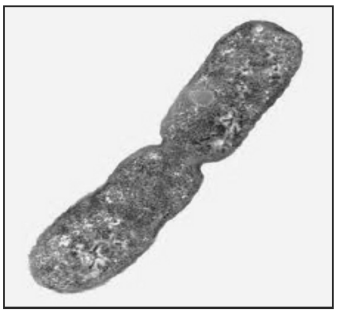
WJEC (Eduqas) Biology GCSE Topic 7.3 Variation and Evolution Questions by Topic

1. The photograph shows one bacterium dividing into two.



(a) (i) State the type of reproduction that involves only one parent. [1]

(iii) Bacteria can divide into two every 20 minutes.

Starting with **one** bacterium, calculate the number of bacteria that will be present after **2 hours**. [2]

number of bacteria = ...

(b) (i) Until recently, antibiotics killed most bacteria.

The list below describes stages in the development of antibiotic resistance in bacteria, but **not in the correct order**.

1 Many more bacteria now have antibiotic resistance.
2 There was a mutation to a gene in a few bacteria.
3 The survivors reproduce, passing on the mutated gene.
4 Bacteria with the mutation survive antibiotics.

Place the four statements above in the correct order. One has been done for you. [2]

..... → **4** → ..... → .....

The development of antibiotic resistance in bacteria is an example of

artificial selection

sexual selection

natural selection

2. The owner of a garden centre wanted to know whether young strawberry plants in two boxes **X** and **Y** had been grown from seeds or had been grown asexually. He allowed them to grow to maturity in identical conditions.

Plants from box **X** produced identical flowers, all at the same time.
Plants from box **Y** produced flowers which varied in shape and size, some of which were produced earlier than others.

(a) State why plants from box **X** could be described as *clones*. [1]

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(b) (i) Explain how sexual reproduction results in the variation seen in the plants in box **Y**. [2]

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(ii) Give **one** advantage to the species of variation produced by sexual reproduction.

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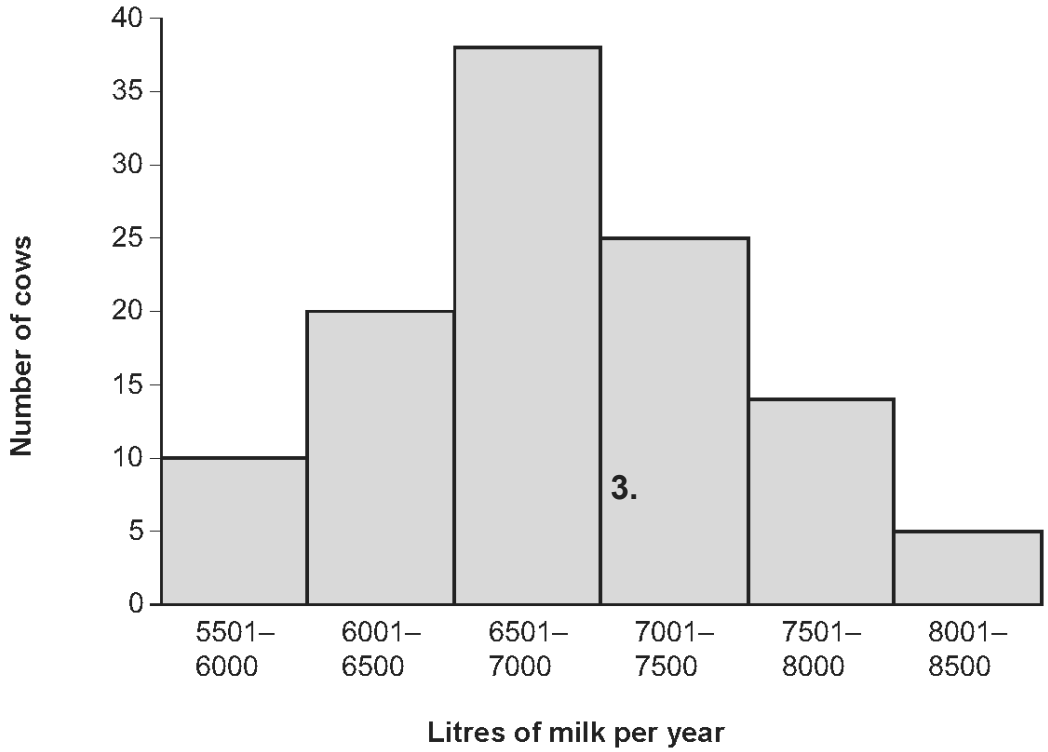
3. *(a)* The graph below shows the variation in the volume of milk produced by a herd of cows in one year. All the cows were the same breed.



(i) During the winter months, the herd is kept indoors in large barns. All the cows in the herd are fed exactly the same quality and quantity of food. Suggest a reason why the volumes of milk produced by the cows varied during the winter months. [1]

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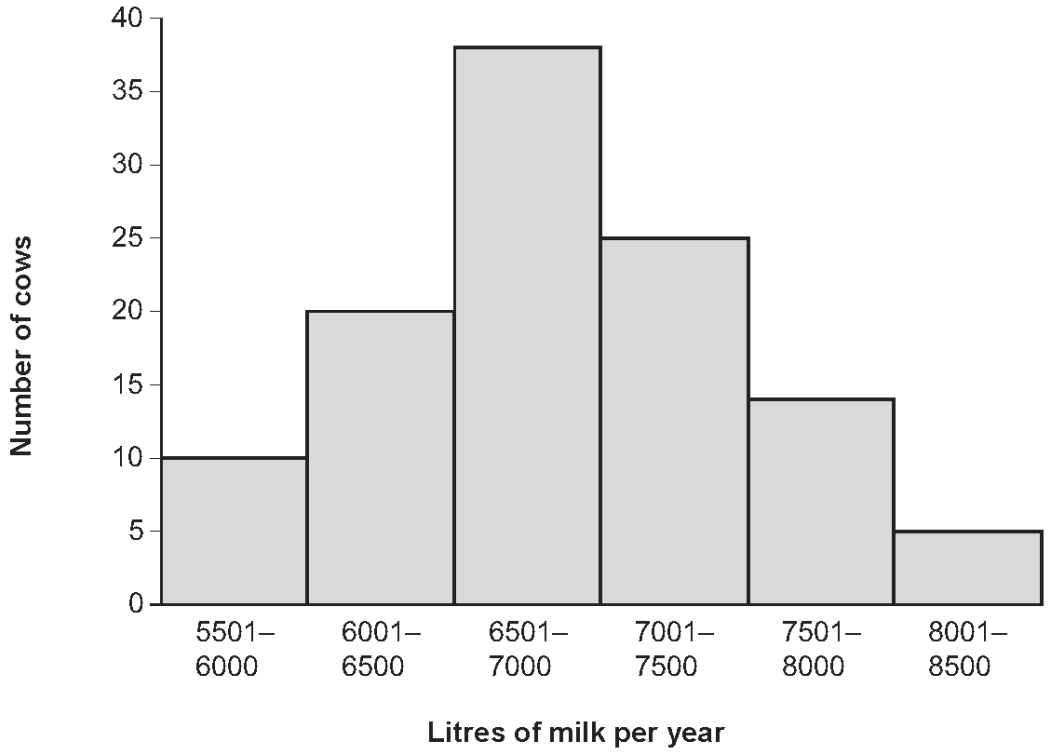
(a) The graph below shows the variation in the volume of milk produced by a herd of cows in one year. All the cows were the same breed.



(i) During the winter months, the herd is kept indoors in large barns. All the cows in the herd are fed exactly the same quality and quantity of food. Suggest a reason why the volumes of milk produced by the cows varied during the winter months. [1]

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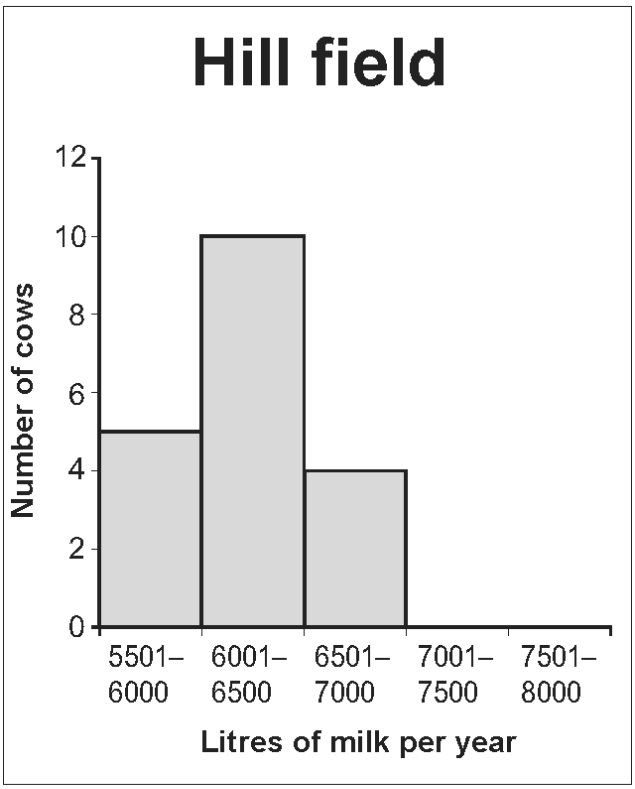
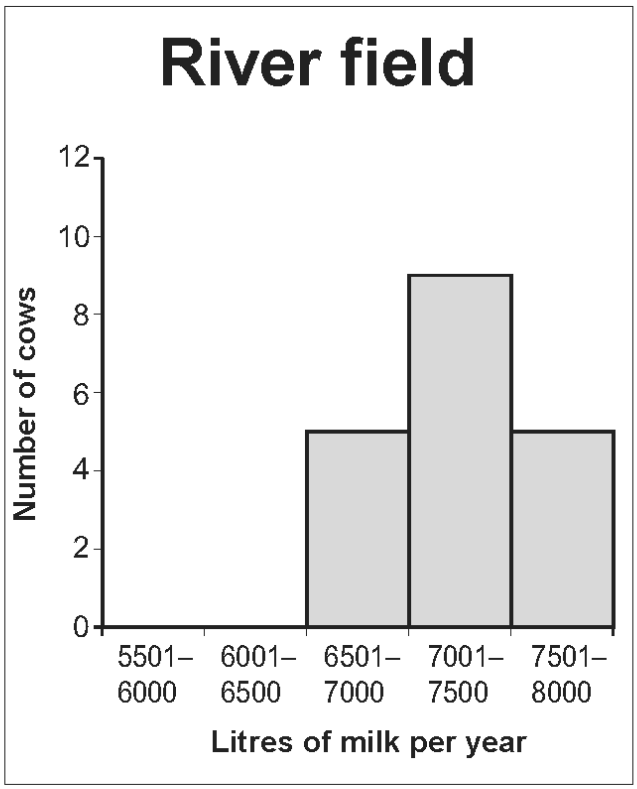
During the summer months, the farmer noticed that the volume of milk produced by the cows varied depending on which fields on the farm the cows were grazing on.

He divided the cows that produced 6501 – 7000 litres of milk per year into two groups. One of these groups grazed on a field by the river and the other on a field on the hill.

The graphs below show the results.





(ii) Explain the differences in the results shown in the graphs. [2]

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(iii) When the farmer breeds from his cows he uses a method called artificial insemination (AI). The sperm are introduced into the cows mechanically rather than by using a bull directly.
How does this information suggest that AI is a method of sexual reproduction? [1]

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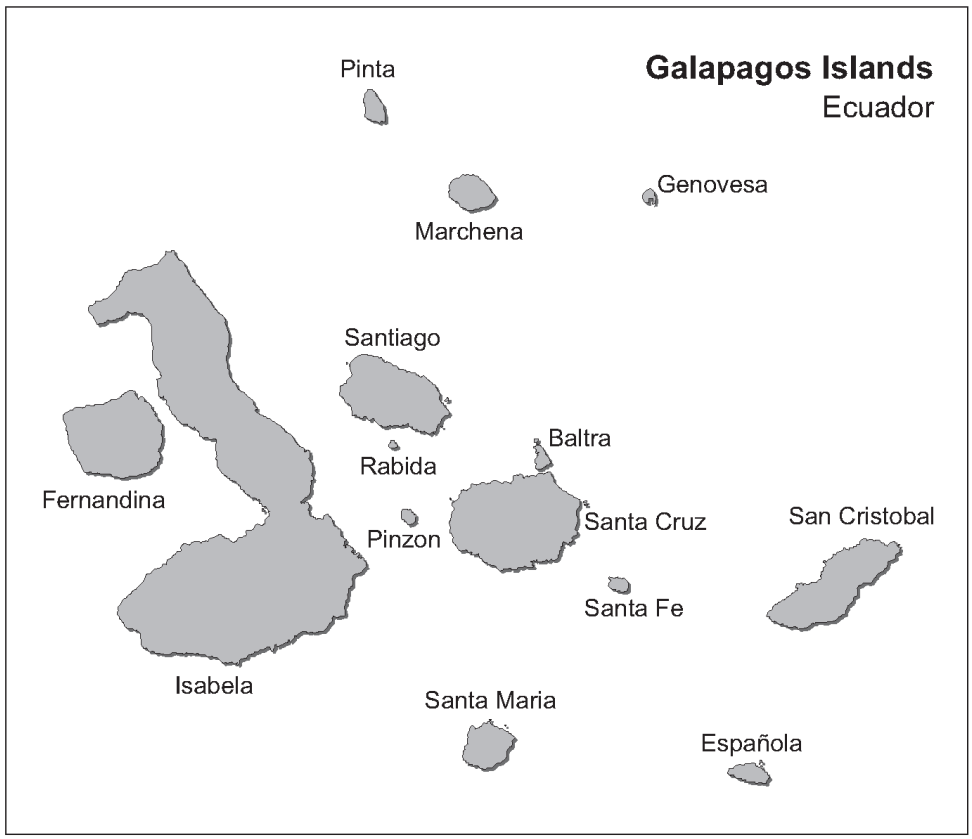
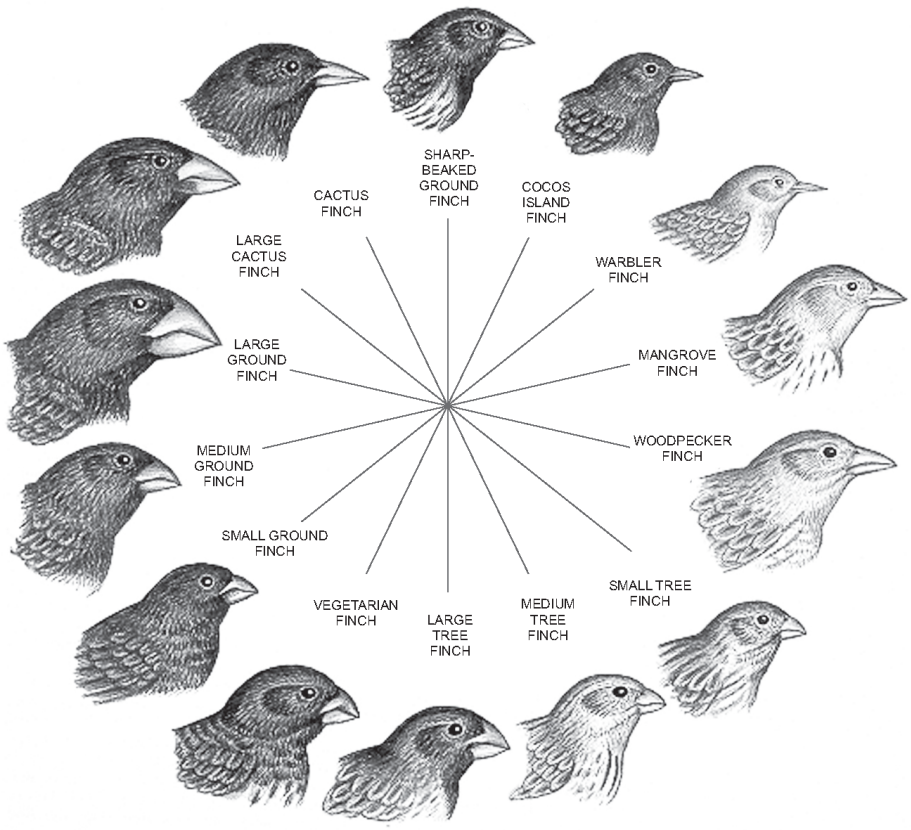
4. When Charles Darwin visited the Galapagos Islands he collected birds from the different islands. On his return to Britain he studied the birds and thought that they had all evolved from a single bird type. These birds became known as Darwin's Finches.



Darwin's Finches (drawn to scale)



(a) (i) What **two** observations can be made from the drawings opposite about the birds' beaks? [2]

I. .....

II. .....

(ii) Suggest the advantage to the birds of the variation in their beaks. [1]

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5. Henderson Island in the Pacific Ocean is very small and has eight endangered species of birds. Rats live on the island and eat 95% of the birds' eggs. Scientists hope to kill all of the rats on the island by using a poison.

In Wales, a population of rats, resistant to the poison were discovered in the 1960s.

Write an account to explain how this resistance developed and spread throughout Britain. Suggest why using poison as a method of control on Henderson Island might be more successful. [6 QWC]

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6.

Deer mice live in the sand hills of Nebraska, USA. The genetic analysis of ancient remains of deer mice has shown that 10 000 years ago, the only genes for their coat colour were for dark coloured fur.

Their environment changed about 10 000 years ago when sand hills formed. Deer mice, living today, have sand coloured fur which is controlled by a gene called 'agouti'. This gene has not been found in the ancient remains of deer mice.

Write an explanation of the evolution of the coat colour in deer mice. In your explanation, refer to the processes of natural selection and the importance of genetic analysis in finding evidence for evolution. [6 QWC]

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7.

A population of sheep lives on the Scottish island of St. Kilda.
The photograph below shows a sheep.

yaandborerayssheep.com

(d) The sheep on the island are either pale or dark in colour.

The table below gives the percentage (%) of dark sheep on St. Kilda between 1985 and 2005.

Year	Percentage (%) of dark sheep
1985	76
1990	74
1995	71
2000	70
2005	69

(i) Using the data above, plot a line graph on the grid below by:

I. Labelling the vertical axis. [1]
II. Plotting the points. [2]
III. Joining the points with a ruler. [1]

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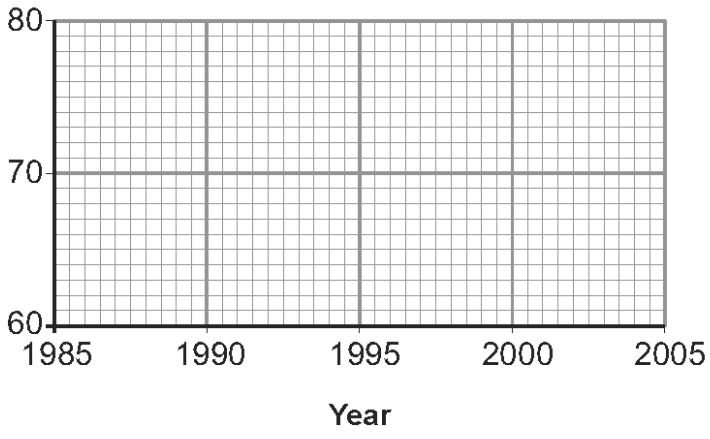
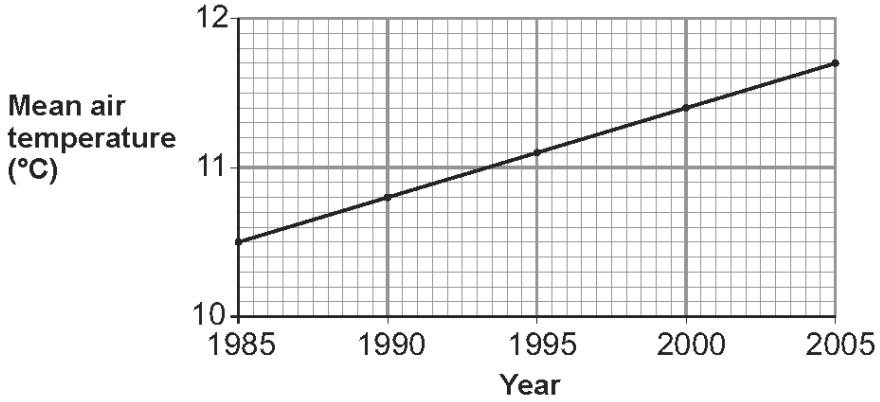


(ii) The graph below shows the mean air temperature on the island over the same period.



Some scientists have the opinion that the change in the percentage of dark sheep on the island is due to a change in the mean air temperature.

I. Using **both** of the graphs opposite, describe the evidence that supports the scientists' opinion. [1]

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II. It is not possible to be sure that the change in the percentage of dark sheep on the island is due to the change in the mean air temperature.

State **two** *other* factors that could cause the change in the percentage of dark sheep. [2]

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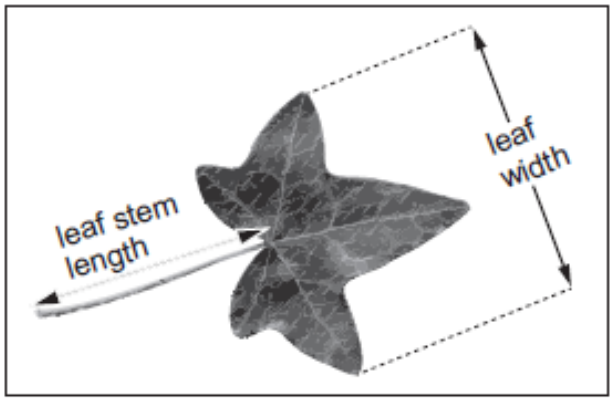
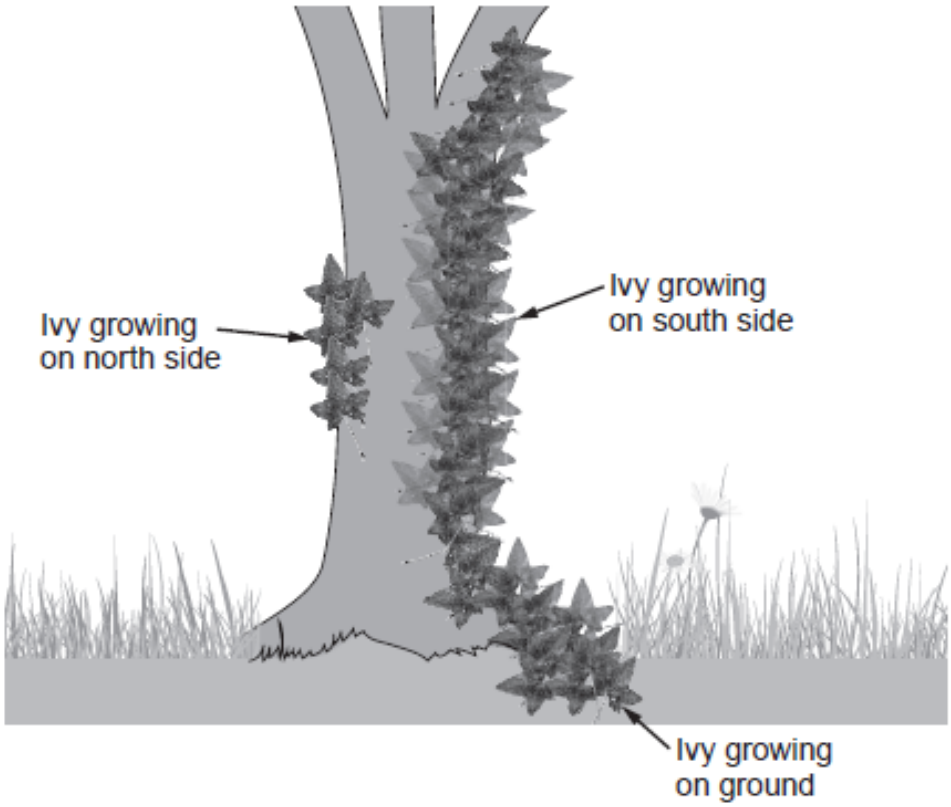
8. Students investigated factors affecting leaf growth of ivy *(Hedera sp.)*.

They measured the leaf stem length and the leaf width of 50 leaves of an ivy plant growing on the south side of a tree trunk at a height between one and two metres.





They compared these measurements with ivy leaves of the same ivy plant growing on the north side of the same tree trunk at the same height and also leaves from the same ivy plant growing flat on the ground.

Their results are shown below:

	Leaves from ivy growing on the south side	Leaves from ivy growing on the north side	Leaves from ivy growing on the ground
Mean leaf stem length (mm)	63	60	42
Mean leaf width (mm)	55	52	38
Ratio of leaf stem length to leaf width	1·15 : 1	..... :	1·11 : 1

(a) (i) Calculate the ratio of leaf stem length to leaf width for the ivy growing on the north side of the tree and **write your answer in the table**. [2]

SPACE FOR WORKING

(ii) Suggest why there is a difference between the ratio of leaf stem length to leaf width for the ivy growing on the ground and the ivy growing on the south side of the tree. [1]

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(b) Students recorded the data for the ratio in the frequency table below.

Ratio	South facing	North facing	Ground growing
0.51 - 0.75	7	4	4
0.76 - 1.00	9	7	13
1.01 - 1.25	15	27	24
1.26 - 1.50	13	9	7
1.51 - 1.75	3	5	2
1.76 - 2.00	0	0	0

State the type of variation shown by the ratio. [1]

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9.

(a) Until the 1960s, turkeys, bred for meat on turkey farms, all had black feathers. Then, mutant pure white-feathered turkeys were hatched in a turkey farm. Turkey farmers used the mutant turkeys to produce all white-feathered flocks of turkeys. Almost all turkeys sold in supermarkets today are of the white-feathered variety.

(i) What type of genetic variation is shown by the feather colour of turkeys? [1]

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(ii) Why is it not possible to breed black-feathered turkeys from white-feathered turkeys? [1]

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10.

Scientists recently discovered that 30 000 years ago a gene became altered in some people from Tibet. This altered gene, called EPAS1, soon spread through the population. The altered gene increased the ability of the blood to take up oxygen. This allowed these people to live at 4 000 m above sea level. At this altitude, air has less oxygen than at sea level.

Explain how the altered gene EPAS1 became widespread in the Tibetan population and how modern technology has enabled the detection of the altered EPAS1 gene. [6 QWC]

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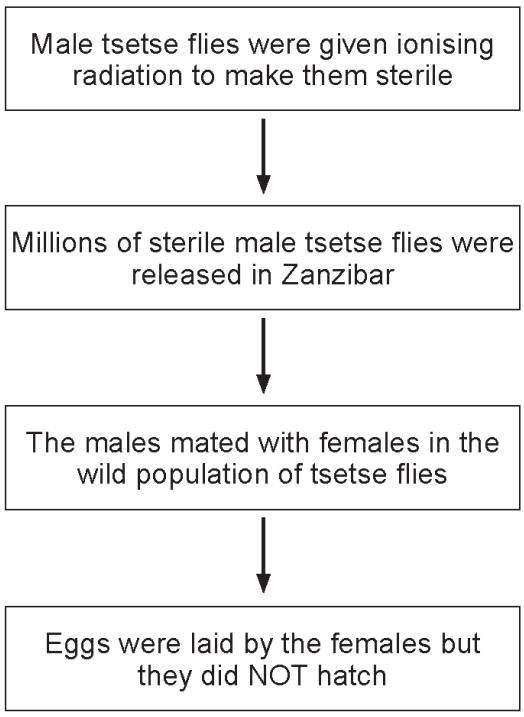
11. The photograph below shows a male tsetse fly *(Glossina palpalis)*.

© Ray Wilson/Alamy

- The tsetse fly *Glossina palpalis* is a pest.
- One method of pest control relies on releasing sterile male insects (insects which cannot produce sex cells) into wild populations.
- Sterile male tsetse flies have been used in pest control in this way, in a successful attempt at controlling the tsetse fly population in Zanzibar.
- Zanzibar is a small island off the coast of the continent of Africa.

The principle of this method of pest control is as follows:



(a) State how ionising radiation caused the tsetse flies to become sterile. [1]

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12. Some rats have evolved a resistance to the rat poison warfarin.

(a) The information below shows some stages in the development of this resistance **but not in the correct order.**

1 so the useful mutation is passed on to offspring

2 a mutation occurred in a gene

3 the mutation is useful

4 rats with the mutation survive to reproduce

5 as a result, there is an increase in the population of rats with the mutation

Complete the sequence below to show the stages in the correct order. *One has been done for you.*

2 → ..... → ..... → ..... → ..... [4]

(b) What may happen to **species** that do not adapt to new environmental conditions? [1]

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13. *Plasmodium falciparum* is a single-celled organism which causes malaria when it is in human blood.

Chloroquine is a medication which kills *Plasmodium falciparum*.

In the early 20th century a lot of chloroquine was used throughout Africa and was very successful. By the 1980s *Plasmodium falciparum* showed widespread resistance to chloroquine.

The mutation which caused resistance was originally very rare in the population.

(a) (i) Name the chemical that had become mutated. [1]

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(ii) Explain how natural selection caused the mutated *Plasmodium falciparum* to become very common in the 1980s. [4]

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(b) In the 1980s, some Health Authorities in Africa stopped using chloroquine. In 2011, a trial using chloroquine again took place in the African country of Senegal. It was then found that 70% of *Plasmodium falciparum* had been killed by chloroquine.
Suggest a reason for this observation. [1]

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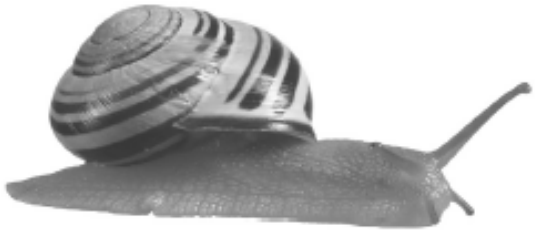
14.

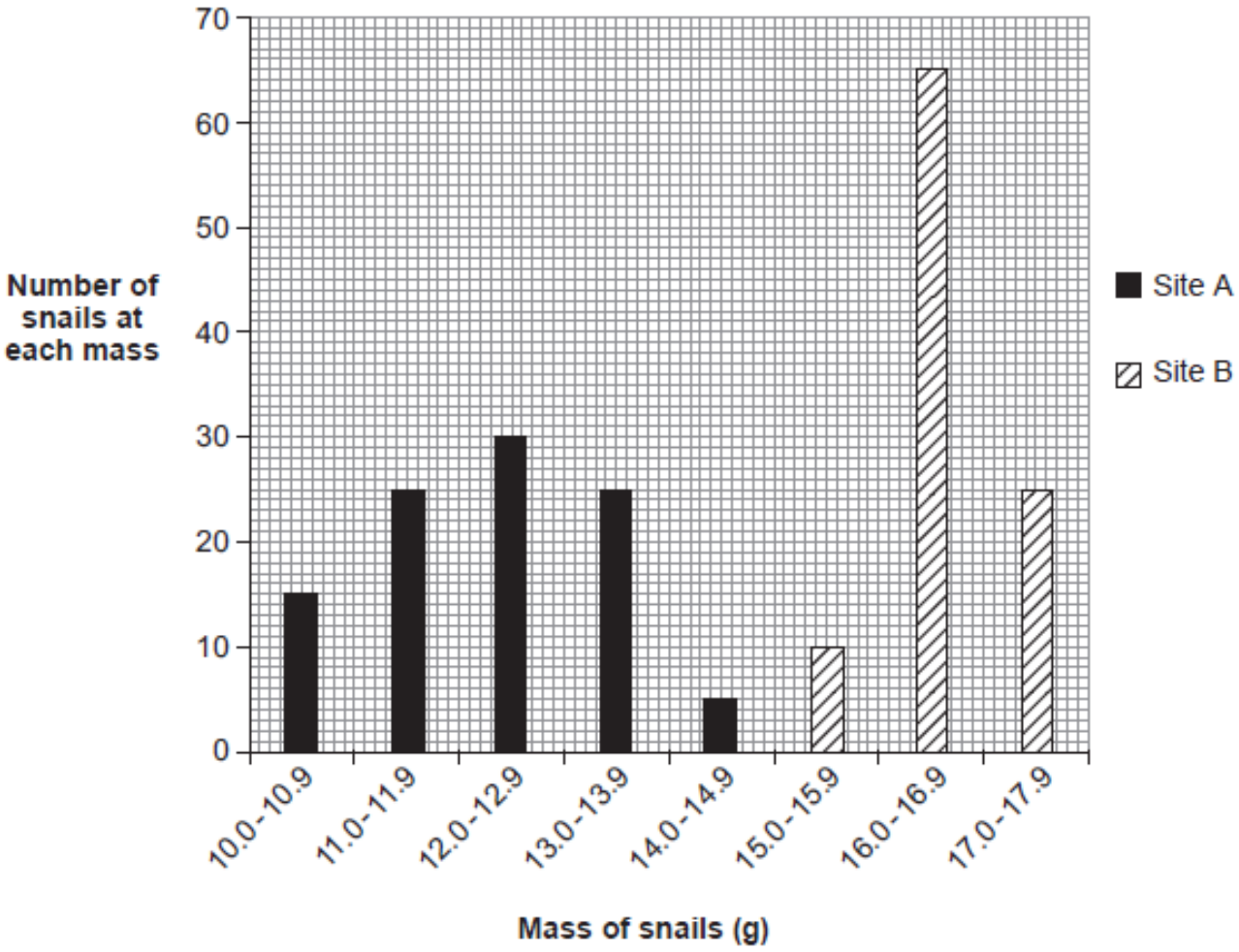
Cockroaches are pests which spoil food and spread disease. They have a gene which makes them attracted to sugar. In the 1980s pest controllers used a mixture of insecticide and sugar as a means of pest control. The sugar attracted the cockroaches and the insecticide killed them. In the 1990s certain populations of cockroaches had changed so that they were no longer attracted to sugar. The insecticide was still lethal but the cockroaches avoided eating it when it was mixed with sugar.

Explain how the cockroaches evolved to survive the pest control that was used in the 1980s.
[6 QWC]

15. The photograph shows the banded snail, *Cepaea nemoralis*.



(a) Scientists investigated variation in the mass of individual snails sampled at random from two different sites, **A** and **B**. The mass of each snail was recorded to the nearest 0.1 g. The results are shown in the bar chart.



(i) The table below shows the mean mass of snails collected at each site.

Site	Mean mass (g)
A	12.3
B	16.8

Calculate the percentage increase in the mean mass of the snails at site **B** compared to site **A**.

[2]

increase in mean mass = ... %

(ii) At which of the two sites do the snails show the greater variation in mass? Give the reason for your choice. [1]

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(iii) How did the scientists reduce bias in their investigation? [1]

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(iv) Why is it important that other scientists carry out the same investigation as these scientists? [1]

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(b) *Cepaea nemoralis* shows genetic variation.

Use your knowledge of natural selection to explain the long term advantage of genetic variation to *Cepaea nemoralis* in a changing environment. [3]

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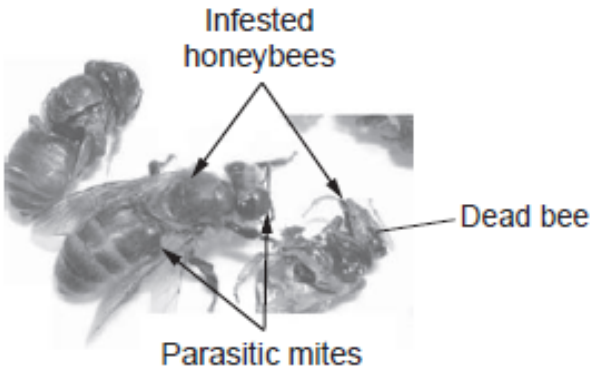
16. *Varroa destructor* is a parasitic mite of honeybees. A colony of honeybees affected by the parasite becomes weakened and eventually dies out. The parasitic mite originated in Asia, where it is a pest of the Asian honeybee, *Apis cerana*. It has spread across most continents, arriving in the UK in the early 1990s and affecting the native European honeybee, *Apis mellifera*.



In 2014-2015 there were 1650 registered beekeepers in Wales who kept bee colonies, each of which is one beehive. The National Bee Unit recommends that honeybees should be treated with pesticides to try and reduce the numbers of the parasitic mite in beehives.

In recent years many beekeepers in North West Wales have stopped treating their bees with pesticides. These beekeepers believe that there is no difference in colony losses between bees treated with pesticides and bees not treated with pesticide.

The table below shows Winter Losses (the number of colonies that died out) between 2010-2015 in North West Wales.

Season	Number of beekeepers in the survey		Total number of colonies	Number of treated colonies	% winter loss in treated colonies	Number of colonies not treated	% winter loss in not treated colonies
	Treating	Not treating					
2010-2011	10	5	71	44	27	27	11
2011-2012	11	31	355	180	8	175	7
2012-2013	8	46	251	75	41	176	32
2013-2014	12	55	396	81	9	315	6
2014-2015	17	65	500	97	8	403	8

(b) What percentage of beekeepers in Wales took part in this survey in 2014-2015? [2]

percentage of beekeepers = ... %

(d) Early attempts at control of the parasitic mite involved using the chemical, pyrethroid. By the late 1990s the parasitic mite developed resistance to the chemical and beekeepers were advised to use other chemicals to control the pest.

Explain why, over time, the pyrethroid chemical became less effective at killing the parasitic mite. [4]

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17. There is a gene (FOXI 1) in humans which controls how much water is lost from the body in sweat and urine. Scientists found that 85% of a large sample of people who lived in the Sahara desert had a form of the FOXI 1 gene which had changed over time.
It has been estimated that climate change caused the Sahara desert to form between 10 000 and 20 000 years ago at the same time that the change in the FOXI 1 gene took place.
Explain how evolution has resulted in the changed FOXI 1 gene increasing in frequency in people living in the Sahara desert. [6 QWC]

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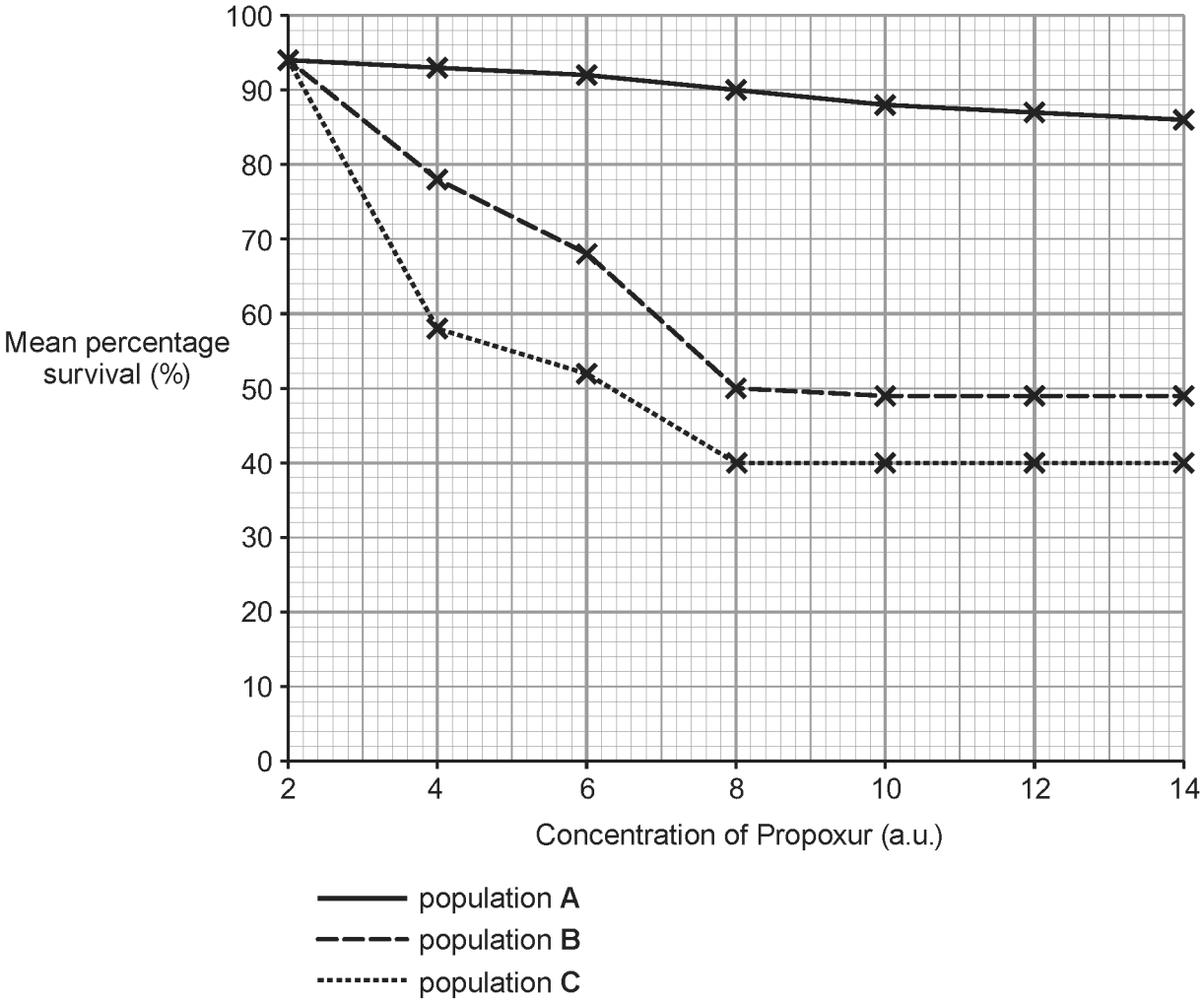
18. The photograph below shows a mosquito *(Aedes aegypti)* feeding on a human.

The pesticide, Propoxur, has been used to control mosquitoes in South America. In 2016, an outbreak of a disease caused by a virus which is carried by mosquitoes occurred in South America. Scientists investigated the effectiveness of Propoxur under controlled conditions in a laboratory. They used 200 mosquitoes of the same species from each of three separate populations **A**, **B** and **C** and subjected them to a range of concentrations of Propoxur. They calculated the percentage survival of the mosquitoes for each concentration of Propoxur. The results are shown in the graph below.



(a) Use the data in the graph to answer the following questions.

(i) Which population, **A**, **B** or **C** is the most resistant to Propoxur? Give a reason for your choice. [1]

Population .....

Reason .....

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(ii) What is the optimum concentration of Propoxur to use to control the mosquitoes in population **C**? Explain the reason for your choice. [3]

Concentration ..... a.u.

Reason .....

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(b) State **two** factors, other than any given in the question, that should be kept constant to make this a fair test. [2]

1. .....

2. .....

(c) Propoxur destroys a protein in mosquitoes. This protein is needed for the nervous systems of mosquitoes to function. Mosquitoes that are resistant to Propoxur have a different protein which is not destroyed by Propoxur.
Use your knowledge of natural selection to explain how a population of mosquitoes has become resistant to Propoxur. [4]

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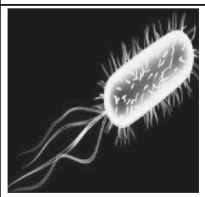
The photographs show five organisms (**A** to **E**) and the group to which each one belongs.

Organism	**A**	**B**	**C**	**D**	**E**
Photograph					
Group	fungi	insects	bacteria	mosses	mammals
Magnifications of photograph	× 0.50	× 1.0	× 2 000	× 0.40	× 0.25

(c) Two of the groups belong to the same Kingdom.

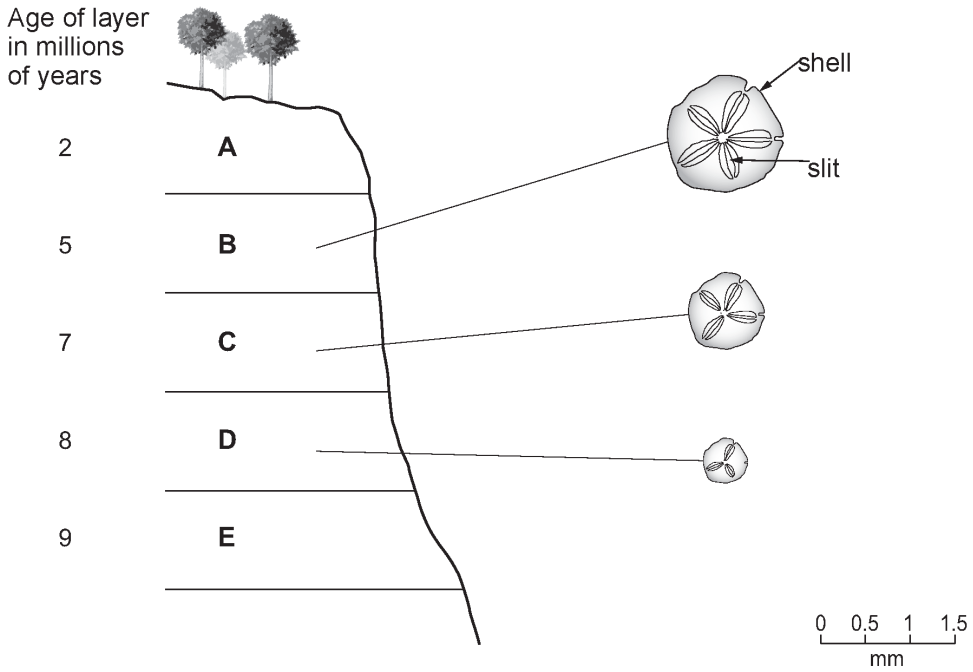
Give the names of the two groups and the Kingdom to which they belong. [2]

Name of group: ..... and .....

Kingdom: .....

20.

(a) Scientists found fossilised shells of one species of animal in the rock layers of a cliff. The age of each layer (**A**-**E**) is shown.



(ii) Describe **two** ways that the shell evolved (changed) over time. [2]

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(iv) Scientists think that this species became extinct about 2 million years ago. Give the evidence in the diagram that supports this idea. [1]

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(b) Species evolve by natural selection.
Give the name of the scientist who first described evolution by natural selection. [1]

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