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ETDP - SETA TRAINING

Life Sciences

Evolution

- **Planning for effective teaching and learning**
- **Diagnostic Report**
- **Topic Plan**
- **Learner Activities**
- **Topic Tests**
- **Teaching Tools**
- **Lesson Plans**

July 2019

STEPS INVOLVED IN PLANNING FOR EFFECTIVE TEACHING AND LEARNING

1. Read Exam Guideline document
2. How many hours/how many periods
3. How many marks for topic and which paper?
4. How to allocate sub-topics to different periods – has time been allowed for daily assessment tasks (completing and reviewing?)
5. Study the textbook against the exam guideline document to get familiar with the content required in the topic.
6. Examine how topic has been assessed through the years – what aspects are assessed more frequently?
7. What does the diagnostic report of the last few years say about errors, misconceptions and strategies for the given topic?
8. What prior knowledge is required for the topic or for each sub-topics?
9. How will prior knowledge be assessed?
10. How will knowledge of each lesson be re-capped at the start of the next lesson?
11. What terminology is relevant to the topic and how will you teach and assess this terminology?
12. What diagrams are relevant to the topic and how will you get learners familiar with structure-function-adaptation where relevant?
13. Are there simple diagrams in this topic that learners can be given practice at drawing?
14. What summaries would you expect learners to have in their exercise books?
15. Study the memoranda of past exam question papers to see how answers to certain concepts/processes have been structured and how marks have been distributed.
16. What opportunity is there for drawing graphs and what data can you compile from which graphs can be draw in the relevant topic? Allow learners to mark one of the graphs to get them familiar with the criteria.
17. Is there any opportunity for performing calculations in this topic?
18. Have you collected articles/case studies relating to the given topic to use in teaching and assessing?
19. What practical work is relevant and what resources/preparation is required for this?
20. What opportunity is there to develop the broad principles of scientific investigations in this topic?
21. What opportunity is there for learners to practice writing a paragraph or an essay?
22. What activities will you use to get the learners actively involved in the learning process?
23. How will the learner activities allow for multiple exposure to concepts?
24. What opportunities will there be to encourage learning through reading/writing/speaking?
25. In what conscious way will you get learners familiar with the action verbs used in questions especially as it relates to the given topic?
26. What classwork/homework activities will you compile for each sub-topic?
27. Have you compiled a balanced SBA task of good standard should one be based on the relevant topic?
28. What is your plan for monitoring learners written work?

ERRORS AND MISCONCEPTIONS - EVOLUTION

Candidates:

- ❑ Provided general accounts on natural selection rather than contextualizing it to the specific example provided
- ❑ Provided general accounts on speciation rather than contextualizing it to the specific example provided
- ❑ Did not understand the following concepts:
 - Difference between species and population
 - Transitional species
 - Selection pressure
- ❑ Were not able to analyse a *phylogenetic tree*
- ❑ Performed poorly in scientific investigations
- ❑ Could not differentiate between features of the skull versus features of the skeleton with regard to trends in human evolution
- ❑ Experienced difficulty in describing evidence for the Out of Africa hypothesis
- ❑ Could not fully describe the skeletal features that relate to bipedalism
- ❑ Were not able to differentiate between a family name, a species name and a common name. Hominidae was confused with hominids, *Homo sapiens* and hominins.
- ❑ Compared different features, for example, teeth in one species and jaw shape in the other species as opposed to looking at a common feature in all three species e.g. considering the shape of the palate in *Australopithecus* and comparing it to that of the chimpanzee and *Homo sapiens*.

PRIOR KNOWLEDGE

- ❑ Grade 10: Biodiversity and Classification; History of Life on Earth
- ❑ Grade 11: Plant and Animal Diversity
- ❑ Grade 12: Genetics and Meiosis – Sources of variation

Lesson	Aspect	Elaboration
1.	Introduction	- Introduce the terms evolution and biological evolution - Review related concepts from Grades 10-11 - Introduce terms species and population
2.	Evidence for Evolution	- Fossil, biogeography, modification by descent, genetics
3.	Sources of Variation	- Meiosis, random fertilisation, random mating, mutations - Types of variation (continuous and discontinuous)
4.	Lamarckism	- Laws - Application - Rejection
5.	Darwinism	- Gradualism/Natural Selection
6.	Darwinism	- Application
7.	Punctuated Equilibrium	- Involves natural selection - Pace is different
	Artificial Selection	- Advantages - Compare with natural selection
8.	Speciation	- Speciation through geographic isolation -
9.	Speciation	- Application
10.	Reproductive Isolating Mechanisms	- Breeding at different times, Species-specific courtship behaviour, adaptation to different pollinators, infertile offspring, prevention of fertilisation
	Evolution in Present Times	- Mosquitoes/TB
11.	Topic test	- General evolution
12.	Introduction to Human Evolution	- Our place in the animal kingdom
	Similarities: Humans and African Apes	- List of characteristics
13.	Differences: Humans and African Apes	- Table of differences
14.	Evidence for common ancestors of living hominids	- <i>Ardipithecus, Australopithecus, Homo</i>
15.	Evidence for common ancestors of living hominids	- <i>Ardipithecus, Australopithecus, Homo</i>
16.	Out of Africa Hypothesis	- Evidence
17.	Topic test	- Human evolution

CHECKLIST

TOPIC	ASPECT					
Reproduction in vertebrates	Diversity in reproductive strategies					
Human reproduction	Male reproductive system					
	Female reproductive system					
	Puberty					
	Menstrual cycle (incl hormones)					
	Development of foetus					
Responding to the environment: Humans	The brain					
	Neurons, reflex actions and reflex arcs					
	Peripheral nervous system					
	Autonomic nervous system					
	Structure and functions of parts of the eye					
	Accommodation					
	Pupillary mechanism					
	Visual defects					
	Structure and functions of parts of the ear					
	Hearing					
	Balance					
	Hearing defects					
Human endocrine system	Glands and the hormones they secrete					
	Negative feedback - glucose					
	Negative feedback - thyroxine					
Homeostasis in humans	Negative feedback - glucose					
	Negative feedback - carbon dioxide					
	Negative feedback - water					
	Negative feedback – salts					
	The role of the skin on hot and cold days					
Responding to the environment: Plants	Functions of auxins, gibberellins and abscisic acid					
	Role of auxins in phototropism and geotropism					
Human impact on the environment	Atmosphere and climate change					
	Water availability					
	Water quality					
	Food security					
	Loss of biodiversity					
	Waste disposal					
Meiosis	The process of meiosis using diagrams					
	Significance of meiosis					
	Differences between meiosis I and meiosis II					
	Non-disjunction					
DNA – The Code of Life	Structure of DNA and RNA					
	Differences between DNA and RNA					
	DNA replication					

	Protein synthesis					
TOPIC	ASPECT					
Genetics and inheritance	Genetic terminology					
	Complete dominance					
	Incomplete dominance					
	Co-dominance					
	Inheritance of sex					
	Sex-linked characteristics					
	Dihybrid crossing					
	Mutations					
	Pedigree diagrams					
	Genetic modification					
	Stem cell and cloning					
	Paternity testing and DNA profiling					
Evolution	Evidence for evolution					
	Sources of variation					
	Lamarck and Darwin's theories					
	Natural and artificial selection					
	Punctuated equilibrium					
	Speciation					
	Mechanisms for reproductive isolation					
	Evolution in present times					
	Human evolution : similarities with African apes					
	Human evolution: differences with African apes					
	Trends in human evolution					
	Out of Africa hypothesis					
	Phylogenetic trees					
Skills	Draw a line graph					
	Draw a bar graph					
	Draw a histogram					
	Draw a pie chart					
	Answering essay questions					
	Interpret tables					
	Interpret graphs					
	Extracts					
	Calculations					
	Scientific investigations					
	Paragraph questions					
	Terminology					
	Essay writing					

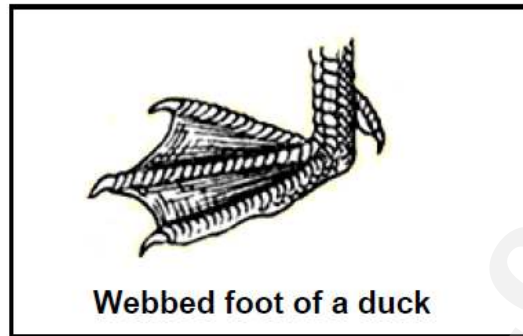
EVOLUTION

Question 1

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

Question 2

- 2.1 Study the diagram of a duck's foot below.



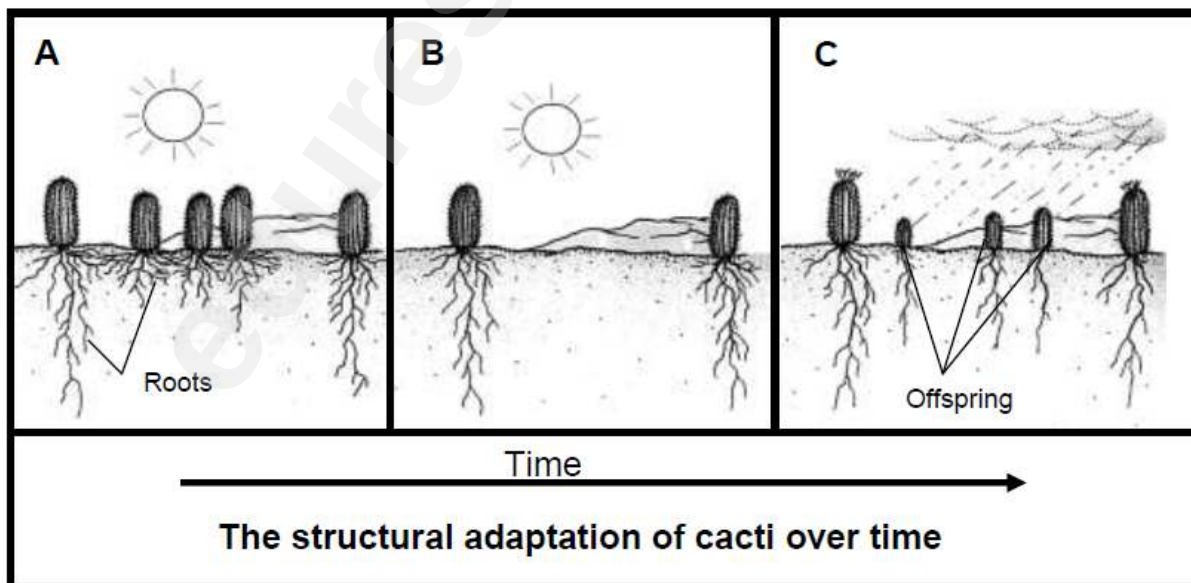
Ancestors of ducks did not have webbed feet. In terms of natural selection, explain how the webbed feet could have evolved. (7)

Question 3

- 3.1 Describe how speciation occurs when a population becomes separated by a geographical barrier. (5)

Question 4

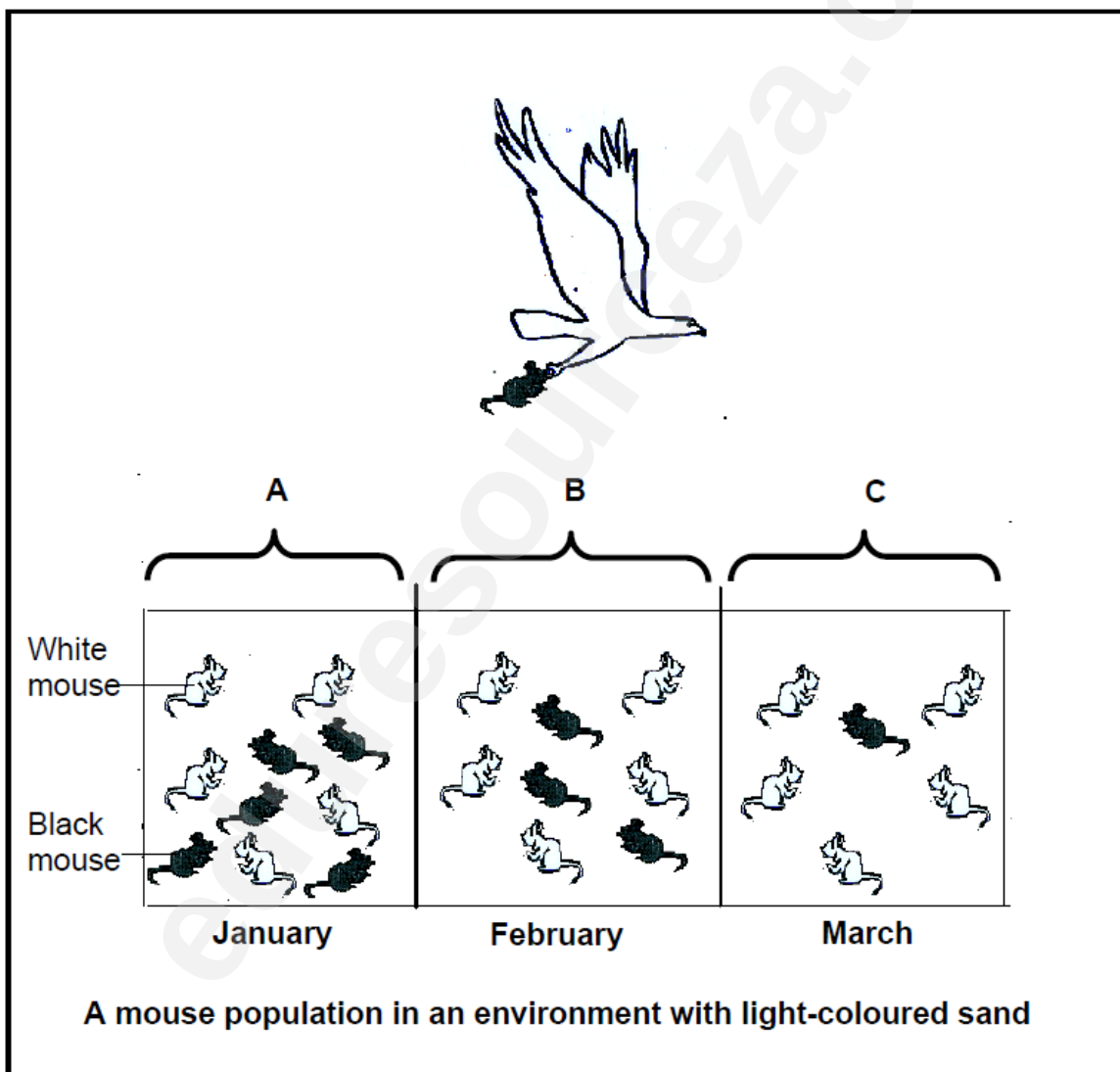
Study the three diagrams (A, B and C) below that show a mechanism used to explain evolution.



- 4.1 From a comparison of pictures A and B, describe the feature of the cacti that have enabled them to survive long periods of hot, dry weather conditions. (1)
- 4.2 Name the mechanism put forward by Darwin to explain his theory of evolution that is illustrated in these diagrams. (1)
- 4.3 Use the three diagrams above to explain the mechanism mentioned in QUESTION 4.2 (5)

Question 5

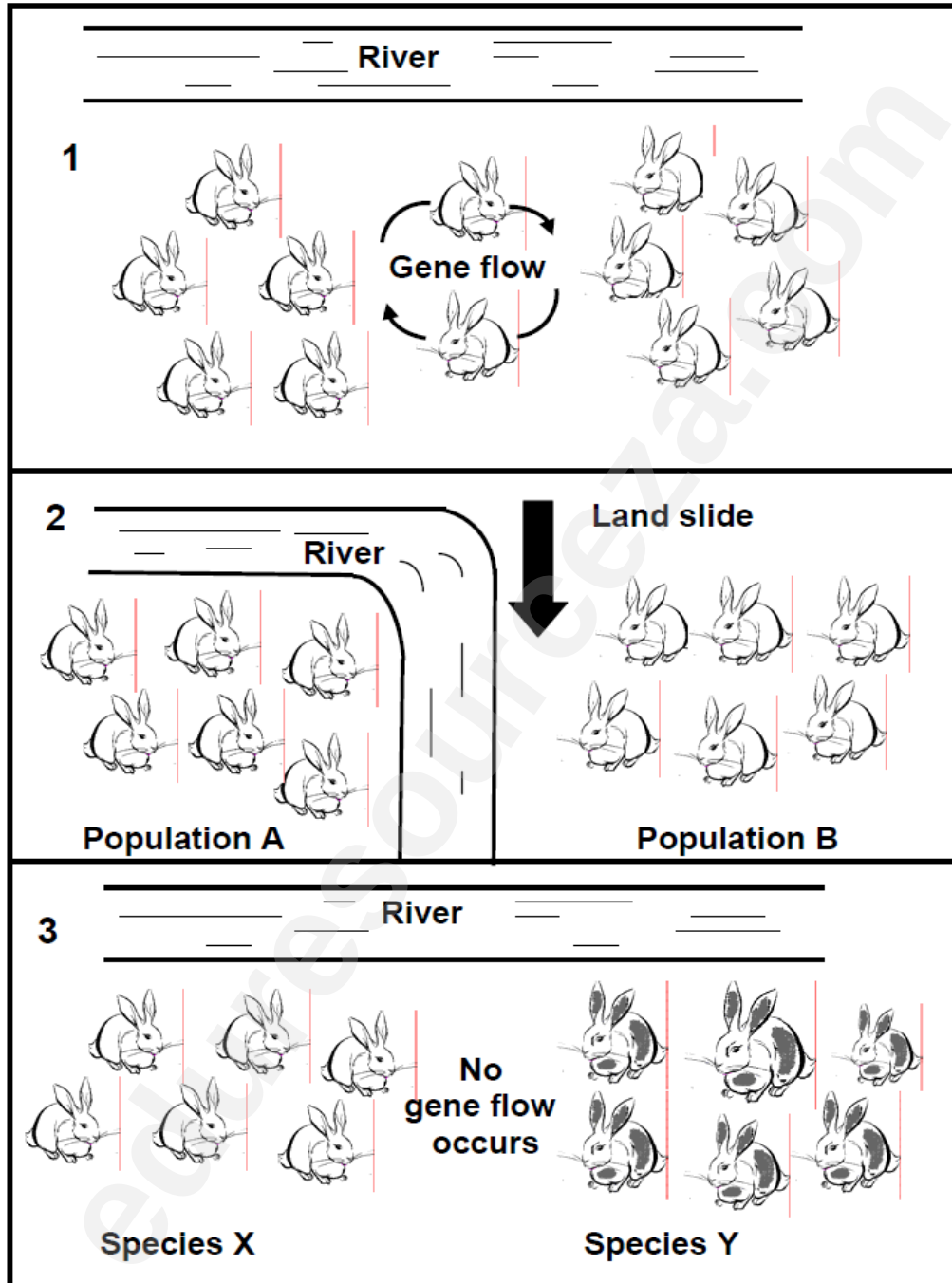
Study the diagram below that shows the change in numbers of black and white mice living in an environment with light-coloured sand.



- 5.1 What phenomenon is illustrated in the diagram? (1)
- 5.2 Describe how the sequence of events labelled A, B and C represents the phenomenon named in QUESTION 5.1 (5)
- 5.3 Will the next generation of mouse population more likely be all white or all black? (1)

Question 6

Study the diagrams below showing a process of evolution. DIAGRAMS 1, 2 and 3 show the sequence of events that occurred in rabbit populations over many thousands of years.

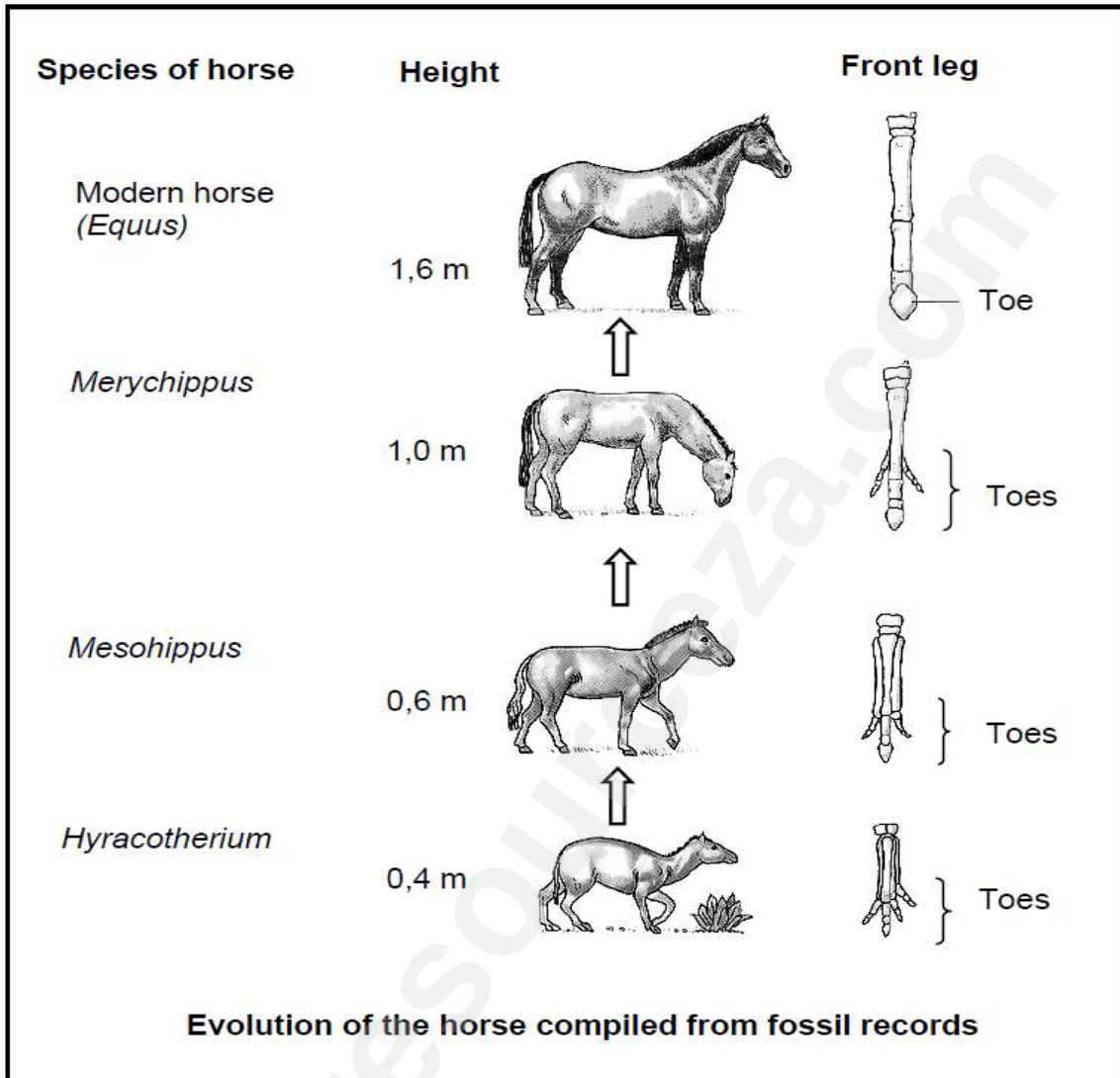


6.1 Name the evolutionary process represented by the sequence of events shown in DIAGRAMS 1, 2 and 3 above. (1)

6.2 Describe the process stated in QUESTION 6.1 using the diagrams above. (5)
(6)

Question 7

The diagrams below represent the evolution of the horse, compiled from fossil records.



- 7.1 How many times is the modern horse taller than its earliest ancestor? Show your working. (3)
- 7.2 What happened to the appearance of the feet of the horse over time? (2)
- 7.3 Palaeontologists suggest that ancient horses lived in forests, but modern horses live in open grassland. Explain ONE way in which the modern horse is adapted to open grassland. (2)

Question 8

Read the extract below.

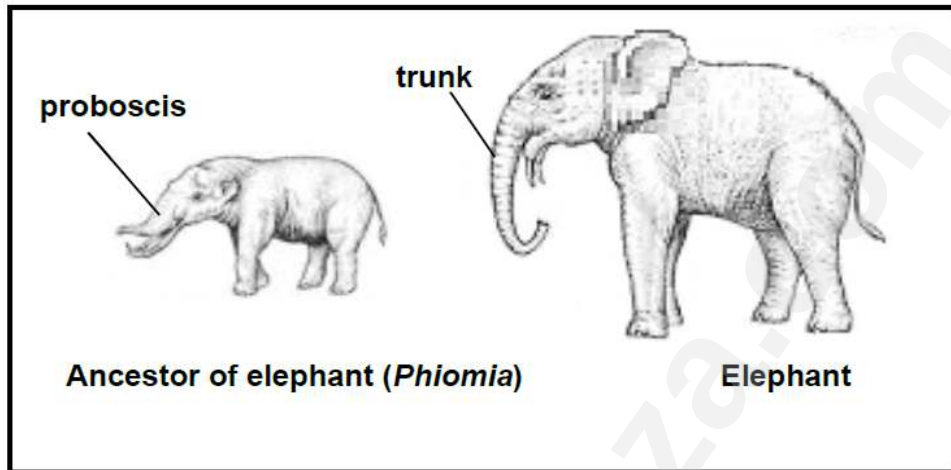
The red-bellied black snake (*Pseudechis porphyriacus*) and the green tree snake (*Denderelaphis punctulatus*) are predators that sometimes feed on cane toads (*Bufo marinus*) that contain a toxin that may kill them.

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.

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

Question 9

An ancestor of the elephant, *Phiomia*, had a long nose-like structure called a proboscis which evolved into the trunk of the elephant. The proboscis was used to gather leaves as food. The proboscis of *Phiomia* and the trunk of the elephant are shown below. The diagrams have been drawn to scale.



Explain the evolution of the elephant's trunk in terms of Lamarckism and Darwinism as well as the way in which an increase in the length of the trunk of the elephant could be achieved through artificial selection.

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

NOTE: NO marks will be awarded for answers in the form of flow charts, tables or diagrams.

Question 10

Describe how Lamarck and Darwin explained evolution, and compare Darwin's ideas to the ideas of Punctuated Equilibrium.

Content: (17)
 Synthesis: (3)

NOTE: NO marks will be awarded for answers in the form of flow charts, diagrams or tables.

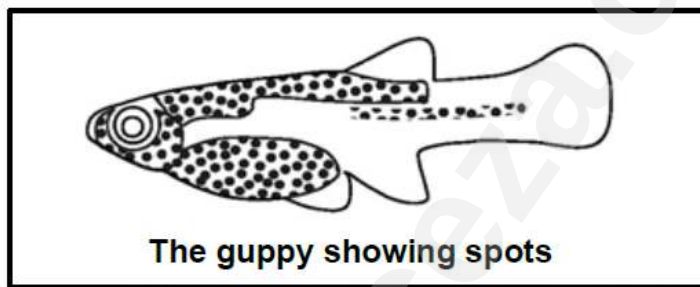
Question 11

A scientist used guppies (*Poecilia reticulata*) in an investigation to test Darwin's theory of natural selection.

Male guppies have brightly coloured spots to attract females, but these spots also attract predators.

It was previously observed that males living in streams where there were many predatory fish tended to have fewer spots. This reduced their risk of being eaten.

Those males living in streams with fewer predators had more spots.



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

The procedure of the investigation was as follows:

- Equal numbers of male and female guppies were put in two ponds (pond 1 and pond 2).
- In pond 1, predatory fish that prey on guppies were introduced.
- In pond 2, predatory fish that do not feed on guppies were introduced.
- The guppies were allowed to breed for 20 months, representing several generations of guppies. (Guppies reproduce when they are about three months old.)

The result of the investigation was:

The male guppies in pond 2 had significantly more spots than the male guppies in pond 1.

- 11.1 How could the validity of this investigation be increased? (2)
- 11.2 Identify the:
- (a) Independent variable (1)
- (b) Dependent variable (1)
- 11.3 Explain why the scientist included pond 2 in this investigation. (3)
- 11.4 Describe how Darwin's theory of natural selection can be used to explain why the guppies in pond 1 had fewer spots. (5)
- (12)

Question 12

Study the extract and the information below.

A species of the clover plant (*Trifolium repens*) developed a mutation that caused the poison, cyanide, to form in the plant's cells. This gives the clover a bitter taste to herbivores that feed on them. However, in a colder climate, some cells burst, releasing the cyanide into the plants' tissues, thereby killing the plants.

Scientists observed that there were more clover plants of this species in warmer areas than in colder areas. They formulated a hypothesis that more clover plants survive at higher temperatures.

They conducted the investigation on the survival of clover plants at different temperatures as follows:

- They placed 200 clover plants in a greenhouse with the temperature controlled at 5 °C and 200 clover plants in a greenhouse with the temperature controlled at 25 °C.
- They controlled all other variables.
- They allowed a period of time for the plants to grow and counted the number of clover plants that survived in each greenhouse.
- Then they calculated the percentage survival of clover plants.

The results of the investigation are shown in the table below.

TEMPERATURE	PERCENTAGE SURVIVAL OF CLOVER PLANTS
5 °C	13
25 °C	72

- 12.1 State the:
- (a) Independent variable (1)
 - (b) Dependent variable (1)
- 12.2 State TWO ways in which the scientists could have improved the reliability of the investigation. (2)
- 12.3 Describe how the scientists calculated the percentage survival of clover. (2)
- 12.4 Explain if the hypothesis will be accepted or rejected. (3)
- 12.5 Based on information in the passage, apart from temperature, explain ONE other way in which the survival rate of clover plants is increased. (2)
- 12.6 Refer to Darwin's theory of natural selection and explain how the mutation affected the survival of the clover plants at lower temperatures. (6)
- (17)

Study the extract and the information provided.

An insecticide is used by farmers to control insect populations of *Plodia interpunctella* which feeds on stored grain. Farmers treat the grain with the insecticide to prevent an insect infestation.

This insecticide is extremely poisonous to certain insects, yet causes little or no harm to humans and beneficial insects.

In recent years it has been noticed that this insecticide is no longer effective in controlling insect populations of *Plodia interpunctella*.

Scientists hypothesised that insect populations that had previously been exposed to the insecticide had a higher survival rate when the grain was treated again.

In an investigation to test this hypothesis, they:

- Identified storage bins that had previously been treated with the insecticide and bins that had never been treated with the insecticide
- Collected a sample of 300 insects from each bin
- Kept each sample in a separate container of equal size and the same conditions
- Sprayed the same concentration and volume of insecticide over both containers
- Allowed 24 hours for the insecticide to take effect
- Counted the number of insects that survived in each container

The results are given in the table below:

PREVIOUS EXPOSURE TO INSECTICIDE	NUMBER OF INSECTS THAT SURVIVED
With previous exposure to insecticide	182
No previous exposure to insecticide	66

- 13.1 Give the:
- (a) Independent variable (1)
 - (b) Dependent variable (1)
- 13.2 State THREE factors that were kept constant in this investigation. (3)
- 13.3 Give TWO reasons why the scientists' results may not be reliable. (2)
- 13.4 State a conclusion for this investigation. (2)
- (9)**

Question 14

Lizards of a certain species on an island are usually brown in colour. A mutation in one gene for body colour results in red or black lizards. Black lizards camouflage well against the dark rocks and warm up faster on cold days which will give them energy to avoid predators.

Scientists investigated the relationship between the colour of lizards in a population and their survival rate on an island.

They conducted the investigation as follows:

- They selected a group of lizards of a certain species in a habitat.
- They recorded the percentage of each colour (brown, red or black) in the selected group.
- They repeated the investigation over a period of 30 generations of offspring.

The results of the investigation are shown in the table below.

COLOUR OF LIZARDS	PERCENTAGE (%) OF EACH COLOUR IN THE POPULATION			
	Initial population	10 th generation	20 th generation	30 th generation
BROWN	80	80	70	40
RED	10	0	0	0
BLACK	10	20	30	60

[Adapted from <http://.hhmi.org/biolactive>]

- 14.1 State the: **Downloaded from eduresourceza.com**
- (a) Independent variable (1)
- (b) Dependent variable (1)
- 14.2 Explain the effect of the mutation on the survival of the red lizards. (2)
- 14.3 Explain why the scientists had to conduct this investigation over 30 generations. (2)
- 14.4 State TWO ways in which the scientists could have improved the validity of the investigation. (2)
- 14.5 Use the theory of natural selection to explain the higher percentage of black lizards in the population of the 30th generation. (6)
- 14.6 Draw a bar graph to compare the percentage of the brown and the black lizards in the initial population and the 30th generation. (6)
- (20)**

Question 15

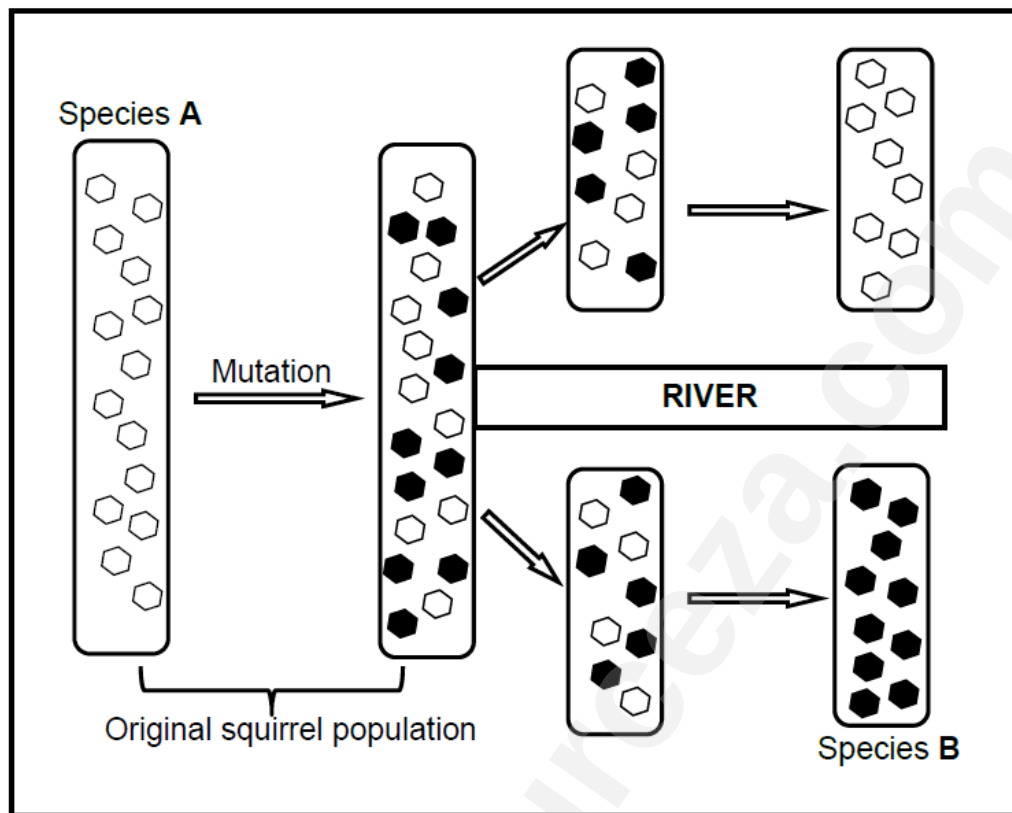
There was variation in neck length in a population of Galapagos tortoises. The original population from the mainland was separated onto two islands with different environmental conditions. Many years later it was established that speciation of the tortoises had occurred.

Describe how mutations and meiosis lead to variation within a population and the role of variation in the speciation of the tortoises.

Content: (17)
Synthesis: (3)

NOTE: NO marks will be awarded for answers in the form of a table, flow charts or diagrams.

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.



- 16.1 Define a *population*. (2)
- 16.2 Other than mutations, give THREE causes of variation in a population. (3)
- 16.3 Explain why there were eventually more squirrels with the mutation on one side of the river. (3)
- 16.4 Explain what effect the process above has on the biodiversity in this ecosystem. (2)
- 16.5 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)

Question 17

Read the extract below.

Long before the development of agricultural crops, South African villagers would pick the sweetest and largest fruits of the marula tree and scatter them around their camps. The seeds of these fruit would germinate and grow into fruit-bearing trees. The best fruit would then be chosen from these trees and the process would be repeated.

In recent times, farmers use a process called marcotting. This involves peeling away the bark in one area around a branch. This area is stimulated to form roots. The branch is then removed from the tree and planted in the soil to produce more marula trees.

- 17.1 Name the characteristics that the villagers were selecting. (2)
- 17.2 Explain how this practice is an example of artificial selection. (3)
- 17.3 Give ONE environmental factor that could affect the characteristics named in QUESTION 17.3. (1)
- 17.4 Explain ONE disadvantage of a plantation of marula trees grown through marcotting compared to a population of marula trees that have reproduced naturally. (2)
- 17.5 Explain whether the fruits from marcotted marula trees could be classified as genetically modified (GM). (2)
- 17.6 State TWO benefits of genetic modification. (2)

Question 18

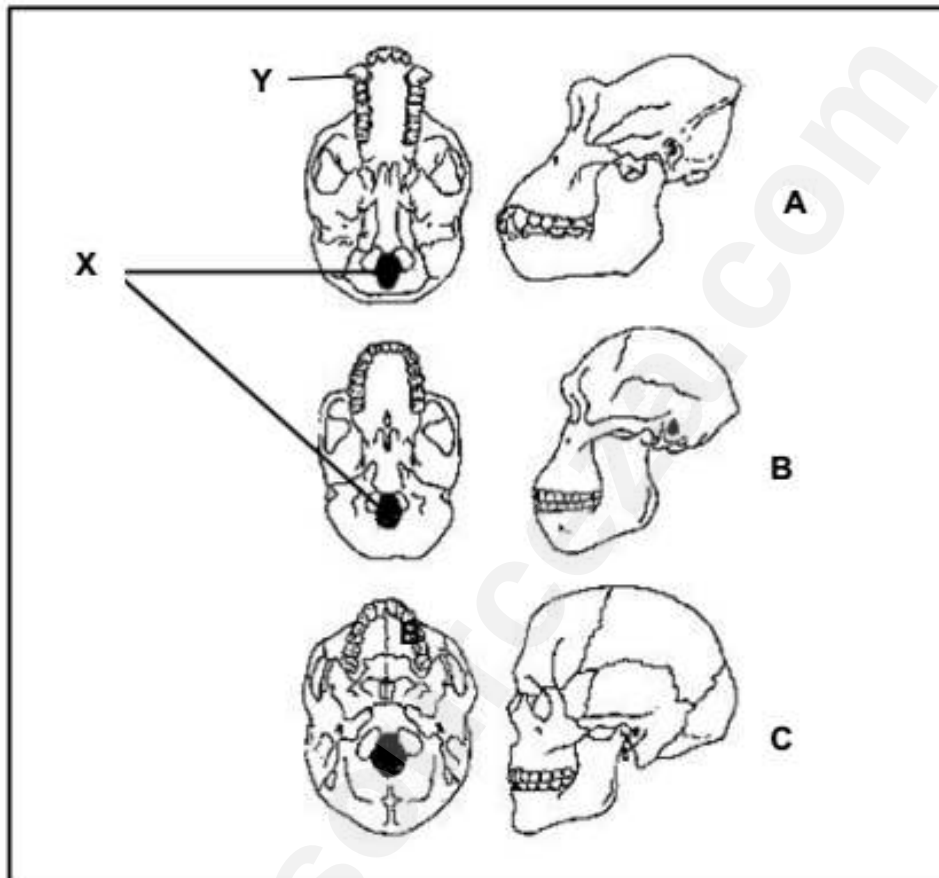
Differentiate between a *population* and a *species*, describe speciation by geographic isolation and explain how speciation and extinction affect biodiversity.

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

NOTE: NO marks will be awarded for answers in the form of a table, flow charts or diagrams.

Question 19

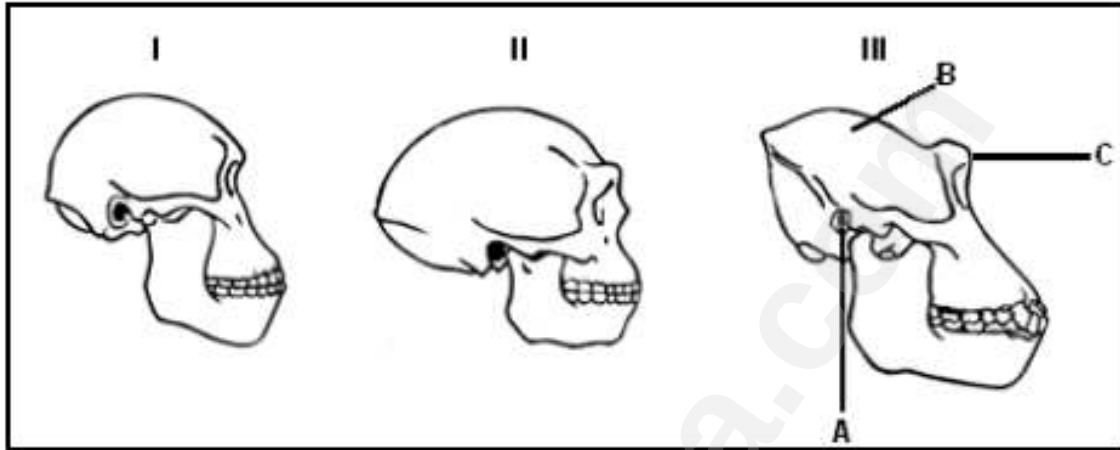
The diagram below represents the fossilised skulls of three different species of primates. They were either bipedal or quadrupedal (organisms that habitually walk on all four limbs).



- 19.1 Label part **X** and the type of teeth at **Y**. (2)
- 19.2 Explain the significance of the location of structure **X** in organism **C**. (3)
- 19.3 Which of the skulls (**A**, **B** or **C**) belongs to: (1)
- (a) An *Australopithecine* (1)
- (b) A quadrupedal primate (1)
- 19.4 Explain how the change in the skull from **B** to **C** could indicate a change in intelligence. (3)
- 19.5 Tabulate TWO observable differences, other than those mentioned in QUESTION 19.2 and 19.4 between skulls **B** and **C** that represent trends in human evolution. (5)
- (15)

Question 20

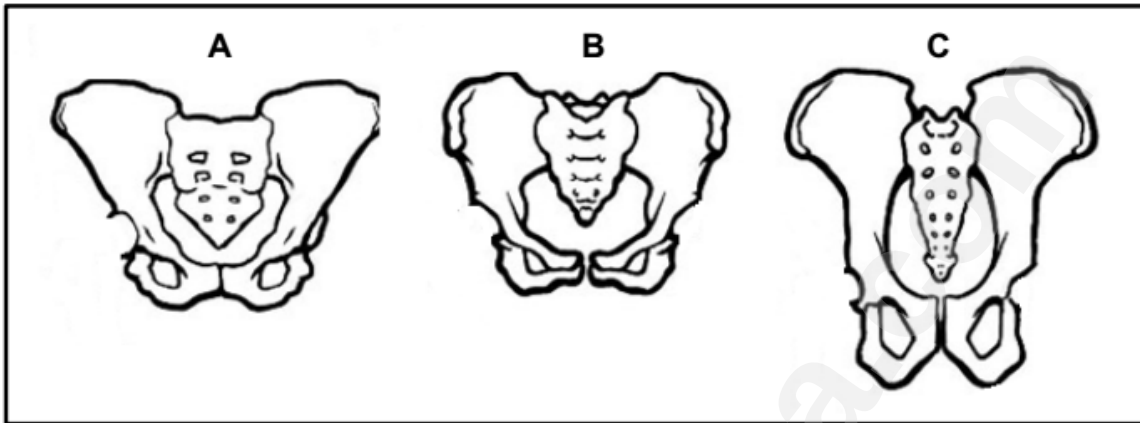
The diagram below shows the skulls of three primate genera and is NOT drawn to scale.



- 20.1 Name parts **B** and **C** respectively. (2)
- 20.2 Name the type of teeth that is larger in genus **III** compared to that of genera **I** and **II**. (1)
- 20.3 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)
- 20.4 Give only the LETTER of the structure that is more pronounced in organism **III** than in organisms **I** and **II**. (1)
- 20.5 Give the correct sequence of the organisms (**I**, **II** and **III**), from most primitive to most evolved. (2)
- (11)**

Question 21

In a study to establish the mode of locomotion of some species, scientists compared the pelvic structure of their fossils. They established that two of these species had the ability to walk upright permanently. The diagrams (A, B and C) below show the pelvic structure of three species, drawn to scale.



- 21.1 What term is used to describe organisms that are able to walk upright permanently? (1)
- 21.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 21.1 (2)
- 21.3 Explain your answer to QUESTION 21.2 (2)
- 21.4 State ONE feature of the spine of the organism represented by C. (1)
- (6)**

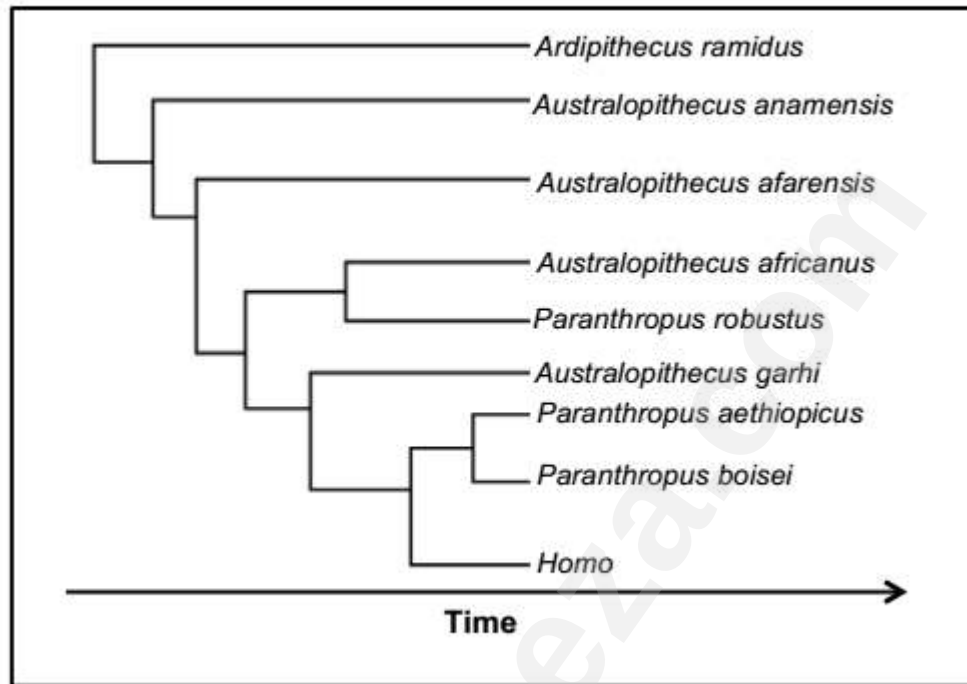
Question 22

Humans and African apes share many characteristics, yet each is a distinct species.

- 22.1 Name FIVE characteristics that humans share with African apes. (5)
- 22.2 Describe how each of the following structures is different between humans and apes:
- (a) Spine (2)
- (b) Pelvic girdle (2)
- 22.3 Explain the significance of the changes to the teeth of humans that show progression in evolution. (4)
- (13)**

Question 23

The diagram below shows possible evolutionary relationships between hominids.

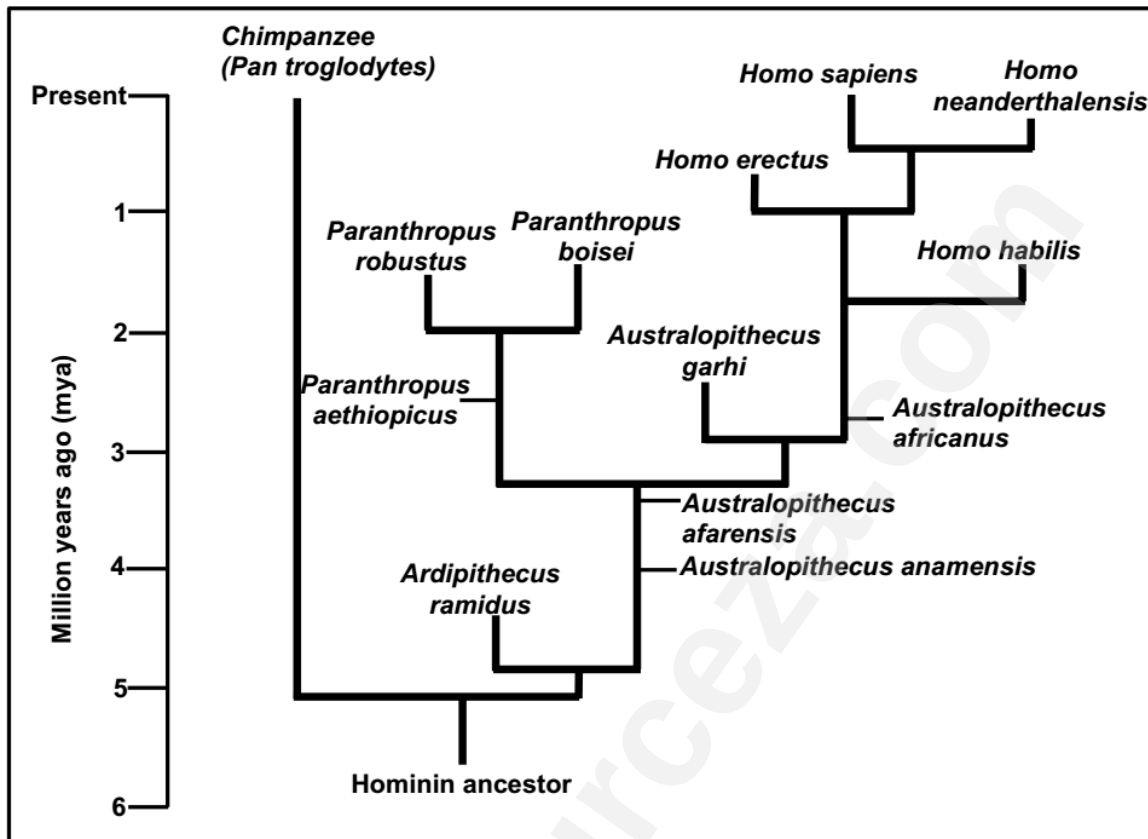


[Source: <http://tolweb.org/tree>]

- 23.1 What is this type of diagram called? (1)
- 23.2 How many genera are shown in the diagram above? (1)
- 23.3 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)
- 23.4 Give ONE example of an *Australopithecus africanus* fossil found in South Africa. (1)
- 23.5 Name TWO *Homo* species, besides *Homo sapiens*, that were found in Africa. (2)
- (8)**

Question 24

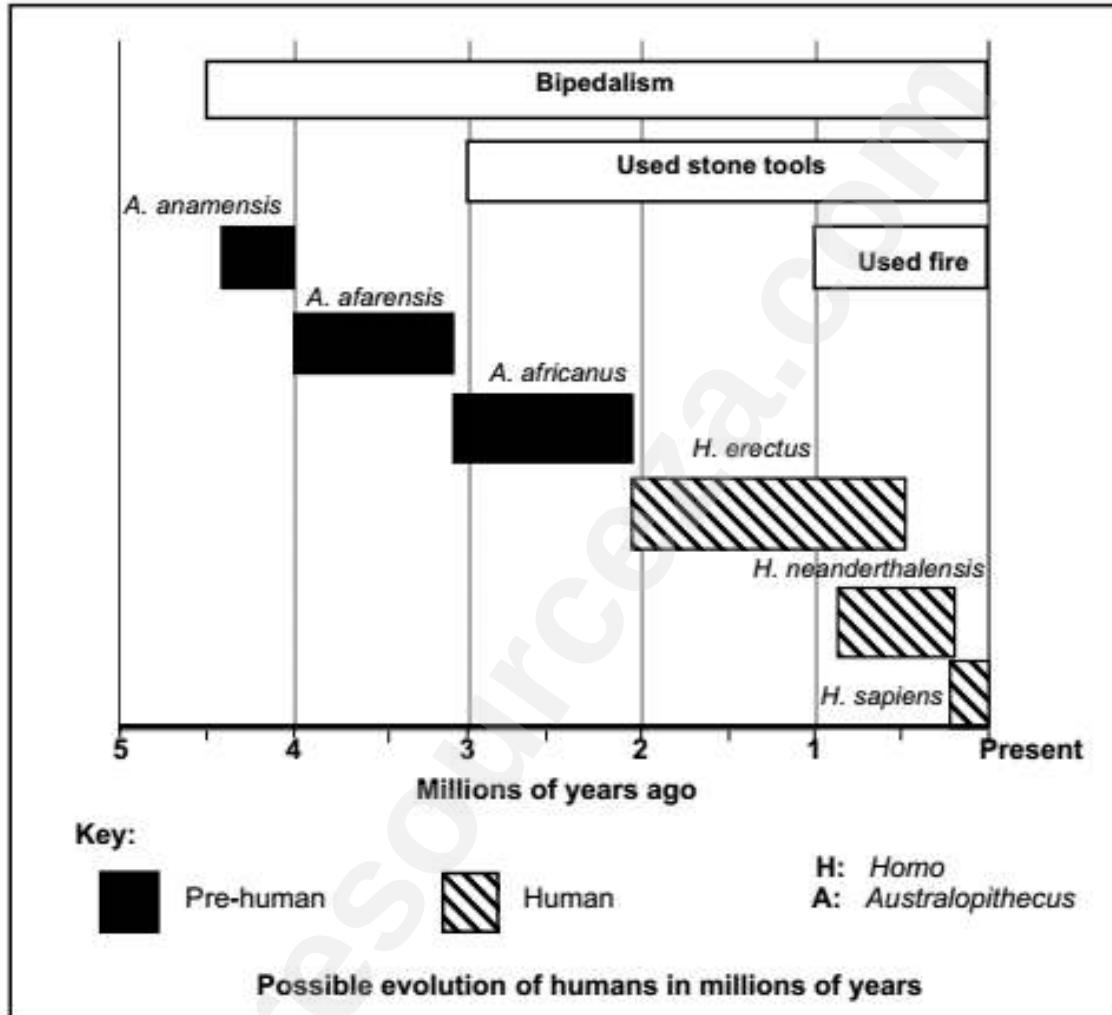
The diagram below shows possible evolutionary relationships among some hominids.



- 24.1 What is this type of diagram called? (1)
- 24.2 How many of EACH of the following are represented in the diagram: (1)
- (a) Genera (1)
 - (b) *Homo* species (1)
- 24.3 Name the species that have *Paranthropus aethiopicus* as a common ancestor. (2)
- 24.4 When did: (1)
- (a) *Ardipithecus ramidus* become extinct (1)
 - (b) *Homo erectus* first appear (1)
- 24.5 Name the: (1)
- (a) Hominid species that existed at the same time as *Homo sapiens* (1)
 - (b) First *Homo* species to use tools (1)
- (9)

Question 25

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.



- 25.1 Use the diagram above and identify TWO bipedal organisms that did not use stone tools or fire. (2)
- 25.2 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)
- 25.3 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)
- 25.4 Explain the relationship between the use of fire and changes in dentition in the *Homo* species. (2)

(9)

Question 26

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

- 26.1 Apart from fossil evidence, give TWO other types of evidence for human evolution. (2)
- 26.2 Which primate became extinct first? (1)
- The brain of an organism is not preserved as a fossil.
- 26.3 How do scientists determine the brain volume of extinct primates? (2)
- 26.4 Calculate the difference in brain volume (in cm³) between the two living primates. Show ALL calculations. (2)
- 26.5 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)
- 26.6 Draw a bar graph to show the average brain volume of EACH of the species of the genus *Homo*. (6)
- (15)

Question 27

Read the passage below.

NEW HOMININ SPECIES DISCOVERED

On 13 September 2013 scientists discovered fossils in the Sterkfontein Caves in South Africa which appeared to belong to a previously unknown species of hominins.

The fossils were classified as a new species, *Homo naledi*. The physical characteristics of *H. naledi* are described as having traits similar to the genus *Australopithecus*, mixed with traits more characteristic of the genus *Homo*. It appeared that *H. naledi* represented a transitional fossil.

An analysis of *H. naledi*'s skeleton suggests that it stood upright and was bipedal. The structure of the pelvis is similar to the *Australopithecines*, but its legs, feet and ankles are more similar to the genus *Homo*.

Four skulls were discovered, each with approximately half the volume of modern human skulls. The *H. naledi* skulls are closer in cranial volume to the skull of *Australopithecus*, but the cranium structure is more similar to those found in the genus *Homo*.

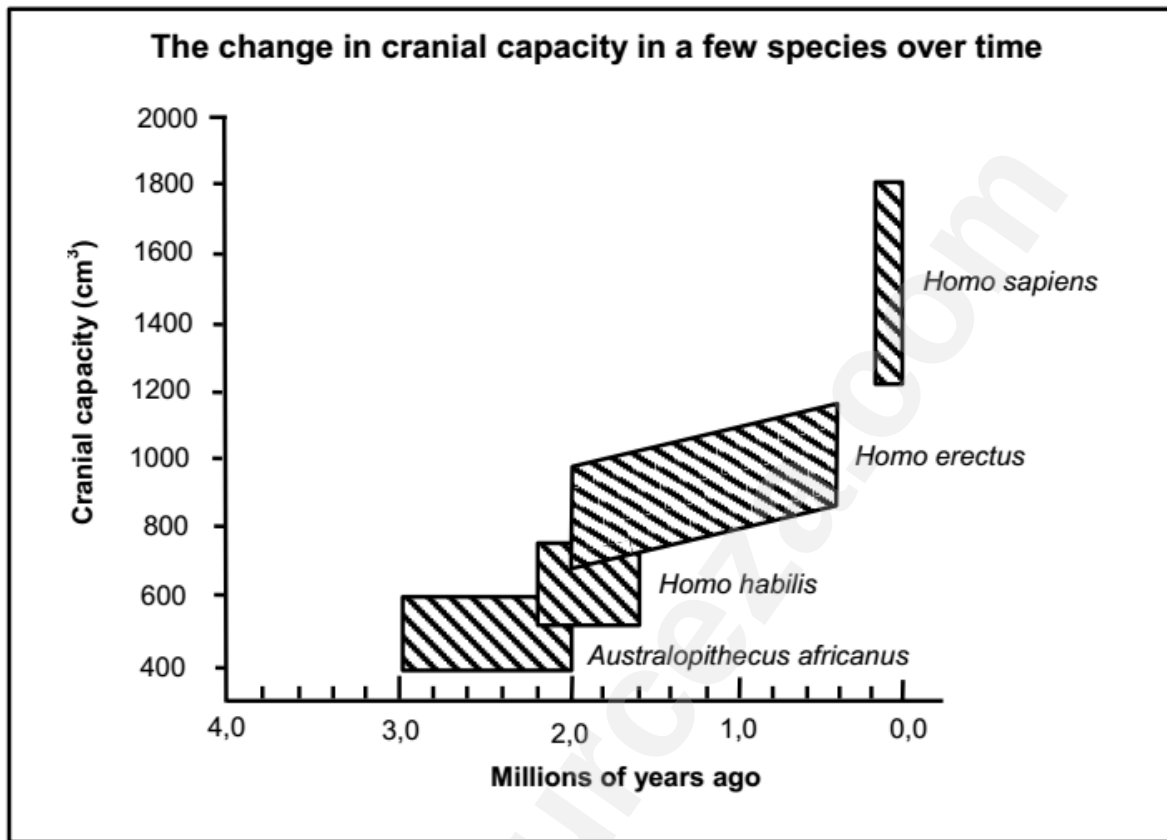
The teeth are much smaller than those of *Australopithecus* and similar to the teeth of modern humans.

[Adapted from <https://humanorigins.si.edu/evidence>]

- | | | |
|------|---|-------------|
| 27.1 | Define the term <i>transitional fossil</i> . | (2) |
| 27.2 | Name a characteristic from the passage that <i>Homo naledi</i> shared with both <i>Australopithecus</i> and <i>Homo</i> . | (1) |
| 27.3 | State ONE other characteristic from the passage that <i>Homo naledi</i> shared only with <i>Australopithecus</i> . | (1) |
| 27.4 | Explain TWO characteristics of a skeleton which are adaptations for bipedalism. | (4) |
| 27.5 | Give ONE possible reason why there was a change to smaller teeth in modern humans. | (3) |
| | | (11) |

Question 28

Study the graph below.



- 28.1 Name the family to which all these species belong. (1)
- 28.2 What is the largest cranial capacity (in cm³) of *Australopithecus africanus*? (1)
- 28.3 When did *Homo habilis* become extinct? (1)
- 28.4 Name TWO *Australopithecus* fossils found in South Africa. (2)
- 28.5 Which of the organisms represented above has the greatest range in cranial capacity? (1)
- (6)

Question 29

Professor Lee Berger and his colleagues studied the fossils they found in a cave at the Cradle of Humankind. The skeletons from the cave are ranked amongst the most complete finds to date. The adult female, *Australopithecus sediba*, was remarkably well preserved and some of the following characteristics were identified:

Some characteristics of *Australopithecus sediba*:

- A small brain size
- Bipedal
- Smaller canines
- Projecting nose
- Small body size

[Adapted from 'Part Ape Part Human', Josh Fischmann, *National Geographic*, August 2011]

- 29.1 Write down THREE characteristics from the list above that also apply to the *Homo* species. (3)
- 29.2 State TWO advantages of *A. sediba* being bipedal. (2)
- 29.3 Professor Berger called *Australopithecus sediba* a transitional fossil. Using the information in the list above, explain why he called *A. sediba* a species in transition. (2)
- (7)

Question 30

The passage below refers to human evolution.

Research, using DNA evidence, suggests that all modern humans arose from a single group of *Homo sapiens* that migrated from Africa 2 000 generations ago and spread throughout Europe and Asia over thousands of years.

[Source: <http://images.sciencedaily.com>]

- 30.1 Name the hypothesis on human evolution that is described in the passage. (1)
- 30.2 Name the type of DNA outside the nucleus that is analysed in support of the hypothesis named in QUESTION 30.1 (1)
- 30.3 Explain how the type of DNA named in QUESTION 30.2 is used to provide evidence for the hypothesis named in QUESTION 30.1 (3)
- 30.4 Apart from DNA evidence, state ONE other line of evidence that may be used to support the hypothesis mentioned in QUESTION 30.1 (1)
- (6)

Question 31

Fossils of the bipedal primates *Ardipithecus*, *Australopithecus* and early *Homo* species are used to support the 'Out of Africa' hypothesis.

State the 'Out of Africa' hypothesis. Describe the evidence that supports the 'Out of Africa' hypothesis and the evidence that shows that the three primate genera mentioned above, were all bipedal.

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

Question 32

Describe the structural changes to the skull that characterise the evolution of modern humans from their ape-like ancestors, and explain the significance of these changes.

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

NOTE: NO marks will be awarded for answers in the form of flow charts or diagrams.