
simple life forms

.

(1)

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

Give **one** reason why.

_____

_____

(1)

(Total 8 marks)

Q19.

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)

Q20.

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)

Q21.

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.

_____

_____

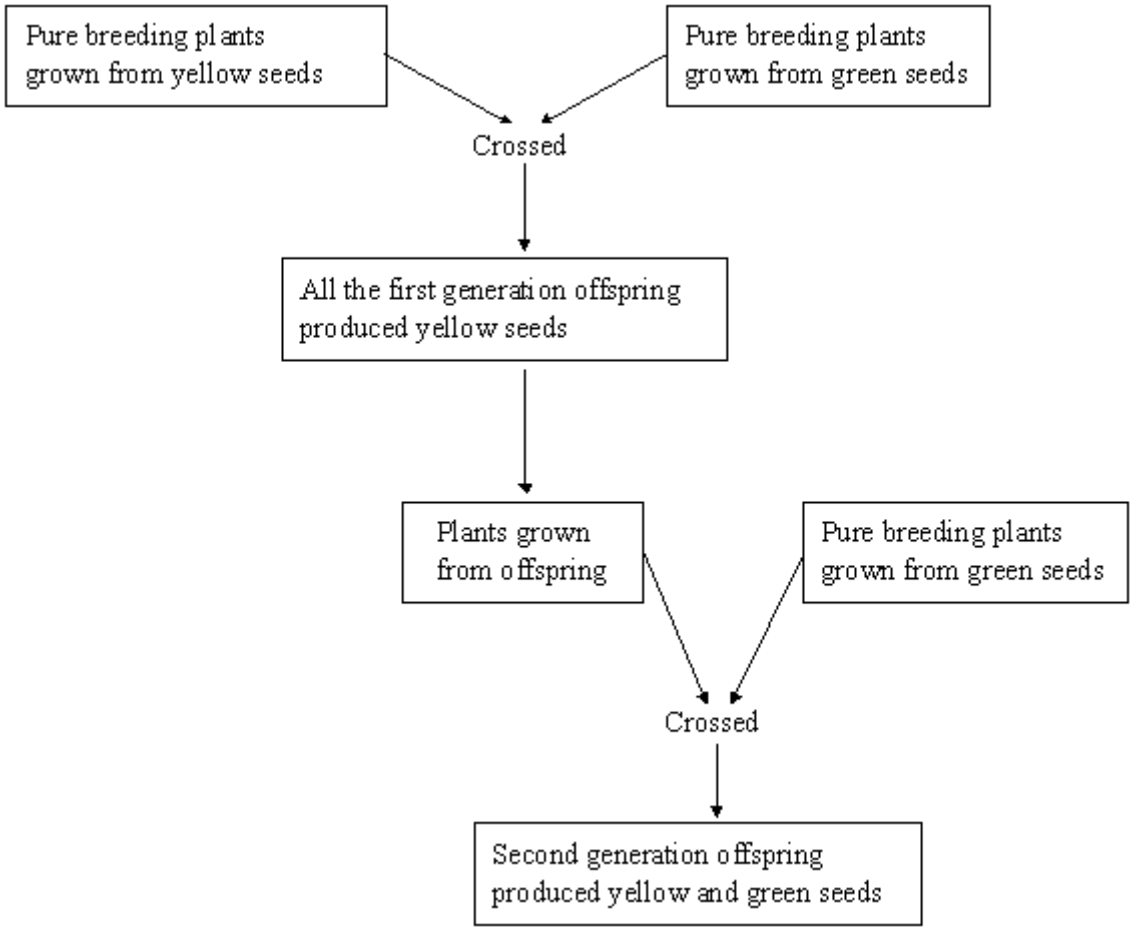
_____

_____

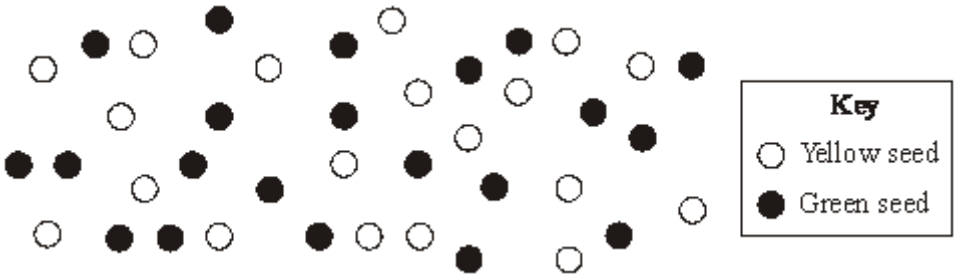
(2)

(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)

Q22.

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.

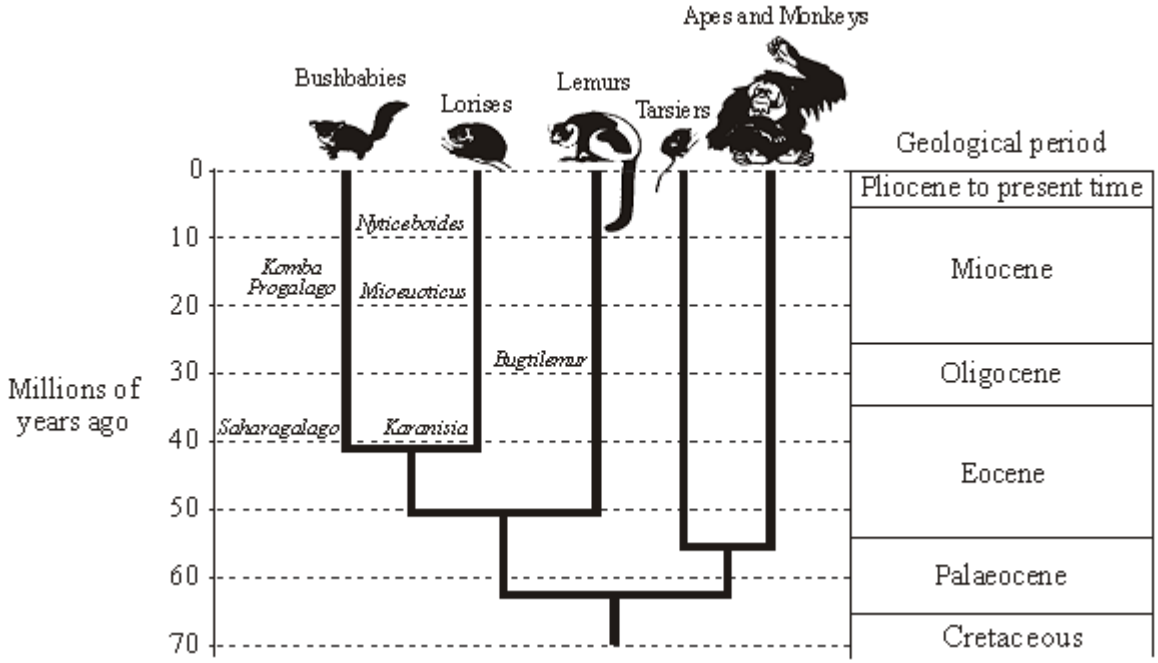


Illustration by Lucrezia Beerli-Bieler

(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)

Q23.

Pathogenic bacteria and viruses may make us feel ill if they enter our bodies.

(a) Why do bacteria and viruses make us feel ill?

Bacteria _____

_____

Viruses _____

_____

(2)

(b) Most drugs that kill bacteria cannot be used to treat viral infections.

Explain why.

_____

_____

_____

_____

_____

_____

(2)

(c) Antibiotic-resistant strains of bacteria are causing problems in most hospitals.

Explain, as fully as you can, why there has been a large increase in the number of antibiotic-resistant strains of bacteria.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q24.

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*.

_____

_____

_____

_____

_____

_____

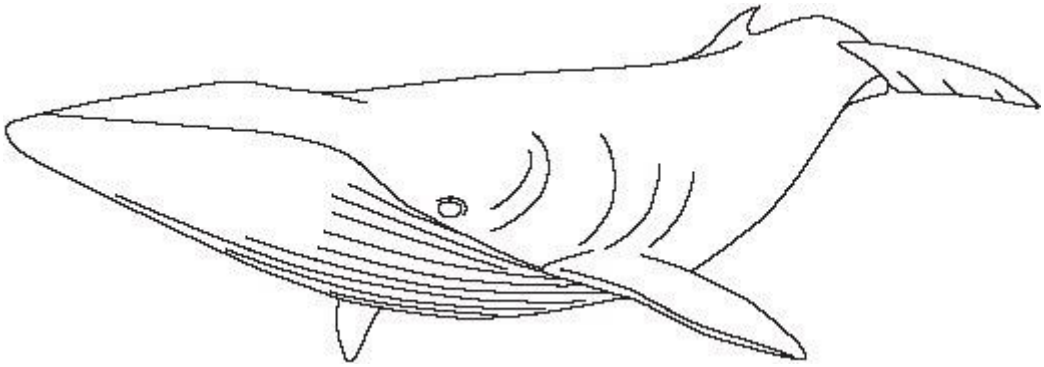
_____

(Total 4 marks)

Q25.

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

Figure 1



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

1. _____

_____

2. _____

_____

(2)

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

Figure 2

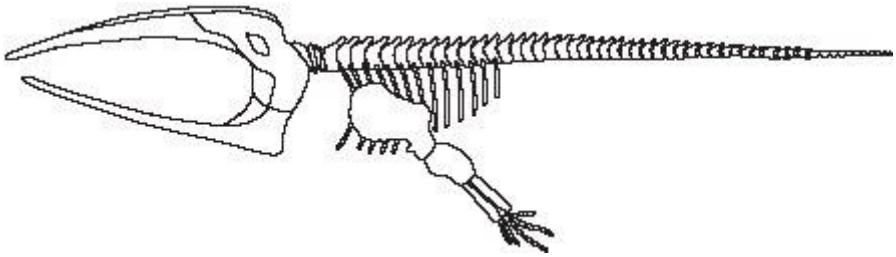
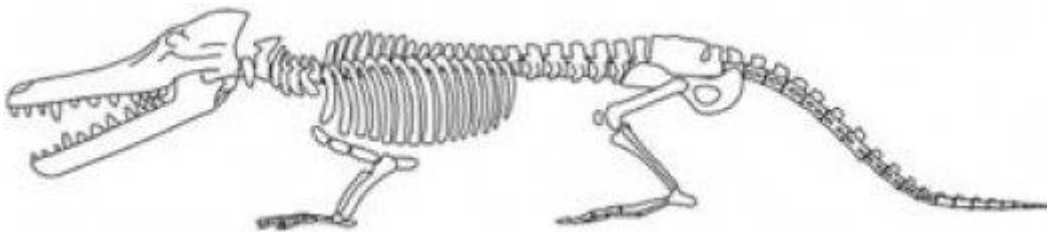


Figure 3 shows the fossil skeleton of an extinct whale.

Figure 3



Hans G Thewissen/ The Thewissen Lab

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

1. _____

_____

2. _____

_____

(2)

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

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

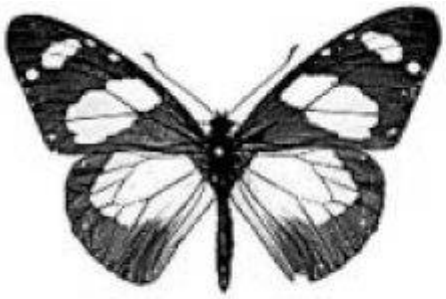
Fossils | disprove / give evidence for / prove | the theory of evolution.

(2)

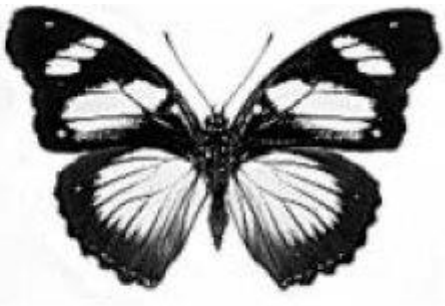
(Total 6 marks)

Q26.

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*.

_____

_____

_____

_____

_____

_____

_____

_____

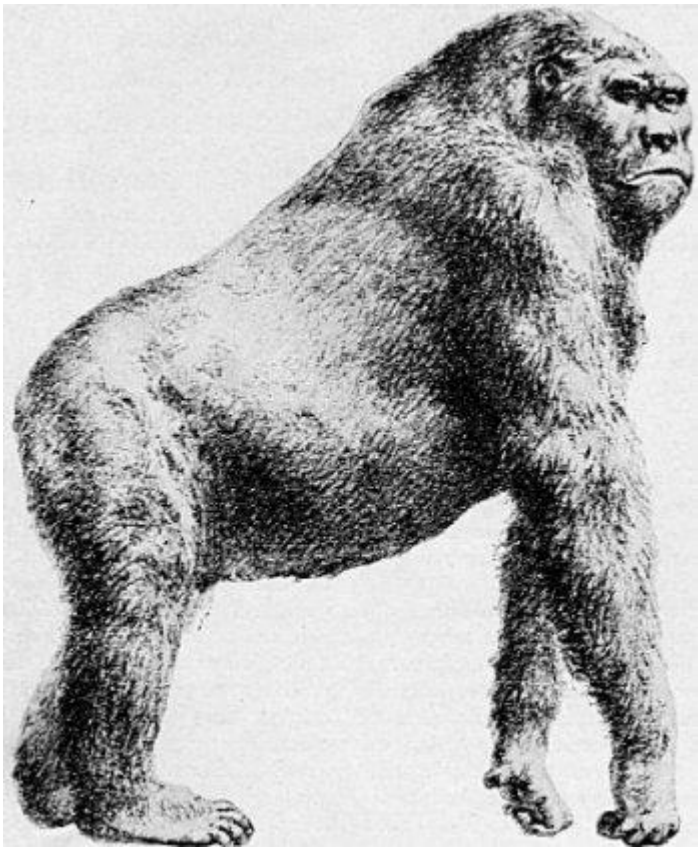
(3)

(Total 5 marks)

Q27.

Read the article from a recent newspaper.

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



Gigantopithecus blackii, R F Zallinger

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

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

_____

_____

(1)

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

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

_____

_____

(1)

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

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

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q28.

(a) (i) Some diseases can be tackled by using antibiotics and vaccination. Explain fully why antibiotics cannot be used to cure viral diseases.

_____

_____

_____

_____

(2)

(ii) A recent study found that babies in 90 % of hospitals are infected with the MRSA bacterium.

Explain how the MRSA bacterium has developed resistance to antibiotics.

_____

_____

_____

_____

(2)

(b) A person can be immunised against a disease by injecting them with an inactive form of a pathogen.

Explain how this makes the person immune to the disease.

_____

_____

_____

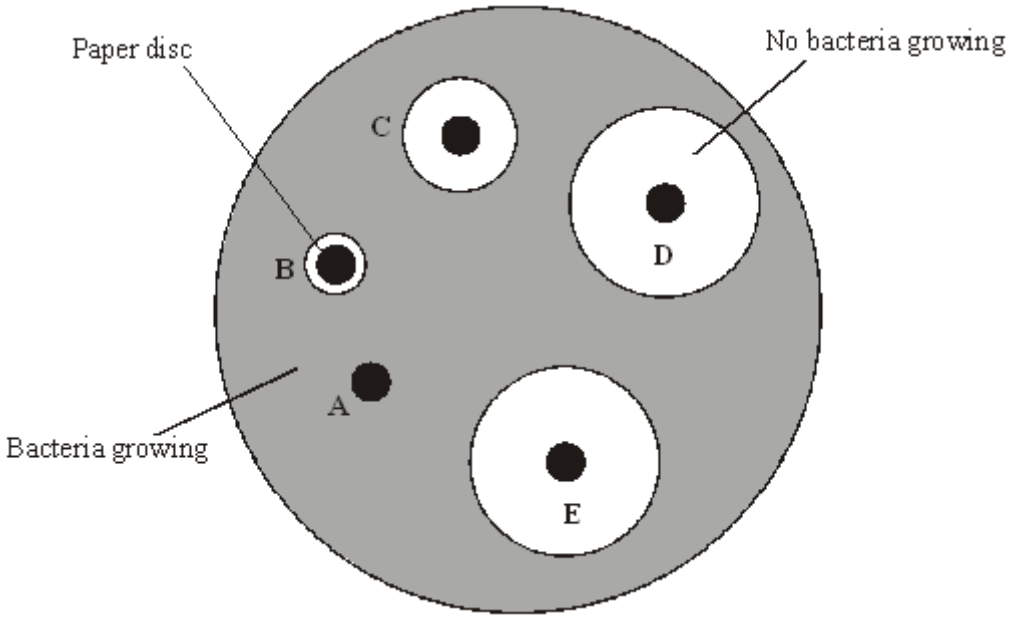
(3)

(Total 7 marks)

Q29.

An investigator placed paper discs containing different concentrations of an antibiotic onto a culture of bacteria in a petri dish.

After an incubation period of two days, the dish looked like this.



(a) Explain why there are areas around some of the paper discs where no bacteria are growing.

(2)

(b) The concentration of the antibiotic on the paper discs is given in the table, along with the diameter of the circles where no bacteria are growing.

Disc	Concentration of the antibiotic in units	Diameter of circle where no bacteria are growing, in mm
A	0	0

B	2	8
C	4	14
D	6	26
E	10	26

What effect does an increase in the concentration of the antibiotic have on the growth of the bacteria?

(2)

(c) When students carry out this experiment, they need to take several safety precautions.

The precautions include:

- passing inoculating loops through a flame
- sealing the lid of the petri dish with tape
- incubating at a maximum temperature of 25 °C.

Explain why each of these precautions is necessary.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific word.

(5)

(d) Scientists are concerned that many bacteria are developing resistance to antibiotics.

Suggest **two** ways by which this problem could be limited.

_____

_____

_____

_____

(2)

(Total 11 marks)

Q30.

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)

Q31.

Doctors give antibiotics to patients to kill bacteria in their bodies.

Explain how the overuse of antibiotics has led to the evolution of antibiotic-resistant bacteria.

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

_____

_____

_____

_____

_____

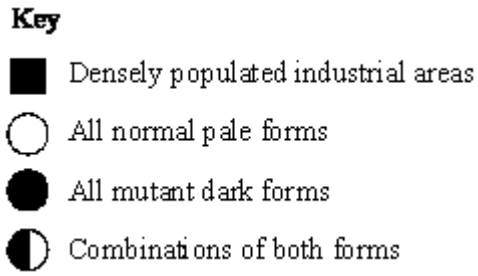
_____

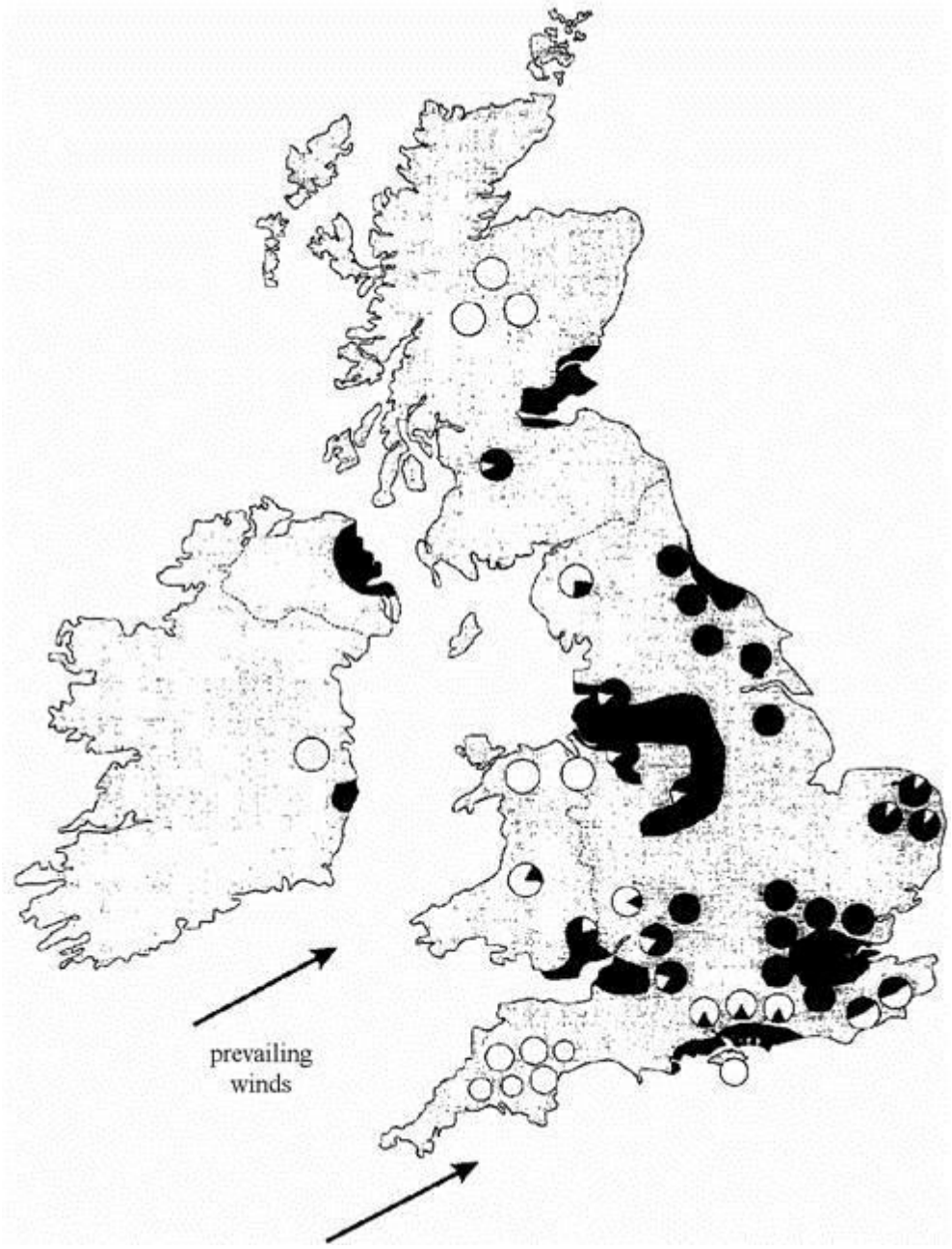
(Total 3 marks)

Q32.

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)

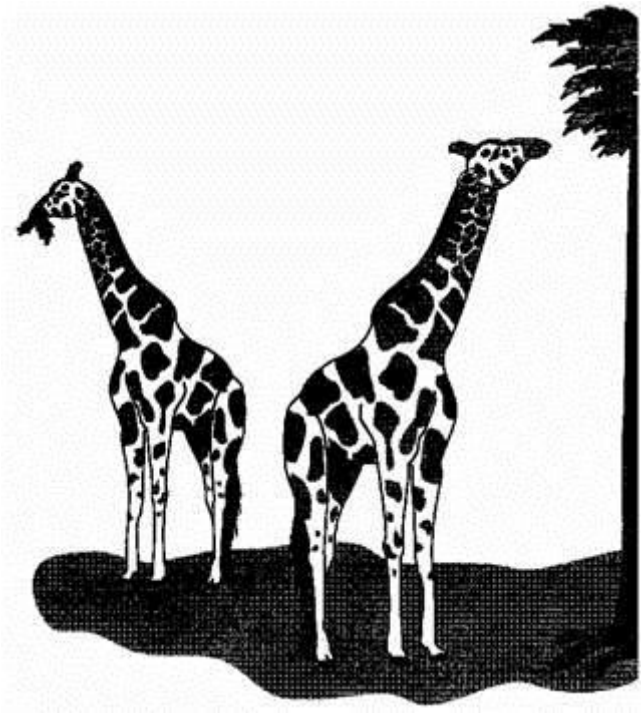
(c) Using the idea of Natural Selection explain why the dark form of the moth is restricted to the areas shown.

(4)

(Total 7 marks)

Q33.

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)

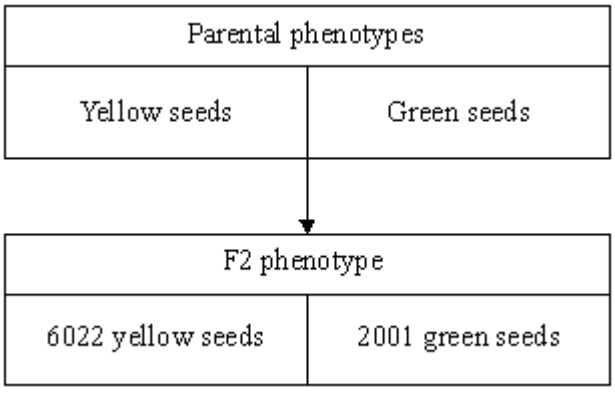
Q34.

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

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

(1)

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

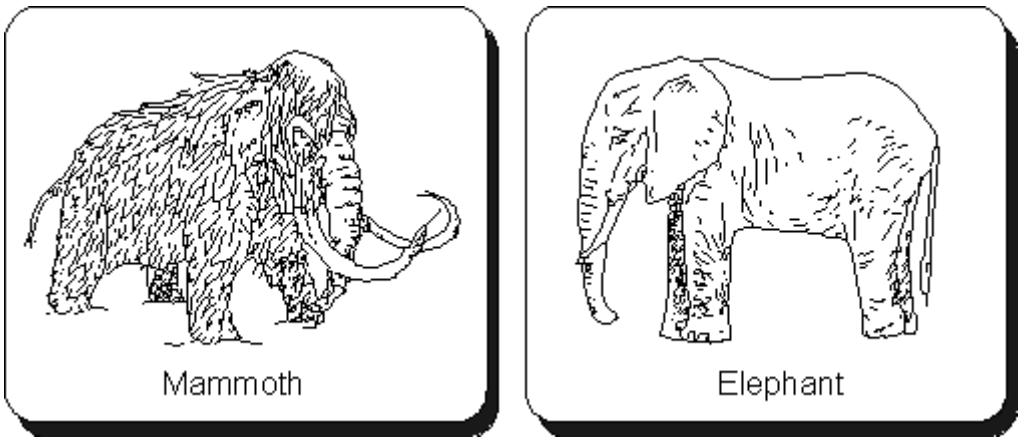


(4)

(Total 5 marks)

Q35.

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)

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) <u>mutation</u>

correct spelling only

ignore other adjectives eg random / spontaneous

1

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

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

1

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

allow immunity rather than resistance throughout

1

(so survivors) breed / reproduce

1

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

allow resistance / characteristic for gene
'gene passed on' is insufficient

1

[5]

Q4.

(a) (soft) body parts / other parts / named parts

accept flesh

1

decayed / decomposed / rotted / eaten

or

bones do not decay / decompose / rot / get eaten

ignore disintegrated / dissolved
ignore microorganisms

1

(b) any **one** aquatic feature from: eg

- streamlined body shape
- long tail
- eyes on top of head
- scales
- fins / paddles / flippers / webbed feet

ignore gills

1

any **one** terrestrial feature from:

- (front) legs / limbs / hands
- could lift front end upwards

ignore feet
*accept for **2** marks eg fin / flipper can be used for walking **or** fins like legs*

1

[4]

Q5.

(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]

Q6.

(a) (i) dead / inactive / weakened

allow antigen / protein
ignore ref to other components
ignore small amount

1

pathogen / bacterium / virus / microorganism

ignore germs / disease

1

(ii) *antigen / antibiotic instead of antibody = max 2*

white blood cells produce / release antibodies

accept lymphocytes / leucocytes / memory cells produce antibodies
*do **not** accept phagocytes*

1

antibodies produced quickly

1

(these) antibodies destroy the pathogen

allow kill
*do **not** accept antibodies engulf pathogens*

1

(b) (i) (live) bacteria still in body
ignore numbers
1

would reproduce
ignore mutation / growth
1

(ii) antibiotics / treatment ineffective **or** resistant pathogens survive
accept resistant out compete non-resistant
1

these reproduce
1

population of resistant pathogens increases
allow (resistant pathogens reproduce) rapidly
1

[10]

Q7.

(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]

Q9.

(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 <u>in each area</u>

1

OR

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

allow genes

so <u>differences</u> lead to inability to interbreed

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

1

[9]

Q10.

(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]

Q11.

(a) 18.06 / 18 / 18.1

*correct answer gains **2** marks*

if answer incorrect evidence of

(4131 - 3499) ÷ 3499 × 100

***or** 632 ÷ 3499 × 100*

***or** ((4131 ÷ 3499) × 100) - 100*

***or** 0.18*
*gains **1** mark*

2

(b) antibiotics kill non-resistant strain
or resistant strain bacteria survive

accept resistant strain the successful competitor
*do **not** accept intentional adaptation*
ignore strongest / fittest survive
ignore mutation
ignore people do not finish antibiotic course

1

resistant strain bacteria reproduce
or resistant strain bacteria pass on genes

1

population of resistant strain increases **or** proportion of resistant bacteria increases

allow high numbers of resistant bacteria

or
people more <u>likely</u> to be infected by resistant strain (than non-resistant strain)

1

[5]

Q12.

(a) <u>kills</u> / destroys bacteria / MRSA

*do **not** allow germs*

1

prevents / reduces transfer

allow stops MRSA entering ward

1

(b) mutation

*do **not** accept antibiotics causes mutation*

1

(causes) resistance

allow not effective
ignore immunity

1

to <u>antibiotics</u>

1

[5]

Q13.

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]

Q14.

(a) Aa

*allow dominant **and** recessive*

allow heterozygous

1

(b) (i) gametes A, a **and** A, a

*max **1** if gametes are incorrect (eg in punnet square)*

1

correctly derived offspring from cross

allow ecf from their gametes

1

identification of round **and** wrinkled offspring

for this mark the phenotype of each different offspring genotype must be indicated

1

(ii) (due to) chance **or** expected ratio is only a probability

accept the idea of small numbers not representative

ignore anomaly / random / coincidence

*do **not** accept error*

1

(c) any **one** idea from:

- genes / chromosomes / alleles / DNA not discovered / known about
  *do **not** accept religious theme (ie confusion with Darwin's difficulties with the church)*
- published in obscure journal / few scientists read his work

1

[6]

Q15.

(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]

Q16.

(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]

Q17.

(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]

Q18.

(a) protection / defence

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

ignore camouflage

1

from predators / from being attacked / from being eaten

1

(b) looks like snake / looks scary

1

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

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

1

(c) (i) natural selection

1

(ii) Darwin

1

(iii) simple life forms

1

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

1

[8]

Q19.

(a) killed by poachers / killed for tusks

1

less trees / leaves to eat

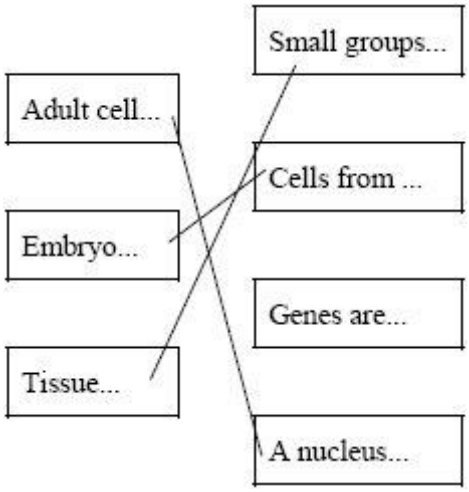
ignore feed on lots of leaves

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]

Q20.

(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]

Q21.

(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

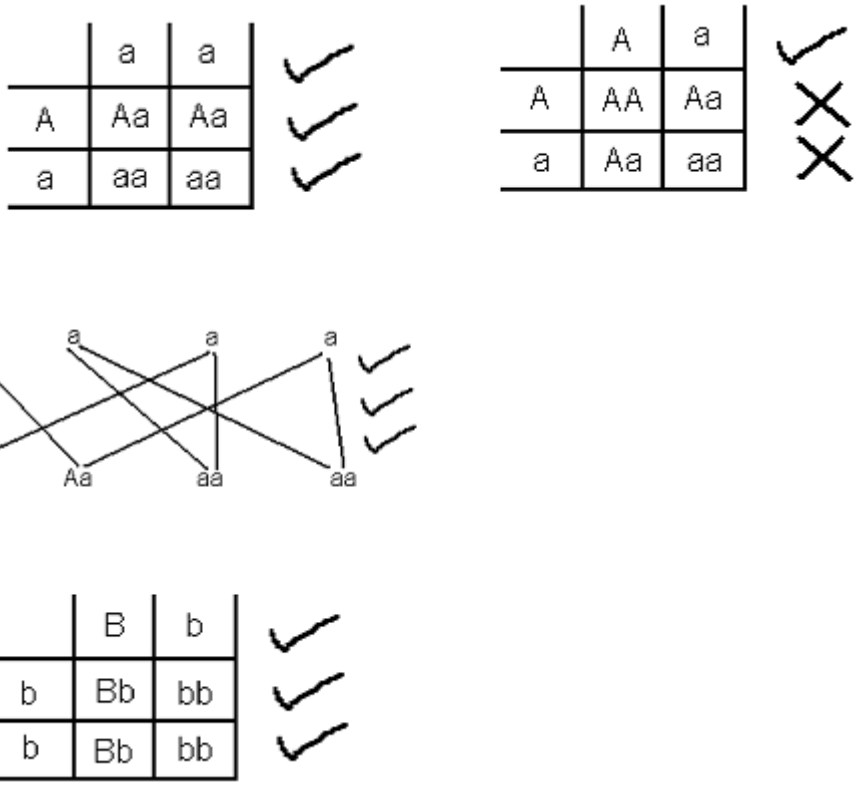
1

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



1

[8]

Q22.

(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]

Q23.

(a) (bacteria) produce toxins / poisons

1

(viruses) damage / kills cells **or** toxins released from cell

1

(b) any **two** from:

- viruses live inside cells
- viruses inaccessible to drug
- drug would damage body cells / tissue

2

(c) any **four** from:

- overuse of antibiotics
- bacteria mutate
  *do **not** allow antibiotic causes mutation*
- antibiotics kill non-resistant strains **or** idea of selection
- reduced competition
- resistant bacteria reproduce

4

[8]

Q24.

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]

Q25.

(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]

Q26.

(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]

Q27.

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

1

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

1

(c) any **two** from:

- hunted by human
- (new) predator
  allow more predators
- (new) competitor
- (new) disease
- environment changed / named environmental change
  allow natural disaster
- prey extinct / loss of food supply
  ignore not enough food

2

[4]

Q28.

(a) (i) viruses live inside cells

1

viruses inaccessible to antibiotic
allow drug / antibiotic (if used) would (have to) kill cell

1

(ii) mutation
ignore mutation caused by antibiotic

1

natural selection **or** no longer recognised by antibiotics
accept description of natural selection

1

(b) (stimulate) antibody production
ignore antitoxin

1

(by) white cells

1

rapidly produce antibody on re-infection
ignore antibodies remain in blood

1

[7]

Q29.

(a) antibiotics diffuse / pass (into agar)
*do **not** allow into dish*

1

kill / prevent growth of bacteria or destroy cell wall / bacteria

accept bacteria are dead

1

(b) it / higher concentration kills more bacteria **or** causes less growth

*do **not** accept anything referring to size of circle*

1

levels off (at 6 units)

accept above 4 units

1

(c) **Quality of written communication**:
for correct sequencing or linking of ideas or points

this mark can only be awarded for a plausible attempt (not necessarily biologically correct) to link a precaution to a purpose
Q ✓ or Q ✗

1

Loop flamed

to sterilise it / kill unwanted microorganisms

*accept so no bacteria present do **not** accept to clean it*

1

Lid taped

prevent bacteria getting in / out **or** prevent someone touching bacteria

accept microorganisms/fungi for bacteria
*do **not** accept viruses or germs*

1

25°C

prevents / reduces growth of / reproduction

1

harmful bacteria / microorganisms or pathogens

1

(d) any **two** from:

- to avoid over-use of antibiotics **or** use no / less / low concentration antibiotics
- select antibiotic that is most effective
- finish the course
- don't give or use for animals
- develop new antibiotics **or** alternatives

2

[11]

Q30.

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]

Q31.

Quality of written communication

*for correct use of at least **two** scientific terms eg mutation, resistant (**not** just 'antibiotic-resistant', **not** 'immune') / selection / natural selection / survival / reproduction / gene / allele / DNA*

1

any **two** from:

mutation occurs in bacteria or change in DNA / gene occurs
cancel if mutation 'caused by' antibiotic

(when antibiotic used) only resistant bacteria survive **or** non-resistant bacteria are killed **or** reference to 'natural selection'

resistant bacteria pass on the gene / allele
allow pass on the mutation
*do **not** accept just 'pass on resistance'*

2

[3]

Q32.

(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) <u>survival in polluted areas:</u>

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

<u>or non survival</u>

(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]

Q33.

(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]

Q34.

(i) (sweet) peas

1

(ii) homozygous parents crossed [1]

heterozygous (F1) offspring crossed [1]

recognition of yellow dominant over green [1]

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

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

4

[5]

Q35.

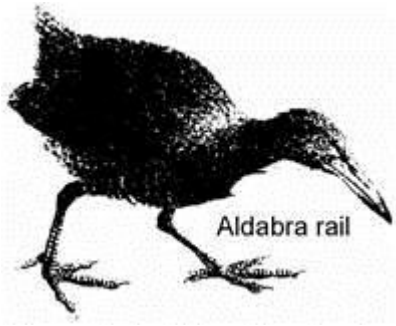
natural variation in amount of body hair;
in cold environment, (having genes) which produce long hair is an advantage;
because hair insulates; OWTTE
such animals more likely to survive;
and pass these genes onto succeeding generations

each for 1 mark

[5]

Q1.

Flightless birds called Rails once inhabited 20 islands in the Pacific Ocean. During the last two centuries they have disappeared from 15 of these islands. The Aldabra Rail, shown below, is one of the few survivors. The island which it lives on is very remote.



Suggest **three** reasons why Rails have disappeared from 15 of the 20 islands they once inhabited.

1. _____

_____

2. _____

_____

3. _____

_____

(Total 3 marks)

Q2.

The picture shows the fossil remains of a bird.

(a) Look carefully at the picture. Some parts of the bird were fossilised.

(i) What were these parts made of?

_____

(1)

(ii) Explain why these parts have been preserved.

_____

_____

_____

(2)

(iii) How can you tell that this fossil was a bird? (You might find information from page 20 of the Data Book helpful.)

_____

(1)

(b) This bird lived about 140 million years ago. This type of bird is now extinct.

(i) What does ‘extinct’ mean?

_____

(1)

(ii) Suggest **one** reason why this bird became extinct.

_____

_____

(1)

(iii) Name **one** other example of an animal that became extinct many millions of years ago.

_____

(1)

(Total 7 marks)

Q3.

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)

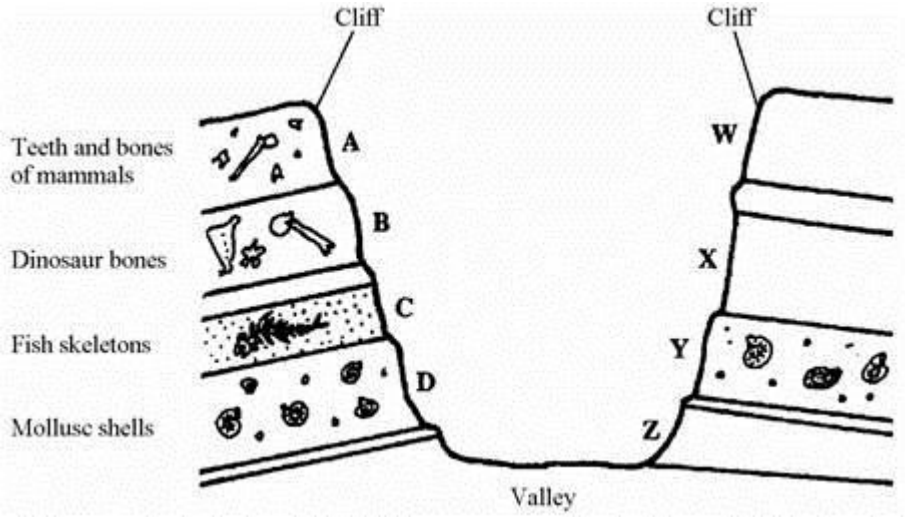
(Total 7 marks)

Q4.

The drawing shows some of the fossils found in the layers of rock in two cliffs.

The two cliffs are on opposite sides of a large valley.

Geologists think that the valley has been carved out by rivers, and that the order of rock layers has not changed.



(a) (i) Which of the rock layers, **A**, **B**, **C** or **D**, is the oldest? _____

(1)

(ii) Give the letters of **two** layers of rock on opposite sides of the valley that are the same age.

_____ and _____

(1)

(b) How do fossils provide evidence for the theory of evolution?

(2)

(Total 4 marks)

Q5.

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)

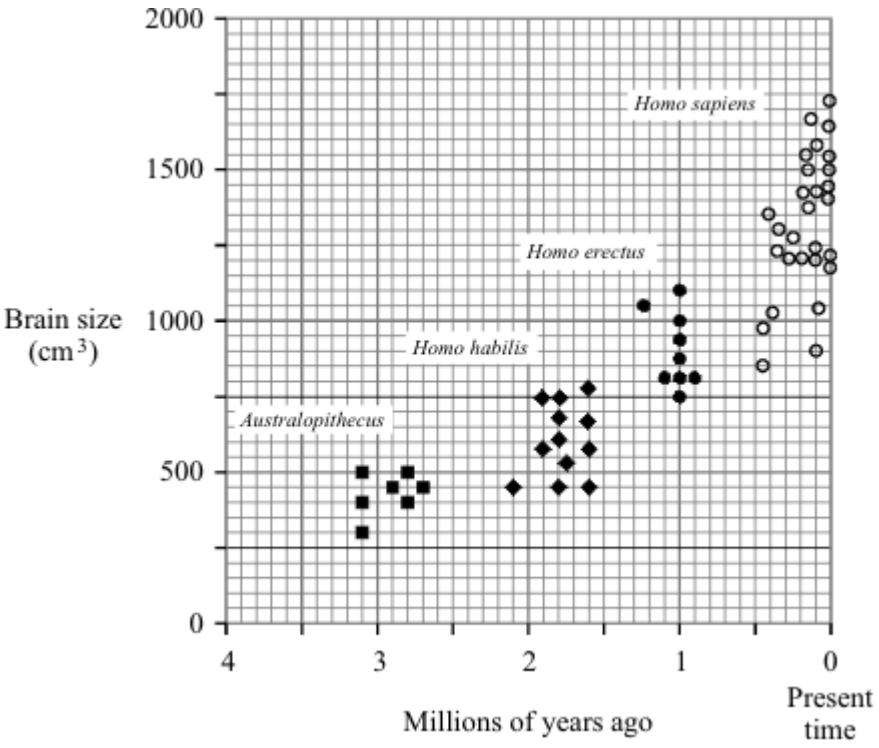
(b) Explain how the results provide evidence for **one** theory of evolution.

(3)

(Total 6 marks)

Q6.

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*.

_____ cm³

(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)

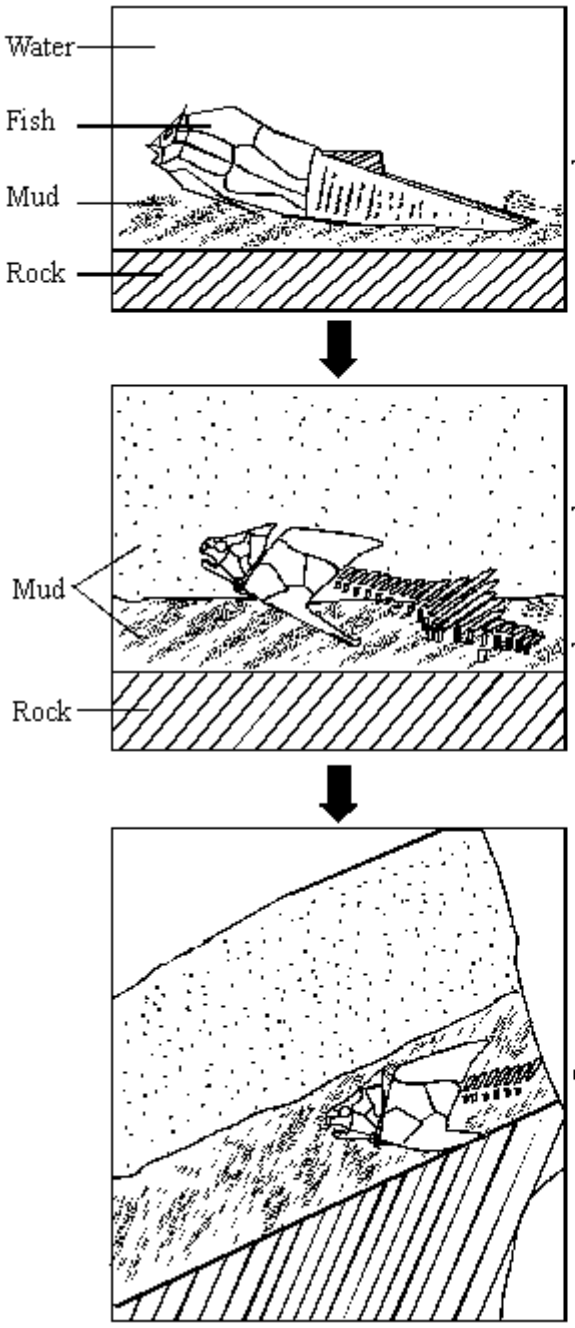
(Total 6 marks)

Q7.

Fossils give us evidence for the theory of evolution.

The diagrams show how a fish became a fossil.

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



The fish died and became covered by [ice / mud / rock]

The organs of the fish [decayed / became extinct / mutated]

The only part of the fish then left was its [brain / heart / skeleton]

The mud surrounding the remains of the fish turned into [ice / rock / water]

(4)

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

_____

_____

(1)

(Total 5 marks)

Q8.

Read the passage about antibiotics.

People do not always agree about the use of antibiotics in food production.

If we put low doses of antibiotics in feed for animals such as cattle and sheep, it helps to produce high-quality, low-cost food. Antibiotics help to keep animals disease-free. They also help animals to grow. Animals get fatter quicker because they do not waste energy trying to overcome illness.

The use of antibiotics in livestock feed means that there is a higher risk of antibiotic-resistant bacteria developing. The rapid reproduction of bacteria means there is always a chance that a population of bacteria will develop which is antibiotic-resistant. These could be dangerous to human health.

(a) *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.*

Explain how a population of antibiotic-resistant bacteria might develop from non-resistant bacteria.

_____

_____

_____

_____

_____

_____

(3)

(b) Do you think that farmers should be allowed to put low doses of antibiotics in animal feed? Explain the reasons for your answer.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q9.

A scientist called Lamarck proposed a theory of evolution. The passage gives Lamarck's explanation of the evolution of the long legs of wading birds.

Change occurs because an animal passes on to its offspring changes it acquires during its lifetime. The long legs of wading birds arose when those animals' ancestors responded to a need to feed on fish. In their attempt to get into deeper

water, but still keep their bodies dry, they would stretch their legs to the full extent, making them slightly longer in the process. This trait would be passed on to the next generation, who would in turn stretch their legs. Over many generations, the wading birds' legs became much longer.

Darwin's theory of natural selection would give a different explanation for the evolution of the long legs of wading birds.

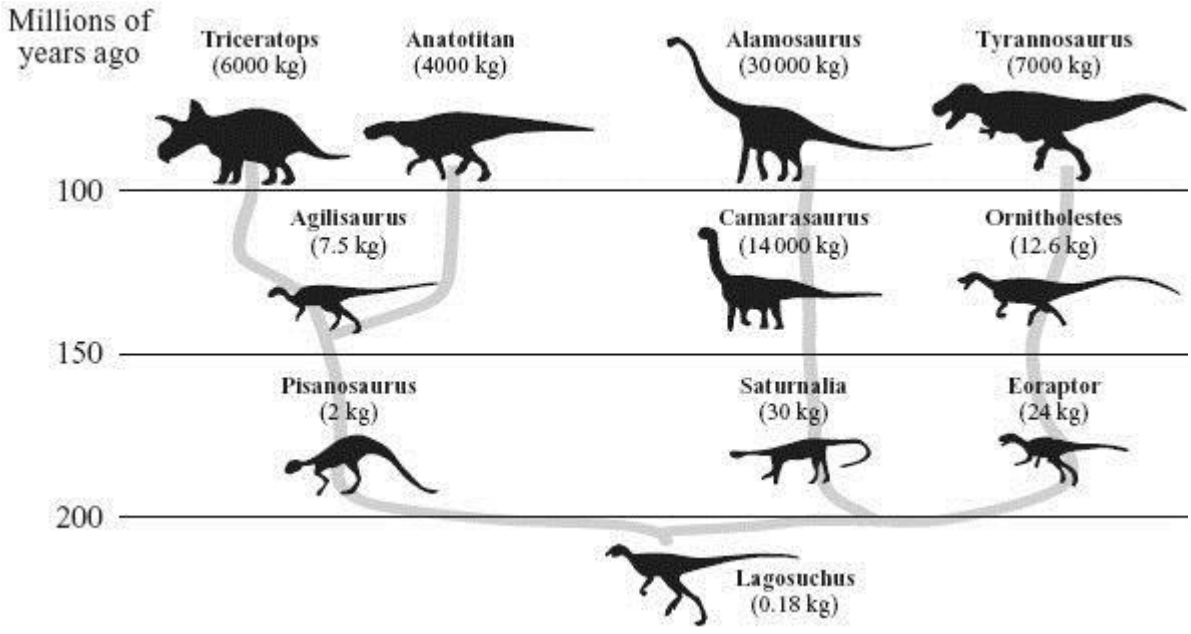
Describe the differences between Lamarck's and Darwin's explanations of the evolution of the long legs of wading birds.

(Total 4 marks)

Q10.

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**

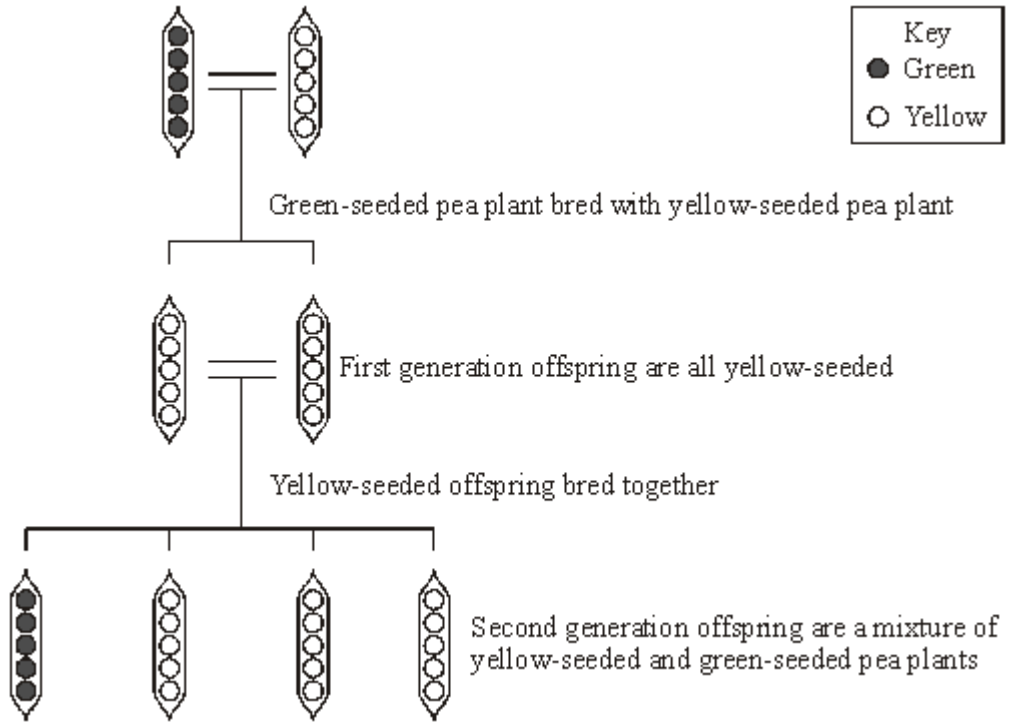
The theory of evolution states that all species of living things have evolved from _____ life forms which first developed more than three _____ years ago.

(2)

(Total 8 marks)

Q11.

The diagram shows one of the experiments performed by a scientist called Mendel in the 1850s. He bred pea plants which had different coloured pea seeds.



(a) Use words from the box to help you to explain the results of this experiment.

dominant	**factor**	**recessive**

(3)

(b) Mendel explained these results in terms of *inherited factors*.

(i) What do we now call *inherited factors*?

(1)

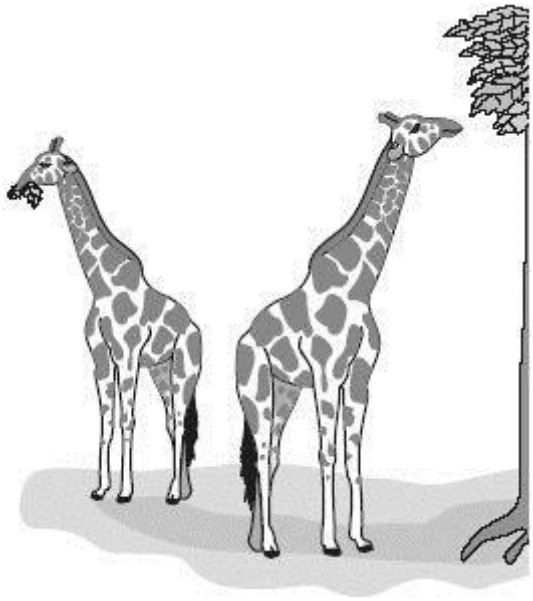
(ii) Where, in a cell, are these *inherited factors* found?

(1)

(Total 5 marks)

Q12.

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)

Q13.

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)

Q14.

One of Mendel's original experiments was to cross pure-breeding, red-flowering pea plants with pure-breeding white-flowering pea plants. The next year he grew the seed he had collected. This first generation, **F_1**, of pea plants all had red flowers. Mendel then made each flower on these plants self-pollinate. He collected the seed from these flowers and grew them. The second generation, **F_2**, gave the following result:

705 red-flowering plants and 224 white-flowering plants.

(a) Which flower colour is due to the recessive allele?

_____

(1)

(b) Draw a genetic diagram to show the inheritance of flower colour in the first generation (**F_1**) of plants.

Use the letters **r** and **R** to represent the alleles for flower colour.

(3)

(c) Explain why Mendel made the first generation of plants self-pollinate.

_____

_____

_____

(2)

(d) If Mendel had taken any two of his white-flowering peas and crossed them, what would have been the colour of the flowers of the next generation of plants?

_____

(1)

(e) It is very difficult to get red-flowering pea plants that breed true. Explain why you cannot guarantee to breed, by self-pollination, pea plants that only have red flowers.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q15.

Choose words from this list to complete the sentences below.

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

Many animals and plants which once existed have died out.

They are now _____ .

We know about them because their remains formed

_____ which are found in _____ .

(Total 4 marks)

Q16.

Choose words from this list to complete the sentences below.

bones extinct fossils
muscles rocks

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

They have become _____ .

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

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

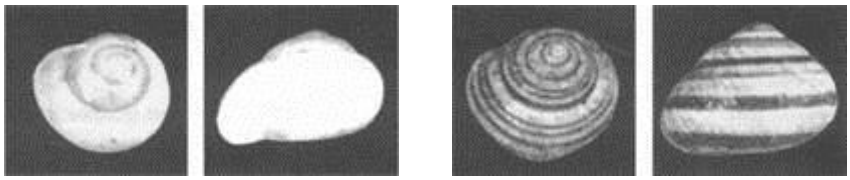
In other cases the bodies of animals and plants were replaced by minerals.

You can still see their shape in _____ .

(Total 4 marks)

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.



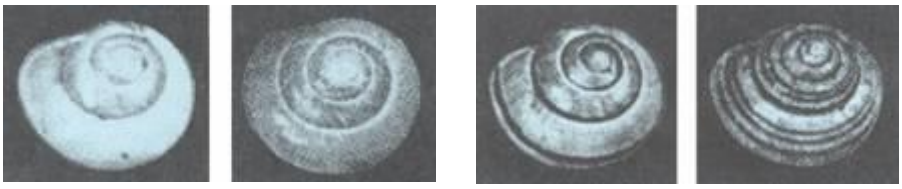
Plain Banded

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.

_____

_____

_____

_____

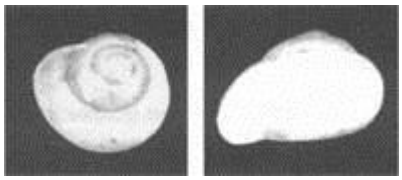
_____

(4)

(Total 11 marks)

Q18.

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.

_____

_____

_____

_____

_____

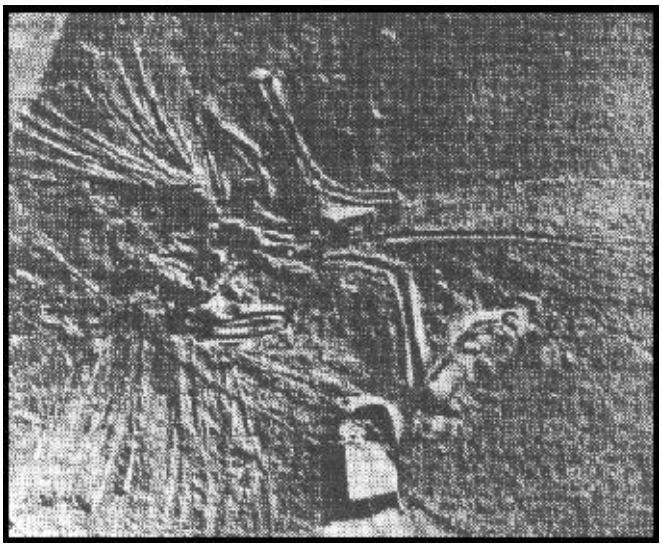
_____

_____

(Total 4 marks)

Q19.

The picture shows a fossil.



(a) (i) What is a fossil?

_____

_____

_____

(3)

(ii) Describe **one** way in which fossils are formed.

_____

_____

_____

(2)

(b) We only know about extinct animals and plants because they have left fossils.
What does the word “extinct” mean?

_____

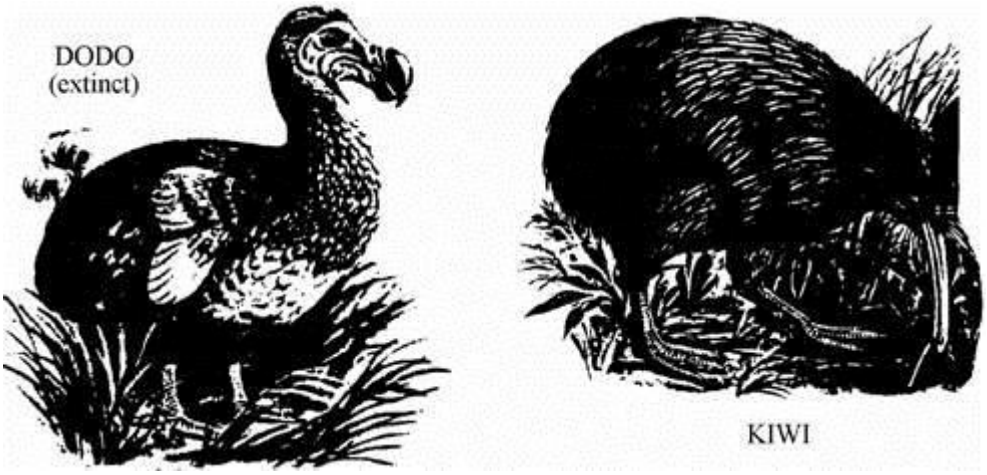
_____

(1)

(Total 6 marks)

Q20.

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. _____

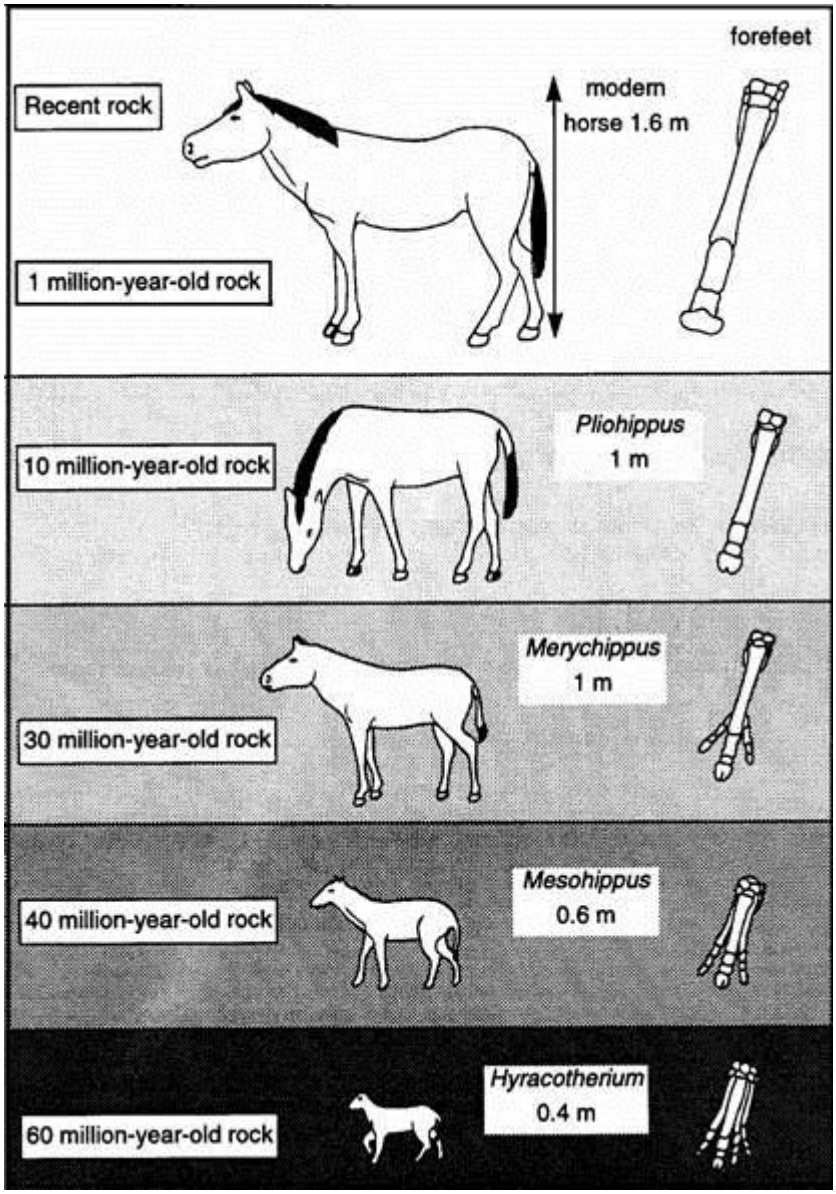
_____

(2)

(Total 8 marks)

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)

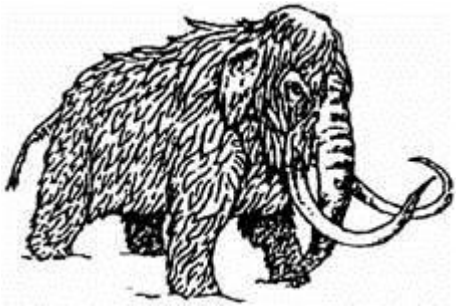
(Total 7 marks)

Q23.

When animals die, bacteria make them decay.
Warmth, moisture and oxygen are needed for this to happen.

(a) (i) In northern Russia whole bodies of mammoths have been found in the frozen soils.

Explain why they did not decay.

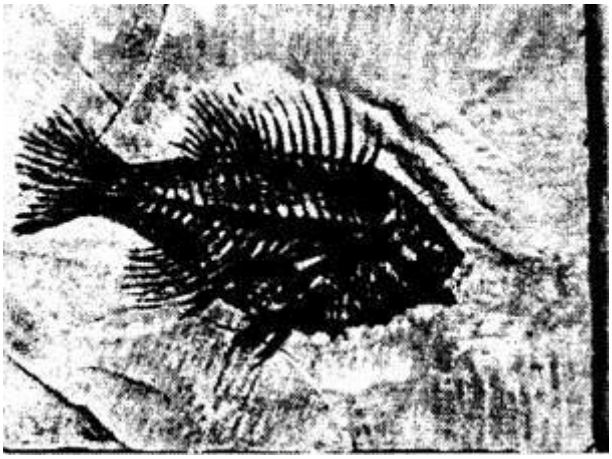


_____

_____

(1)

(ii) Fish fossils have been found in mudstone rock. Explain why they did not decay?



_____

_____

(2)

(b) Some of the mammoths had flint weapons in their bodies.

Suggest **two** things that this tells us about human evolution.

1. _____

2. _____

(2)

(c) Mammoths are now extinct. Suggest **two** reasons for this.

1. _____

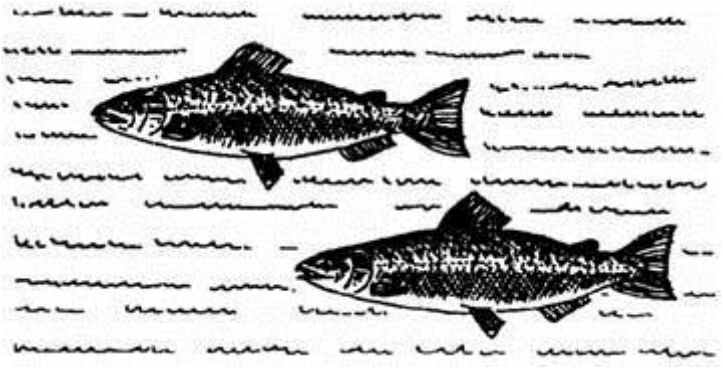
2. _____

(2)

(Total 7 marks)

Q24.

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.

3 of e.g.
new predators
new diseases
new competitors
environmental changes (initiated by Man)

each for 1 mark

[3]

Q2.

(a) (i) bones [and feathers]

1

for 1 mark

(ii) hard parts do not decay

for 1 mark each

2

(iii) has feathers

for 1 mark

1

(b) (i) all of kind have died out

for 1 mark

1

(ii) e.g. change of habitat

for 1 mark

1

(iii) named extinct organism, e.g. Dinosaur

1

for 1 mark

[7]

Q3.

(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]

Q4.

(a) (i) D

for 1 mark

1

(ii) D Y (*both*) or C X (*both*) or B W (*both*)

for 1 mark

1

(b) *N.B. answers must relate to fossils <u>providing evidence</u>*
show types of animals / plants that <u>no longer exist</u> / named ref eg dinosaur
show <u>changes</u> in types *(of animals / plants)*
similar fossils found in rocks of similar age
reference to sequence of change
or example
e.g. horse / limb

any two for 1 mark each

2

[4]

Q5.

(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]

Q6.

(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]

Q7.

(a) mud

1

decayed

1

skeleton

1

rock

1

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

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

1

[5]

Q8.

(a) **Quality of written communication**
The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme

idea of mutation ***or*** variation

*do **not** allow 'bacteria get used to antibiotics' **or** idea that antibiotics change the bacteria **or** 'bacteria become immune' **or** references to adaptation or evolution*

1

(resistant cells) survive antibiotic

1

(resistant cells) breed

1

(b) **EITHER** (yes)

keep animals disease free (1) so grow faster (1 mark) **or** live longer

OR (no)

resistant bacteria may develop (1)
risk to human **or** animal health (1)

allow bacteria become resistant / immune

2

[5]

Q9.

idea of variation
Darwin's theory based on range of variation in organisms

accept some (birds) have long legs and some have short legs
do not credit inherited characteristics
mention of genes etc – neutral

1

idea of acquisition
Lamarck's based on characteristics **or** long legs acquired during lifetime

e.g. legs stretch during lifetime
*do **not** credit grow*

1

idea of survival of fittest
Darwin's theory based on survival of organisms with beneficial variation

accept reference to survival of the fittest
accept ones with longer legs will survive

1

idea of inheritance
Lamarck's based on inheritance of acquired characteristics

accept reverse point that Darwin recognised that acquired characteristics are not inherited
*do **not** credit reference to other animals*
e.g. giraffes

1

[4]

Q10.

(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]

Q11.

(a) any **three** from:

factor for colour has two forms

accept gene for factor and allele for form

yellow dominant since all first generation yellow

accept F1 for first generation

green recessive since reappears in second generation

accept F2 for second generation

3

(b) (i) genes

accept alleles / genetic

1

(ii) nucleus

accept chromosomes / DNA

1

[5]

Q12.

(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:

mutations 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]

Q13.

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

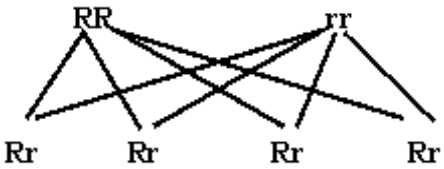
[4]

Q14.

(a) white

1

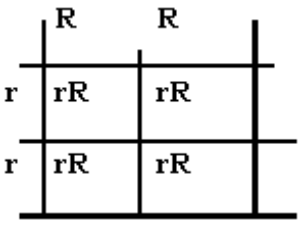
(b)



or a Punnett square

1 mark for parents and separation of genes
*1 mark correct set of four pairs, **rR***

1



1

all are red **or** R is red **or** Rr are red

1 mark for explanation of colour

1

(c) any **two** from

accept allele for gene

to stop cross pollination

*credit so they could not breed with other flowers **or** colours*

to control the gene pool **or** prevent other genes getting in

*credit characteristics **or** factors*
do not accept to use the same genes again

to see which genes were present

credit factors

to test if F_1 **or** they contained any genes for white **or** recessive genes

credit a suitable Punnett square
referenced to white
*credit to see if there was variation in the genes **or** to see if he got any white flowers*
do not accept for a fair test

2

(d) white

1

(e)

the term gene may be in place of allele

the situation mark

red is dominant so masks any white alleles **or** could be heterozygous

credit some (may) have both alleles

credit you do not know if a white allele is there

the consequence marks

1

EITHER

if a recessive **or** white allele is present
there is a chance of a white flower

credit if white alleles are there the recessive can show

OR

chance of white flower could be 1 in 4
if all red flowers contain a dominant and a recessive allele

1

[9]

Q15.

fossils

gains 1 mark

but
extinct

gains 2 marks

fossils
rocks/coal

each for 1 mark

[4]

Q16.

extinct (NOT fossils)
fossils
bones
rocks

each for 1 mark

[4]

Q17.

(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]

Q18.

idea

- banded snails camouflaged/less easily seen
- fewer banded eaten [by birds]
- more banded survive <u>to breed</u>
- 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]

Q19.

(a) (i) *ideas that*

- remains of animal/plant of specific organism
- (from) many years ago/thousands or millions of years
- found in rocks/covered by sediments

for 1 mark each
Mark (a) as a whole to a total of 5 marks.

3

(ii) *ideas that*

- hard parts/bones/shells/skeletons
  link required
- don't decay

or

- no decay
  link required
- conditions needed absent/no oxygen/no water

or

- parts replaced by rock mineral chemicals;
  Do not accept 'materials' or 'substances'.
- as they decay
  Accept 'hard' or 'soft' parts for 1 mark each

2

(b) *idea*

died out/none left/died off

Do not accept 'died' alone
for 1 mark

1

[6]

Q20.

(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]

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 <u>from earlier species</u>/ <u>horses</u>

- 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

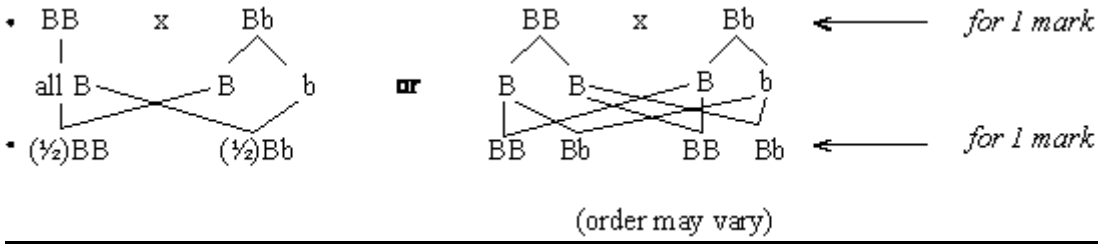
[First bullet point answer is required before marks can be awarded for others]

3

[7]

Q22.

(a) <u>First Generation</u>



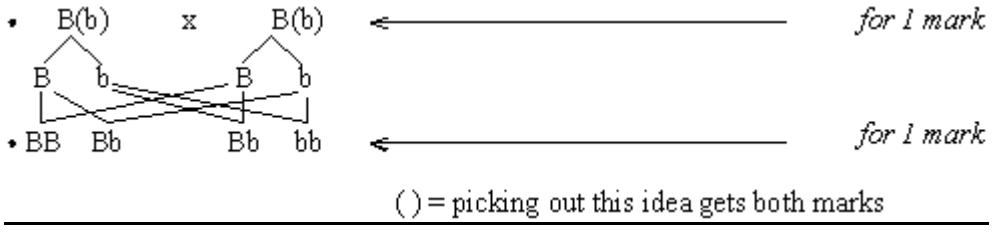
<u>or</u> as matrix

	B	B
B	BB	BB
b	Bb	Bb

1 mark for correct column and row headings
1 mark for correct outcomes

allow one mark for being able to produce a correct genetic cross
(even if from an incorrect starting point)

<u>Second generation</u>



or as a matrix

	B	b
B	BB	Bb
b	Bb	bb

1 mark for correct column and row headings
1 mark for correct outcomes

4

(b)
- green colour gives an advantage/camouflage
- more green flies dm black flies survive to breed*
- pass on their genes to the next generation
- (* but implied by 3rd bullet point)

for 1 mark each

3

[7]

Q23.

(a) (i) (too) cold / all moisture / water frozen / no moisture / no warmth / conditions for decay are absent.

for 1 mark

(*No* oxygen is neutral)
(*Do not accept* frozen or ice has preserved them)

1

(ii)
- (bacteria have) no oxygen / air (because dead fish covered in mud)

(No moisture x)

(No moisture and no oxygen or warmth x)

- bones / hard parts do not decay easily

idea that

- material of fish replaced by minerals

any two for 1 mark each

2

(b) *ideas that*

- mammoths lived at the same time as humans / there was man in these times
- mammoths lived in the same place as humans
- humans hunted mammoths / ate mammoths / were carnivorous / for fur etc
- reference to later use of more advanced weapons
- humans needed to protect themselves from mammoths

- humans used flints / weapons / tools

  any two for 1 mark each

2

(c) *idea that*

- environment changed / became too cold / became too warm / vegetation changed / humans destroyed environment
- (new) predator / humans killed them
- new disease
- new competitor / type of elephant
- shortage of food / no food / ran out of prey
- mammoths reproduced too slowly
- mammoths didn't adapt to changes

  any two for 1 mark each

2

[7]

Q24.

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]