

Western Cape Education Department

LIFE SCIENCES

Grade 12 Term 3

2025

Learner Material

Session 1 : Endocrine System and Homeostasis

Session 2 : Evolution 1

Session 3 : Evolution 2

Session 1: Endocrine System and Homeostasis

ENDOCRINE SYSTEM AND HOMEOSTASIS Paper 1: 34 marks	Term 2 and 3	2½ weeks
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CONTENT	ELABORATION
Endocrine system	❑ Difference between an endocrine and an exocrine gland ❑ Definition of a hormone ❑ Location of each of the following glands, using a diagram, the hormones they secrete and function(s) of each hormone: • Hypothalamus (ADH) • Pituitary/Hypophysis (GH, TSH, FSH, LH, prolactin) • Thyroid glands (thyroxine) • Islets of Langerhans in the pancreas (insulin, glucagon) • Adrenal glands (adrenalin, aldosterone) • Ovary (oestrogen, progesterone) • Testis (testosterone)
Introduction – Homeostasis	❑ Homeostasis as the process of maintaining a constant, internal environment within narrow limits, despite changes that take place internally and externally. ❑ The conditions within cells depend on the conditions within the internal environment (the tissue fluid) ❑ Factors such as carbon dioxide, glucose, salt, water concentration, temperature and pH must be kept constant in the internal environment (tissue fluid)
Homeostasis: Negative feedback mechanisms	❑ Negative feedback mechanism controlling each of the following in the body: • Thyroxine levels • Blood glucose levels • Blood carbon dioxide levels • Water balance (osmoregulation) • Salt ❑ Disorders caused by an imbalance in levels of: • Thyroxine – Goitre • Blood glucose – Diabetes mellitus

CONTENT	ELABORATION
Homeostasis: Negative feedback mechanisms (... continued)	❑ Thermoregulation • Structure of the skin, using a diagram, with an emphasis on the parts involved in thermoregulation ❑ Role of the following in negative feedback mechanism for controlling temperature/thermoregulation: • Sweating • Vasodilation • Vasoconstriction

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers

1.1.1 Which ONE of the following shows the correct combination of the hormone with its target organ?

	HORMONE	TARGET ORGAN
A	Prolactin	Pituitary gland
B	Glucagon	Pancreas
C	LH	Uterus
D	TSH	Thyroid gland

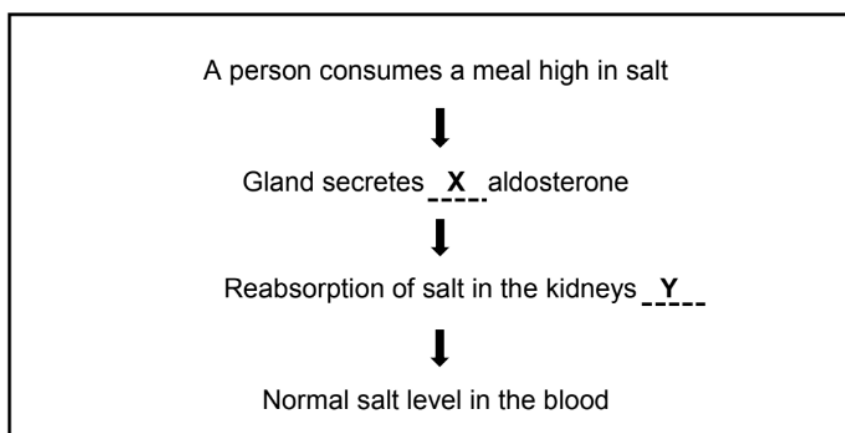
1.1.2 On a hot day ...

- A less blood flows to the surface of the skin
- B the sweat glands become inactive.
- C more blood flows to the surface of the skin.
- D vasoconstriction takes place.

1.1.3 Which ONE of the following will occur in the human body on a cold day?

- A Vasodilation in the skin
- B Increase in the activity of sweat glands
- C Decrease in evaporation of sweat from the surface of the skin
- D Increase in blood flow to the surface of the skin

QUESTIONS 1.1.4 AND 1.1.5 ARE BASED ON THE FLOW DIAGRAM BELOW.



1.1.4 Which gland secretes aldosterone?

- A Adrenal
- B Pituitary
- C Thyroid
- D Pancreas

1.1.5 Which ONE of the following is CORRECT with regard to **X** and **Y** in the flow diagram?

	X	Y
A	More	Increases
B	Less	Increases
C	More	Decreases
D	Less	Decreases

1.1.6 A tumour in the hypothalamus of the brain of a patient caused a condition called diabetes insipidus. Below are some of the patient's symptoms:

- Dehydration
- Production of large quantities of dilute urine

Which ONE of the following is the most likely effect of the tumour?

- A Increased secretion of TSH
- B Decreased secretion of ADH
- C Increased reabsorption of water in the kidneys
- D Increased permeability of the collecting ducts in the kidney to water

1.1.7 A person experiences the following symptoms:

- Loses weight easily
- Is always hungry
- Never feels cold

The most likely explanation for this combination of symptoms is that the person ...

- A secretes too much growth hormone.
- B has an overactive thyroid gland.
- C is diabetic and just had an insulin injection
- D has an underactive hypothalamus.

1.1.8 The level of aldosterone will most likely increase after ...

- A consuming food with a high salt content.
- B sweating excessively.
- C consuming food with a high glucose content.
- D the constriction of blood vessels to the skin.

1.1.9 During periods when the temperature is low, ...

- A the thyroxin levels are expected to be low.
- B sweating increases.
- C the blood vessels to the skin dilate.
- D the ADH levels are expected to be low.

1.10 Which disease occurs when blood sugar levels are too high?

- A Hyperthyroidism
- B Goitre
- C Diabetes
- D Rickets

1.1.11 The list below represents the events of a hormonal control system.

- (i) Message is sent to target organ
- (ii) Control centre responds
- (iii) An imbalance is detected
- (iv) A control centre is stimulated
- (v) Target organ responds

Which ONE of the following represents the correct order of events?

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

1.12 Secretions are released into a cavity or onto the surface through a duct in the body by ...

- A an endocrine gland.
- B an exocrine gland.
- C the nervous system.
- D the circulatory system.

QUESTIONS 1.1.13 AND 1.1.14 REFER TO THE INVESTIGATION BELOW.

A scientist did an investigation to determine the effect of drinking water on urine production.

A healthy athlete was requested not to drink water or eat food for five hours before the investigation started. The investigation was conducted over a period of three days.

The following procedure was followed.

- Day 1, the athlete was given 500ml of water to drink.
- Day 2, the athlete was given 700ml of water to drink.
- Day 3, the athlete was given 900ml of water to drink.
- On each day of the investigation, the amount of urine produced by the athlete was measured and recorded over a four-hour period after drinking the water.
- The average was calculated.

1.1.13 Which ONE of the following CORRECTLY indicates the dependent and independent variable?

	Independent variable	Dependent variable
A	The amount of urine produced	Time in hours
B	The amount of water consumed	The amount of urine produced
C	The amount of urine produced	The amount of water consumed
D	The person participating	Time in hours

1.1.14 The list below shows the planning steps before and after the investigation.

- (i) Permission was obtained from the athlete.
- (ii) The measuring tool was decided upon.
- (iii) The amount of water was measured.
- (iv) The duration of the investigation was decided upon.

Which of the planning steps above are correct?

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

14 x 2 **(28)**

- 1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question numbers
- 1.2.1 The homeostatic process whereby temperature is controlled in the body
 - 1.2.2 The part of the brain that controls body temperature
 - 1.2.3 A hormone that regulates the salt levels in blood
 - 1.2.4 A hormone that regulates the water balance in the body
 - 1.2.5 The process of maintaining a constant internal environment in the human body
 - 1.2.6 A hormone that stimulates the mammary glands to produce milk
 - 1.2.7 The gas in the blood which, when increased, causes an increase in the breathing rate
 - 1.2.8 The system in the body that regulates processes by secreting hormones directly into the blood
 - 1.2.9 The condition of the blood vessels in the skin in humans when the environmental temperature is low
 - 1.2.10 A gland which produces substances that are transported to target organs by ducts
 - 1.2.11 Control of the level of water in the body
 - 1.2.12 The condition caused by an under-secretion of growth hormone in children. **(12)**

- 1.3 Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.4) in the ANSWER BOOK.

	COLUMN 1	COLUMN II
1.3.1	Hormones secreted by the pituitary gland	A: Prolactin B: Growth hormone
1.3.2	Produces oestrogen	A: Pituitary gland B: Graafian follicle
1.3.3	Hyperthyroidism	A: Under secretion of ADH B: Increased metabolic rate
1.3.4	A hormone that stimulates the secretion of the hormone of the thyroid gland	A: Testosterone B: Absciscic acid

4 x 2 **(8)**

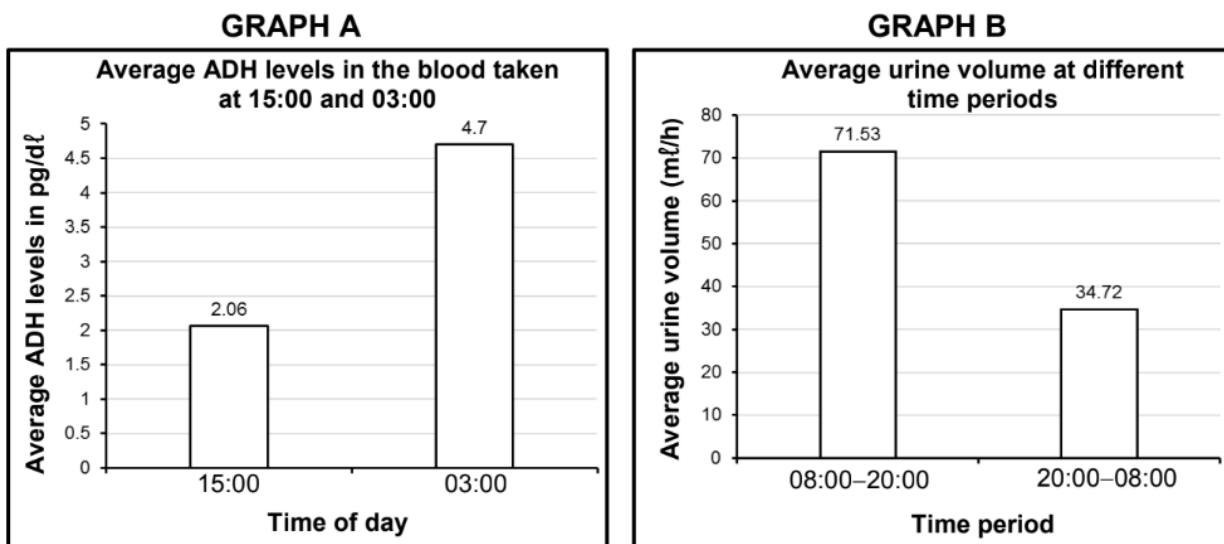
SECTION B

QUESTION 2

2.1 An investigation was conducted to determine the change in the ADH levels in the blood and the volume of urine produced over a 24-hour period. The procedure was as follows:

- One healthy adult participated in the investigation.
- The intake of food and liquids of this person was controlled for the duration of the investigation.
- The ADH levels in the blood were measured at 15:00 and 03:00 for 5 days and the average was calculated.
- The volume of urine produced from 08:00 to 20:00 was measured for 5 days and the average was calculated.
- The volume of urine produced from 20:00 to 08:00 was measured for 5 days and the average was calculated.

The results are shown in the graphs below.



- 2.1.1 Calculate the difference between the average volume of urine (ml/h) produced during the 2 time periods. Show ALL workings. (2)
- 2.1.2 Explain how the ADH levels in the blood at 03:00 affects the volume of urine produced between 20:00 and 08:00. (4)
- 2.1.3 Explain ONE advantage of the high ADH levels at 03:00. (2)
- 2.1.4 A patient whose renal tubules are impermeable to water, underwent the same investigation. Explain why the ADH levels are expected to remain high all the time. (3)
- (11)**

2.2 Type I diabetes mellitus is caused by pancreatic cells which cannot produce insulin. In type II diabetes mellitus the pancreas does secrete insulin, but the body cells are resistant to the effect of insulin.

To diagnose if a person has type I or type II diabetes mellitus, the following tests may be conducted:

- The blood glucose level is tested after fasting (the person is not allowed to eat or drink for 6 hours before the test). If the blood glucose level is above 126 mg/dl, the person is diabetic.
- The person is then given a glucose solution to drink and the blood glucose level is tested after 2 hours.
- The blood is also tested for the presence of GAD antibodies. The presence of GAD antibodies would indicate that the body is destroying the insulin-producing pancreatic cells.
- The levels of C-peptide are measured. This is a substance produced by the same pancreatic cells that produce insulin. If the levels are below 0,3 ng/ml in the blood, the person is diabetic.

2.2.1 Name the cells in the pancreas that secrete insulin. (1)

2.2.2 Explain which type (I or II) of diabetes mellitus would be indicated by the:

a) presence of GAD antibodies in the blood (3)

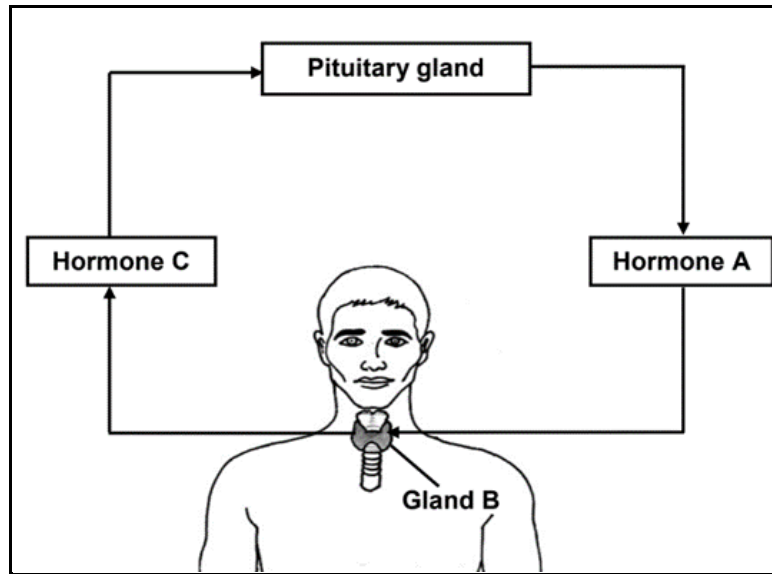
b) C-peptide levels at below 0,3 ng/ml (3)

2.2.3 Explain the insulin levels in the blood of a type II diabetic 2 hours after drinking the glucose solution. (3)

2.2.4 Give ONE reason why a person with untreated diabetes mellitus is expected to be tired all the time. (2)

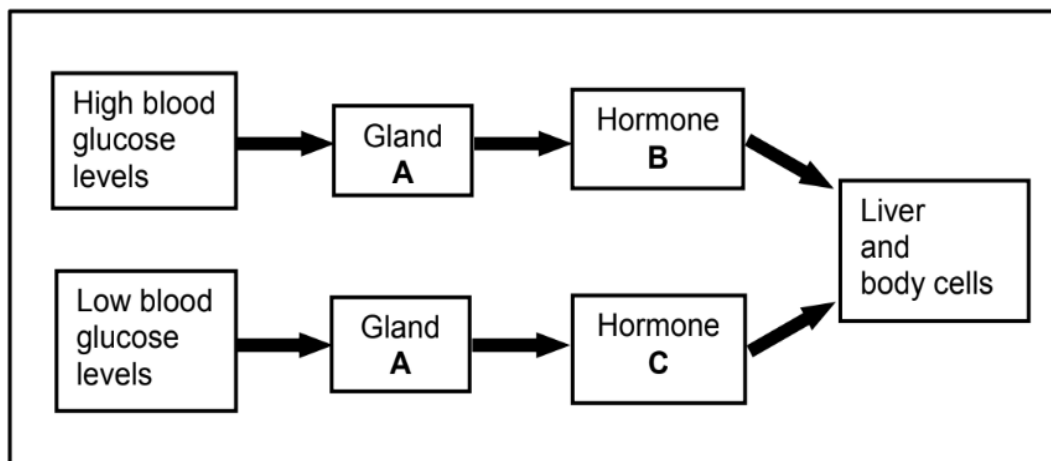
(12)

2.3 The diagram below shows the interaction between two endocrine glands.



- 2.3.1 Name the type of interaction that occurs between hormone **A** and gland **B**. (1)
- 2.3.2 Identify: (1)
(a) Gland **B** (1)
(b) Hormone **A** (1)
(c) Hormone **C** (1)
- 2.3.3 Name the disorder that results when gland **B** is overstimulated and becomes enlarged. (1)
- 2.3.4 Which hormone (**A** or **C**) will be expected to be high in the blood of the person with the disorder named in QUESTION 2.3.3? (1)
(6)

2.4 The diagram below shows the homeostatic control of blood glucose levels.



2.4.1 Identify:

(a) Gland **A**

(1)

(b) Hormone **C**

(1)

2.4.2 A certain disorder causes decreased production of hormone **B**.

(a) Explain how this will affect the blood glucose levels.

(3)

(b) Name the disorder

(1)

2.4.3 Scientists have been investigating the use of adrenalin as a treatment for people who cannot produce hormone **C**.

Explain why this treatment may work.

(3)

(9)

2.5 ADH plays a role in osmoregulation in the human body.

2.5.1 Name the gland that secretes ADH.

(1)

2.5.2 Describe osmoregulation on a cold day.

(3)

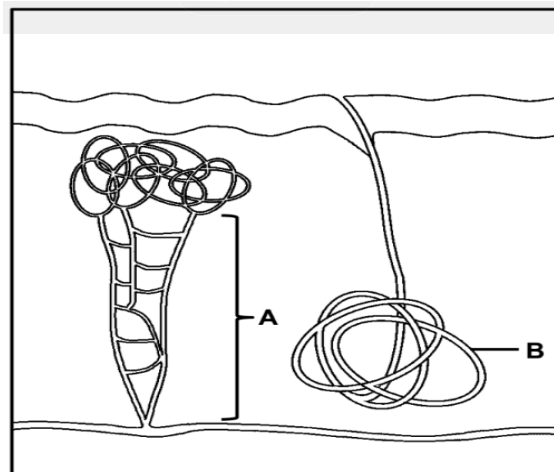
2.5.3 A person with a medical condition that causes the renal tubules to become resistant to the effects of ADH, always produces large volumes of urine.

Explain why the ADH levels in the blood will always be higher than normal for this person.

(3)

(7)

2.6 The diagram below represents a part of the human skin.



2.6.1 Identify part **B**. (1)

2.6.2 Describe how structure **A** functions during thermoregulation on a cold day. (3)

2.6.3 Explain why temperature needs to be kept constant in the human body. (2)
(6)

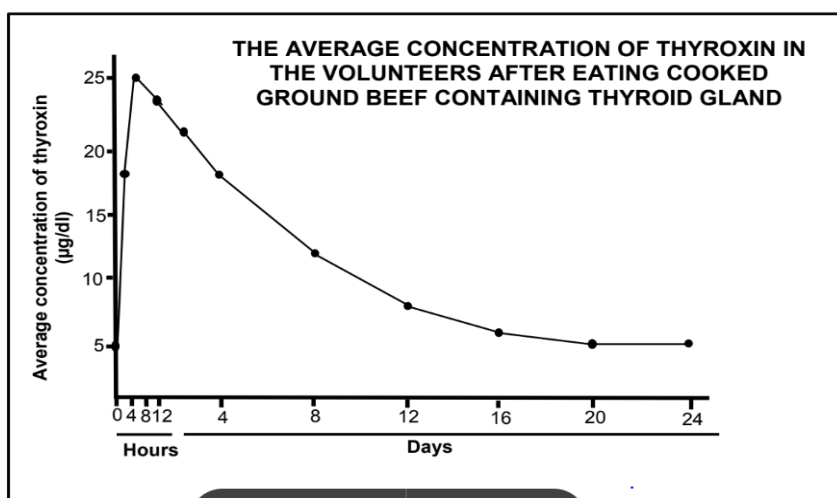
2.7 Read the extract below.

AN OUTBREAK OF THYROTOXICOSIS

Thyrotoxicosis is a medical condition caused by high levels of thyroxine in the blood. There was a sudden increase in the number of reported cases of this condition in one city. They suspected that this was due to people eating ground beef (minced meat) from a local butcher. The butcher added the thyroid glands of cattle when he produced the ground beef. Some people who ate this ground beef showed symptoms of increased heart rate, excessive sweating and weight loss.

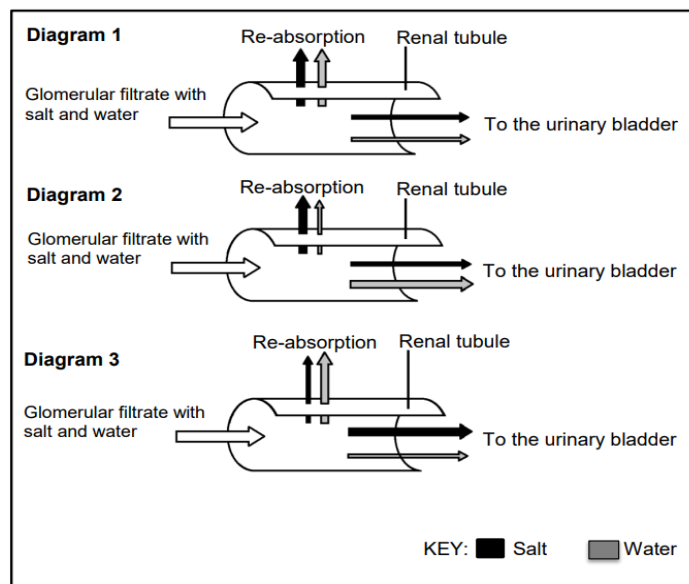
Doctors conducted an investigation to determine if the ground beef caused the thyrotoxicosis. The normal thyroxine levels of 5 volunteers were measured. They were then given cooked ground beef from the butchery to eat. Their thyroxine concentration was measured every 4 hours on day 1 and then **once a day for the next 23 days**. The average thyroxine levels were calculated and recorded.

The results are shown in the graph below.



- 2.7.1 Give the average normal thyroxin concentration ($\mu\text{g/dl}$) in the blood of the volunteers. (1)
- 2.7.2 Calculate the percentage increase of the average thyroxin concentration in the first 8 hours after eating the ground beef. Show ALL working. (3)
- 2.7.3 Explain why thyrotoxicosis causes weight loss. (3)
- 2.7.4 Explain the expected concentration of TSH in the blood 8 hours after eating the ground beef. (4)
- (11)**

- 2.8 The diagrams below show the re-absorption of salt and water through the tubules of a nephron in the kidney under three different conditions. The width of the arrows represents the amounts of salt and water.



- 2.8.1 Name the hormone in a human body that is responsible for controlling the:
- (a) Water content (1)
- (b) Salt content (1)
- 2.8.2 Name the gland that secretes the hormone in QUESTION 2.8.1 (b). (1)
- 2.8.3 Which diagram (1, 2 or 3) would represent a person who had eaten salty chips on a hot day without any intake of water? (1)
- 2.8.4 Explain your answer to QUESTION 2.8.3. (5)
- (9)**

2.9 Read the extract below.

People with Type I diabetes mellitus are usually insulin-dependent (must inject themselves with insulin to control their blood glucose levels). It has been determined that these people also lose their ability to secrete glucagon within five years of being diagnosed and they become glucagon deficient.

During a stressful situation adrenalin is secreted, which has the same effect as glucagon on the blood glucose levels.

An investigation was conducted to determine the influence of adrenalin on the blood glucose levels of Type I diabetics who were also glucagon deficient.

The investigation was conducted as follows:

- 100 male patients with Type I diabetes mellitus, who were also glucagon deficient, participated in the investigation.
- They were then given the same amount of food and water at the same time for a period of three days.
- Their blood glucose levels were measured on the morning of the third day.
- A solution with a low concentration of adrenalin was then administered intravenously (injected).
- After 20 minutes, the blood glucose concentration in each person was measured again.
- The blood glucose levels before and after administering adrenalin were compared.

- | | | |
|-------|---|-----|
| 2.9.1 | Name the gland that secretes glucagon. | (1) |
| 2.9.2 | Identify the independent variable in the investigation. | (1) |
| 2.9.3 | State THREE other factors that should have been kept constant during the investigation. | (3) |
| 2.9.4 | Explain why the blood glucose levels were measured before injecting adrenalin on the third day. | (2) |
| 2.9.5 | Explain why the adrenalin was injected instead of given orally. | (2) |
| 2.9.6 | Explain what would be the expected results after adrenalin was injected into the patients. | (2) |
| 2.9.7 | Give a reason for the use of 100 patients in the investigation instead of only 10 patients. | (1) |

(12)

- 2.10 Describe what happens when the carbon dioxide level in the blood increases above normal.

(5)

2.11 Read the passage below

Sphiwe was walking alone in the bush. She suddenly saw a big snake and she was very frightened. She screamed asking for help, turned around and ran away. During that time, she was breathing heavily and her eyes were wide open.



2.11.1 Name the hormone that prepared the body to evade the danger. (1)

2.11.2 State the role of the liver during an emergency. (1)

2.11.3 Explain the effects of the hormone mentioned in QUESTION 2.11.1 on the blood vessels of skeletal muscles. (4)
(6)

2.12 Explain how the thyroid gland is functionally related to body temperature on a cold day. **(4)**

Session 2: Evolution 1

CONTENT	ELABORATION
Introduction	❑ Definition of biological evolution change in the characteristics of species over time ❑ 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 ❑ Types of variation: • Continuous variation – those characteristics where there is a range of intermediate phenotypes, e.g. height • Discontinuous variation – those characteristics that fall into distinct categories e.g., blood groups
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
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 • Plant adaptation to different pollinators • Infertile offspring • Prevention of fertilisation
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

SECTION A

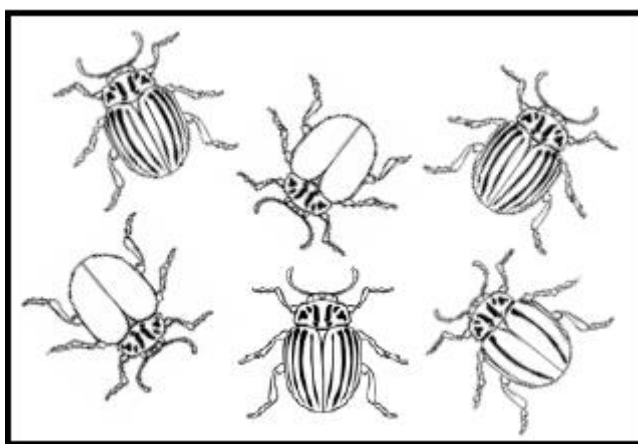
QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A to D) next to the question numbers.

1.1.1 Who formulated the law of use and disuse?

- A Lee Berger
- B Rosalind Franklin
- C Gregor Mendel
- D Jean Baptiste de Lamarck

1.1.2 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

1.1.3 Comparisons of the amino acid sequences in a protein have been made between humans and a number of other organisms. The number of differences is shown in the table below.

ORGANISM	SHARK	KANGAROO	FISH	COW	LIZARD
Number of differences in amino acid sequences in a protein compared to humans	79	27	68	17	62

[Adapted from AQA Biology 1998]

The type of evidence for evolution in the table above is ...

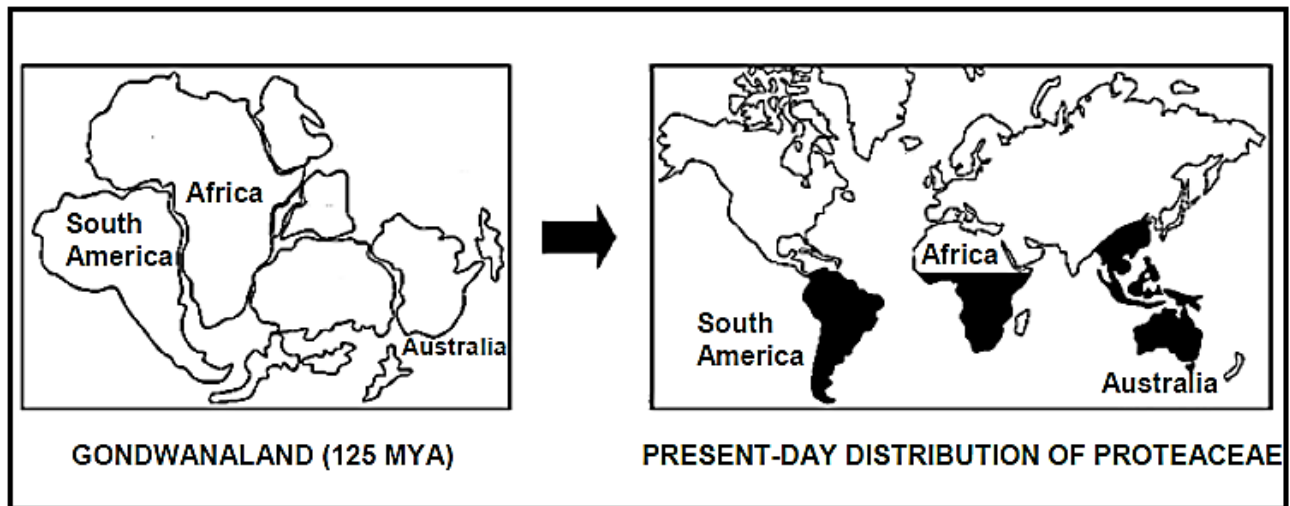
- A fossil evidence.
- B biogeography.
- C cultural evidence.
- D genetic evidence.

1.1.4 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.

QUESTIONS 1.1.5 AND 1.1.6 ARE BASED ON THE DIAGRAM BELOW.



Shrubs of the family Proteaceae (for example waratahs and proteas) can be found in Australia, South America, Indo-China and parts of Africa.

1.1.5 This type of evidence for evolution is called ...

- A the 'Out of Africa' hypothesis.
- B fossil evidence.
- C biogeography.
- D cultural evidence.

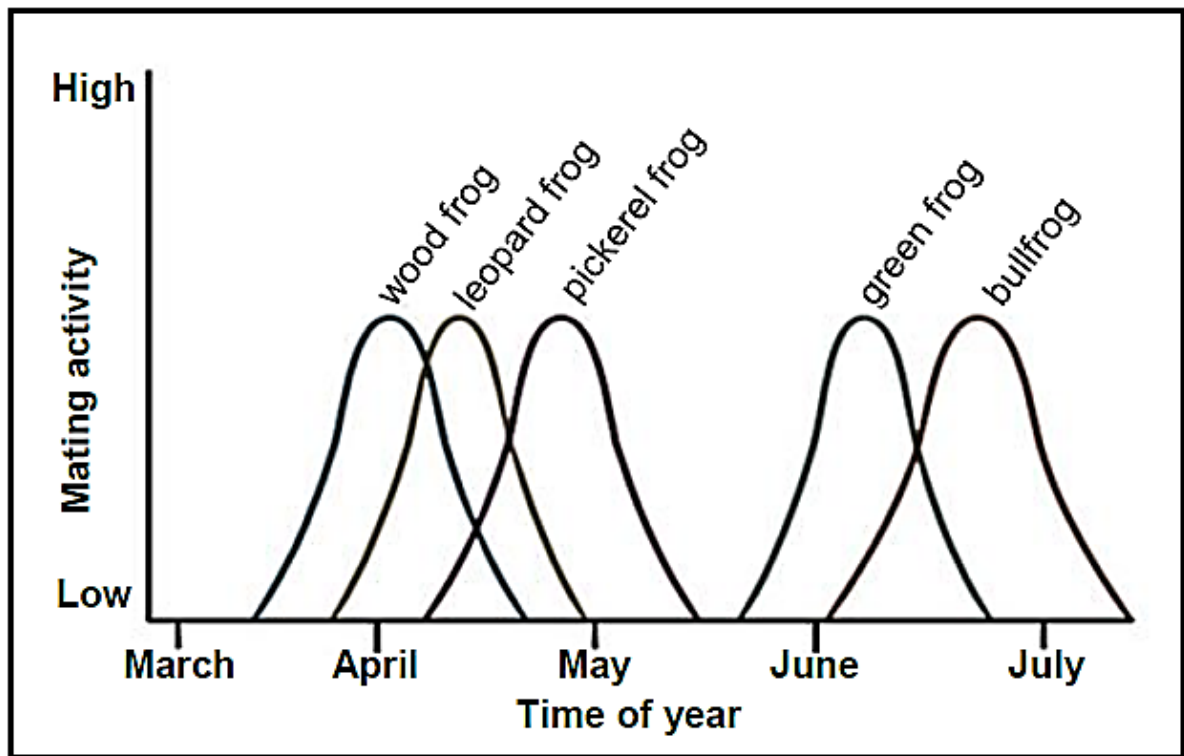
1.1.6 It is evident from the diagram that all proteas ...

- A developed from a common ancestor.
- B are found in the Southern Hemisphere.
- C became extinct when Gondwanaland separated.
- D are equally distributed on all continents.

1.1.7 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.

- 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

- 1.1.9 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.

- 1.1.10 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

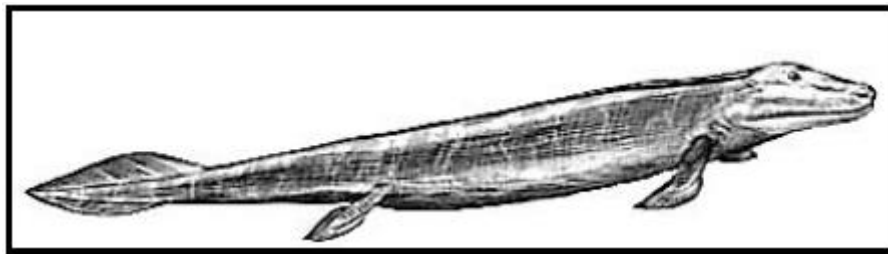
1.1.11 Study the mechanisms below:

- (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)

1.1.12 The diagram below shows *Tiktaalik roseae*, a fish that may be the ancestor of the first organisms to live on land.



According to Lamarck, this species of fish may have evolved the ability to 'walk' on land by ...

- A undergoing natural genetic mutations which caused the fins to develop into legs.
- B the process of natural selection.
- C passing on the acquired characteristic of fins to their offspring.
- D stretching its fins and using them for 'walking'.

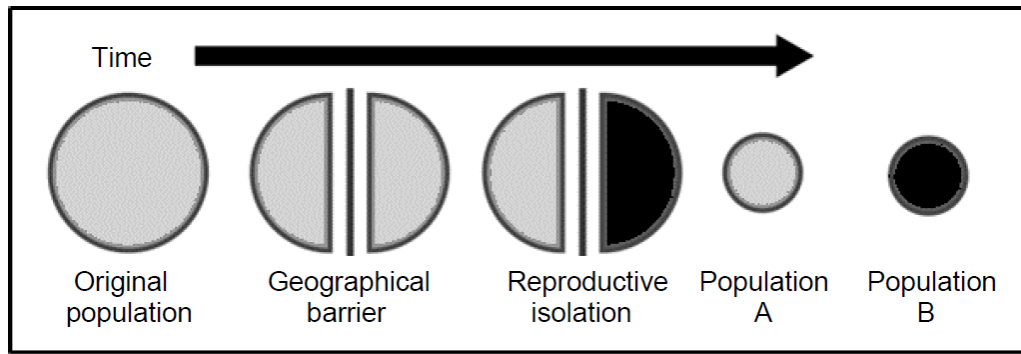
1.1.13 Punctuated equilibrium suggests the following:

- A Evolution is always a slow and gradual process.
- B Natural selection does not explain evolution.
- C New species can appear quickly, over a relatively short period of time.
- D Artificial selection is the only mechanism that causes evolution.

1.1.14 According to Charles Darwin, organisms that will be most successful biologically, are those that ...

- A are best adapted to their environment.
- B are the largest in the population.
- C reproduce the slowest.
- D do not change.

1.1.15 The diagram below shows a process in evolution.



This diagram illustrates ...

- A natural selection.
- B variation.
- C punctuated equilibrium.
- D speciation.

15 x 2 **(30)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number.

- 1.2.1 The process of change in the characteristics of biological species over time
- 1.2.2 Similar structures that are inherited from a common ancestor and are modified for different functions
- 1.2.3 Type of evolution characterised by long periods of little or no change alternating with short periods of rapid change
- 1.2.4 The breeding of plants and animals by humans for desired characteristics
- 1.2.5 The formation of new species
- 1.2.6 The type of variation in a population with no intermediate phenotypes
- 1.2.7 A testable statement that may be accepted or rejected
- 1.2.8 The distribution of species in different parts of the world.
- 1.2.9 Descent with modification over time.

9 x 1 **(9)**

- 1.3 Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, both **A and B** or **none** next to the question numbers.

COLUMN I	COLUMN II
1.3.1 Proposed by Lamarck	A: 'Law' of use and disuse B: 'Law' of inheritance of acquired characteristics
1.3.2 Law of inheritance of acquired characteristics	A: Darwinism B: Modification by descent
1.3.3 Humans select the characteristics when breeding organisms	A: Artificial selection B: Natural selection
1.3.4 The variable that is observed or measured by an investigator during an investigation	A: Independent B: Dependant
1.3.5 Characteristics are inherited from the parents by the offspring	A: Lamarck's observation B: Darwin's observation
1.3.6 Type of variation represented by skin colour in humans	A: Continuous variation B: Discontinuous variation
1.3.7 An example of discontinuous variation in humans	A: Skin colour B: Height
1.3.8 Reproductive isolating mechanisms in plants	A: Flowering at different times of the year B: Adaptation to different pollinators
1.3.9 Evidence for evolution	A: Biogeography B: Fossil record

9 x 2 (18)

SECTION B

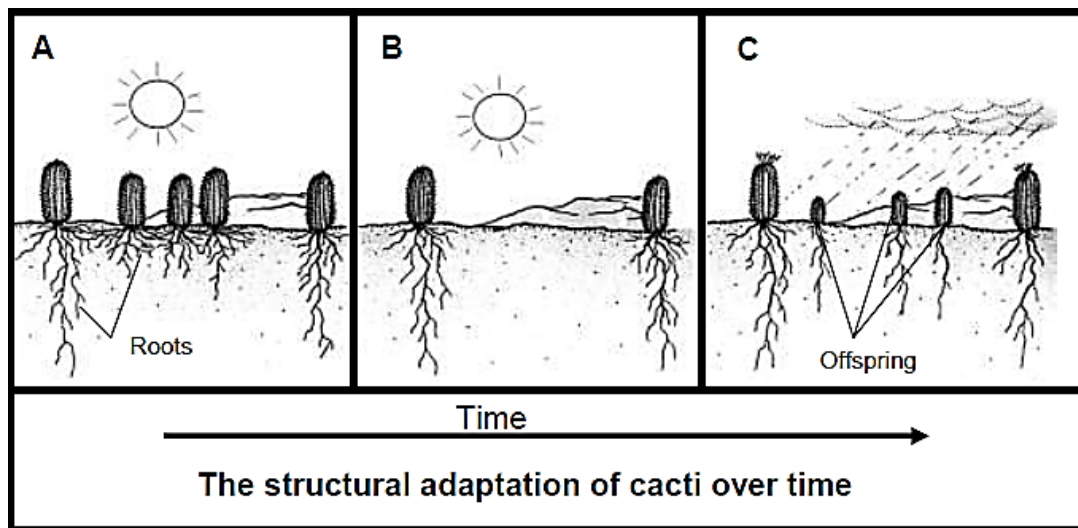
QUESTION 2

- 2.1. The following questions refer to Lamarck's explanation of evolution:

- 2.1.1 Describe the idea proposed by Lamarck to explain evolution. (4)
- 2.1.2 State why Lamarck's explanation is not accepted by most scientists today. (2)
- 2.1.3 Describe the process of natural selection. (7)

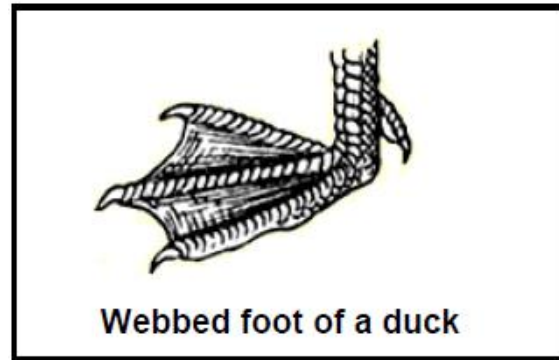
(13)

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



- 2.2.1 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)
- 2.2.2 Name the mechanism put forward by Darwin to explain his theory of evolution that is illustrated in these diagrams. (1)
- 2.2.3 Use the three diagrams above to explain the mechanism mentioned in QUESTION 2.2.2. (5)
- 2.2.4 Define *punctuated equilibrium*. (3)
- (10)**
- 2.3 Describe how each of the following contributes to genotypic variation within a species:
- 2.3.1 Meiosis (6)
- 2.3.2 Mutation (2)
- 2.3.3 Sexual reproduction (4)
- (12)**

2.4 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)

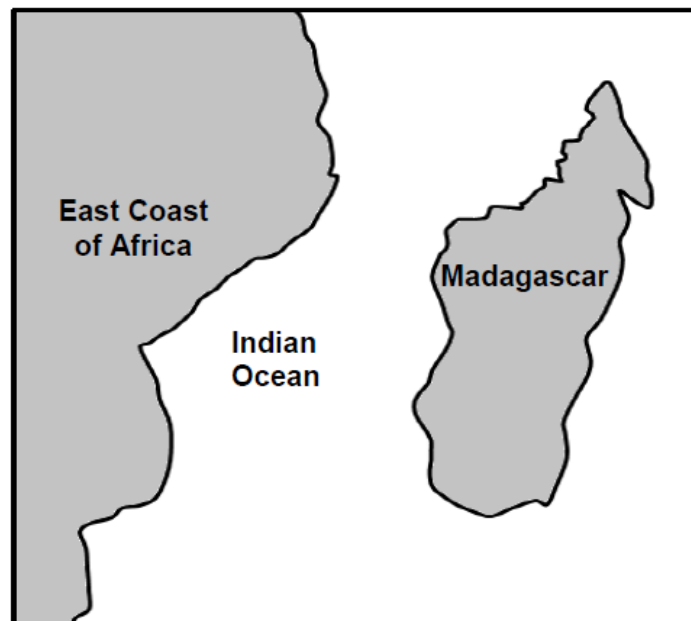
2.5 Describe how speciation occurs when a population becomes separated by a geographical barrier.

(6)

2.6 Pottos and lemurs are small mammals.

Scientists believe that pottos and lemurs share a common ancestor that existed in Africa. Presently pottos only occur in Africa while lemurs are only found in Madagascar.

Madagascar is an island off the East coast of Africa as shown in the diagram below.



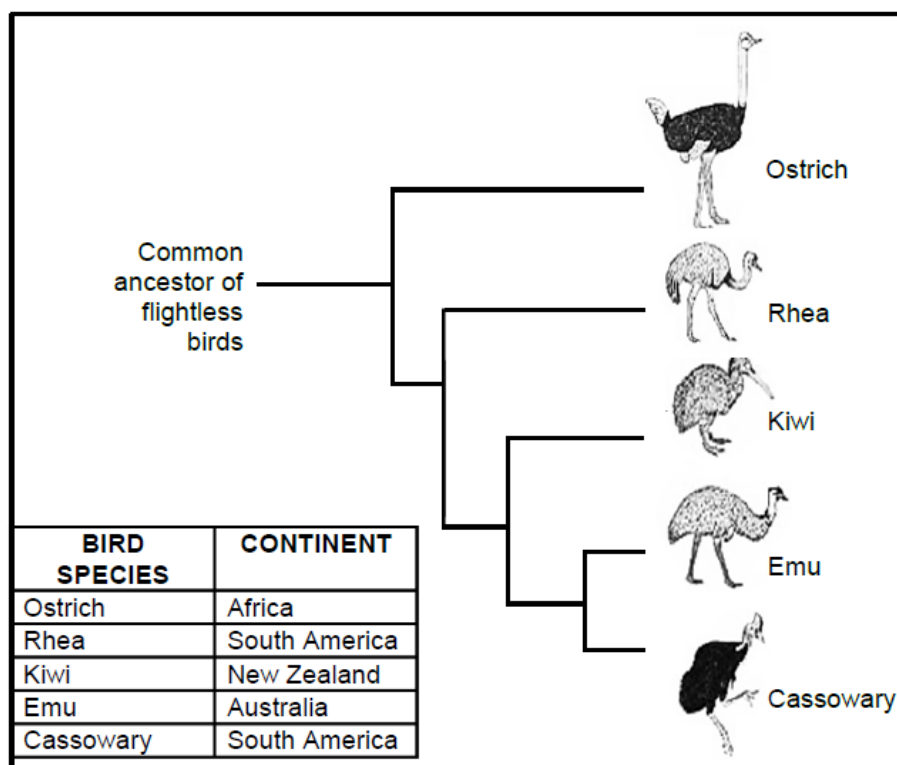
2.6.1 Explain how continental drift could have affected the distribution of the common ancestor.

(4)

2.6.2 Describe the speciation of the pottos and lemurs to become different species.

(6)
(10)

- 2.7 The diagram below represents the evolution of the flightless birds and the continents on which they exist at present.



- 2.7.1 Identify the type of diagram shown above. (1)
- 2.7.2 Name the TWO species that share the most recent common ancestor. (2)
- 2.7.3 Use information in the diagram to describe how biogeography supports the theory of evolution. (4)
- 2.7.4 Describe how it can be proven that ostriches and rheas are different species. (2)
- (9)**

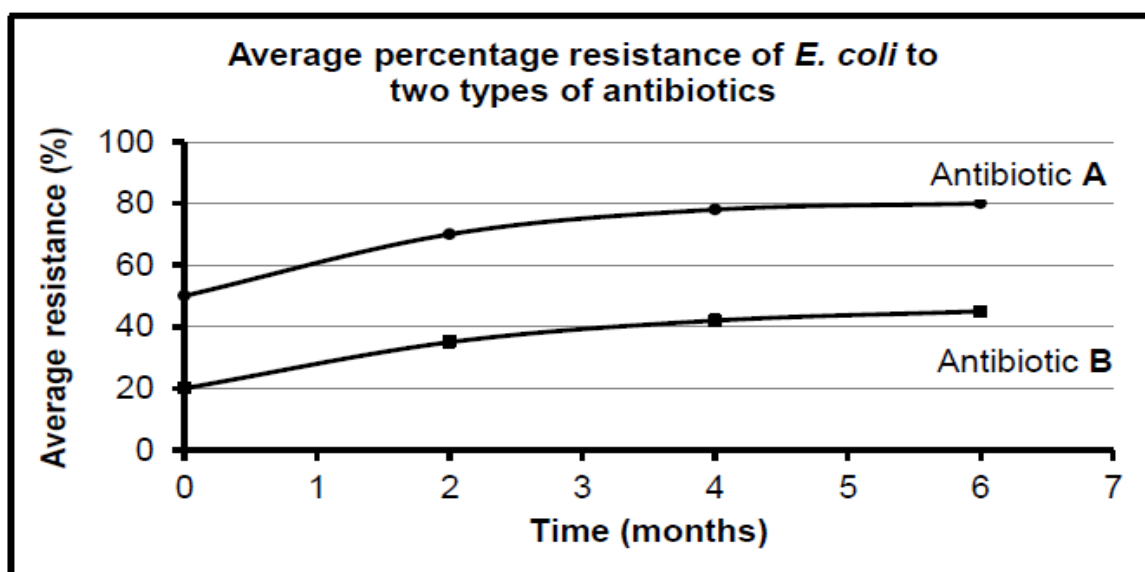
- 2.8 The *E. coli* bacterium lives in the intestines of pigs where they reproduce rapidly. Certain strains of *E. coli* cause diarrhoea in young pigs (piglets).

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.



- 2.8.1 Identify the independent variable in this investigation. (1)
- 2.8.2 Identify TWO factors that should be kept constant during the investigation. (2)
- 2.8.3 State TWO ways in which the scientists ensured the reliability of the investigation. (2)
- 2.8.4 Which antibiotic will you recommend for controlling *E. coli* in piglets? (1)
- 2.8.5 Support your answer to QUESTION 2.8.4 using evidence in the graph. (2)
- 2.8.6 Explain the results that are shown in the graph for antibiotic **A** in terms of natural selection. (5)

(13)

- 2.9 The following series of extracts (1, 2 and 3), explains the poaching and subsequent evolution of the African elephant population in one of Mozambique's national parks. Answer QUESTIONS 2.9.1 – 2.9.7 based on the extracts.

Extract 1

Between 1977 and 1992, a civil war in Mozambique led to the poaching of elephants. Armies need money to fight, and ivory from elephant tusks was a way to get it. The elephant population in Gorongosa National Park in Mozambique was home to 2542 elephants before the war in 1972. By the year 2000, that number had fallen to just 242. Currently there are about 800 elephants.

- 2.9.1 Calculate the percentage decrease in the elephant population due to the war. Show all calculations. (3)
- 2.9.2 Draw a bar graph to represent the information in the extract above. (6)

Extract 2

The development of tuskless elephants in the Gorongosa National Park inspired further research.

Poaching led to a rise in the development of tuskless elephants. However, the researchers only identified tuskless female elephants, never males.

In humans there is an X-linked dominant syndrome causing females to have less developed or no top jaw incisor teeth, while the males that carry this allele die in the uterus (miscarriage).

Elephant tusks are modified incisor teeth. In Gorongosa, the team collected blood samples from seven tusked and 11 tuskless female elephants, then analysed their DNA for differences. The human data gave them an idea where to look.

2.9.3 Name this effect of mutation that resulted in the miscarriage of male elephants. (1)

2.9.4 Identify the evidence for evolution found in this research. (2)

Extract 3

Due to rapid evolution half the females are born without tusks while before the war less than a fifth were tuskless. Of all the offspring born, three quarters were female



Elephant with tusks



Tuskless elephant

2.9.5 Identify the evolution theory that best explains the rapid evolution in the span of one generation. (1)

2.9.6 Using the information from all three extracts, explain how natural selection led to the evolution of tuskless elephants in the Gorongosa National Park. (7)

2.9.7 Predict and explain the trend you will expect to see in the elephant population size over the next few generations due to this mutation. (3)
(23)

2.10 The development of new species is referred to as speciation.
Describe the process of speciation through geographic isolation. (7)

SESSION 3: EVOLUTION 2

CONTENT	ELABORATION
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	❑ The Out-of-Africa hypothesis: Modern humans originated in Africa and then migrated to other continents ❑ 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, Little Foot, Taung Child, Mrs Ples) ○ <i>Homo</i> (fossils of <i>Homo habilis</i> found in Africa only; oldest fossils of <i>Homo erectus</i> and <i>Homo sapiens</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 significant features of each of fossil type to show the differences amongst them ❑ Interpretation of phylogenetic trees proposed by different scientists showing possible evolutionary relationships as it applies to hominid evolution

SECTION A

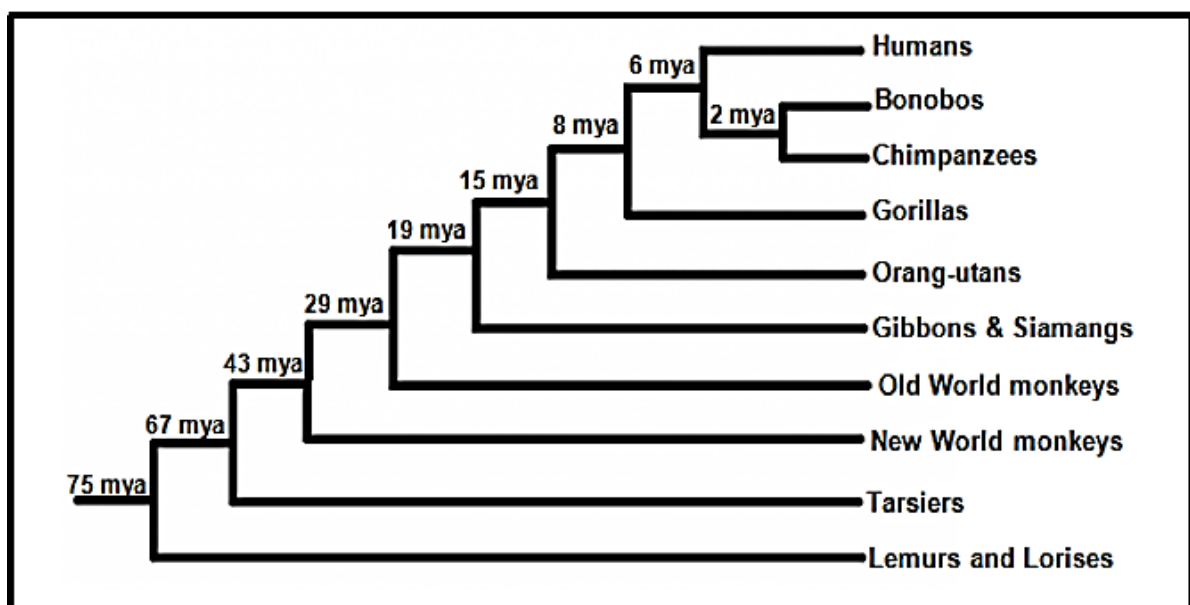
QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A to D) next to the question numbers.

1.1.1 Which ONE of the following features is found in BOTH humans and African apes?

- A Short upper arms
- B Claws instead of nails
- C Opposable thumbs
- D Small brain

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

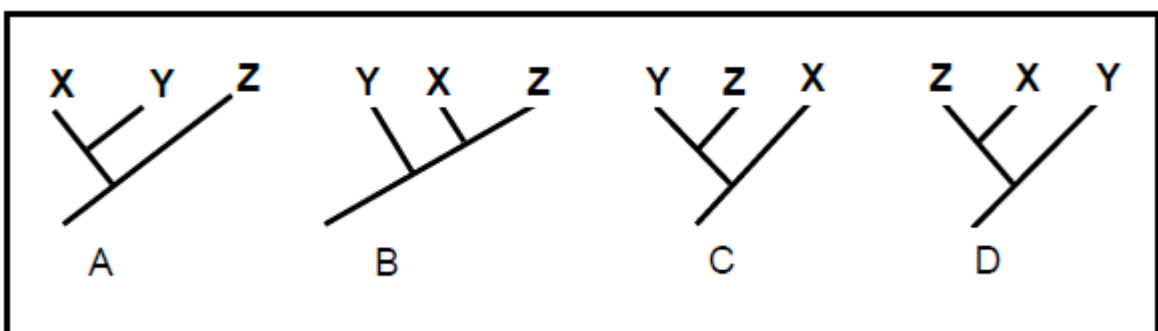


According to the phylogenetic tree, the most recent common ancestor of ...

- 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.

1.1.3 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?



- 1.1.4 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.
- 1.1.5 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
- 1.1.6 Which ONE of the following scientists discovered fossils of *Homo sapiens* and *Ardipithecus sp*?
- A Raymond Dart
 - B Lee Berger
 - C Louis Leakey
 - D Tim White
- 1.1.7 The study of the inheritance of mutations in mitochondrial DNA is an example of ...
- A fossil evidence.
 - B genetic evidence.
 - C modification by descent.
 - D cultural evidence.
- 1.1.8 Evidence of hominid cultural evolution can be found in the fossil record.
This evidence would include the ...
- A position of the attachment of the spine to the head.
 - B length of the upper limbs compared to the length of the lower limbs.
 - C number of teeth present in the skull.
 - D presence of stone tools.

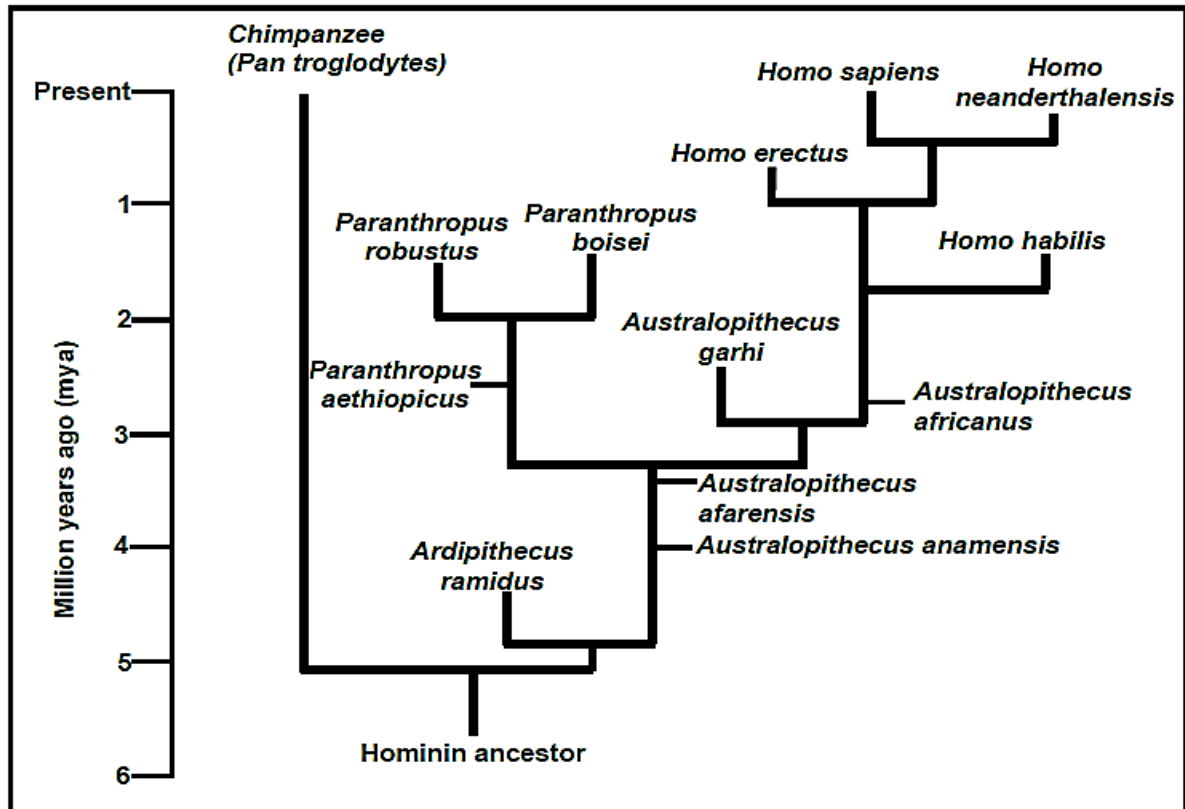
- 1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number.
- 1.2.1 A group of similar organisms that occurs in a particular place at a particular time with the ability to interbreed
 - 1.2.2 The permanent disappearance of a species from Earth
 - 1.2.3 A diagrammatic representation showing possible evolutionary relationships between different species
 - 1.2.4 The type of evidence for human evolution that includes tool-making
 - 1.2.5 Family to which humans belong
 - 1.2.6 Study of fossils
 - 1.2.7 An upright posture and walking only on two legs
 - 1.2.8 The type of vision shared by apes and humans that allows for depth perception
 - 1.2.9 The opening in the base of the skull through which the spinal cord passes
 - 1.2.10 Large, pointed teeth in African apes that are used for tearing food
 - 1.2.11 Genus to which Little Foot and Mrs Ples belongs
 - 1.2.12 The part of the skull that houses the brain
 - 1.2.13 Having a protruding jaw
 - 1.2.14 The first Homo species to use tools
 - 1.2.15 The hypothesis which supports migration of human ancestors from the point of origin
 - 1.2.16 The mineralised remains of organisms that have lived in the past.
- 1.3 Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, both **A and B** or **none**

COLUMN I	COLUMN II
1.3.1 Found in African apes and humans	A: Claws instead of nails B: An opposable thumb
1.3.2 Discovered the fossil called 'Little Foot'	A: Raymond Dart B: Ron Clarke
1.3.3 Australopithecines that were found in South Africa	A: Little Foot B: Mrs Ples
1.3.4 Jaw of African apes	A: No spaces between teeth B: Large canines
1.3.5 Long and narrow pelvis	A: African apes B: Humans
1.3.6 Fossils found in South Africa	A: Little Foot B: Taung Child
1.3.7 Study of ancient humans and their cultural activities	A: Palaeontology B: Archaeology
1.3.8 A group of similar organisms that can interbreed to produce fertile offspring	A: Species B: Genus

SECTION B

QUESTION 2

- 2.1 The diagram below shows possible evolutionary relationships among some hominids.



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

- 2.2 There are anatomical differences between African apes and humans. There are also characteristics that they share.
- 2.1.1 Name ONE characteristic of the hand that African apes share with humans. (1)
- 2.1.2 Tabulate THREE differences between the skulls of African apes and humans. (7)
- 2.1.3 Give TWO characteristics of the pelvis of a bipedal organism. (2)
- (10)**
- 2.3 *Homo* species are characterised by having opposable thumbs and by being bipedal.
- 2.3.1 State ONE possible advantage of having an opposable thumb. (1)
- 2.3.2 Explain TWO possible advantages of bipedalism. (4)
- (5)**
- 2.4 Humans are bipedal organisms.
- 2.4.1 What is meant by bipedalism? (2)
- 2.4.2 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)**
- 2.5 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

- 2.5.1 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)

- 2.5.2 Which hominid had a cranial capacity closest to that of *Homo sapiens*? (1)
- 2.5.3 Give the smallest cranial capacity (in cm³) of a *Homo* species. (1)
- 2.5.4 When did *Australopithecus africanus* become extinct? (1)
- 2.5.5 Fossils are used as evidence of hominid evolution.
Name TWO other lines of evidence. (2)

(10)

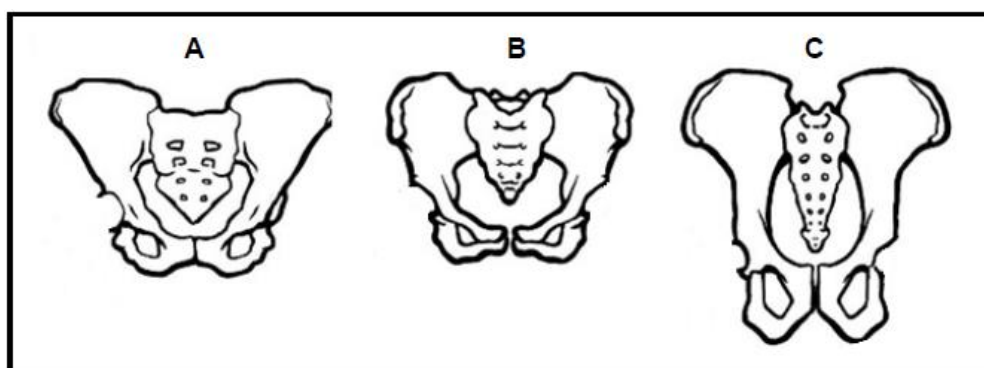
- 2.6 The diagrams below show the skulls of two species of primates.



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

(14)

- 2.7 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.



- 2.7.1 What term is used to describe organisms that are able to walk upright permanently? (1)
- 2.7.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 2.7.1? (2)
- 2.7.3 Explain your answer to QUESTION 2.7.2. (2)
- 2.7.4 State ONE feature of the spine of the organism represented by C. (1)

(6)

2.8 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.

- 2.8.1 Name the TWO lines of evidence for human evolution that is referred to in the extract above. (2)
- 2.8.2 How long did *Homo floresiensis* exist on Earth? (1)
- 2.8.3 Name ONE *Homo* ancestor mentioned in the extract. (1)
- 2.8.4 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)
- 2.8.5 Describe ONE feature of the skull that can be used as evidence for bipedalism. (2)
- 2.8.6 State TWO similarities between the hands of African apes and modern humans. (2)
- 2.8.7 Draw a table to show the brain volumes of the different *Homo* species, using information from the extract. (5)
- (16)**

2.9 The 'Out of Africa' hypothesis is one explanation of the evolution of modern humans.

2.9.1 State the 'Out of Africa' hypothesis. (2)

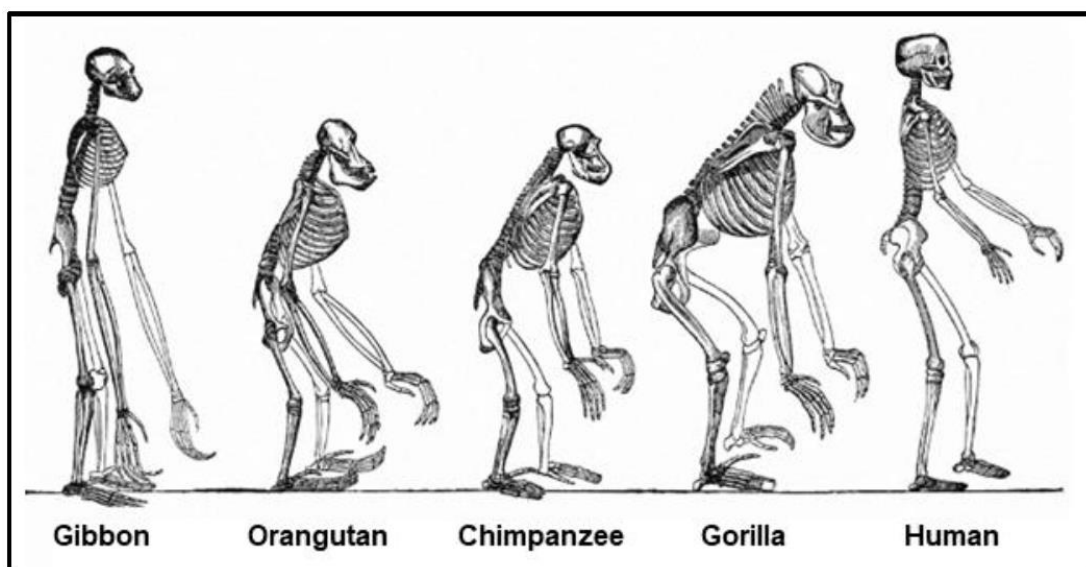
2.9.2 Name the family to which modern humans belong. (1)

2.9.3 What genetic evidence is used to support the 'Out of Africa' hypothesis? (1)

2.9.4 Describe how fossil evidence is used to support the 'Out of Africa' hypothesis. (4)

(8)

2.10. The diagram below shows the development of bipedalism.



2.10.1 List FOUR advantages of bipedalism. (4)

2.10.2 List FOUR ways in which the human skeleton is suitable for bipedalism. (4)

2.10.3 Give the scientific name of the bipedal organism shown in the diagram. (1)

(9)

TERM 3 TUTORING PRE- AND POST TEST



<https://forms.office.com/r/Sb8WV7A5sT>