

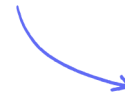
Structured Questions

Natural Selection

Natural Selection & Evolution / Selection Pressures / Selection Pressures: Skills

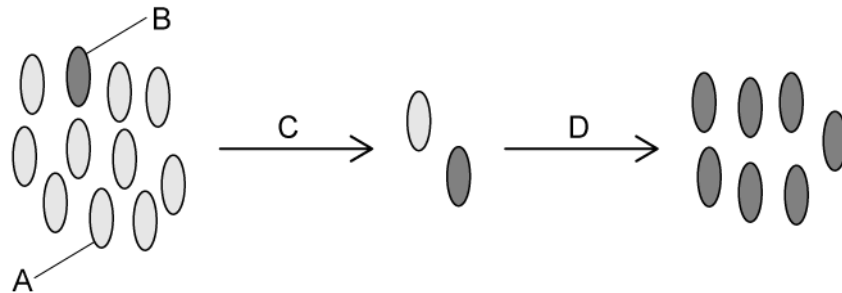
Easy (7 questions)	/26
Medium (7 questions)	/37
Hard (6 questions)	/27
Total Marks	/90

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Easy Questions

1 (a) The following diagram illustrates the development of antibiotic resistance in bacteria.



Annotate the bacteria labelled **A** and **B**.

(2 marks)

(b) State the selection pressure that is applied at **C**.

(1 mark)

(c) The mutation for antibiotic resistance is passed on to other bacteria at point **D**.

List **one** of the processes by which this could occur.

(1 mark)

(d) State **one** strategy that could be used to reduce the rate at which resistance evolves in bacteria.

(1 mark)

2 (a) The blackworm (*Lumbriculus variegatus*) is a species of worm native to North America and Europe. Blackworm habitat includes marshes, swamps and ponds, and they are a popular food source for fish kept in aquariums.

Each body segment is able to regenerate into a complete individual, and sexual reproduction in blackworms is very rare.



Dvortygirl, CC BY-SA 3.0, via [Wikimedia Commons](#)

(i) State the main source of variation in a blackworm population.

[1]

(ii) List **two** other sources of variation in other species.

[2]

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(3 marks)

(b) The blackworm in the image in part a) has grown a second tail. Its ability to regenerate body parts can be considered a useful adaptation.

(i) Define the term 'adaptation'.

[1]

(ii) Suggest **one** role of the regeneration abilities of the blackworm.

[1]

(2 marks)

3 Different alleles in a population result in different phenotypes.

State why it is easier to calculate a phenotype frequency than an allele frequency.

(1 mark)

- 4 (a)** A population of guppies has two alleles of a specific gene in its gene pool. The frequencies of the alleles are shown in the table below.

A mutation occurs in the population that leads to the formation of a new allele for the gene.

Complete the table below with the allele frequencies of the new allele between March and July.

Month	Frequency of allele 1	Frequency of allele 2	Frequency of new allele
January	0.81	0.19	0
February	0.78	0.22	0
March	0.77	0.21	
April	0.65	0.27	
May	0.51	0.34	
June	0.43	0.33	
July	0.40	0.24	

(1 mark)

- (b)** A few individuals with the mutated allele from the original population travelled to a new area and merged with a different population of guppies.

In the new population the frequency of the new allele remained low over many generations and then decreased.

Suggest a reason for the difference in the frequency of the new allele between the population in part a) and this new population.

(2 marks)

5 (a) Selection acting on modern day humans is minimal in the majority of populations.

Suggest **two** reasons why selection is minimal in the majority of populations.

(2 marks)

(b) Isolated groups, such as the Amish, make excellent subjects for scientific study.

Suggest **one** reason why scientists often focus on isolated groups for studies on inheritance and genetics.

(1 mark)

6 (a) Define the term **population**.

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(1 mark)

(b) A population of beetles lives in leaf litter on a forest floor. The beetles are predated on by various species of small birds and rodents.

The beetles have an outer wing case that protect their wings, known as an elytra, which occurs in different colours.

Explain how the beetle population could have evolved from having a large diversity elytra colours to having mostly brown and green.

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(4 marks)

7 Explain how natural selection could enable a population of bacteria to become resistant to an antibiotic.

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(4 marks)

Medium Questions

- 1 (a)** A group of biologists conducted an investigation on a remote archipelago (a collection of islands) in the Pacific Ocean. A species of mouse lives on these islands without any natural predators. The biologists measured the claw length of a large number of these mice.

On half of the islands a species of snake was accidentally introduced that preys on the mice but that cannot climb trees. Several years after the snakes were introduced the biologists returned and found that on the islands with snakes, the claw length of the mice had changed. Some had shorter claws, enabling them to run faster, while others had longer claws, enabling them to climb trees.

Suggest the benefit to the scientists' investigation of there being islands without any snakes present.

(2 marks)

- (b)** The evolution of long claws in the mice in part (a) was made possible by a mutation in the gene controlling claw length.

Explain how a mutation could lead to a change in claw length.

(3 marks)

- (c)** When the biologists conducted the investigation in part (a), flooding of the islands was very rare. Now, due to climate change, flooding of the islands occurs more regularly. This flooding can regularly wipe out large numbers of ground-living species.

Using this information and the information from part (a), explain how the claw length of the mice on the islands are likely to be changing now.

(3 marks)

2 Explain how natural selection can account for the development of antibiotic resistant bacterial strains.

(7 marks)

3 (a) The habitat of this rabbit population changed:

- Temperatures dropped
- Snowfall became more frequent

Explain the effect that this would have on the allele frequencies in the rabbit population over time.

(3 marks)

(b) After several generations the rabbit population accumulated several phenotypic differences to other rabbit populations in nearby habitats.

Explain how scientists could determine whether rabbits from these populations still belong to the same species.

(2 marks)

4 Mining for gold produces waste rocks and mine tailings, which contain sulfur-bearing minerals. When surface water and shallow groundwater come into contact with these minerals, a chemical reaction occurs which produces sulfuric acid. This process is known as acid mine drainage and it can lower the soil pH to a level where very few plants can survive.

Environmentalists studied the area around an abandoned gold mine and discovered a few specimens of earleaf acacia (*Acacia auriculiformis*) surviving in the acidic soil. This species typically occurs in more neutral or alkaline soils.

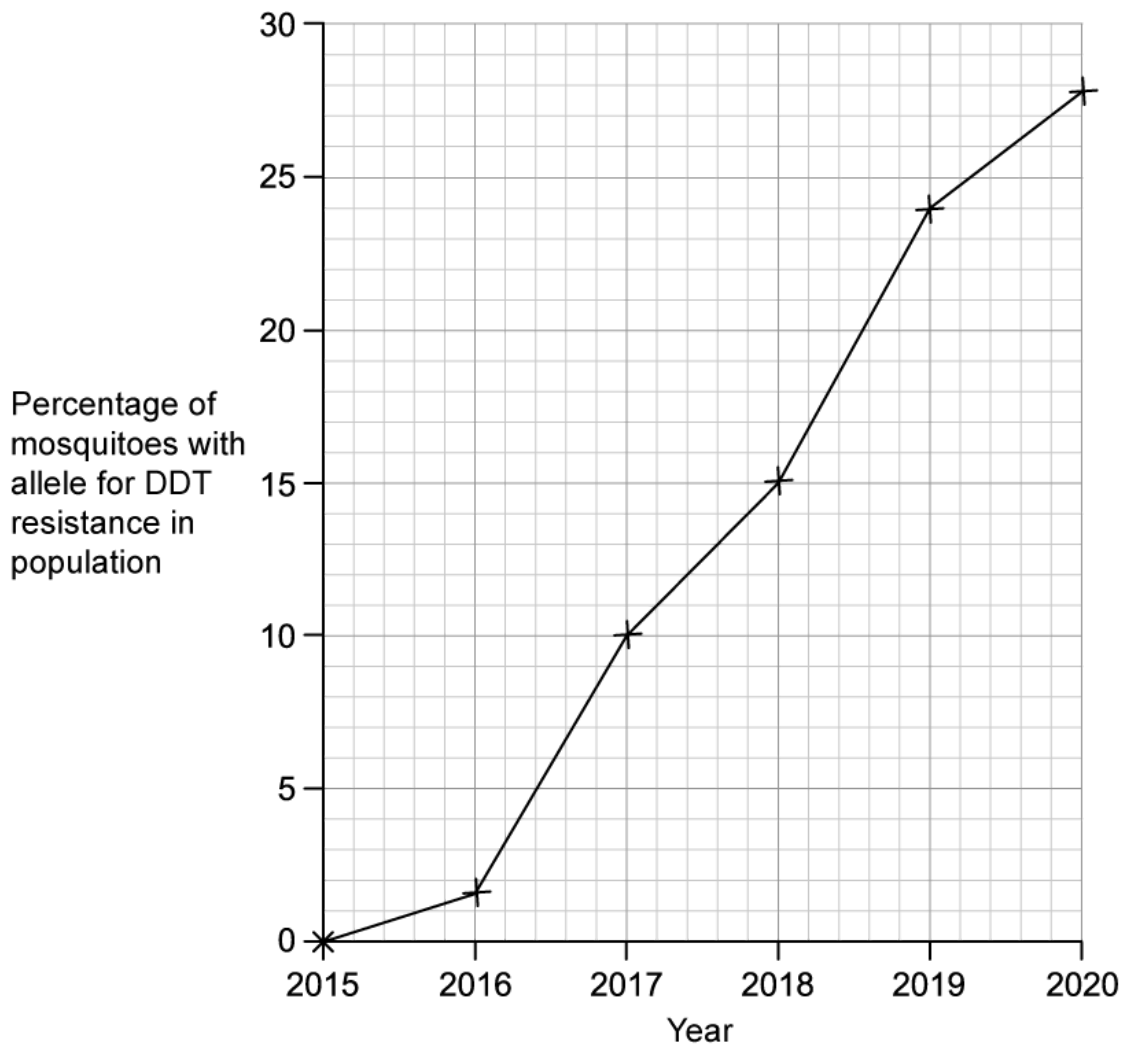
Explain how natural selection could produce a population of *Acacia auriculiformis* that would be tolerant of the acidic soil found around the mine shaft.

(4 marks)

5 (a) Mosquitoes spread a disease called malaria. DDT is a pesticide used to kill mosquitoes; it is used in many countries in Africa to control the spread of malaria.

Some mosquitoes have an allele that gives them resistance to DDT. A group of biologists studied how frequently this allele occurred in a population of mosquitoes in Uganda over 5 years.

The graph below shows the biologists' results.



Explain the results shown in the graph.

(3 marks)

(b) Calculate the percentage increase in the percentage of mosquitoes that have the allele for DDT resistance from 2017 to 2020.

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(2 marks)

6 Describe the process of evolution by natural selection.

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(6 marks)

7 Outline why some areas of the human genome are more susceptible to detrimental mutations than others.

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(2 marks)

Hard Questions

- 1 (a) Natural selection would not be possible without the presence of variation within a species.

Explain how variation allows natural selection to occur.

(3 marks)

- (b) Mutation, meiosis and sexual reproduction are all sources of genetic variation.

Outline the way in which each of these factors contributes to variation within a species.

(5 marks)

- 2 Some of the adjacent subspecies of *Ensatina* can successfully breed with one another, but the western subspecies *E. eschscholtzii* cannot interbreed with the eastern subspecies *E. klauberi*.

Based on the information provided, evaluate the claim made by some scientists that the different subspecies of *Ensatina* should be classified as separate species.

(2 marks)

3 (a) The turtle-headed sea snake, *Emydocephalus annulatus*, can be found in waters off the coast of Australia, New Zealand and New Caledonia. These snakes usually have banded patterns of white with dark rings, although some individuals exhibit a single dark colour with no banded patterns. The dark parts of the skin contains a high concentration of the pigment melanin, which binds to certain trace elements present in the water. These trace elements are removed from the body when the snake sloughs off the skin. It was found that melanic sea snakes will slough off the skin more frequently than those with banded colouration.

Scientists studied the frequency of melanic sea snakes from several sites in waters surrounding urban-industrial areas and waters from non urban-industrial areas. The results are shown in the table below.

Site	Melanic sea snakes in urban-industrial waters / %	Melanic sea snakes in non urban-industrial waters / %
A	78	23
B	95	0
C	64	14
D	92	2
E	98	7

Calculate the percentage difference in the mean frequency of melanic snakes found in urban-industrial waters and those that were present in non urban-industrial waters.

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(3 marks)

(b) Based on the information provided in part a), deduce the adaptive advantage of melanism to turtle-headed sea snakes.

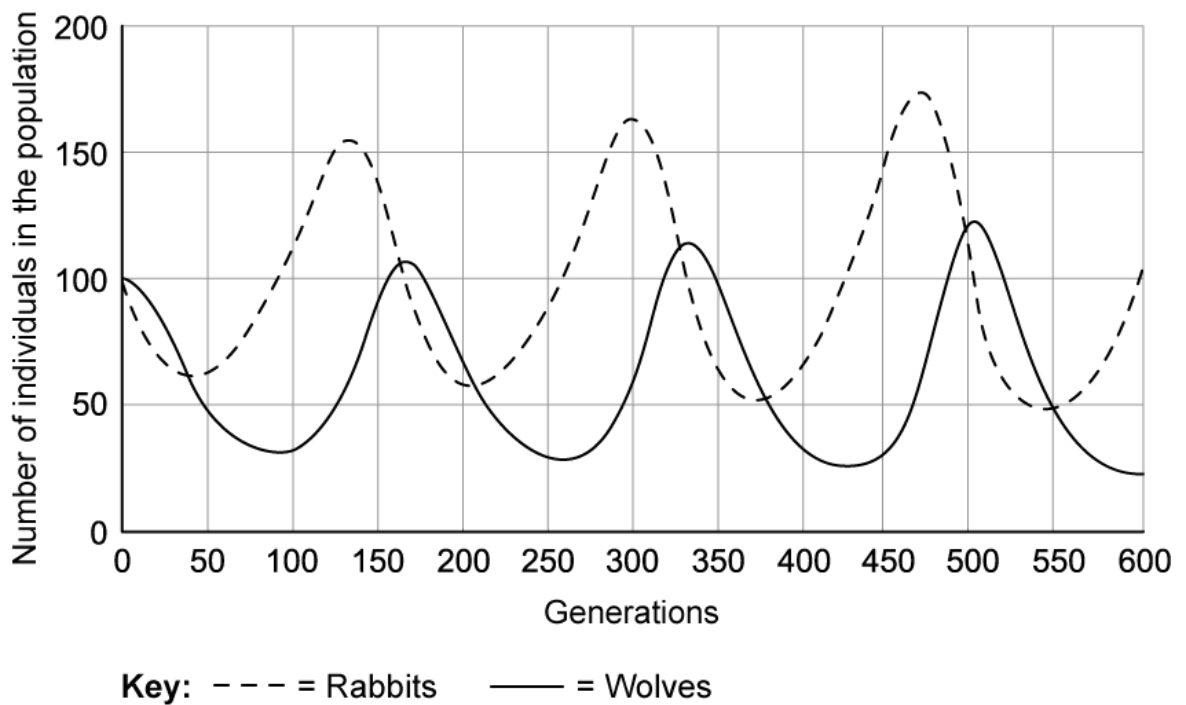
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(3 marks)

4 (a) The graph below shows the population sizes of a rabbit and a wolf population over many generations.



Explain the data in the graph for rabbit and wolf populations over the first 300 generations.

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(4 marks)

(b) At generation 350 in the graph shown in part b) the frequency of allele A is high, but never 100%.

State **one** reason why it is not beneficial for this population to have one allele at 100% frequency.

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(1 mark)

5 The evolution of Black bear body mass happened on Earth thousands of years ago.

Suggest how scientists know about their evolutionary past.

(1 mark)

6 The evolution of some species can be driven by female mating preferences, e.g. in a species of bird called the long-tailed widowbird, females have a preference for males with long tails. The long tails of male widowbirds have evolved from short-tailed ancestors despite being heavy and limiting male flying ability.

Discuss the selection process that has resulted in long tails in male widowbirds.

(5 marks)