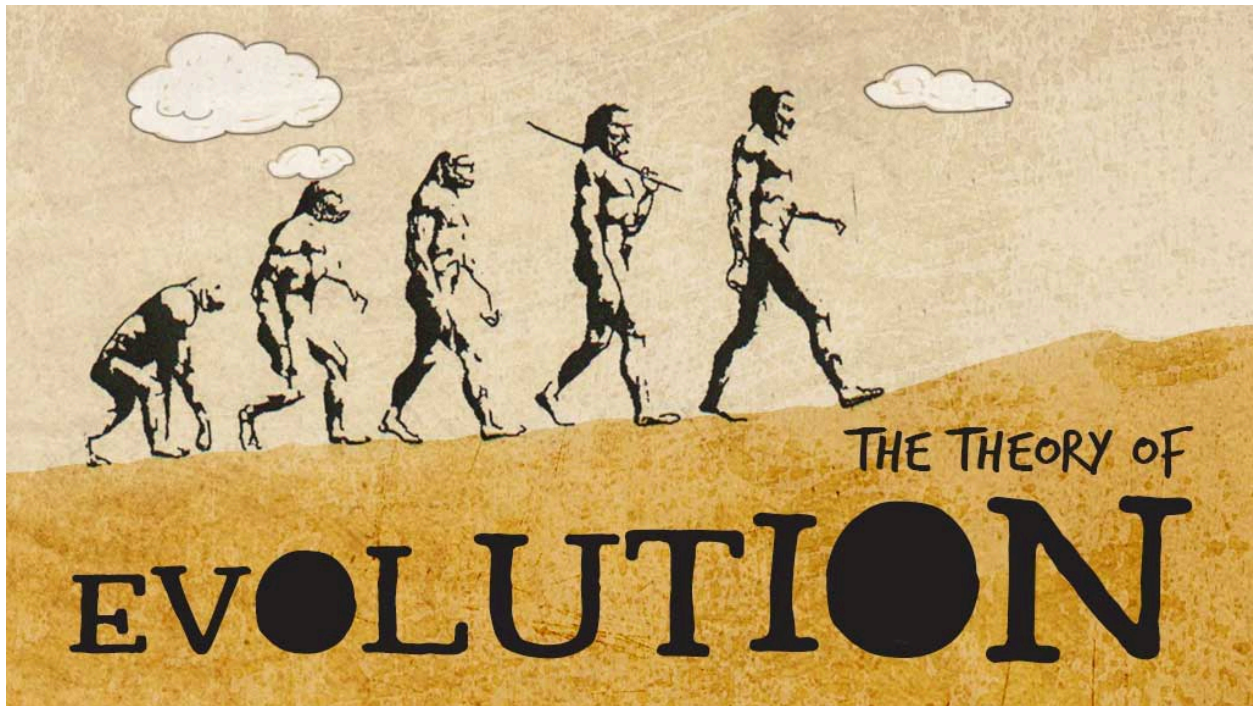


EVOLUTION



REVISION QUESTIONS

Compiled by: M. Fortuin - MNED

EXAM GUIDELINES:

EVOLUTION Paper 2: 66 marks	Terms 3/4	6 weeks
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CONTENT	ELABORATION
Introduction	❑ Definition of biological evolution ❑ Difference between a hypothesis and a theory ❑ The Theory of Evolution is regarded as a scientific theory since various hypotheses relating to evolution have been tested and verified over time
Evidence for evolution	❑ Role of the following as evidence for evolution: • Fossil record – Link to Grade 10 • Biogeography – Link to Grade 10 • Modification by descent (homologous structures) • Genetics
Variation	❑ Definition of a biological species and a population ❑ A review of the contribution of each of the following to variation that exists amongst individuals of the same species: • Meiosis - Crossing over - Random arrangement of chromosomes • Mutations • Random fertilisation • Random mating ❑ Continuous and discontinuous variation
Origin of an idea about origins (a historical development)	❑ Ideas on evolution in the order of their origin are as follows: • Lamarckism • Darwinism • Punctuated Equilibrium
Lamarckism (Jean Baptiste de Lamarck – 1744–1829)	❑ Lamarck used two 'laws' to explain evolution: • 'Law' of use and disuse • 'Law' of the inheritance of acquired characteristics ❑ Reasons for Lamarck's theory being rejected

CONTENT	ELABORATION
Darwinism (Charles Darwin – 1809–1882)	□ Darwin's theory of evolution by natural selection: • Organisms produce a large number of offspring. • There is a great deal of variation amongst the offspring. • Some have favourable characteristics and some do not. • When there is a change in the environmental conditions or if there is competition, • then organisms with characteristics, which make them more suited, survive • whilst organisms with unfavourable characteristics, which make them less suited, die. • The organisms that survive, reproduce • and thus pass on the allele for the favourable characteristic to their offspring. • The next generation will therefore have a higher proportion of individuals with the favourable characteristic. • In this way, the characteristics of a population gradually change over a long period of time.
Punctuated Equilibrium (Eldredge and Gould – 1972)	□ Punctuated Equilibrium explains the speed at which evolution takes place: • Evolution involves long periods of time where species do not change or change gradually through natural selection (known as equilibrium). • This alternates with (is punctuated by) short periods of time where rapid changes occur through natural selection • during which new species may form in a short period of time.
Artificial selection	□ Artificial selection involving: • A domesticated animal species • A crop species
Formation of new species	□ Biological species concept: similar organisms that are capable of interbreeding to produce fertile offspring □ Speciation and extinction and the effect of each on biodiversity □ Speciation through geographic isolation: • If a population of a single species • becomes separated by a geographical barrier (sea, river, mountain, lake) • then the population splits into two. • There is now no gene flow between the two populations. • Since each population may be exposed to different environmental conditions/the selection pressure may be different • natural selection occurs independently in each of the two populations • such that the individuals of the two populations become very different from each other • genotypically and phenotypically. • Even if the two populations were to mix again • they will not be able to interbreed. • The two populations are now different species. □ Speciation through geographic isolation in ONE of the following: • Galapagos finches • Galapagos tortoises • Plants on different land masses (linked to continental drift) - Baobabs in Africa and Madagascar - Proteas in South Africa and Australia • Any example of mammals on different land masses
Mechanisms of reproductive isolation (Keeping species separate)	□ A brief outline of reproductive isolation mechanisms that help to keep species separate: • Breeding at different times of the year • Species-specific courtship behaviour • Adaptation to different pollinators • Infertile offspring • Prevention of fertilisation

CONTENT	ELABORATION
Evolution in present times	□ Any ONE example of natural selection and evolution in present times: • Use of insecticides and consequent resistance to insecticides in insects • Development of resistant strains of tuberculosis-causing bacteria (MDR and XDR) to antibiotics, due to mutations (variations) in bacteria and failure to complete antibiotic courses • HIV resistance to antiretroviral medication • Bill (beak) and body size of Galapagos finches
Evidence of common ancestors for living hominids, including humans	□ Interpretation of a phylogenetic tree to show the place of the family Hominidae in the animal kingdom □ Characteristics that humans share with African apes □ Anatomical differences between African apes and humans, with the aid of diagrams, as it applies to the following characteristics: • Bipedalism (foramen magnum, spine and pelvic girdle) • Brain size • Teeth (dentition) • Prognathism • Palate shape • Cranial ridges • Brow ridges □ Lines of evidence that support the idea of common ancestors for living hominids including humans: • Fossil evidence: Evidence from fossils of different ages show that the anatomical characteristics of organisms changed gradually over time. • Emphasis on evolutionary trends provided by the anatomical features of fossils of the following three genera: - <i>Ardipithecus</i> - <i>Australopithecus</i> - <i>Homo</i> as well as: - The age of each fossil found/time-line for the existence of the three genera - The fossil sites where they were found: emphasis on the fossil sites that form a part of the Cradle of Humankind - The scientists who discovered them • Genetic evidence: mitochondrial DNA • Cultural evidence: tool-making
Out of Africa hypothesis	□ Evidence for the Out of Africa hypothesis: • Fossil evidence: information on each of the following fossils that serve as evidence for the Out of Africa hypothesis: - <i>Ardipithecus</i> (fossils found in Africa only) - <i>Australopithecus</i> (fossils found in Africa only, including Karabo, Littlefoot, Taung Child, Mrs Ples) - <i>Homo</i> (fossils of <i>Homo habilis</i> found in Africa only; oldest fossils of <i>Homo erectus</i> found in Africa, while the younger fossils were found in other parts of the world) • Genetic evidence: mitochondrial DNA □ Timeline for the existence of different species of the genus <i>Homo</i> and the significant features of each type of fossil to illustrate the differences amongst them □ Interpretation of phylogenetic trees proposed by different scientists showing possible evolutionary relationships as it applies to hominid evolution

BIOLOGICAL TERMS:

EXPLANATION	TERM
The deliberate breeding of organisms for desirable characteristics selected by humans.	
The explanation that species experience long periods without physical change, followed by short periods of rapid physical change.	
An explanation for something that has been observed in nature and which can be supported by facts, laws and tested hypotheses.	
Similar structures on different organisms that suggest they have a common ancestor.	
A tentative explanation of a phenomenon that can be tested.	
The distribution of species in different parts of the world.	
A diagrammatic representation showing possible evolutionary relationships among different species.	
The type of vision shared by apes and humans that allows for depth perception.	
The present –day distribution of organisms	
Evolution with long periods of no change followed by short periods of rapid change.	
Descent with modification over time.	
A group of organisms of the same species in a specific habitat.	
The family to which humans belong.	
The type of variation in a population with no intermediate phenotypes.	
The opening in the skull through which the spinal cord enters.	
A testable statement that can be rejected or accepted.	
Total disappearance of a species from Earth.	
The ability to walk on two limbs.	
The breeding of organisms over many generations in order to achieve a desirable phenotype.	

Type of evolution involving long periods of time when species do not change and short periods of rapid change.	
The hypothesis which supports migration of human ancestors from the point of origin.	
The mineralised remains of organisms that have lived in the past.	
The genus of the fossil "Little Foot"	
The first Homo species to use tools	
A breeding process used for the domestication of plants and animals.	
Type of variation within a population in which there is a range of intermediate phenotypes.	
An upright posture and walking only on two legs.	
Study of fossils.	
Present-day distribution of living organisms across the continents.	
Family to which humans belong.	
The type of evidence for human evolution that includes tool-making.	
The process whereby new species are formed.	
The type of variation in a population with no intermediate phenotypes.	
A diagram representing possible evolutionary relationships between species.	
An explanation describing evolution as consisting of long phases of little change alternating with short phases of rapid change.	
The permanent disappearance of a species from Earth.	
Genus to which Little Foot and Mrs. Ples belongs.	

REVISION QUESTIONS: MULTIPLE CHOICE

Question 1.1

- 1.1.3 Lamarck's 'laws' of use and disuse and inheritance of acquired characteristics were ...
- A rejected, because only characteristics that benefit offspring can be inherited.
 - B not rejected, because evidence shows that acquired characteristics can be inherited.
 - C rejected, because only characteristics that are coded for in the DNA can be inherited.
 - D not rejected, because Darwin's theory supports Lamarck's ideas.

Question 1.2

- 1.1.1 The theory of evolution by natural selection was first described by ...
- A Gregor Mendel.
 - B Watson and Crick.
 - C Jean Baptiste de Lamarck.
 - D Charles Darwin.

Question 1.3

- 1.1.7 Study the list below.

1. Fossils
2. Homologous structures
3. Biogeography
4. Genetics

Which ONE of the combinations of the above can be used as evidence for evolution?

- A 1, 2 and 3 only
- B 1, 2, 3 and 4
- C 2, 3 and 4 only
- D 1, 3 and 4 only

Question 1.4

- 1.1.4 A phylogenetic tree represents ...
- A the number of species on Earth.
 - B only species that belong to the same genus.
 - C only organisms that are now extinct.
 - D possible evolutionary relationships.

Question 1.5

- 1.1.8 The modern human skull ...
- A has small canines.
 - B has pronounced brow ridges.
 - C is prognathous.
 - D has a U-shaped arrangement of teeth on each jaw.

Question 1.6

- 1.1.6 A trait that has a range of phenotypes is an example of ...
- A continuous variation.
 - B discontinuous variation.
 - C complete dominance.
 - D codominance.

Question 1.7 & 1.8

1.1.9 Which ONE of the following represents the correct order for the evolution of modern humans?

- A *Ardipithecus* → *Australopithecus* → *Homo*
- B *Australopithecus* → *Ardipithecus* → *Homo*
- C *Homo* → *Australopithecus* → *Ardipithecus*
- D *Ardipithecus* → *Homo* → *Australopithecus*

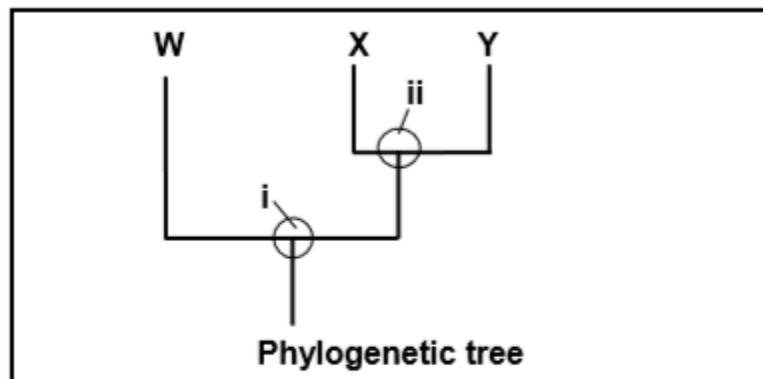
1.1.10 Which ONE of the following represents a trend in human evolution?

- A More developed brow ridges
- B Increased size of canines
- C More developed cranial ridges
- D More forward position of the foramen magnum (10 x 2)

Question 1.9

1.1.5 The diagram below shows a generalised phylogenetic tree.

The different ancestors in the phylogenetic tree are represented by **i** and **ii**.



Which ONE of the following is the most appropriate conclusion that can be made from the phylogenetic tree?

- A **ii** is a common ancestor of **X** and **Y** only.
- B **i** is a common ancestor of **W** and **X** only.
- C **W** and **X** are more closely related than **X** and **Y**.
- D **X** and **Y** belong to the same species.

Question 1.10

1.1.4 Artificial selection in farm animals over many generations has produced changes. These changes are mostly due to ...

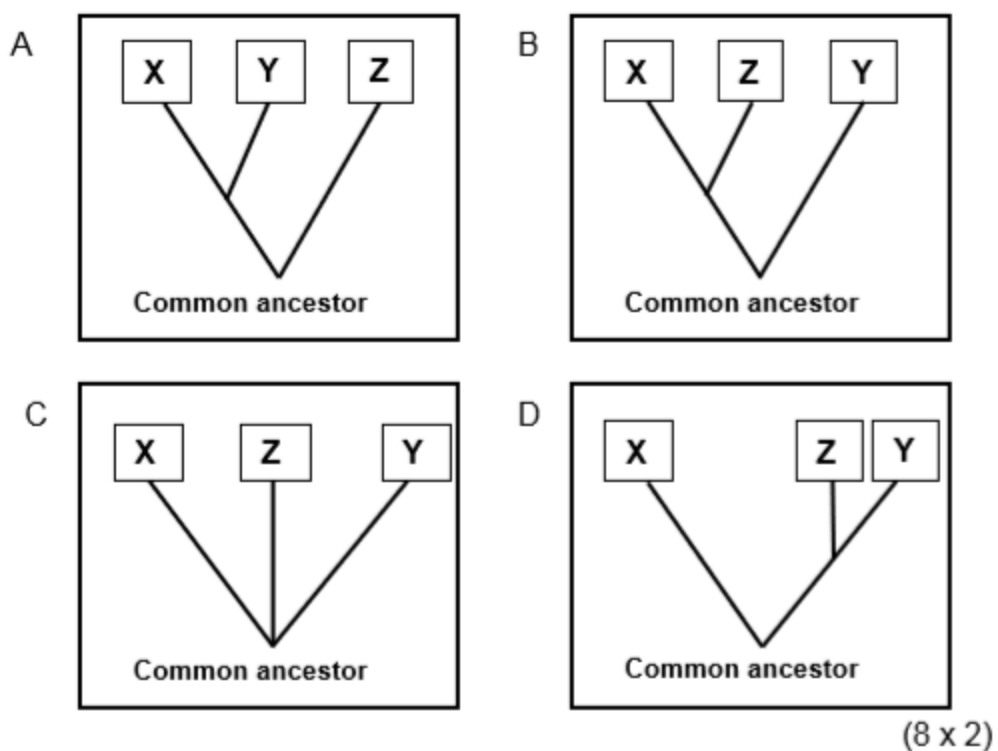
- A random mating.
- B gene mutations in each generation.
- C improved traits for survival.
- D breeding of selected animals.

Question 1.11

- 1.1.8 DNA analyses were done on three related species of fish (**X**, **Y** and **Z**). The number of differences is recorded in the table below. The more differences, the less related the species.

NUMBER OF DIFFERENCES IN DNA		
	Species Y	Species Z
Species X	11	3
Species Y	-	10

Based on this evidence, which phylogenetic tree best represents the evolutionary relationship amongst these three species?

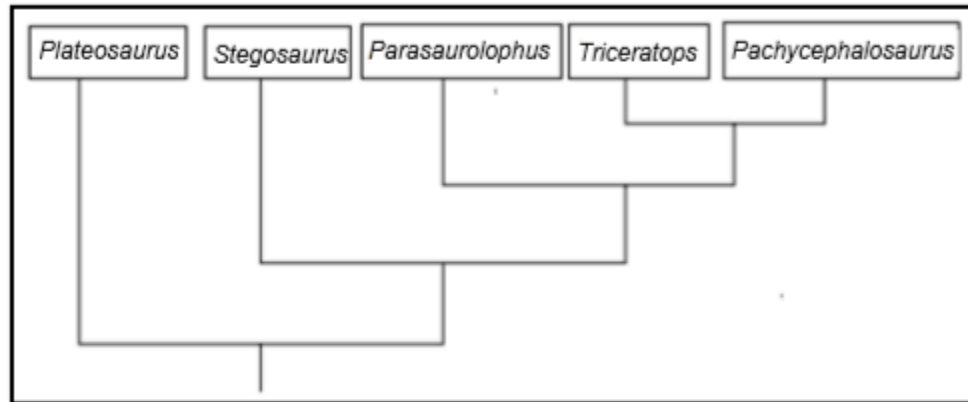


Question 1.12

- 1.1.9 A possible explanation for an observation that can be tested is known as a ...
- A fact.
 - B law.
 - C theory.
 - D hypothesis.

Question 1.13

1.1.10 Common structural characteristics between groups of dinosaurs were used to construct the phylogenetic tree below.



The two groups of dinosaurs with the most characteristics in common are ...

- A *Triceratops* and *Pachycephalosaurus*.
B *Parasaurolophus* and *Triceratops*.
C *Stegosaurus* and *Parasaurolophus*.
D *Plateosaurus* and *Stegosaurus*.

(10 x 2)

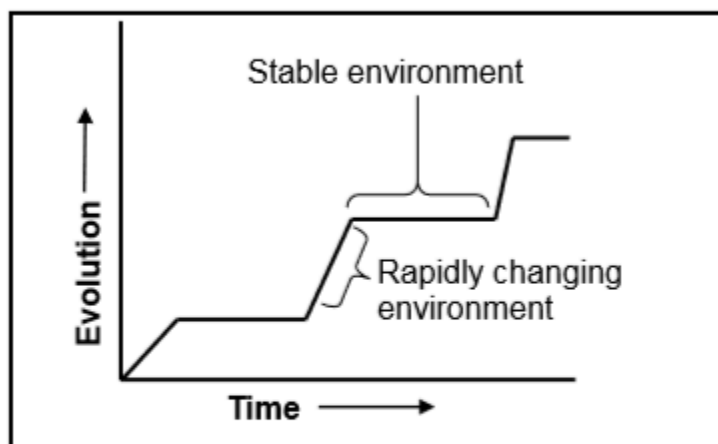
Question 1.14

1.1.9 Which ONE of the following statements is CORRECT for the 'Out of Africa' hypothesis?

- A All modern humans originated in Africa and migrated to other parts of the world.
- B All modern humans evolved from African apes and then migrated to other parts of the world.
- C The most developed artefacts (tools; cutlery; art) were found in Africa.
- D An analysis of mutations on the mitochondrial DNA shows that the oldest male ancestors were located in Africa. (9 x 2)

Question 1.15

- 1.1.10 The graph below shows the pace at which evolution occurs in a species of butterfly.



The type of evolution represented above is ...

- A speciation.
- B inheritance of acquired characteristics.
- C punctuated equilibrium.
- D artificial selection.

(10 x 2)

Question 1.16

- 1.1.2 The list below describes features of evolutionary theories.

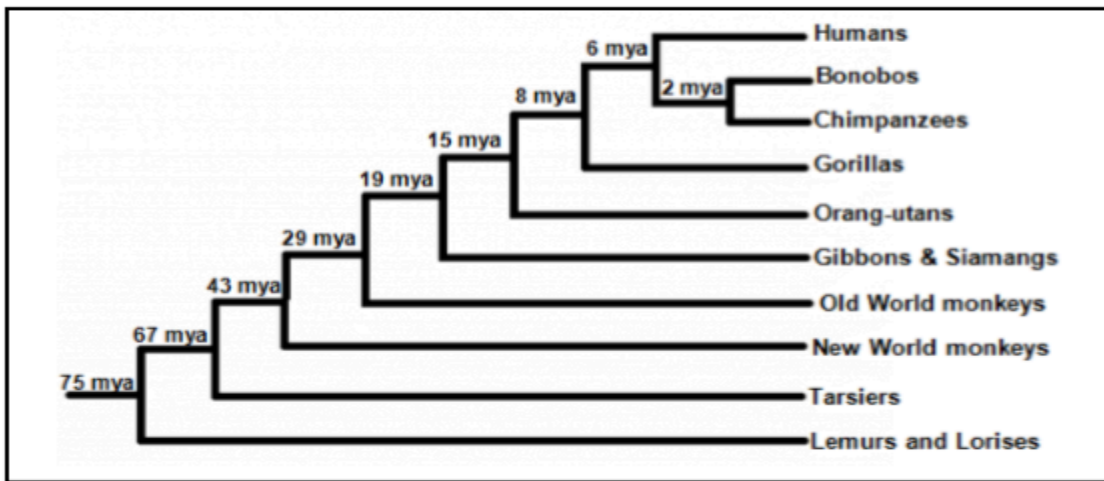
- (i) Involves long periods of time during which species do not change
- (ii) Is always a gradual process
- (iii) Is supported by the absence of transitional fossils
- (iv) New species are formed in a short period of time

Which combination of features gives the correct characteristic of punctuated equilibrium?

- A (i) and (iv) only
- B (i), (iii) and (iv)
- C (ii) and (iii) only
- D (i) and (iii) only

Question 1.17

1.1.10 The diagram below shows a phylogenetic tree of some primates.

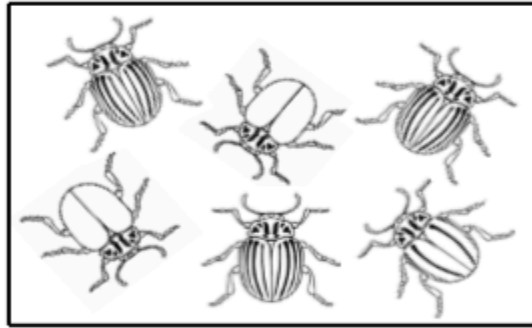


According to the phylogenetic tree, the most recent common ancestor of ...

- A humans and chimpanzees became extinct 2 million years ago.
 - B humans and gorillas became extinct 15 million years ago.
 - C humans and chimpanzees became extinct 6 million years ago.
 - D gorillas and chimpanzees became extinct 2 million years ago.
- (10 x 2)

Question 1.18

- 1.1.3 Charles Darwin based the theory of evolution through natural selection on many observations.



Which ONE of his observations is represented in the diagram above?

- A Limited environmental resources
- B Populations remain stable over time
- C Individuals within a population may vary widely
- D Only the fittest will survive

Question 1.19

- 1.1.4 Antibiotic resistance in bacteria is an example of evolution in present times.

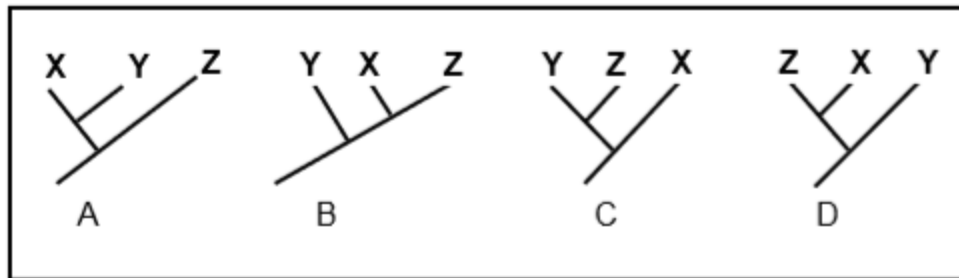
Which ONE of the following is a CORRECT explanation for this evolution?

- A The bacteria acquire resistance to the antibiotic by being exposed to it.
- B There is variation in the bacteria and the resistant bacteria survive.
- C The greater the number of bacteria, the higher the resistance.
- D The greater the number of bacteria, the lower the resistance.

Question 1.20

- 1.1.5 Three related species, **X**, **Y** and **Z**, share a common ancestor. Species **Y** and **Z** share the MOST RECENT common ancestor.

Which phylogenetic tree most accurately represents their evolutionary relationship?



Question 1.21

- 1.1.7 Which ONE of the following is a reproductive isolating mechanism?

- A Breeding at different times of the year
- B Same pollinators for different species of plants
- C Absence of a geographic barrier
- D Cloning

Question 1.22

- 1.1.2 Evidence supporting the evolution theory is obtained by studying the structure of vertebrate forelimbs.

This type of evidence for evolution is best described as ...

- A biogeography.
- B modification by descent.
- C DNA evidence.
- D genetic evidence.

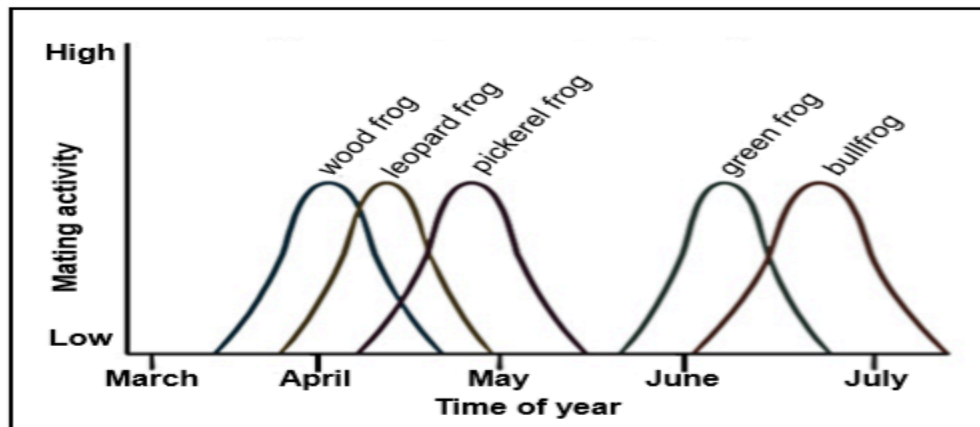
Question 1.23

1.1.7 Which ONE of the following is the correct genus and scientist for the discovery of the 'Taung Child' fossil?

- A *Ardipithecus*; Raymond Dart
- B *Ardipithecus*; Tim White
- C *Australopithecus*; Raymond Dart
- D *Australopithecus*; Tim White

Question 1.24

1.1.8 Different frogs, which all belong to the genus *Lithobates*, are found in the same forest. The graph below shows their mating activity.



Based on the information, what kind of isolating mechanism is most likely keeping the bullfrogs and wood frogs as separate species?

- A Geographic isolation through the presence of geographic barriers
- B Reproductive isolation through species-specific courtship behaviour
- C Reproductive isolation through breeding at different times of the year
- D Reproductive isolation through the production of infertile offspring

QUESTION 1.25

1.1.1 What is the scientific name of the fossil, Mrs Ples?

- A *Homo erectus*
- B *Homo habilis*
- C *Australopithecus africanus*
- D *Australopithecus afarensis*

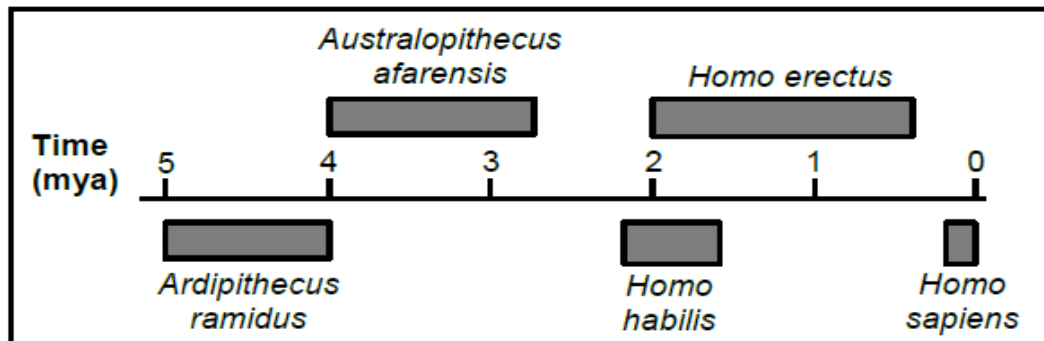
QUESTION 1.26

1.1.2 Which ONE of the following is a structural feature of a bipedal organism?

- A Long, narrow pelvis
- B Short, wide pelvis
- C C-shaped vertebral column
- D Longer arms

QUESTION 1.27 & 1.28

QUESTIONS 1.1.4 AND 1.1.5 ARE BASED ON THE TIMELINE BELOW SHOWING THE POSSIBLE EVOLUTION OF SOME HOMINIDS.



1.1.4 Which species inhabited the Earth for the longest period of time?

- A *Australopithecus afarensis*
- B *Homo erectus*
- C *Homo habilis*
- D *Homo sapiens*

1.1.5 How many years ago did the genus *Homo* first appear?

- A 2,2 mya
- B 2,0 mya
- C 1,6 mya
- D 0,2 mya

QUESTION 1.29

1.1.6 The list below describes some evolutionary events.

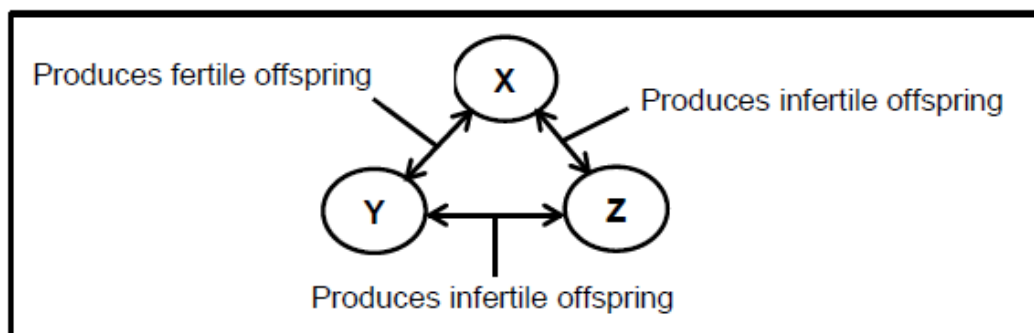
- (i) Each population undergoes natural selection differently and independently.
- (ii) There is no gene flow between the two populations.
- (iii) A population becomes separated.
- (iv) A geographical barrier forms.
- (v) The two populations become different phenotypically and genotypically.

Which ONE of the following combinations gives the CORRECT sequence of these events?

- A (v) → (iii) → (ii) → (i) → (iv)
- B (iv) → (v) → (ii) → (i) → (iii)
- C (iv) → (iii) → (ii) → (i) → (v)
- D (ii) → (iii) → (iv) → (i) → (v)

QUESTION 1.30

1.1.7 The diagram below shows the fertility of the offspring produced when three populations of mice, X, Y and Z, interbreed.



Which ONE of the following statements is CORRECT?

- A All three populations are of the same species.
- B Populations X and Z are of the same species, but populations X and Y are different species.
- C Populations Y and Z are different species, but populations X and Y are of the same species.
- D Populations X and Y are different species, but populations Y and Z are of the same species.

QUESTION 1.31

Which ONE of the following characteristics applies to bipedal organisms?

- A A more backwards position of the foramen magnum
- B A short, narrow pelvis
- C A long, wide pelvis
- D An S-shaped spine

QUESTION 1.32

Which ONE of the following statements about biodiversity is CORRECT?

- A Speciation increases biodiversity.
- B Biodiversity is the number of organisms in a population.
- C Extinction increases biodiversity.
- D Speciation and extinction have no effect on biodiversity.

QUESTION 1.33

Thando and Mary gave the four characteristics below about themselves.

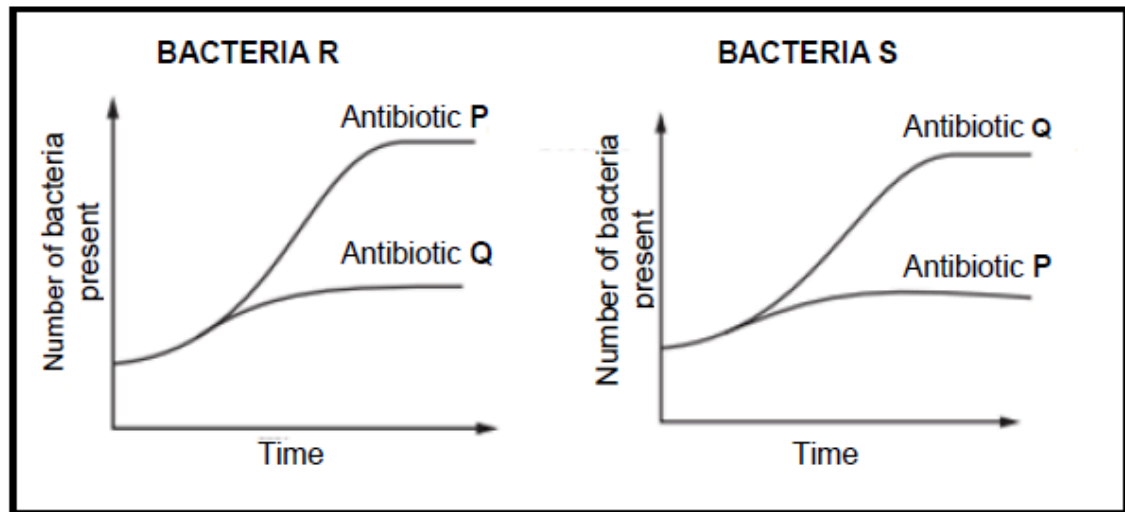
	THANDO	MARY
P	I am a boy.	I am a girl.
Q	I am 150 cm tall.	I am 153 cm tall.
R	I have attached earlobes.	I have attached earlobes.
S	My blood group is A.	My blood group is AB.

Which statements describe the characteristics of discontinuous variation?

- A P, Q and S only
- B P, R and S only
- C Q, R and S only
- D P, Q, R, and S

QUESTION 1.34

- 1.1.8 The graphs below show the effect of two antibiotics, **P** and **Q**, on two different species of bacteria, **R** and **S**.



What conclusion can be drawn from the graphs?

- A Bacteria **R** is less resistant to antibiotic **P** than **Q**.
- B Bacteria **R** is more resistant to antibiotic **P** than **Q**.
- C Antibiotic **Q** is equally effective on bacteria **R** and **S**.
- D Antibiotic **P** is equally effective on bacteria **R** and **S**. (8 x 2)

QUESTION 1.35

Which ONE of the following refers to a gradual change in the structure of organisms over time?

- A Natural selection
- B Mutation
- C Evolution
- D Speciation

QUESTION 1.36

Study the mechanisms below:

- (i) Species-specific courtship behaviour
- (ii) Infertile offspring
- (iii) Adaptation to different pollinators
- (iv) Breeding at the same time of the year

Which ONE of the following combinations represents reproductive isolating mechanisms?

- A (i), (ii) and (iv) only
- B (ii), (iii) and (iv) only
- C (i), (ii) and (iii) only
- D (i), (ii), (iii) and (iv)

QUESTION 1.37

The theory of evolution has been supported by a comparative study of the structure of vertebrate forelimbs from the fossil record.

Which ONE of the following represents the statement above?

- A Genetic evidence
- B Modification by descent
- C Natural selection
- D Biogeography

QUESTION 1.38

The table below compares the rate of extinction of mammal species over two different time periods.

TIME PERIOD (YEARS)	RATE OF EXTINCTION (PER 100 YEARS)
1500–1900	4,5
1900–2000	90

What is the ratio between the rate of extinction from 1500 to 1900 compared to the rate of extinction from 1900 to 2000?

- A 1 : 20
- B 1 : 2
- C 2 : 1
- D 20 : 1

QUESTION 1

VARIATION

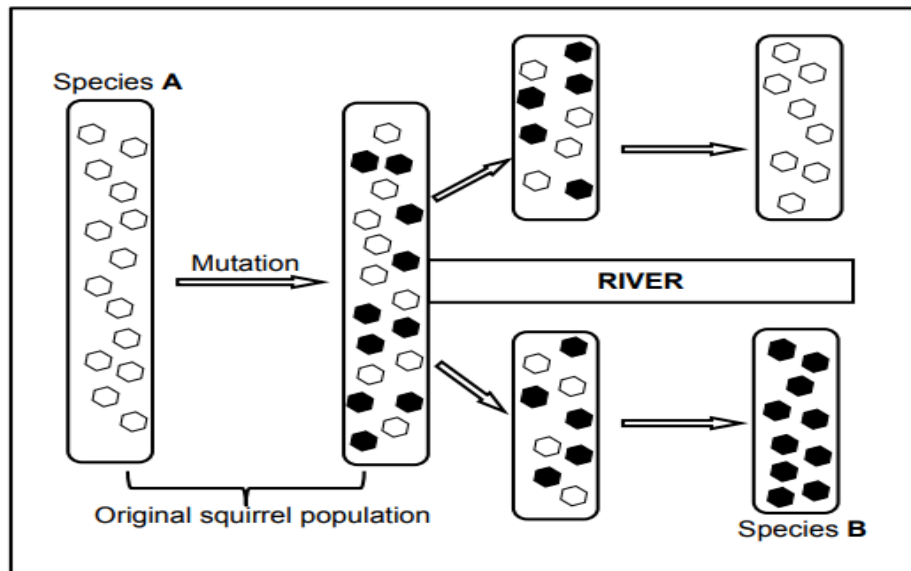
2.2 Mutations result in genetic variation.

2.2.1 Give THREE other sources of genetic variation in a species. (3)

2.2.2 Differentiate between *continuous variation* and *discontinuous variation*. (2)
(5)

QUESTION 2

2.2 A mutation occurred within a population of squirrels. This population was then separated by a river. Many years later it was discovered that the original population had undergone speciation. The process of speciation is shown in the diagram below.



2.2.1 Define a *population*. (2)

2.2.2 Other than mutations, give THREE causes of variation in a population. (3)

2.2.3 Explain why there were eventually more squirrels with the mutation on one side of the river. (3)

2.2.4 Explain what effect the process above has on the biodiversity in this ecosystem. (2)

2.2.5 It was discovered that species **A** and **B** were TWO separate species.

Describe what can be done to confirm that the squirrels belong to two different biological species. (2)
(12)

QUESTION 3

EVOLUTION THEORIES

- 2.1 The explanation for evolution by Lamarck is not accepted today.
- 2.1.1 Describe how Lamarck explained evolution. (4)
- 2.1.2 Give TWO reasons for the rejection of Lamarck's theory. (2)
- 2.1.3 Differentiate between a *hypothesis* and a *theory*. (2)
- (8)**

QUESTION 4

- 3.2 Tabulate THREE differences between *Lamarckism* and *Darwinism*. (7)

QUESTION 5

- 3.2 Read the extract below.

The red-bellied black snake (*Pseudechis porphyriacus*) and the green tree snake (*Dendrelaphis punctulatus*) are predators that sometimes feed on cane toads (*Bufo marinus*) that contain a toxin that may kill them.

The snakes consume the toads by swallowing them whole. A decrease in the average jaw size of the snakes has been observed over a period of 70 years. Some scientists believe that this may be an example of punctuated equilibrium. With this change it was also noted that the snakes could no longer swallow the large cane toads. This has resulted in an increase in the survival of the snakes.

- 3.2.1 Define *punctuated equilibrium*. (3)
- 3.2.2 What characteristic of the toad species protects it from predation? (1)
- 3.2.3 Explain how the change in jaw size helped the snakes to survive. (3)
- 3.2.4 How would Lamarck have explained the development of a small jaw size in the snakes? (4)
- (11)**

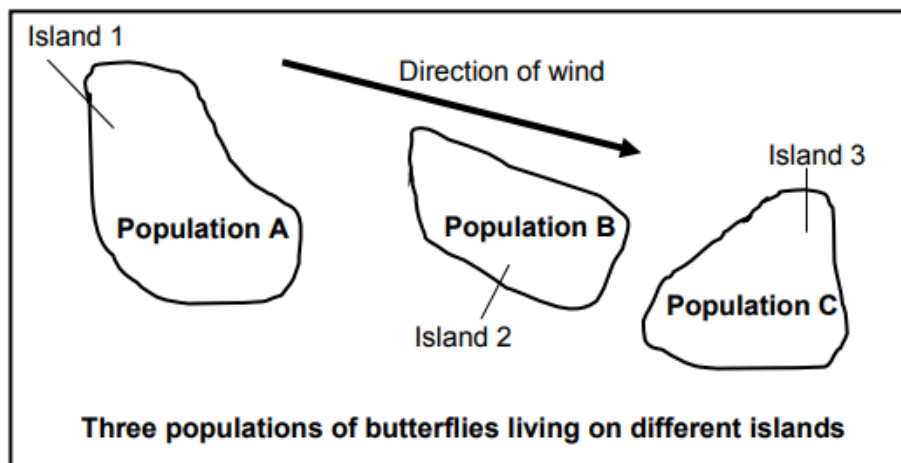
QUESTION 6

SPECIATION

- 3.1 Three populations of butterflies, **A**, **B** and **C** live separately on three oceanic islands. The butterflies on Island 2 and Island 3 originated from Island 1.

The islands experience strong prevailing winds from the north-west throughout the year.

Populations **A** and **B** can interbreed and produce fertile offspring. Population **B** can mate with Population **C**, but the offspring are infertile. Mating does not occur between Populations **A** and **C** at all.



[Adapted from *Advanced Biology*, M Kent, 2000]

- 3.1.1 How many species are represented by the three populations? (1)
- 3.1.2 Explain your answer to QUESTION 3.1.1. (2)
- 3.1.3 Use the information provided to explain how speciation might have taken place in the above example. (5)
- (8)

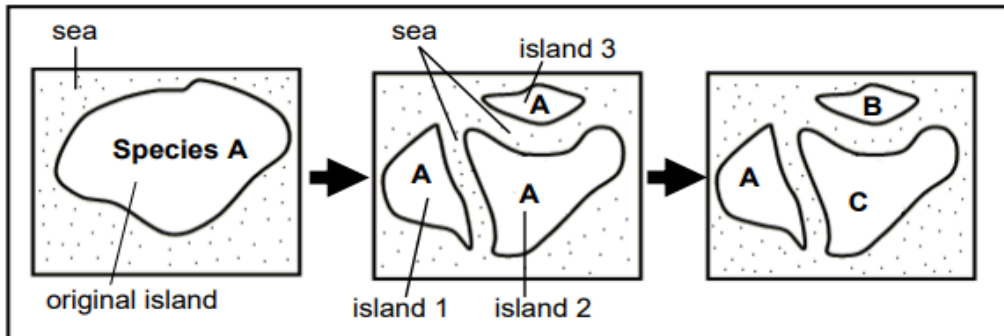
QUESTION 7

- 2.5 Describe how new species may form through geographic isolation. (6)

QUESTION 8

2.1 The diagrams below represent the process of speciation in tortoises.

Over a period of time species **B** and **C** evolved from species **A**.

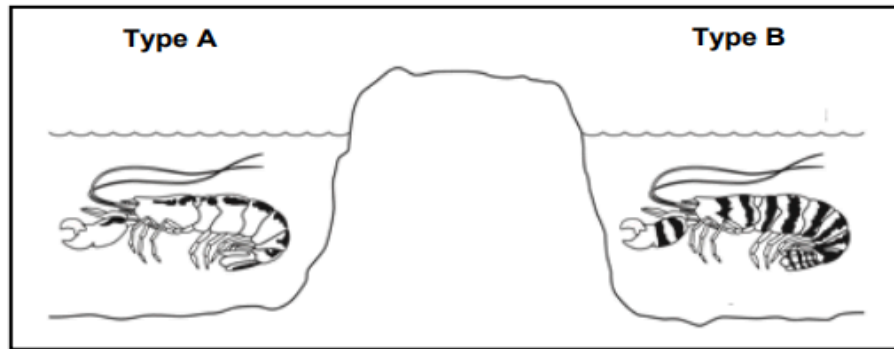


2.1.1 Explain why species **A** continued to exist on island **1**. (2)

2.1.2 Describe how species **B** and **C** evolved from species **A**. (6)
(8)

QUESTION 9

- 2.2 The diagram below represents two types of shrimp. Each type lives in shallow seas on opposite sides of a strip of land.



[Adapted from www.pbs.org/wgbh/evolution/library]

In an investigation to determine whether the two types of shrimp were from one species, scientists placed type A shrimps and type B shrimps together in a tank of seawater.

Although the shrimps mated with their own types, the two types of shrimp did not mate with each other. The scientists repeated the investigation several times and obtained the same result each time.

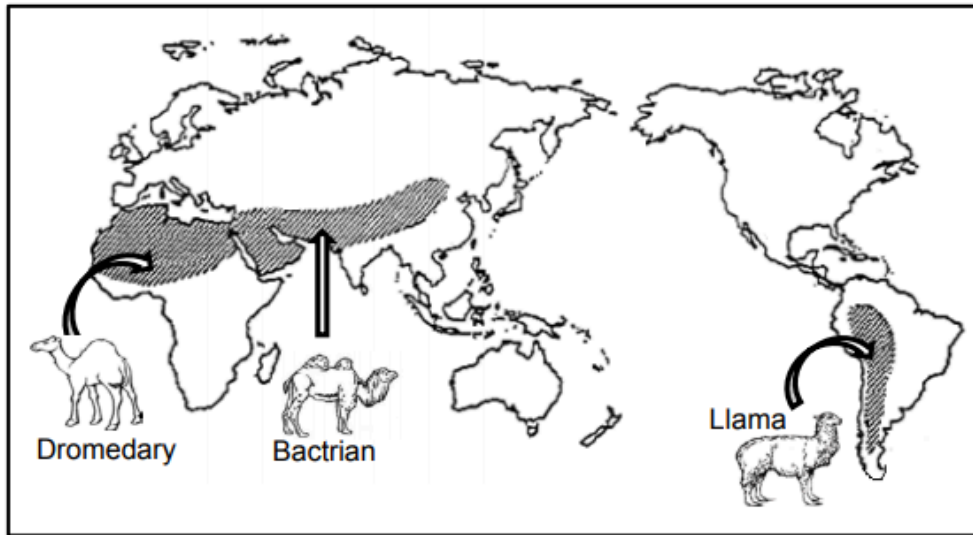
- 2.2.1 Give ONE conclusion the scientists came to after the investigation. (1)
- 2.2.2 Explain your answer to QUESTION 2.2.1. (2)
- 2.2.3 Why did the scientists repeat the investigation? (1)
- (4)

QUESTION 10

- 2.3 Describe how speciation occurs through geographic isolation. (5)

QUESTION 11

- 3.3 The diagram below shows the distribution of members of the camel family on the different continents. The arrows indicate the current distribution of the animals.



[Adapted from <http://www.ck12.org>]

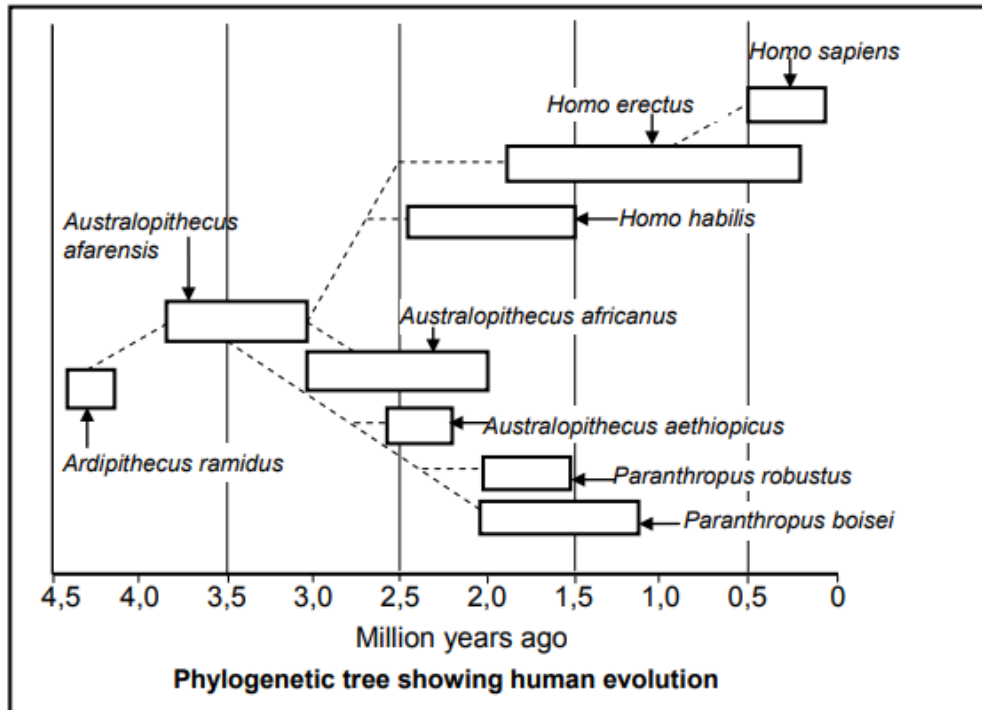
Explain how speciation of camels may have occurred.

(6)

QUESTION 12

PHYLOGENETIC DIAGRAMS

- 2.3 Study the phylogenetic tree below showing a possible representation of human evolution and answer the questions which follow.

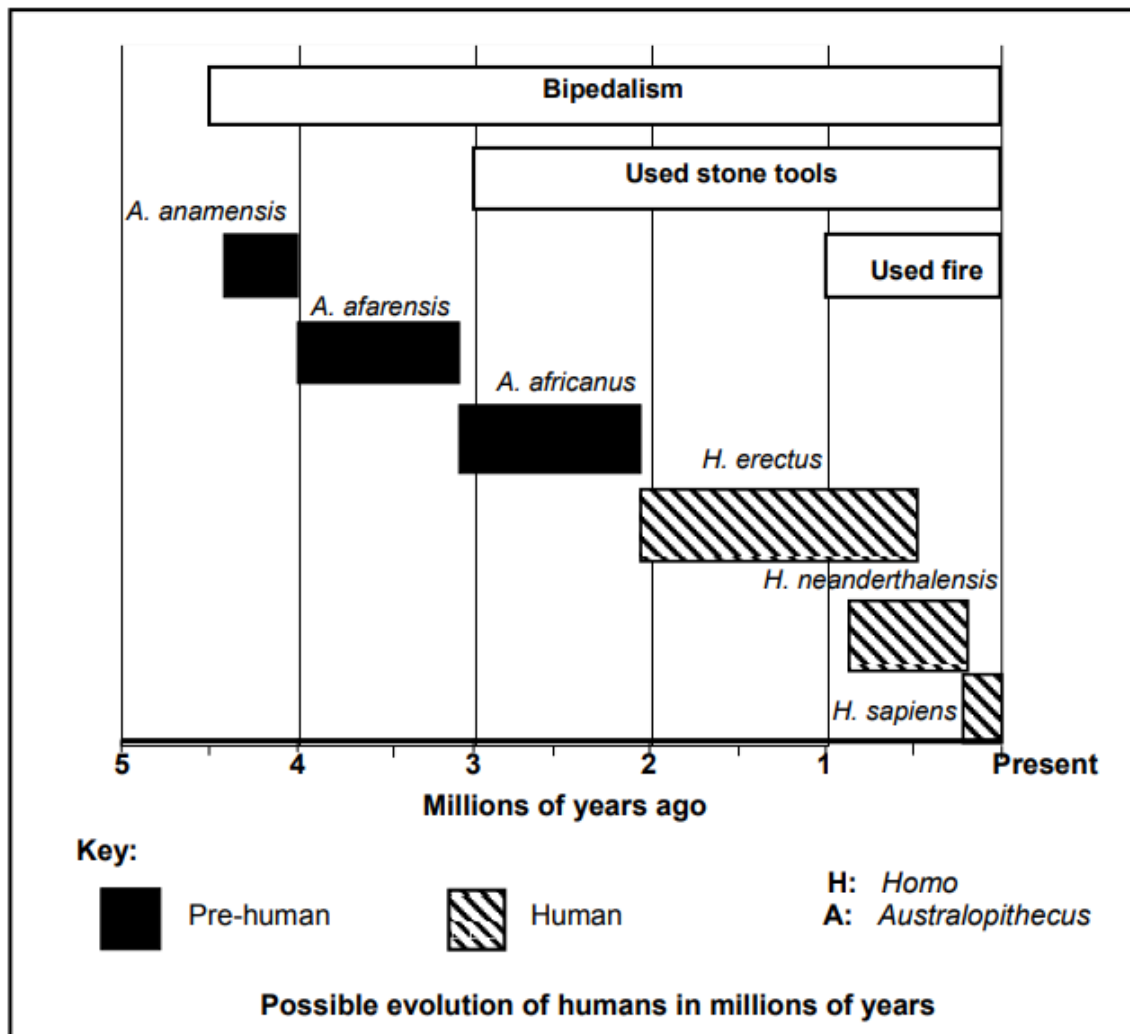


[Adapted from *Biology: Understanding Life*, Sandra Alters, 1995]

- 2.3.1 According to the phylogenetic tree, which organism, *Paranthropus boisei* or *Homo habilis*, appeared first on Earth? (1)
- 2.3.2 Name TWO species whose existence on Earth overlapped with that of *Homo erectus*. (2)
- 2.3.3 Which organism was the direct ancestor of *Homo habilis*? (1)
- 2.3.4 List FIVE characteristics that are shared by all the organisms in the above phylogenetic tree. (5)
- 2.3.5 How long did *Australopithecus africanus* exist on Earth? (1)
- (10)

QUESTION 13

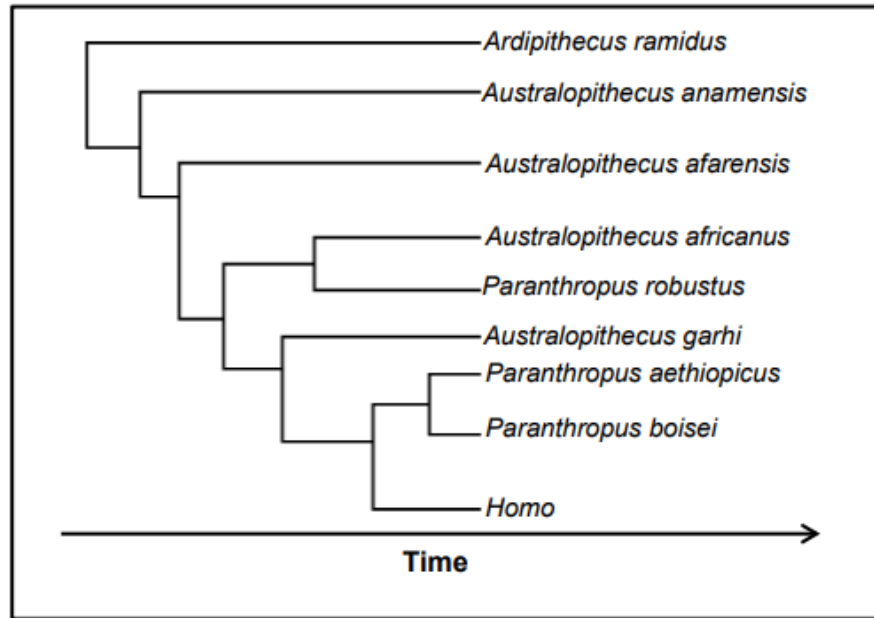
- 3.4 The diagram below represents the possible evolution of humans, as well as the time period for the development of bipedalism, the use of fire and the use of tools.



- 3.4.1 Use the diagram above and identify TWO bipedal organisms that did not use stone tools or fire. (2)
- 3.4.2 How long after developing the ability to walk on two feet did pre-humans develop the ability to use stone tools? Show ALL working. (3)
- 3.4.3 Explain the significance of the characteristic of the skull which allowed for the development of the ability to use tools in the *Homo* species. (2)
- 3.4.4 Explain the relationship between the use of fire and changes in dentition in the *Homo* species. (2)
- (9)

QUESTION 14

- 2.5 The diagram below shows possible evolutionary relationships between hominids.

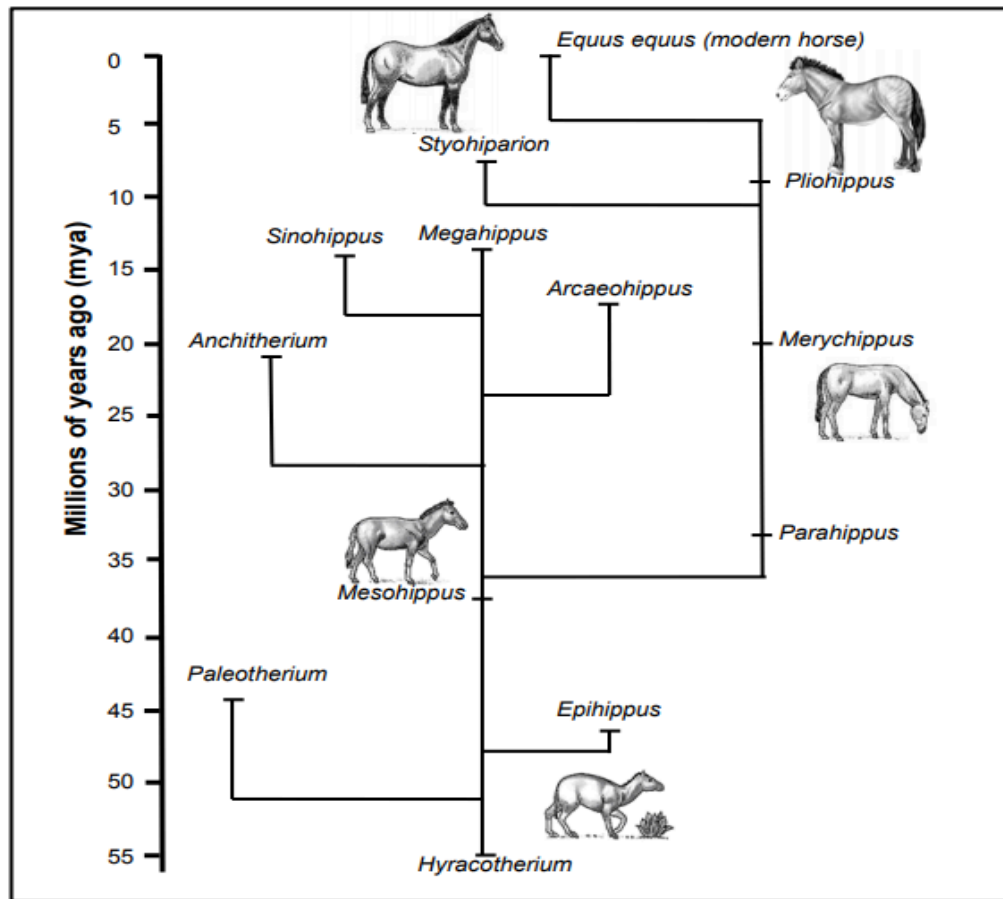


[Source: <http://tolweb.org/tree>]

- 2.5.1 What is this type of diagram called? (1)
- 2.5.2 How many genera are shown in the diagram above? (1)
- 2.5.3 According to this diagram, which:
- (a) Genus is most recently evolved (1)
 - (b) Genus is the oldest (1)
 - (c) Hominid share a common ancestor with *Australopithecus africanus* (1)
- 2.5.4 Give ONE example of an *Australopithecus africanus* fossil found in South Africa. (1)
- 2.5.5 Name TWO *Homo* species, besides *Homo sapiens*, that were found in Africa. (2)
- (8)**

QUESTION 15

1.6 The diagram below represents the possible evolution of the horse.

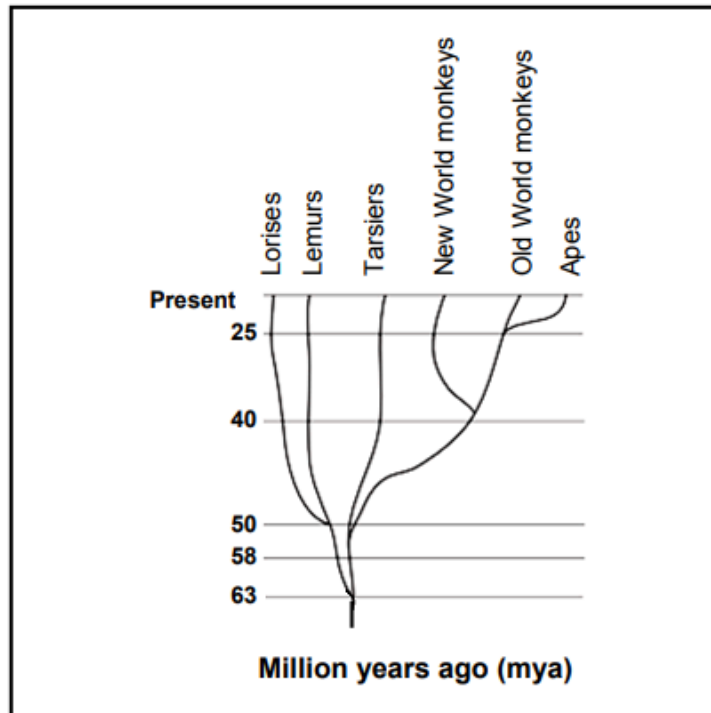


[Adapted from <http://archaeologyinfo.com>]

- 1.6.1 Name the:
- (a) Common ancestor of all horses (1)
 - (b) Genus most closely related to *Megahippus* (1)
- 1.6.2 When did *Paleotherium* become extinct? (2)
- 1.6.3 How long did it take for the modern horse to evolve from *Hyracotherium*? (2)
- (6)

QUESTION 16

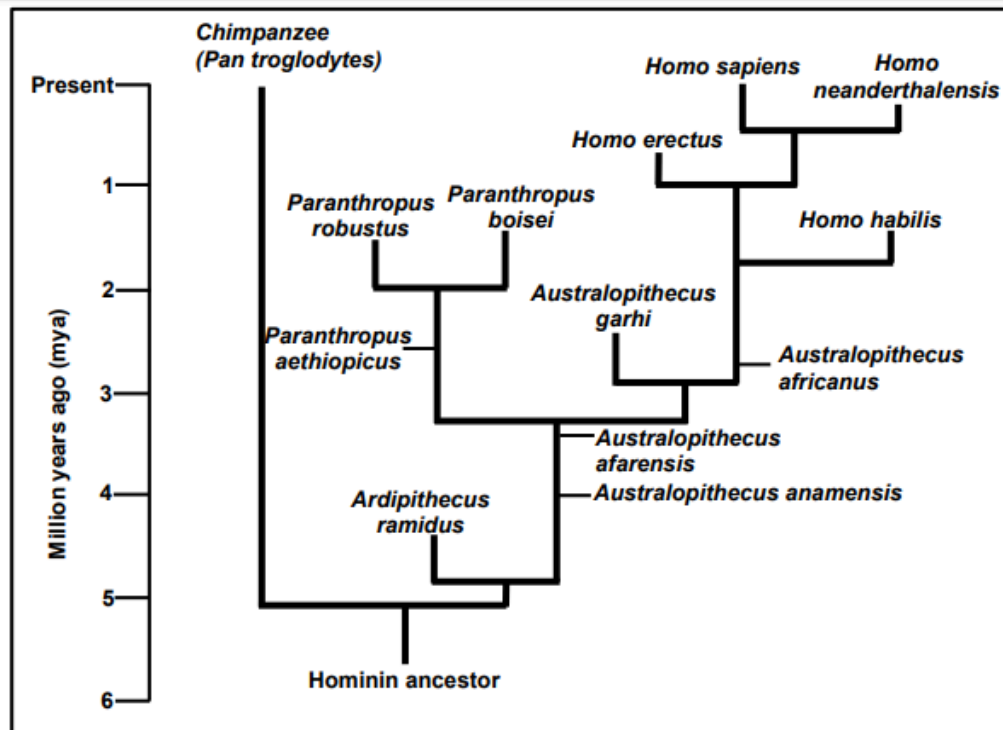
- 1.4 The diagram below shows possible evolutionary relationships among primates.



[Source: <http://dl0.creation.com/articles>]

- 1.4.1 How many million years ago did the:
- (a) Apes appear on Earth (1)
 - (b) Common ancestor evolve to form the Tarsiers and Lemurs (1)
- 1.4.2 Which TWO species share the most recent common ancestor? (2)
- 1.4.3 Which species is most closely related to the Lemur? (1)
- (5)**

QUESTION 17



- 1.5.1 What is this type of diagram called? (1)
- 1.5.2 How many of EACH of the following are represented in the diagram:
 - (a) Genera (1)
 - (b) *Homo* species (1)
- 1.5.3 Name the species that have *Paranthropus aethiopicus* as a common ancestor. (2)
- 1.5.4 When did:
 - (a) *Ardipithecus ramidus* become extinct (1)
 - (b) *Homo erectus* first appear (1)
- 1.5.5 Name the:
 - (a) Hominid species that existed at the same time as *Homo sapiens* (1)
 - (b) First *Homo* species to use tools (1)

(9)

QUESTION 18

HUMAN EVOLUTION

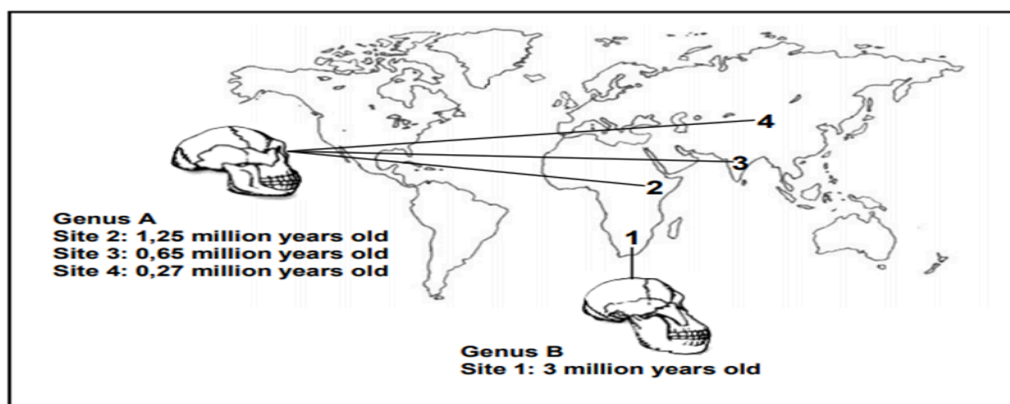
- 3.3 Study the diagrams below showing the pelvis of *Homo sapiens* and *Pan troglodyte* (chimpanzee). The diagrams are not drawn to scale.



- 3.3.1 Which organism, **A** or **B**, is bipedal? (1)
- 3.3.2 Give ONE observable reason for your answer to QUESTION 3.3.1. (2)
- 3.3.3 Explain TWO advantages of bipedalism. (4)
(7)

QUESTION 19

- 1.4 The diagram below shows a world map indicating four sites (1 to 4) where hominid fossils, representing two different genera, have been found. Genus **A** was found at three sites and genus **B** at one site. The age of each fossil was determined using radiometric dating.



[Adapted from www.biologyreference.com]

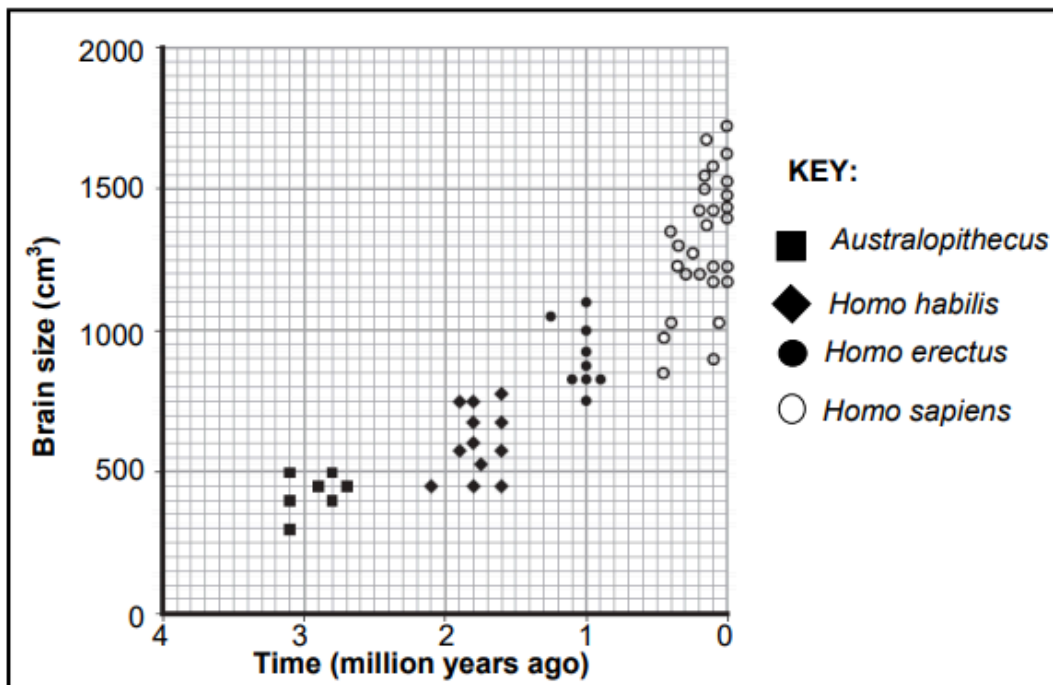
- 1.4.1 Which genus (**A** or **B**): (1)
- (a) Represents *Australopithecus* (1)
 - (b) Had a more prognathous skull (1)
 - (c) Had smaller canines (1)
 - (d) Is more closely related to *Homo sapiens* (1)
- 1.4.2 Name TWO examples of fossils of genus **B** found at site 1 in South Africa. (2)
- 1.4.3 At which site, 1 to 4, were the youngest fossils found? (1)
- 1.4.4 Other than fossil evidence, what other evidence can be used to support the Out of Africa hypothesis? (1)
(8)

QUESTION 20

- 1.5 Scientists estimated the brain sizes of *Australopithecus*, *Homo habilis*, *Homo erectus* and *Homo sapiens* by using the cranial capacity of fossil specimens. They then compared their results to the time that each hominid existed on earth.

The graph below represents the range of brain size and the time period that the hominid existed according to fossil evidence.

The results of the investigation are shown on the graph below.

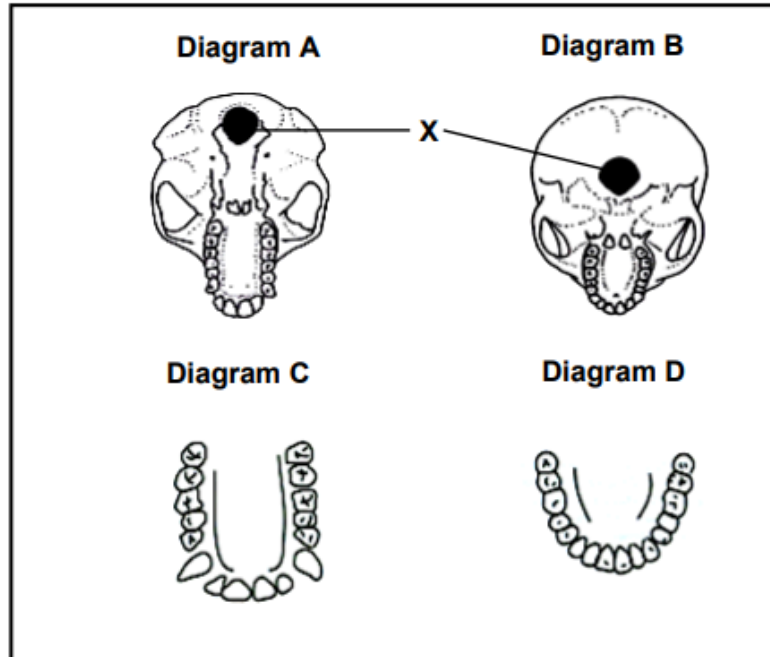


[Adapted from AQA-BLY1B-W-QP-NOV07 Unit 1b]

- 1.5.1 According to the graph:
- When did the first *Australopithecus* appear (2)
 - Which of the species shows the greatest variation in brain size (1)
- 1.5.2 Give the size (in cm³) of the:
- Largest brain of *Australopithecus* (1)
 - Smallest brain of *Homo sapiens* (1)
- 1.5.3 State TWO types of evidence, other than fossils, that support the idea that all hominids evolved from a common ancestor. (2)
(7)

QUESTION 21

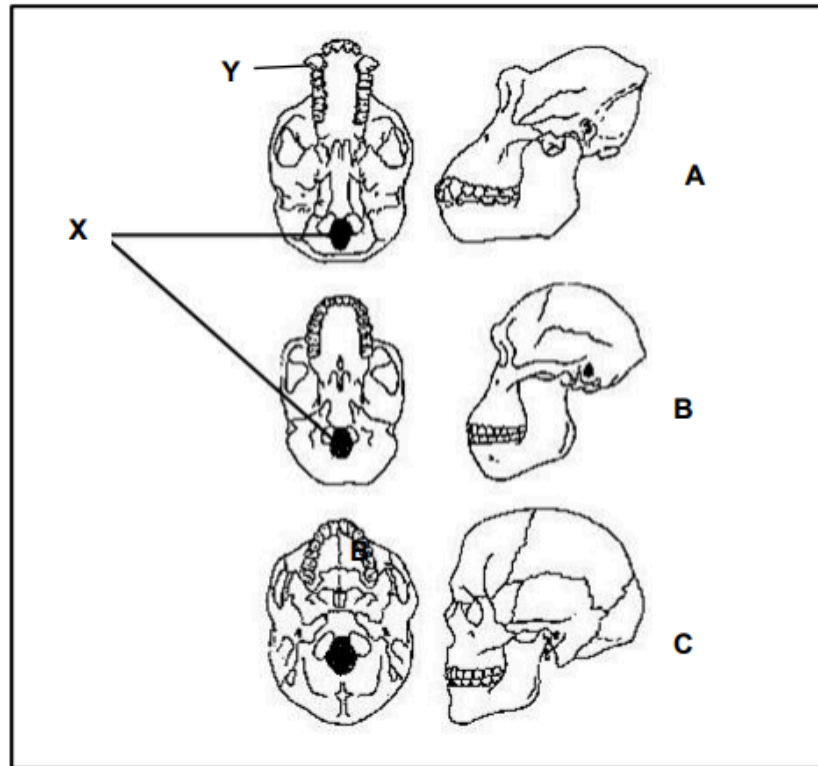
- 3.1 Study the diagrams below showing the different anatomical structures of a chimpanzee and a human. The diagrams are not drawn to scale.



- 3.1.1 Provide a label for **X**. (1)
- 3.1.2 Tabulate TWO anatomical differences between the jaws in diagrams **C** and **D** which represent trends in human evolution. (5)
- 3.1.3 Give the LETTER ONLY of the diagram that represents:
- (a) The skull with a larger brain capacity (1)
 - (b) A more prognathous skull (1)
- 3.1.4 Account for the position of **X** in the skull in diagram **B**. (2)
- 3.1.5 Explain the significance of the shape of the spine that is associated with the skull in diagram **B**. (2)
- (12)**

QUESTION 22

- 3.4 The diagram below represents the fossilised skulls of three different species of primates. They were either bipedal or quadrupedal (organisms that habitually walk on all four limbs).



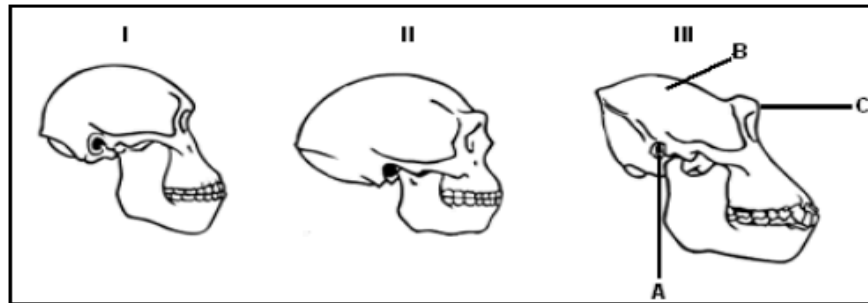
- 3.4.1 Label part **X** and the type of teeth at **Y**. (2)
- 3.4.2 Explain the significance of the location of structure **X** in organism **C**. (3)
- 3.4.3 Which of the skulls (**A**, **B** or **C**) belongs to:
- (a) An *Australopithecine* (1)
 - (b) A quadrupedal primate (1)
- 3.4.4 Explain how the change in the skull from **B** to **C** could indicate a change in intelligence. (3)
- 3.4.5 Tabulate TWO observable differences, other than those mentioned in QUESTIONS 3.4.2 and 3.4.4, between skulls **B** and **C** that represent trends in human evolution. (5)
- (15)**

QUESTION 23

- 3.3 Humans and African apes share many characteristics, yet each is a distinct species.
- 3.3.1 Name FIVE characteristics that humans share with African apes. (5)
- 3.3.2 Describe how each of the following structures is different between humans and apes:
- (a) Spine (2)
- (b) Pelvic girdle (2)
- 3.3.3 Explain the significance of the changes to the teeth of humans that show progression in evolution. (4)
- (13)**

QUESTION 24

- 1.4 The diagram below shows the skulls of three primate genera and is NOT drawn to scale.



- 1.4.1 Name parts **B** and **C** respectively. (2)
- 1.4.2 Name the type of teeth that is larger in genus **III** compared to that of genera **I** and **II**. (1)
- 1.4.3 Give only the NUMBER(S) (**I**, **II** or **III**) of the skull(s) that:
- (a) Most likely belongs to a bipedal primate (2)
 - (b) Has the largest brain size (1)
 - (c) Is attached to a C-shaped vertebral column (1)
 - (d) Is most prognathous (1)
- 1.4.4 Give only the LETTER of the structure that is more pronounced in organism **III** than in organisms **I** and **II**. (1)
- 1.4.5 Give the correct sequence of the organisms (**I**, **II** and **III**), from most primitive to most evolved. (2)
- (11)**

QUESTION 25

- 3.1 Scientists use fossils as evidence for human evolution. The brain volume of some extinct primates has been estimated from their fossils and have been compared to the brain volumes of living primates.

The results are shown in the table below.

PRIMATE	PERIOD OF EXISTENCE (million years ago)	AVERAGE BRAIN VOLUME (cm ³)
<i>Ardipithecus ramidus</i>	5,8 to 4,4	400
<i>Australopithecus afarensis</i>	4 to 2,7	450
<i>Australopithecus africanus</i>	3 to 2	450
<i>Homo habilis</i>	2,2 to 1,6	750
<i>Homo erectus</i>	2 to 0,4	1 000
<i>Homo neanderthalensis</i>	0,3 to 0,23	1 500
<i>Homo sapiens</i>	0,2 to present	1 400
Modern apes	0,2 to present	500

- 3.1.1 Apart from fossil evidence, give TWO other types of evidence for human evolution. (2)
- 3.1.2 Which primate became extinct first? (1)
- 3.1.3 The brain of an organism is not preserved as a fossil.
How do scientists determine the brain volume of extinct primates? (2)
- 3.1.4 Calculate the difference in brain volume (in cm³) between the two living primates. Show ALL calculations. (2)
- 3.1.5 Give evidence in the table that suggests that:
(a) *Homo habilis* and *Homo erectus* may have existed at the same time (1)
(b) *Ardipithecus* was the most primitive of all the primate genera (1)
- 3.1.6 Draw a bar graph to show the average brain volume of EACH of the species of the genus *Homo*. (6)
(15)

QUESTION 26

2.3 The extract below is about human evolution.

In 2004 scientists in Indonesia discovered the first fossil of the species *Homo floresiensis* along with stone tools and animal remains. The fossil was made up of a nearly complete skull and skeleton, including hand and foot bones and a pelvis.

Dating of the tools suggests that *H. floresiensis* may have lived from as early as 95 000 years ago until about 12 000 years ago.

Researchers closely analysed three wrist bones and found that they more closely resembled those of apes than modern humans. This finding implied that *H. floresiensis* was indeed a separate species from modern humans.

They had skulls that resembled early *Homo* species. This included a flat forehead and a short, flat face; however, their teeth and jaws more closely resembled *Australopithecus*.

The scans of the skull suggested that the brain volume of *H. floresiensis* was about 426 cm³; around one-third the size of the modern human brain which has an average volume of about 1 300 cm³. The findings suggested that *H. erectus* may be the ancestor of *H. floresiensis*, as *H. erectus* had brains about 860 cm³ in size or, alternatively, it may have evolved from *H. habilis*, whose brains were about 600 cm³ in size.

- 2.3.1 Name the TWO lines of evidence for human evolution that is referred to in the extract above. (2)
- 2.3.2 How long did *Homo floresiensis* exist on Earth? (1)
- 2.3.3 Name ONE *Homo* ancestor mentioned in the extract. (1)
- 2.3.4 State THREE features of the jaw of *H. floresiensis* that might have led scientists to believe that it resembled that of *Australopithecus*, rather than of a *Homo* species. (3)
- 2.3.5 Describe ONE feature of the skull that can be used as evidence for bipedalism. (2)
- 2.3.6 State TWO similarities between the hands of African apes and modern humans. (2)
- 2.3.7 Draw a table to show the brain volumes of the different *Homo* species, using information from the extract. (5)
- (16)

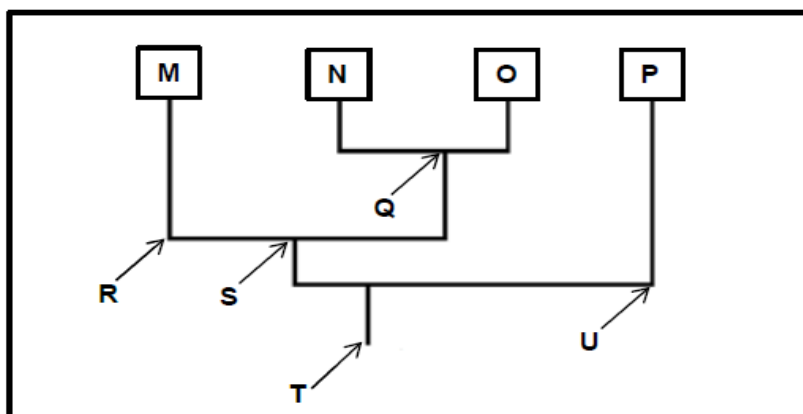
QUESTION 27

1.5 Read the extract below.

Trilobites are an extinct group of marine arthropods. Many of their fossils have been discovered. They had a tough exoskeleton and they are thought to be closely related to three other phyla of extinct arthropods, namely helmetids, tegopeltids and naraoids.

The tegopeltids and helmetids are the two most closely related phyla and are more closely related to trilobites than to naraoids.

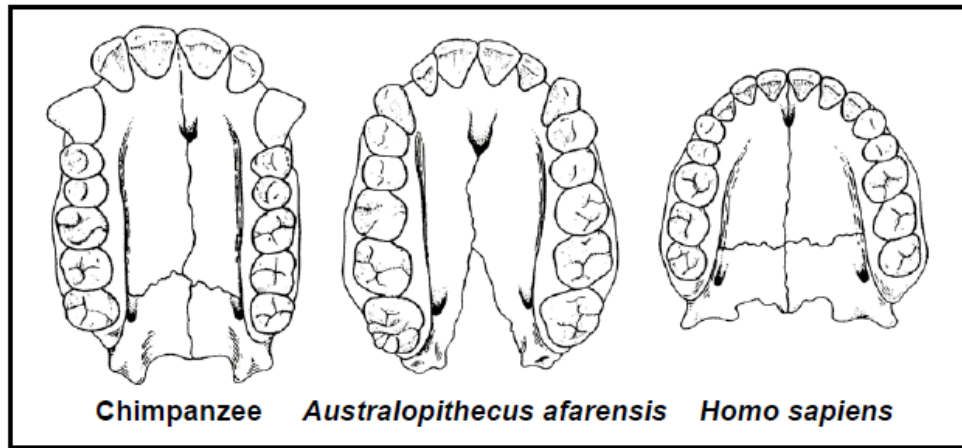
Study the diagram below, which illustrates the possible evolutionary relationships among the four phyla, represented by the letters M, N, O and P.



- | | | |
|-------|---|------------|
| 1.5.1 | Name the type of diagram illustrated. | (1) |
| 1.5.2 | What structural feature of trilobites, described in the extract, improved the chances of fossilisation? | (1) |
| 1.5.3 | Give only the LETTER of the most recent common ancestor for phyla: | |
| (a) | M and O | (1) |
| (b) | M, N, O and P | (1) |
| 1.5.4 | Which of the extinct arthropods (trilobites, helmetids, tegopeltids or naraoids) are represented by phylum: | |
| (a) | M | (1) |
| (b) | N | (1) |
| (c) | O | (1) |
| (d) | P | (1) |
| | | (8) |

QUESTION 28

- 3.1 The diagrams below show the upper jaws of some fossils. These diagrams are drawn to scale.



- 3.1.1 Describe ONE visible difference between the jaw of a chimpanzee and that of *Homo sapiens* which show trends in human evolution. (2)
- 3.1.2 Based on the differences in dentition, what conclusion can be made about the change in diet from *Australopithecus afarensis* to *Homo sapiens*? (2)
- 3.1.3 *Australopithecus* may be described as a transitional species between the chimpanzee and *Homo sapiens*.
- (a) Define a *transitional species*. (1)
- (b) Use ONE visible feature of the jaw to explain why *A. afarensis* may be described as a transitional species. (2)
- (7)

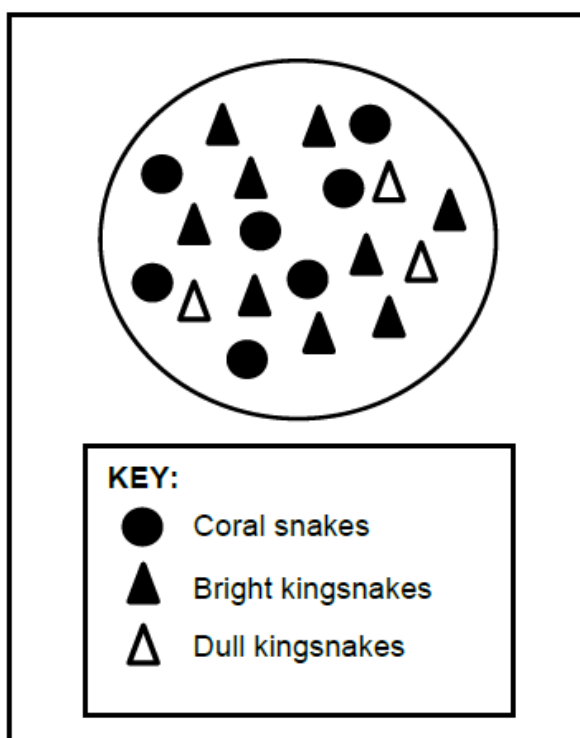
QUESTION 29

- 3.2 There are two variations in the colour of kingsnakes. Some have a bright colourful pattern and others have a dull pattern. Kingsnakes are non-poisonous to their predators.

Coral snakes also have a bright colour pattern, but are poisonous to their predators. This is a defence mechanism as predators avoid them.

Scientists observed that where kingsnakes shared the same habitat with coral snakes, there were more kingsnakes that had bright colourful patterns.

The diagram below represents the distribution of the snakes.

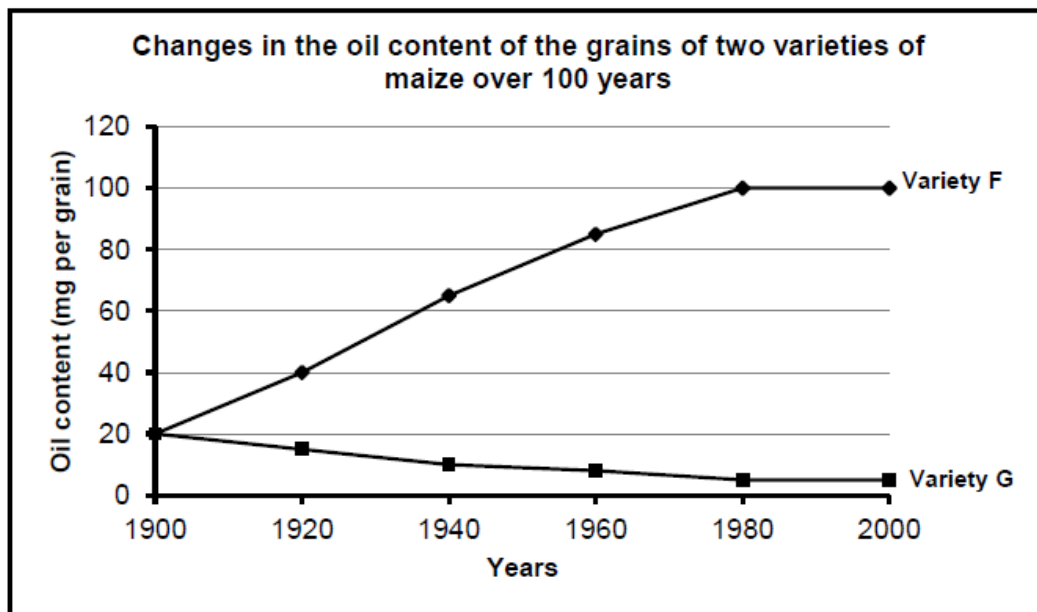


- 3.2.1 Explain how the bright colour pattern of coral snakes influences their survival. (3)
- 3.2.2 Use Darwin's theory of evolution through natural selection to explain why there are more brightly coloured kingsnakes in this habitat. (6)
(9)

QUESTION 30

- 3.3 Artificial selection programmes have produced two varieties of maize. The one has grains with a high oil content (**Variety F**) and the other has grains with a low oil content (**Variety G**).

The graph below shows the changes in the oil content of the grains of the two varieties over 100 years of artificial selection.



- 3.3.1 In which year did the two maize varieties have the same oil content? (1)
- 3.3.2 Calculate the percentage increase in the oil content of **Variety F** over the 100-year period. Show ALL working. (3)
- 3.3.3 Tabulate TWO differences between natural selection and artificial selection. (5)
- (9)

QUESTION 31 (JUNE 2019)

1.6 The table shows the evolution of cranial capacity in some species.

SPECIES	PERIOD OF EXISTENCE (MILLION YEARS AGO)	AVERAGE CRANIAL CAPACITY (cm ³)
<i>Sahelanthropus</i>	7,0–6,0	450
<i>Australopithecus africanus</i>	3,0–2,0	480
<i>Homo habilis</i>	2,2–1,6	650
<i>Homo erectus</i>	2,0–0,4	900
<i>Homo neanderthalensis</i>	0,4–0,04	1 500
<i>Homo sapiens</i>	0,2–0	1 450

1.6.1 Name:

- (a) TWO hominid genera in the table above (2)
- (b) TWO fossils of *A. africanus* that were found in South Africa (2)
- (c) The genus that appeared first on Earth as shown in the table (1)

1.6.2 Which hominid had a cranial capacity closest to that of *Homo sapiens*? (1)

1.6.3 Give the smallest cranial capacity (in cm³) of a *Homo* species. (1)

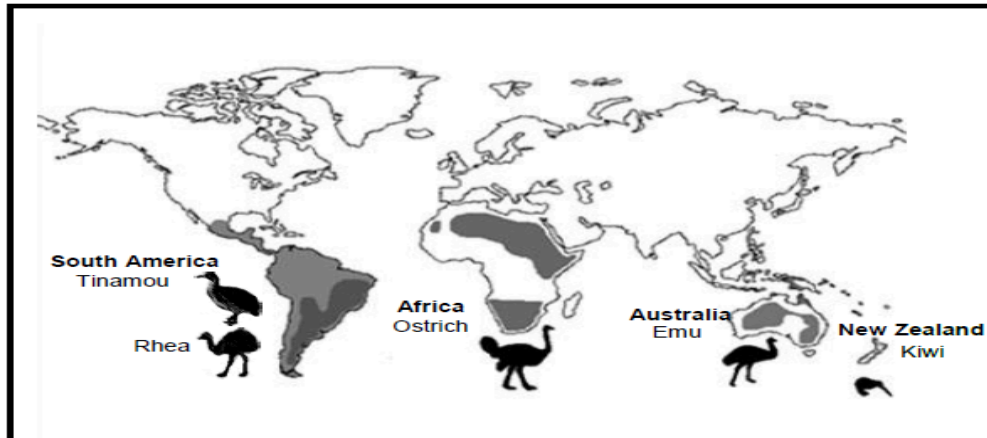
1.6.4 When did *Australopithecus africanus* become extinct? (1)

1.6.5 Fossils are used as evidence of hominid evolution.

Name TWO other lines of evidence. (2)
(10)

QUESTION 32 (JUNE 2019)

- 3.4 Flightless bird species that are currently distributed across different continents are shown in the picture below.



Scientists hypothesise that these species of flightless birds arose from a single common ancestor that was able to fly.

- 3.4.1 Describe how Lamarck would have explained the evolution of flightless birds. (4)
- 3.4.2 Name THREE reproductive isolation mechanisms that keep species separate. (3)
- (7)

QUESTION 33 (JUNE 2019)

QUESTION 4

Describe natural selection and punctuated equilibrium. Also state THREE ways in which natural selection differs from artificial selection.

Content: (17)
Synthesis: (3)
(20)

QUESTION 34 (NOV 2019)

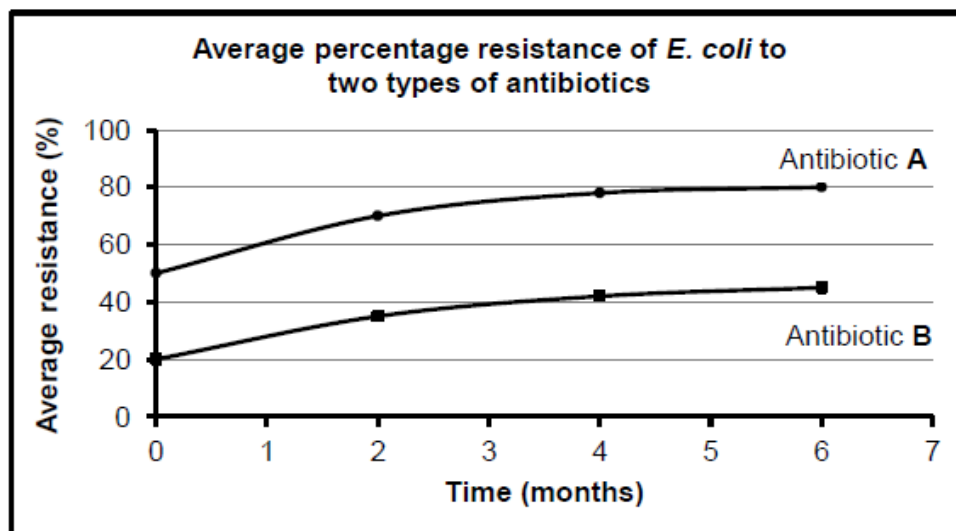
2.5 The *E. coli* bacterium lives in the intestines of pigs where they reproduce rapidly. Certain strains of *E. coli* cause diarrhoea in young pigs (piglets).

Scientists carried out an investigation using 100 piglets to determine the resistance of *E. coli* to two antibiotics, **A** and **B**.

The scientists:

- Injected the piglets with antibiotic **A** and antibiotic **B**
- Took a sample of *E. coli* from the intestines of each piglet a week later and placed them in separate petri dishes
- Allowed the bacteria to grow for 24 hours
- Added antibiotic **A** to one petri dish and antibiotic **B** to the other petri dish
- Measured the growth of the bacteria in each petri dish after 24 hours
- Used the growth measurement as an indication of the resistance of the bacteria to each antibiotic
- Repeated the process over a period of six months
- Calculated the average percentage resistance to both antibiotics

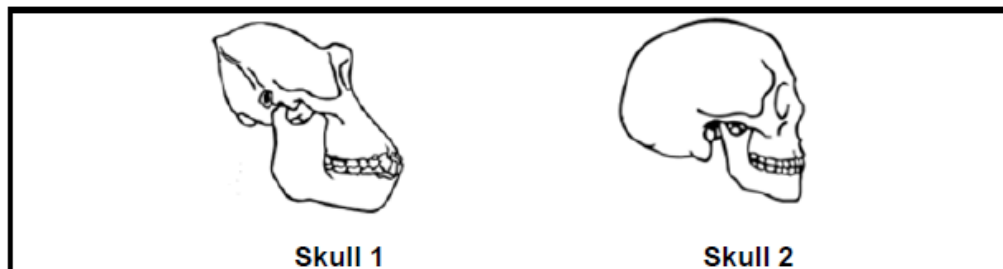
The results are shown in the graph below.



- 2.5.1 Identify the independent variable in this investigation. (1)
- 2.5.2 Identify TWO factors that should be kept constant during the investigation. (2)
- 2.5.3 State TWO ways in which the scientists ensured the reliability of the investigation. (2)
- 2.5.4 Which antibiotic will you recommend for controlling *E. coli* in piglets? (1)
- 2.5.5 Support your answer to QUESTION 2.5.4 using evidence in the graph. (2)
- 2.5.6 Explain the results that are shown in the graph for antibiotic **A** in terms of natural selection. (5)
- (13)**

QUESTION 35 (NOV 2019)

- 3.1 The diagrams below show the skulls of two species of primates.



- 3.1.1 Tabulate THREE observable differences between skull 1 and skull 2 that show trends in human evolution. (7)
- 3.1.2 Give FOUR characteristics of the upper limbs that humans share with other primates. (4)
- 3.1.3 Explain how an increase in cranial volume is related to intelligence. (3)
- (14)**

QUESTION 36 (NOV 2019)

- 3.2 Humans are bipedal organisms.
- 3.2.1 What is meant by *bipedalism*? (2)
- 3.2.2 Explain how each of the following skeletal structures have contributed to bipedalism in humans:
- (a) Foramen magnum (2)
 - (b) Pelvic girdle (2)
 - (c) Spine (2)
- (8)**

QUESTION 37 (NOV 2019)

- 3.3 Describe the process of speciation through geographical isolation. (6)

QUESTION 38 (NOV 2019)

- 3.4 Read the following extract.

**MUTATION IN GENE ALLOWS TIBETANS
TO SURVIVE AT HIGH ALTITUDE**

It is possible to cope with the low oxygen content at high altitudes.

One way is for the body to produce more red blood cells in response to an increase in altitude.

Another way of coping has developed in Tibetans as a result of a gene mutation that they inherited from their ancestors. The mutant gene helps them to use the low amount of oxygen present more efficiently. The mutant gene was found in 87% of the Tibetan population but only in 9% of the Han population that live at a lower altitude than the Tibetans.

- 3.4.1 A gene mutation caused variation between the Tibetan population and the Han population.
- Name THREE other sources of variation in a human population. (3)
- 3.4.2 Give evidence in the extract which suggests that the survival of people living at high altitudes could be:
- (a) Due to a genetically inherited trait (1)
 - (b) Caused by an environmental factor (1)
- 3.4.3 Explain the advantage of producing more red blood cells. (2)
- 3.4.4 Describe how Lamarck would have explained the survival of Tibetans at high altitudes. (5)
- (12)**

