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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

CURRICULUM GRADE 10-12
DIRECTORATENCS (CAPS)

LIFE SCIENCES

LEARNER SUPPORT DOCUMENT

GRADE 12

HIGH FLYERS

2026

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TOPIC: DNA CODE OF LIFE

ACTIVITY 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 number (1.1 to 1.2) in the ANSWER BOOK, for example 1.3 D.

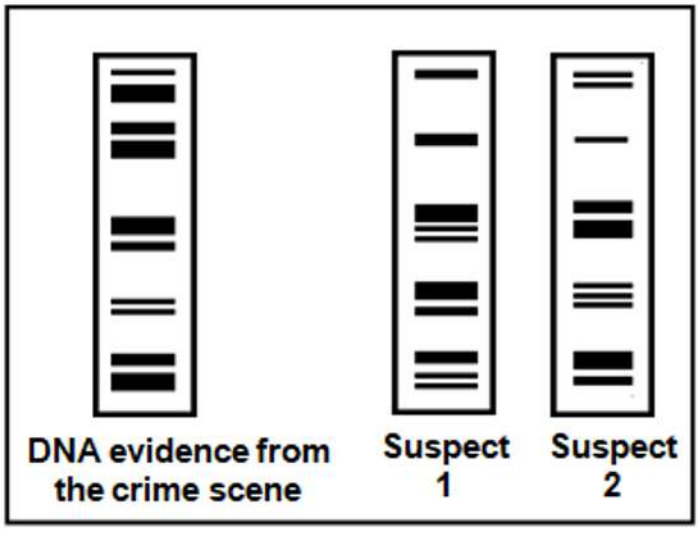
1.1 A segment of DNA contains:

- 31% of adenine in strand **1**
- 12% of cytosine in strand **2**
- 27% of guanine in strand **2**

In this segment of DNA, there will also be …

A 31% of adenine in strand **2**
B 12% of cytosine in strand **1**
C 31% of thymine in strand **2**
D 27% of cytosine in strand **2**

1.2 The police arrested two suspects accused of housebreaking. Their DNA profiles were analysed and compared to the profile of DNA evidence collected from the crime scene.



What conclusion can be drawn from the DNA analysis conducted by the police?

A Suspect **1** is positively linked to the crime.
B Suspect **2** is positively linked to the crime.
C Both suspects are positively linked the crime.
D Neither of the suspects are positively linked to the crime.

(2 x 2) **(4)**

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ACTIVITY 2

2 Haemoglobin is a protein found in blood that carries oxygen to all the cells of the body. A portion of this protein is called a beta chain. If the sequence of amino acids in this chain changes, then a different form of haemoglobin, called haemoglobin S, is formed. Haemoglobin S cannot transport oxygen as efficiently as normal haemoglobin.

Position of amino acids in the beta chain	1	2	3	4	5	6	7
Normal haemoglobin	Val	His	Leu	Thr	Pro	Glu	Glu
Haemoglobin S	Val	His	Leu	Thr	Pro	Val	Glu

The table below shows the DNA base triplets coding for some amino acids.

DNA BASE TRIPLET	AMINO ACID
CAC	Val
GTG	His
GAC	Leu
TGA	Thr
GGA	Pro
CTC	Glu

2.1 What is a change in the sequence of DNA base triplets called? (1)

2.2 Use the information in the tables to explain how a change in the sequence of the DNA base triplets results in the formation of haemoglobin S, rather than normal haemoglobin. (4)

2.3 Describe how a person with haemoglobin S would be affected. (2)

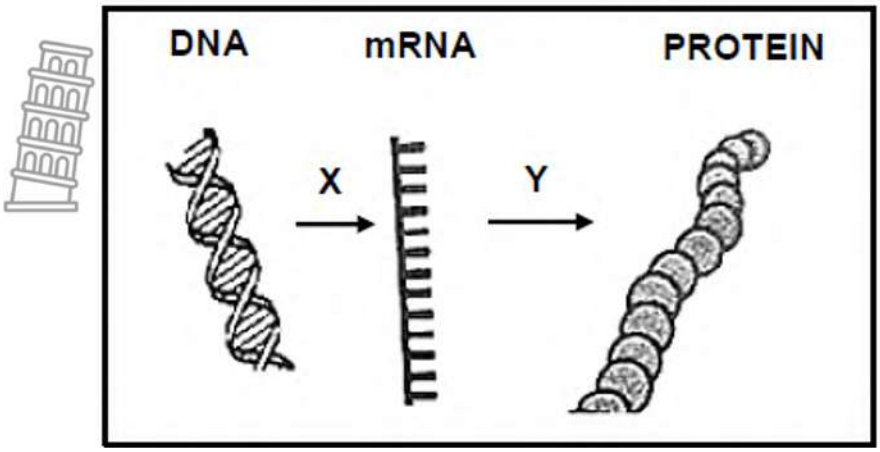
(7)

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ACTIVITY 3

3 The diagram below represents two processes that occur during protein synthesis.



3.1 Where in the cell does EACH of the following processes occur?

(a) **X** (1)

(b) **Y** (1)

3.2 Name and describe process **X.** (6)

(8)

ACTIVITY 4

4 Read the extract below.

> Researchers have discovered that members of a particular family have high bone density that may be caused by a gene mutation. High bone density reduces the risk of bone fractures.
>
> Twenty members of the family had their bone density measured and DNA samples taken. Seven had high bone density. The high bone density occurred throughout their bodies but especially in the spine and hips.

4.1 Describe what is a gene mutation. (2)

4.2 Explain why it was necessary for the researchers to collect DNA samples. (2)

4.3 State the effect of this mutation. (1)

4.4 Calculate the percentage of the family members who had normal bone density. Show ALL your working. (3)

(8)

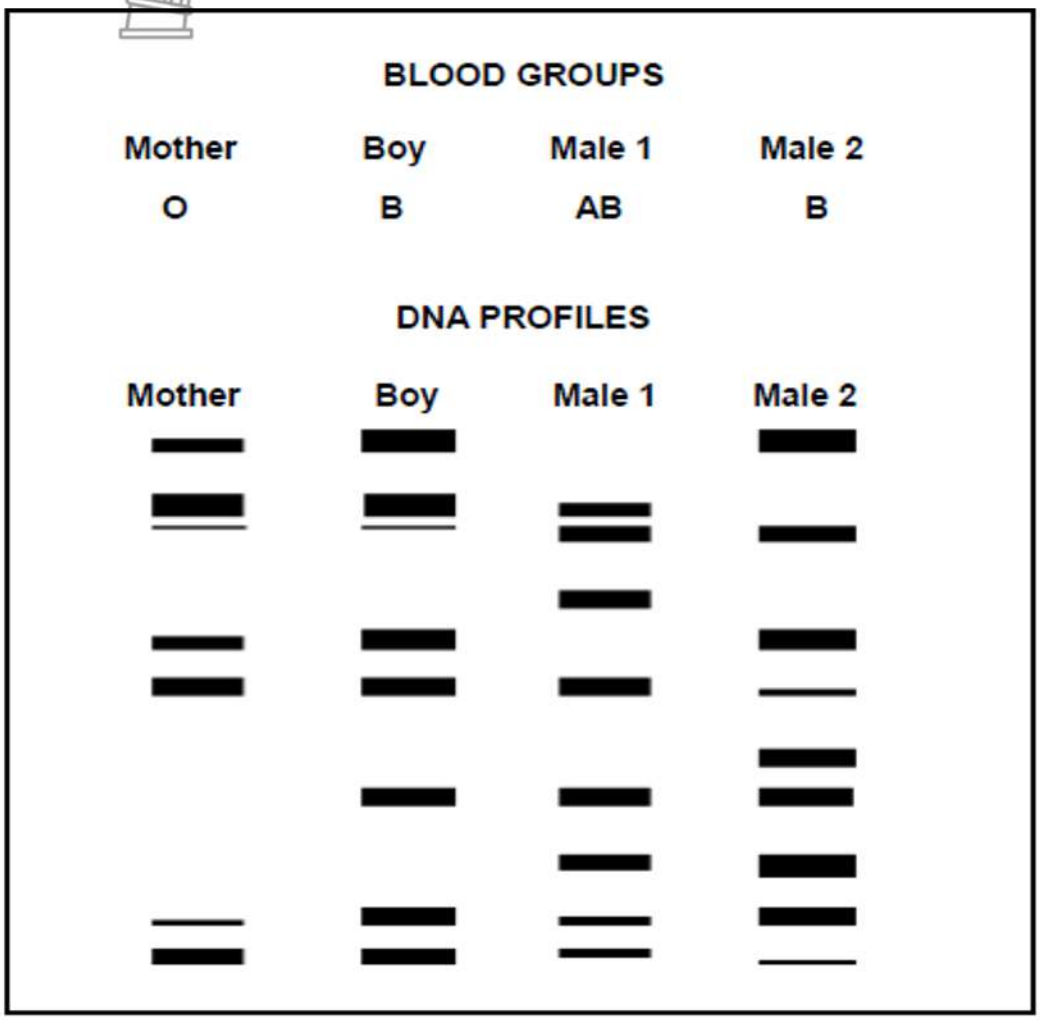
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ACTIVITY 5

5 A family wanted to identify the biological father of a boy. The mother of the boy is known. Blood groups and DNA profiles of the mother, the boy and two males were used to determine paternity.

The data below shows the results of the two procedures.



5.1 Explain why paternity of the boy could not be established using blood groups only. (5)

5.2 Who is the biological father of the boy according to the DNA profiles? (1)

5.3 Explain your answer to QUESTION 5.2. (3)

(9)

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ACTIVITY 6

6 The table below shows the codons that code for some amino acids.

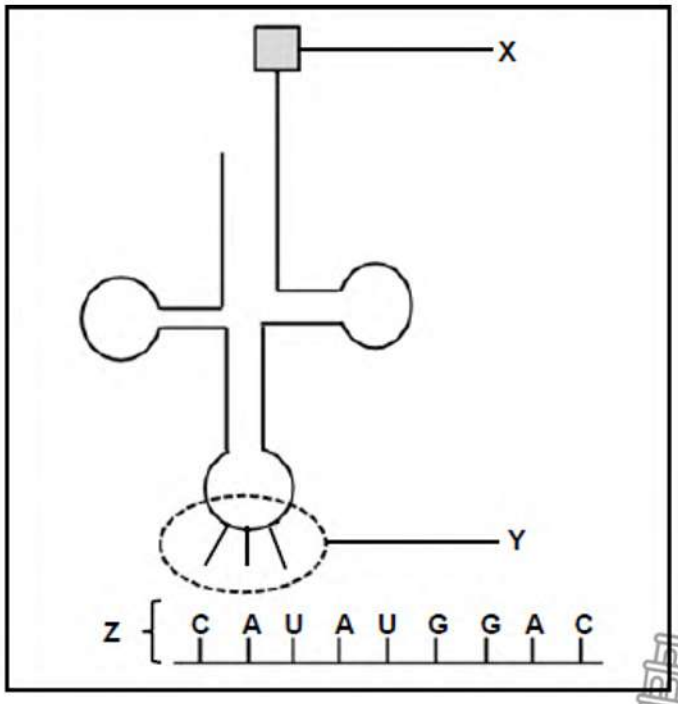
mRNA codon	Amino acid
AUG	methionine
CAU	histidine
CUA	leucine
GUA	valine
GAC	aspartic acid
GAG	glutamic acid
GAU	aspartic acid

A mutation caused a DNA base triplet to change from CTG to CTA.

6.1 Describe the effect of this mutation on the protein formed. **(4)**

ACTIVITY 7

7 The diagram below represents a process that occurs during protein synthesis.



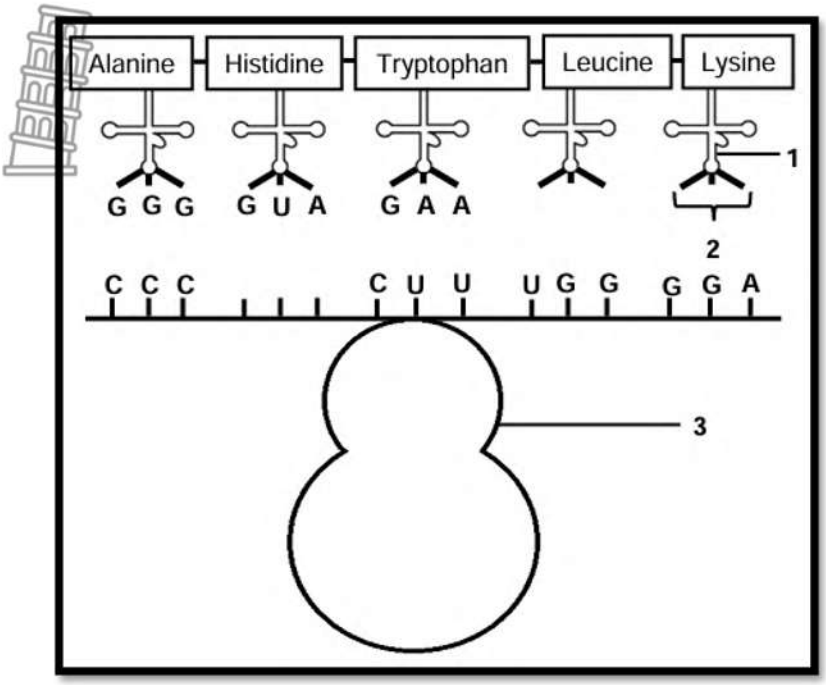
7.1 Name and describe the process shown in the diagram during the formation of a protein. **(7)**

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ACTIVITY 8

8 Give the sequence of nitrogenous bases:



8.1 Give the sequence of nitrogenous bases:

(a) At **2** (1)

(b) On the DNA molecule that coded for histidine (2)

8.2 During the synthesis of the same protein, there was a change in the amino acid sequence because alanine was replaced by tryptophan.

Explain the possible reason for this. (3)
(6)

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ACTIVITY 9

9 The diagram below shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects.
In their investigation, police conducted a comparison of the DNA to identify the criminal.



9.1 Name the technique used in this criminal investigation. (1)

9.2 Which ONE of the suspects (**1** or **2**) was at the crime scene? (1)

9.3 Give ONE observable reason for your answer to QUESTION 9.2 (1)

9.4 Give TWO possible reasons why the suspect identified in QUESTION 9.2 might NOT be convicted if only this evidence is used. (2)

9.5 Explain how the technique named in QUESTION 9.1 is used in paternity testing. (4)

(9)

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ACTIVITY 10

10 A mutation occurred on a DNA molecule where one nitrogenous base was affected. This caused the amino acid serine to be replaced by glycine during protein synthesis.

The table below shows amino acids and their codons.

AMINO ACID	CODON
Methionine	AUG
Glycine	GGU;GGA
Serine	AGU;AGC
Threonine	ACA;ACU
Isoleucine	AUC;AUA
Aspartate	GAU

10.1 Name the type of mutation that occurred. (1)

10.2 During which process could a DNA mutation occur? (1)

10.3 Name the DNA base triplet for this glycine. (2)

10.4 Explain how this mutation will affect the protein formed. (2)

(6)

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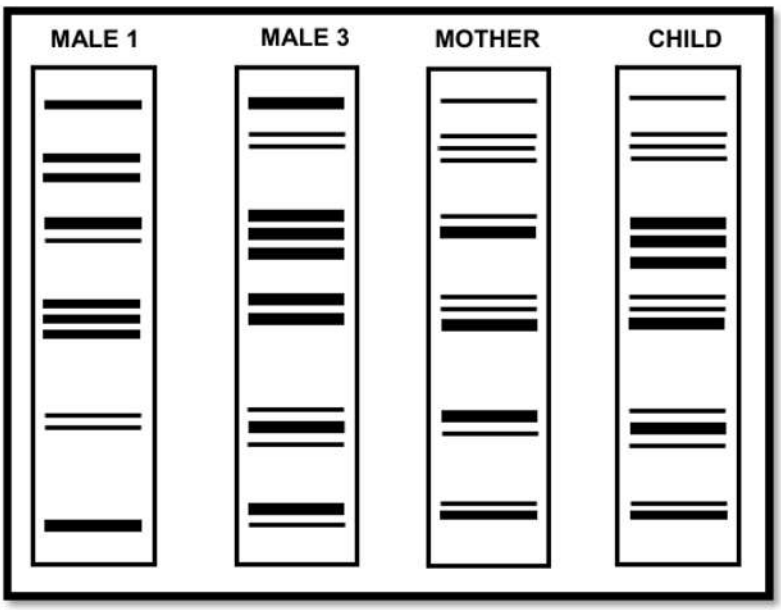
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ACTIVITY 11

11 In a paternity test, investigators first analysed the blood groups before they conducted DNA profiling. A paternity test was done for THREE males.

The results from the blood group analysis and DNA profiling are shown below.

	MALE 1	MALE 2	MALE 3	MOTHER	CHILD
BLOOD GROUP	B	O	A	AB	AB



11.1 Name ALL the possible genotypes for male **3**. (2)

11.2 Explain why the investigators excluded male **2** in the DNA profiling. (5)

11.3 Explain why the mother was included in the DNA profiling. (2)

11.4 According to the DNA profiles, which male (**1** or **3**) is the father? (1)

11.5 State ONE other use of DNA profiling. (1)

(11)

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ACTIVITY 12

12 The table below represents the anticodons coding for different amino acids.

ANTICODON	AMINO ACID
UAU	Tyrosine (Tyr)
CCU	Proline (Pro)
AAG	Lysine (Lys)
GUA	Valine (Val)
CGU	Arginine (Arg)

12.1 Identify the complementary bases (from left to right) representing the following:

(a) Anticodon **2** (1)

(b) The DNA triplet for codon **1** (1)

12.2 A mutation occurs during replication. The mutation results in the amino acid proline (Pro) being replaced by arginine (Arg).

Use the table and explain how this mutation will affect the protein that is synthesised. (7)
(9)

TOPIC: MEIOSIS

ACTIVITY 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 number (1.1 to 1.6) in the ANSWER BOOK, for example
1.7 D.

1.1 A cell has 24 chromosomes at the start of meiosis. How many chromatids would there be in one daughter cell at the end of telophase I?

A 24
B 48
C 12
D 6

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1.2 Which ONE of the following refers to the end product of mitosis of a human somatic cell?

A Four haploid daughter cells
B Four diploid daughter cells
C Two haploid daughter cells
D Two diploid daughter cells

1.3 The following statements relate to cell division:

(i) Crossing over occurs
(ii) Contributes to genetic variation in a population
(iii) Produces cells with a diploid number of chromosomes
(iv) Produces somatic cells only

Which ONE of the following combinations of statements refer to meiosis?

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

1.4 During Anaphase II of meiosis, the two chromatids of a chromosome are pulled apart, each moving towards opposite poles at a rate of 1 micrometre per second.

The distance, in micrometres, between the chromatids after 20 seconds is …

A 10.
B 20.
C 30.
D 40.

1.5 Down syndrome is a genetic disorder where an individual has an extra copy of chromosome 21.

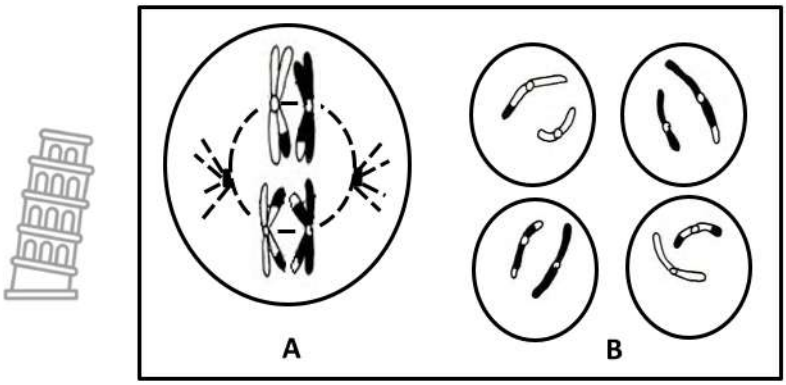
Which ONE of the following may lead to Down syndrome?

A Failure of chromosomes to replicate during mitosis
B Failure of chromosome pairs to separate during meiosis
C Failure of chromosome to form pairs during fertilisation
D Failure of chromosome pairs to crossover during meiosis

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1.6 The diagram below represents two phases of meiosis.



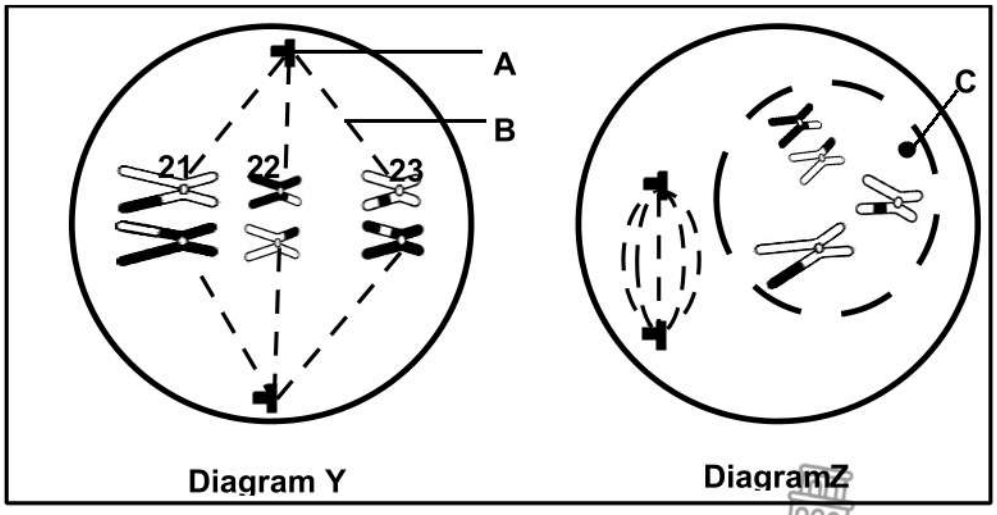
Which ONE of the following represents the correct sequence of phases between phase **A** and phase **B**?

A Anaphase I, Metaphase I, Prophase II and Telophase II
B Metaphase I, Telophase I, Prophase II and Metaphase II
C Anaphase I, Telophase I, Prophase II, Metaphase II
D Anaphase II, Telophase I, Prophase II , Telophase II

(6 x 2) **(12)**

ACTIVITY 2

2 The diagrams below show chromosomes **21**, **22** and **23** in a human cell in different phases of cell division.



2.1 Identify:

(a) Structure **B** (1)

(b) Structure **C** (1)

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(c) The type of gamete that will be formed at the end of this cell division (1)

2.2 State ONE function of part **A** during cell division. (1)

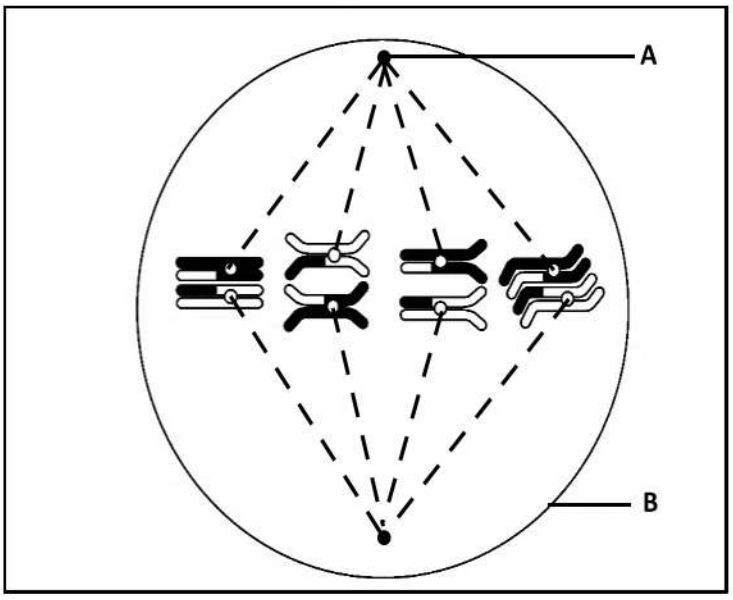
2.3 Identify the phase in diagram **Y**. (1)

2.4 Describe TWO observable differences between the phase identified in QUESTION 2.3 and the same phase in mitosis. (4)

2.5 Explain the chromosome number in the phase represented in diagram **Z.** (3)
(12)

ACTIVITY 3

3 The diagram below represents metaphase I of meiosis.



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

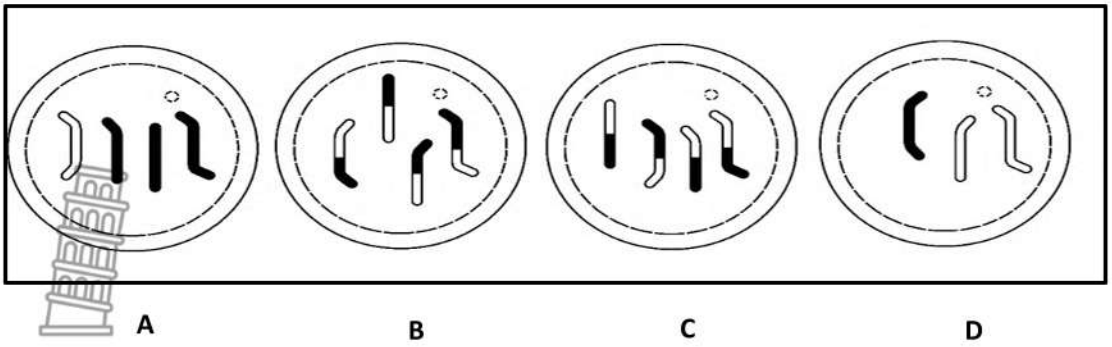
3.2 State ONE function of part **A**. (1)

3.3 Explain the contribution of metaphase I to natural selection. (6)

The diagram below shows four possible daughter cells formed at the end of this meiosis.

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3.4 Draw cell **D**, including the missing chromosome. (3)

(11)

ACTIVITY 4

4 Down syndrome is the result of an individual having an extra copy of chromosome 21.

Two genetic variations that can cause Down syndrome are:

- Trisomy 21
  All the somatic cells in an individual have three copies of chromosome 21 due to an abnormal process that occurs during gamete production.

- Mosaic Down syndrome
  The individual has only some cells with an extra copy of chromosome 21 which is caused by an abnormal process during cell division after fertilisation.

4.1 Name the:

(a) Type of mutation that leads to Trisomy 21 (1)

(b) Abnormal process during gamete production that leads to three copies of chromosome 21 (1)

(c) Type of cell division that occurs after fertilisation (1)

4.2 Describe how the process in QUESTION 2.4.1(b) leads to Trisomy 21. (5)

4.3 Describe TWO differences between *Trisomy 21* and *Mosaic Down syndrome*. (4)

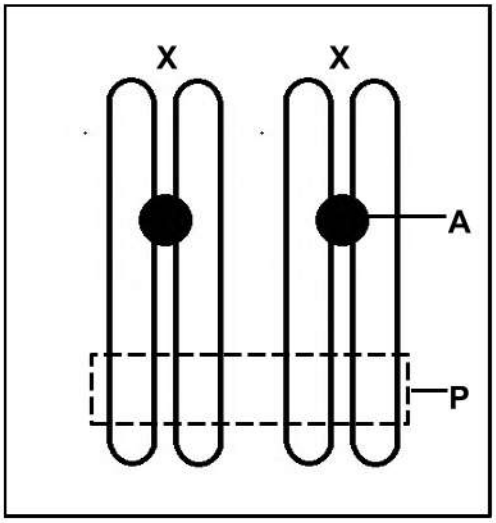
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ACTIVITY 5

5 The diagram below represents the sex chromosomes in a female.



5.1 Identify structure **A**. (1)

5.2 Give the biological term for the sex chromosomes. (1)

5.3 Describe how these chromosomes would differ in the somatic cells of a male. (1)

5.4 An exchange of genetic material takes place at region **P**.

(a) Name the process above. (1)

(b) Identify the phase during which the process named in QUESTION 5.4(a) takes place. (1)

(c) Give ONE reason why the process named in QUESTION 5.4(a) is important. (1)

5.5 Explain how the structure of the chromosomes would differ at the end of meiosis II. (2)

5.6 Non-disjunction of these chromosomes occurred during meiosis and a gamete with an extra chromosome is formed. If this gamete is fertilised by normal gametes, the resulting zygotes will not be normal.

Explain the genetic composition of these zygotes. (3)

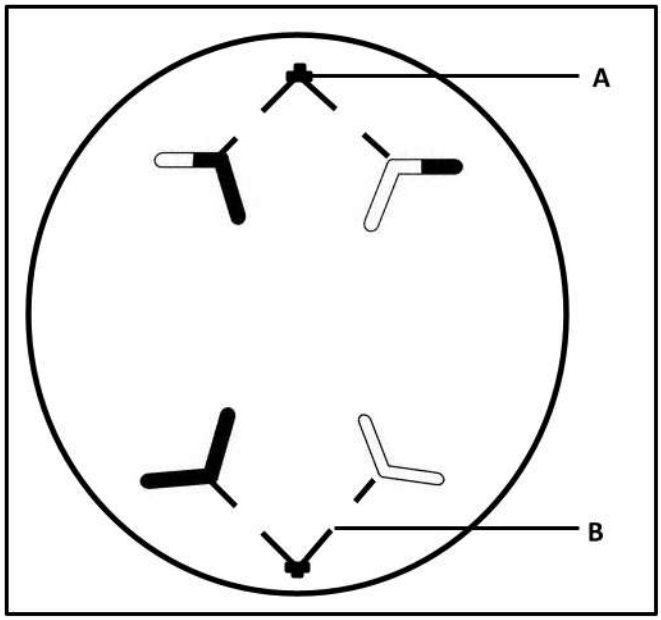
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ACTIVITY 6

6 The diagram below represents a phase of meiosis **II**.



6.1 Identify the phase of meiosis shown. (1)

6.2 State ONE difference between the phase shown in the diagram above and the same phase in meiosis **I** (1)

6.3 Identify structure:

(a) **A** (1)

(b) **B** (1)

6.4 Describe the role of structure **B** during cell division. (2)

6.5 Draw a labelled diagram representing the cell above as it would have appeared in metaphase **II**.

NOTE: The diagram should show the correct shading and include labels (exclude labels for **A** and **B**). (5)

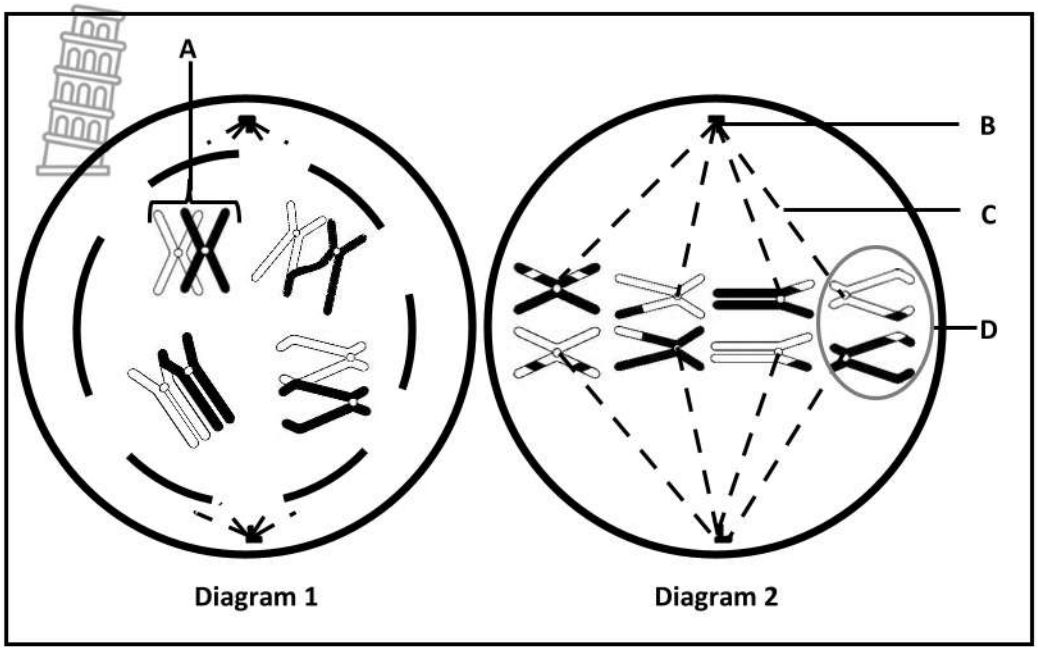
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ACTIVITY 7

7 The diagrams below represent two stages of meiotic cell division.



7.1 Name structure:

(a) **B** (1)

(b) **C** (1)

7.2 Identify the phase represented in Diagram **1**. (1)

7.3 Give THREE reasons for your answer to QUESTION 7.2 (3)

7.4 Describe the process taking place at **A**. (3)

7.5 (a) Identify the phase represented in Diagram **2**. (1)

(b) Describe the difference in the events that take place in the phase mentioned in 7.5(a) and the same phase during mitosis. (2)

7.6 Describe the results at the end of meiosis if the chromosomes at **D** failed to separate. (3)

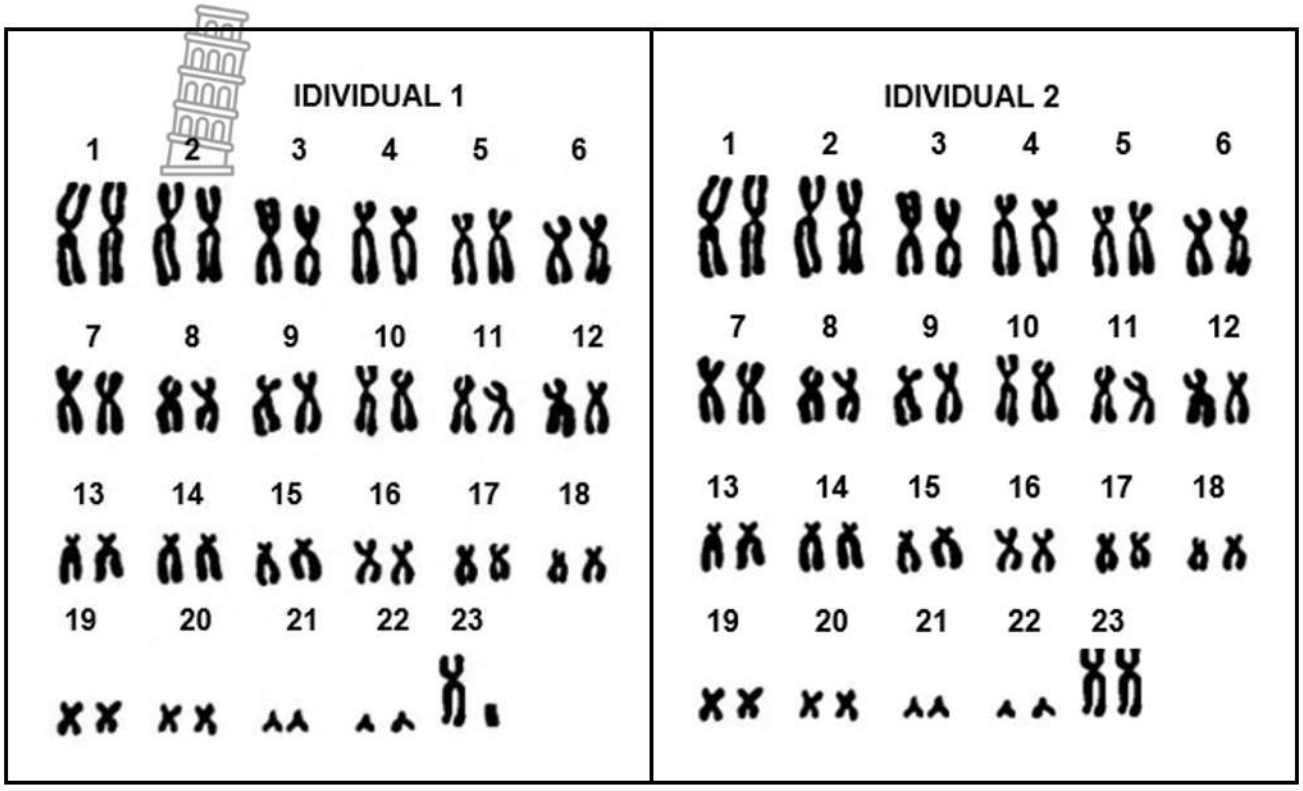
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ACTIVITY 8

8 The diagram below represents the chromosomes from the human somatic cells of two individuals who are twins.



8.1 What are *somatic cells*? (1)

8.2 Name the specific type of chromosomes numbered 1 to 22. (1)

8.3 Each of the pairs shown is a homologous pair of chromosomes. (1)

(a) State the origin of each chromosome in a homologous pair during zygote formation. (2)

(b) List THREE characteristics that chromosomes in a homologous pair have in common. (3)

8.4 Explain ONE observable reason why the two individuals are not identical twins. (3)
(10)

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TOPIC: REPRODUCTIVE STRATEGIES

ACTIVITY 1

1 In bird eggs, the yolk is the main source of energy for the developing embryo.

The table below provides information about the eggs of some bird types.

TYPE OF BIRD	AVERAGE % OF YOLK IN THE EGG
Goose	35,1
Eagle	12,0
Duck	35,4
Vulture	14,0
Chicken	31,9
Pigeon	17,9

1.1 Explain why we may conclude that ducks display precocial development. (3)

1.2 Name the THREE bird types that would have a higher degree of parental care. (3)

1.3 Give a reason for your answer to QUESTION 1.2. (2)

(8)

ACTIVITY 2

2 The passage below describes the breeding habits of vultures.

Vultures are birds of prey that feed on the flesh of dead animals.

A female vulture lays only one to two fertilised eggs, which are then protected by both parents during incubation. Incubation is the period from the time an egg is laid up to the time it hatches. Vultures have a short incubation period of 32 to 45 days. This short incubation period is typical of birds displaying altricial development. After hatching, the parents feed the young chicks as often as 20 times a day.

2.1 Give ONE reason from the passage why vultures:

(a) Are considered as oviparous (1)

(b) Have a high survival rate even though few eggs are laid (1)

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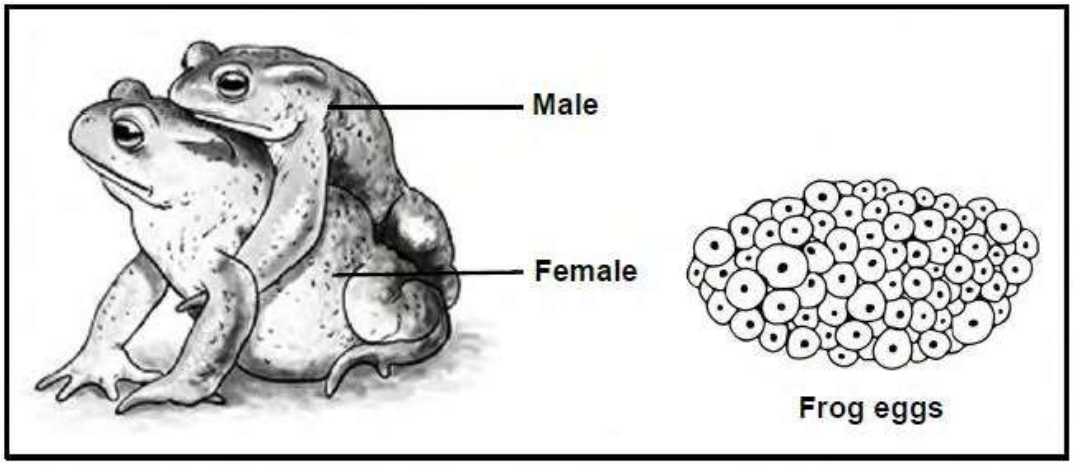
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2.2 Explain why birds with altricial development would have short incubation periods. (2)

(4)

ACTIVITY 3

3 In some frog species, during mating, the male climbs onto the back of the female and grasps her with his front legs. During this time, the female will release about 6 000 ova, while the male releases sperm onto them. This mating behaviour is called amplexus.



3.1 Explain why the fertilised eggs of these frogs do not survive on land. (2)

3.2 Explain how amplexus increases the chances of fertilisation in frogs. (2)

3.3 From the information above, explain ONE other strategy that contributes to the reproductive success of the frog species. (2)

(6)

ACTIVITY 4

4 Frogs can survive in water and on land. Most frogs, however, need water for reproduction. During the breeding season, male and female frogs release millions of gametes into the water.

4.1 Name the type of fertilisation described above. (1)

4.2 State why the reproduction in frogs is an example of ovipary. (1)

4.3 Explain why millions of gametes are released. (3)

(4)

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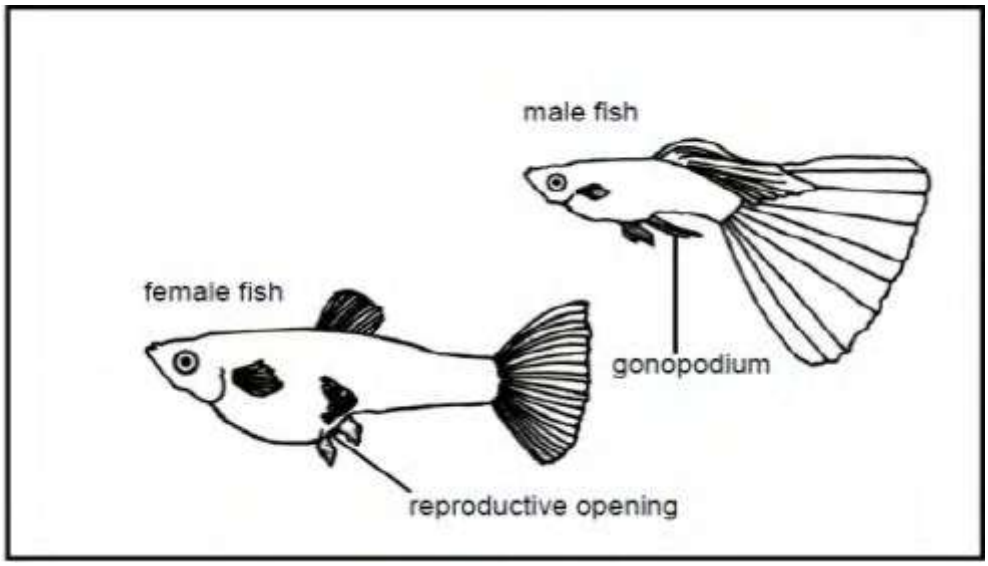
ACTIVITY 5

5 Read the extract below.

REPRODUCTION IN GUPPY FISH

Guppy fish have a very interesting method of breeding. During mating the male deposits packets of sperm inside the female's reproductive opening using an organ called 'gonopodium".This process takes place several times and the female stores some of the extra sperm.

The fertilised eggs remain in the females body until they hatch and the young are born live. The gestation period is usually between 22 and 28 days.



5.1 Name the type of fertilisation in guppies (2)

5.2 Explain TWO ways in which the type of fertilisation named in QUESTION 5.1 increases reproductive success. (4)

(6)

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ACTIVITY 6

6 Read the extract below.

> The Bluefin tuna, the great white shark and the bottlenose dolphin are three aquatic species that are found in the Indian Ocean.
>
> An adult Bluefin tuna releases up to 540 000 000 eggs into the water annually, while the great white shark female produces 2 to 12 offspring through ovoviviparous and produces one offspring every two to three years.

6.1 Name the type of fertilisation that takes place in the bottlenose dolphin. (1)

6.2 Explain how TWO of the reproductive strategies of the great white shark increase its reproductive success. (4)

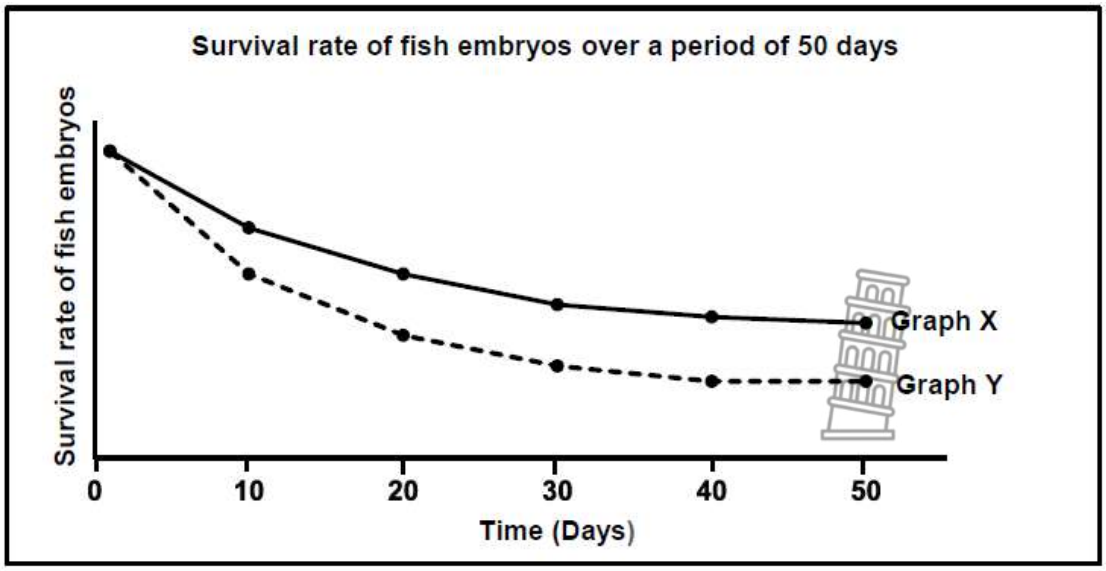
6.3 Explain ONE reason why the Bluefin tuna releases a large number of eggs. (2)

(7)

ACTIVITY 7

7 Read the extract below.

> Anchovy is a type of fish found in the Pacific Ocean. During the breeding season, the females and males gather in large groups and release ova and semen into the water. Once fertilised, the eggs float in the water and embryonic development occurs until hatching.
>
> The northern pike fish is found mainly in rivers. During the breeding season, the female releases thousands of ova and the male releases semen all around the female. The fertilised eggs attach to vegetation near the riverbed, where embryonic development occurs until hatching.
>
> The graph below shows the survival rate of both fish species.



7.1 Explain why both fish species are oviparous. (2)

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7.2 Which graph (X or Y) represents the survival rate of the northern pike fish? (1)

7.3 Explain your answer to QUESTION 7.2. (3)
(6)

TOPIC: HUMAN REPRODUCTION

ACTIVITY 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 number (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1. The table below shows the average testosterone levels of males of different age groups.

Group	Age (years)	Average testosterone level (n/M)
I	0–10	less than 5
II	11–15	15
III	16–20	19

Which ONE of the following is an explanation for the different testosterone levels between the age groups?

Testosterone levels are higher in …

A Group **I** than Group **III** due to the start of puberty.
B Group **II** than Group **I** due to the start of puberty.
C Group **III** than Group **I** because it is needed to inhibit the growth of long bones.
D Group **I** than Group **II** because it is needed to inhibit the growth of long bones.

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1.2 A man is fertile if his semen contains a minimum of 20 million sperm per cm^3 and at least 75% of the sperm cells are active.
The table below shows the results of a sperm analysis of four semen samples.
Identify the sample that was obtained from an infertile man.

	NUMBER OF SPERM IN SAMPLE (million/cm^3)	**INACTIVE SPERM (%)**
A	23	30
B	25	20
C	22	25
D	20	15

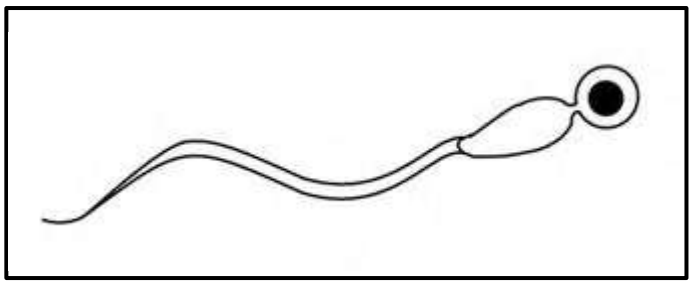
1.3 The following is a list of male reproductive parts:

(i) Prostate gland
(ii) Seminal vesicle
(iii) Urethra
(iv) Cowper's gland

Which ONE of the following combinations is responsible for the formation of semen?

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

1.4 The diagram below represents a human sperm.



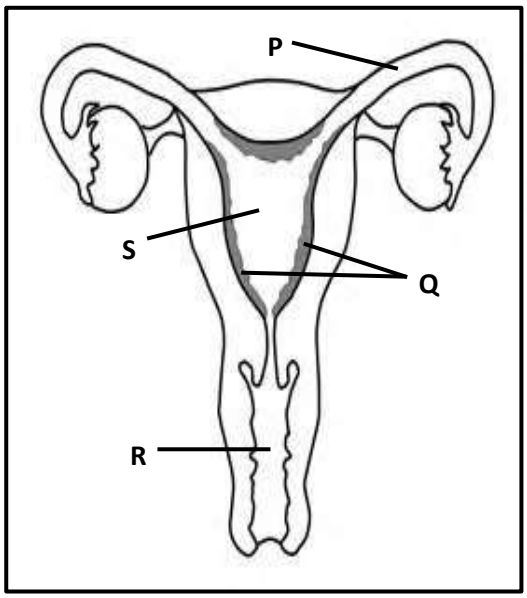
This sperm is NOT structurally suitable for fertilisation because of the …

A Absence of a nucleus to provide genetic material.
B Absence of an acrosome to improve motility.
C Presence of a long tail for the movement of the sperm.
D Absence of mitochondria to provide energy.

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1.5 **QUESTIONS 1.5 AND 1.6 ARE BASED ON THE DIAGRAM THE FEMALE REPRODUCTIVE SYSTEM.**



Which ONE of the following combinations is CORRECT for a normal pregnancy?

	SITE OF FERTILISATION	SITE OF IMPLANTATION
A	**P**	**S**
B	**S**	**Q**
C	**P**	**Q**
D	**R**	**P**

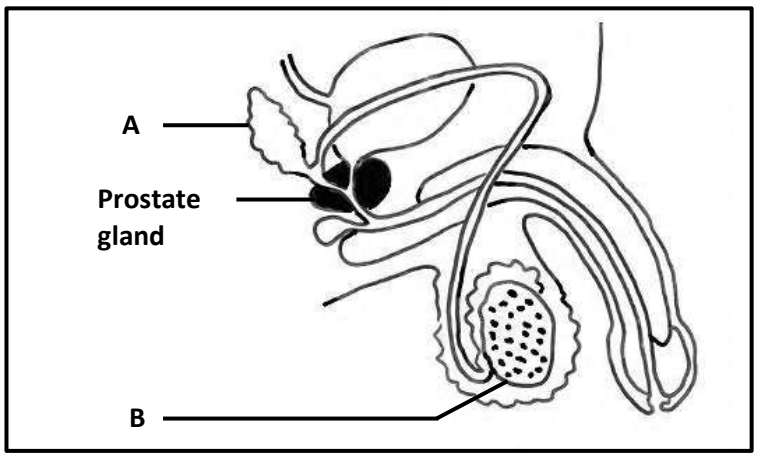
5X2 **(10)**

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ACTIVITY 2

2 The diagram below represents the male reproductive system.



2.1 Name:

(a) Part **A** (1)

(b) The hormone secreted by **B** (1)

2.2 Explain ONE function of the fluid secreted by the prostate gland during reproduction. (2)

2.3 Prostate cancer is one of the most common types of cancer among men

The table below shows the number of men per 100 000 men of different age groups that were diagnosed with prostate cancer in a certain country over a period of 14 years.

AGE GROUP	NUMBER OF PROSTATE CANCER CASES (PER 100 000 MEN)
<49	5
50–54	135
55–59	288
60–64	488
65–69	720
70–74	764
75–79	693
>80	473

(a) According to the table, which age group of men is most likely to develop prostate cancer? (1)

(b) Draw a histogram to represent the data for men from the age group 60–64 to the age group 75–79. (6)

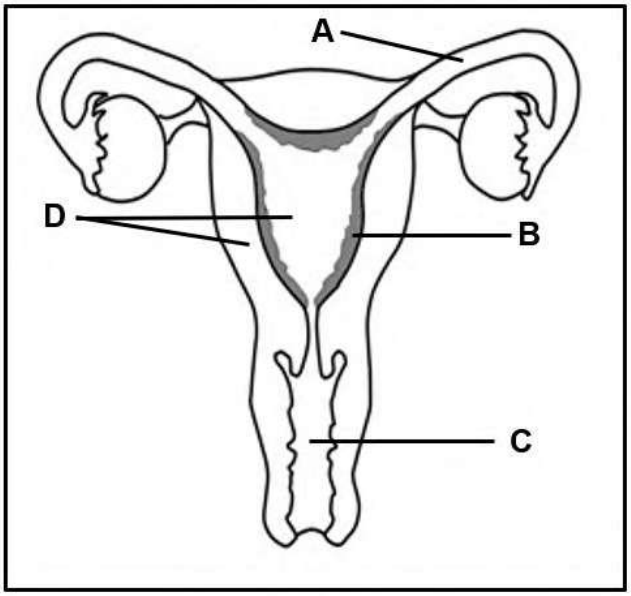
(11)

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ACTIVITY 3

3 The diagram below represents the female reproductive system.



3.1 Identify part B (1)

3.2 Name the process that takes place in part **A** that leads to zygote formation. (1)

3.3 Describe the process named in QUESTION 3.2 (1)

3.4 Describe the development of the zygote until implantation occurs. (4)

3.5 Explain TWO ways in which part **D** is structurally suited for gestation. (4)

3.6 Describe how the secretion of the prostate gland provides protection for sperm from the conditions in part **C**. (2)

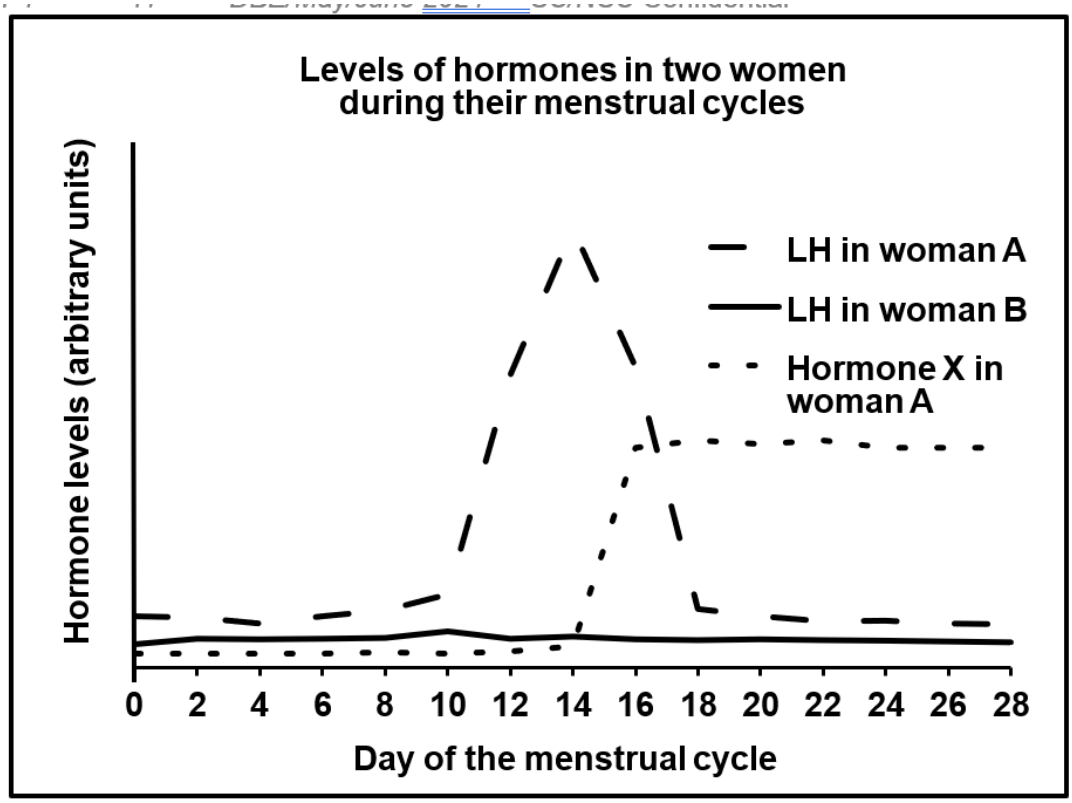
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ACTIVITY 4

4 Sheehan's syndrome is a condition that results in females having very low levels of the luteinising hormone (LH).

The graph below shows the hormone levels of two different women during a 28-day menstrual cycle. Woman **A** has normal luteinising hormone (LH) levels while woman **B** suffers from Sheehan's syndrome.



4.1 Give TWO functions of LH during the menstrual cycle (2)\

4.2 Give the name of hormone **X** (1)

4.3 Use the information in the graph to explain how the level of hormone **X** will be different in woman **B**. (4)

4.4 What evidence in the graph suggests that woman **A** is pregnant? (1)
(8)

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ACTIVITY 5

5 Read the extract below.

> Endometriosis is a medical condition that occurs when the endometrium develops in or on other structures such as the Fallopian tubes, ovaries or pelvis. It is caused by higher than normal levels of oestrogen. Females with this condition will most likely experience mild to severe menstrual pains. This condition can sometimes lead to infertility.
>
> Doctors may prescribe a contraceptive pill as treatment to reduce the development of the endometrium. The pill contains progesterone.

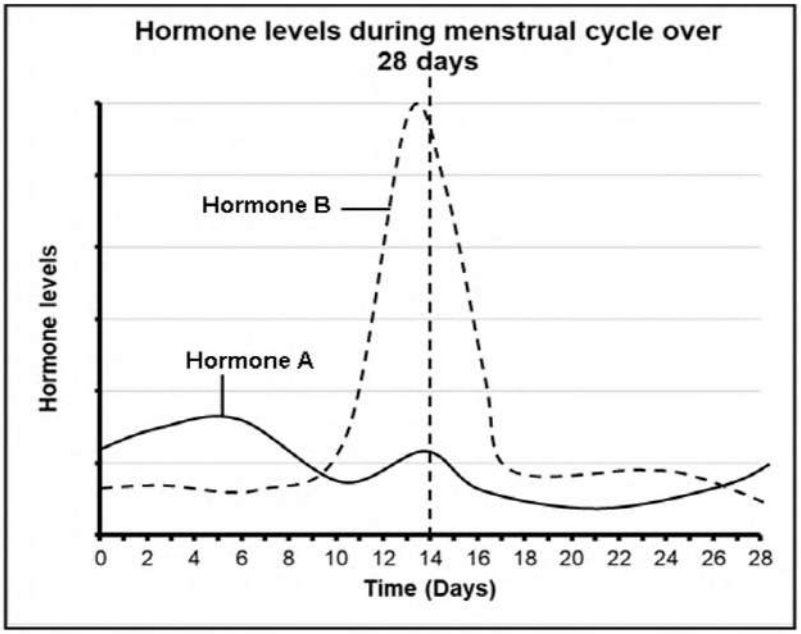
5.1 Name the structure where the endometrium normally develops. (1)

5.2 Explain why endometriosis in the Fallopian tubes may lead to infertility. (3)

5.3 Use the negative feedback mechanism to explain why the pills containing progesterone are successful in treating endometriosis. (4)

ACTIVITY 6

6 The graph below shows the levels of two hormones that are secreted by the pituitary gland during the menstrual cycle.



6.1 Give TWO functions of hormone **B**. (2)

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6.2 Explain why a female who is struggling to get pregnant:

(a) May be given pills containing hormone **A** as a treatment (3)

(b) Will have her levels of hormone **B** constantly monitored (2)

6.3 Explain how the levels of hormone **A** on days 0 to 5 will differ in a pregnant female. (3)

(10)

ACTIVITY 7

7.1 Read the extract below.

OVARIAN CYSTS IN FEMALES

Ovarian cysts are fluid-filled structures that develop inside the ovaries of some women. The two most common types of cysts in women of reproductive age are follicular cysts and corpus luteum cysts.

Follicular cysts develop when a Graafian follicle fails to rupture and release the ovum. The follicle continues to grow because of continued hormonal stimulation.

A corpus luteum cyst develops when the corpus luteum does not degenerate, even when a person is not pregnant.

Women often show no symptoms and the cysts disappear, but in rare cases ovarian cysts keep on increasing in size. A very large cyst can cause intense pain and may rupture, leading to internal bleeding. Such cysts will require surgical removal.

7.1 From the extract, give:

(a) TWO structures in the ovary that may develop into cysts (2)

(b) TWO symptoms associated with very large cysts (2)

7.2 Name the hormone:

(a) Responsible for the growth of the follicle under normal conditions (1)

(b) That will be high in concentration in the blood of women where follicular cysts develop (1)

7.3 Give a reason for your answer to QUESTION 8.2 (b). (1)

7.4 Explain why a woman will not be able to fall pregnant if she has a corpus luteum cyst that does not disappear. (5)

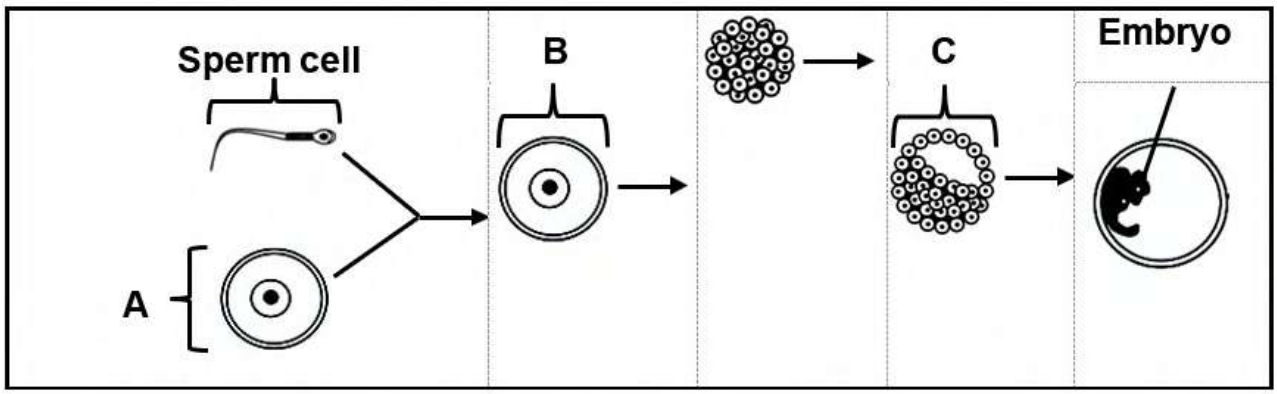
(12)

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ACTIVITY 8

8 The diagram below represents human embryonic development.



8.1 Identify structure B (1)

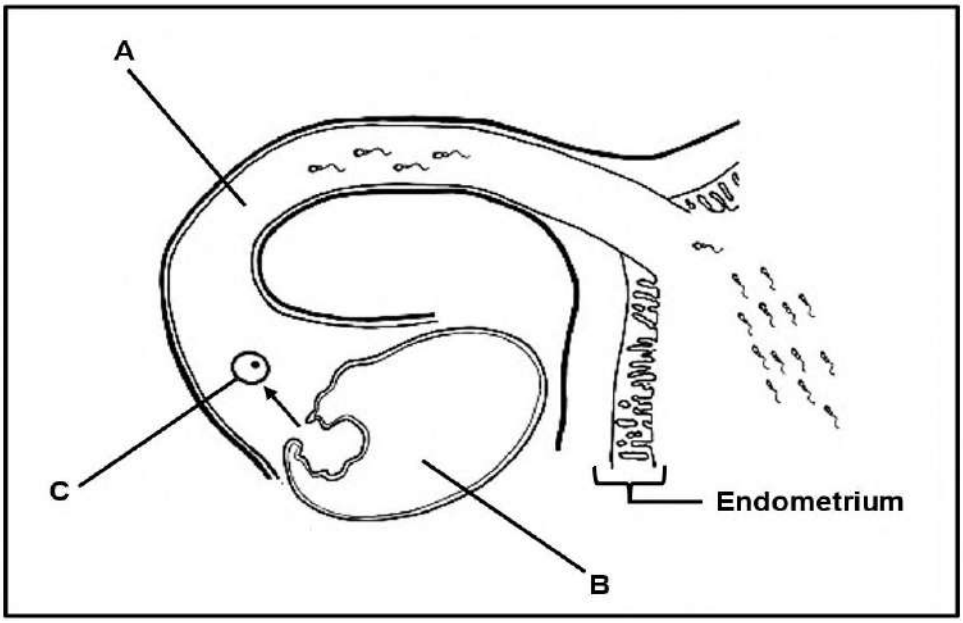
8.2 Explain the difference between cell **A** and cell **B**. (3)

8.3 Name the fluid surrounding the embryo. (1)

8.4 Give THREE functions of the fluid named in QUESTION 4.3 (3)
(8)

ACTIVITY 9

9 The diagram below represents a part of the female reproductive system.



9.1 Give TWO:
(a) Characteristics of the endometrium that make it suitable for implantation (2)

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(b) Visible reasons why there is an increased chance of fertilisation in this female (2)

9.2 Identify and describe the type of gametogenesis that leads to the formation of structure **C**. (6)

9.3 In an ectopic pregnancy, the fertilised ovum can become implanted in part **A**. This normally results in the death of the embryo and may endanger the mother's life.

Explain why an ectopic pregnancy may result in the death of an embryo. (3)

(13)

ACTIVITY 10

10 The table below shows the levels of two hormones during the menstrual cycle of a healthy human female.

DAY OF MENSTRUAL CYCLE	OESTROGEN LEVEL (pg/mℓ)	PROGESTERONE LEVEL (ng/mℓ)
4	55	0,23
8	70	0,03
10	280	0,03
12	300	0,03
14	140	3,0
16	110	12,5
20	80	15,0
24	70	5,0
28	65	0,8

10.1 On which day of this menstrual cycle is the level of progesterone the highest? (1)

10.2 Name the reproductive hormone that will begin to increase from day 24 of this female's menstrual cycle. (1)

10.3 Use data from the table to explain your answer to QUESTION 10.2 (2)

10.4 Calculate the percentage increase in the oestrogen level from day 8 to day 10. Show ALL your working. (3)

10.5 How would the progesterone level differ after day 20 if this female was pregnant? (1)

10.6 Explain what causes the change in the progesterone level stated in QUESTION 10.5 (2)

(10)

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ACTIVITY 11

11 The thickness of the endometrium varies throughout the menstrual cycle of a female.

The table below shows the results recorded for a woman who had her endometrial thickness monitored for a particular menstrual cycle.

DAY OF THE MENSTRUAL CYCLE	THICKNESS OF THE ENDOMETRIUM (mm)
0	14
7	3
14	5
21	13
28	16

11.1 Referring to ovarian hormones, explain the:

(a) Decrease in thickness of the endometrium from day 0 to day 7 (3)

(b) Increase in thickness of the endometrium from day 7 to day 14 (2)

11.2 Describe changes in the endometrium that cause it to become thicker. (2)

11.3 State the significance of the change in endometrium thickness described in QUESTION 11.2 (1)

11.4 Draw a bar graph to show the results in the table. (6)
(14)

ACTIVITY 12

12 Scientists conducted an investigation to determine the relationship between age and fertility in men.

This investigation was done from 1999 to 2017 using 1 294 healthy men from the age group 16–65.

Men with occupations (working in environments) involving exposure to excessive heat were excluded during the selection of participants.

The procedure was as follows:

- Semen was collected after 5 days of no sexual activities.
- A specialised microscope was used to determine the sperm count (number of normal sperm per mℓ of semen) and progressive motility (ability of sperm to swim effectively in a straight line).
- An electron microscope was used to determine sperm necrosis (immature/dead sperm per fresh semen sample).

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12.1 Identify in this investigation the:

(a) Independent variable (1)

Dependent variable (1)

12.2 State THREE ways in which the dependent variable was determined. (3)

12.3 Give TWO reasons why the investigation can be considered to be reliable. (2)

12.4 Explain why men with occupations involving exposure to excessive heat were excluded from the investigation. (3)

(10)

TOPIC: GENETICS AND INHERITANCE

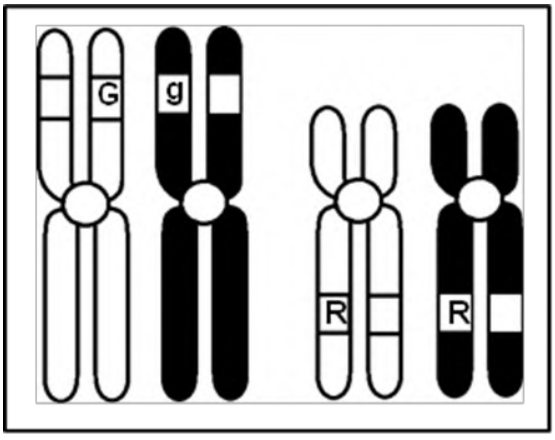
ACTIVITY 1

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 number (1.1 to 1.5) in the ANSWER BOOK, for example 1.6 D.

QUESTIONS 1.1 AND 1.2 REFER TO THE INFORMATION AND THE TWO SETS OF HOMOLOGOUS CHROMOSOMES BELOW.

In tomato plants, the genes for fruit size and fruit colour are located on different chromosomes. The gene for fruit size has two alleles, large (**G**) and small (**g**). The gene for fruit colour also has two alleles, red (**R**) and yellow (**r**).

The diagram below shows the alleles from one tomato plant.



1.1 What is the CORRECT genotype and phenotype of this tomato plant?

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	GENOTYPE	PHENOTYPE
A	GGRR	Large and red
B	GgRR	Large and red
C	GgRR	Small and yellow
D	GGRr	Small and yellow

1.2 This tomato plant is crossed with a tomato plant that has small, yellow fruit.

What is the expected phenotypic ratio in the offspring?

A 1 : 1
B 9 : 3 : 3 : 1
C 1 : 1 : 1 : 1
D 3 : 1

1.3 The statements below describe the steps in the process of cloning an animal.

(i) The embryo is implanted into the uterus of an adult female for development.
(ii) The nucleus from a somatic cell of the donor is extracted.
(iii) The nucleus from the somatic cell is inserted into the ovum.
(iv) The nucleus from the ovum of another individual is removed.
(v) The ovum with the new nucleus is given an electric shock to stimulate cell division and the formation of the embryo.

Which combination shows the CORRECT order of the steps?

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

1.4 Which ONE of the following is a CORRECT description of stem cells?

A Specialised cells that divide by mitosis to produce cells that may become further specialised for specific functions
B Unspecialised cells that divide by mitosis to produce cells that may become specialised for specific functions
C Unspecialised cells that divide by meiosis to produce cells that may become specialised for specific functions
D Specialised cells that divide by meiosis to produce cells that may become specialised for specific functions

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1.5 In a dihybrid cross, an animal with long ears (E) and red fur (R) was crossed with an animal with short ears (e) and black fur (r).

Which ONE of the following could represent the genotypes of the parents?

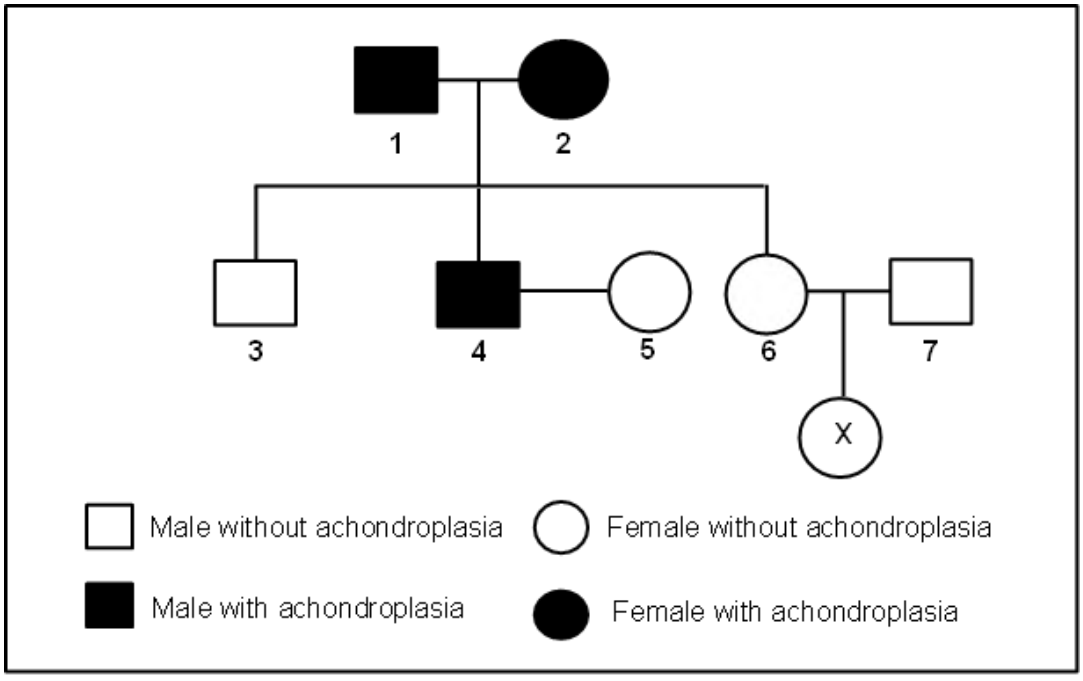
A EERR x eerr
B EeRr x EeRr
C eeRR x eerr
D Eerr x EERr

(5 x 2) **(10)**

ACTIVITY 2

2 Achondroplasia is an autosomal genetic disorder caused by the dominant allele (**A**). This genetic disorder leads to a form of dwarfism. Offspring who inherit both dominant alleles, die during the baby/infant stage.

The pedigree diagram below shows the inheritance of achondroplasia.



2.1 State what is meant by a *dominant allele*. (2)

2.2 How many generations are represented in this diagram? (1)

2.3 State the:

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(a) Phenotype of individual **2** (1)

(b) Genotype of individual **1** (1)

(c) Number of individuals that are heterozygous (1)

2.4 Individuals **6** and **7** had one daughter **X**.

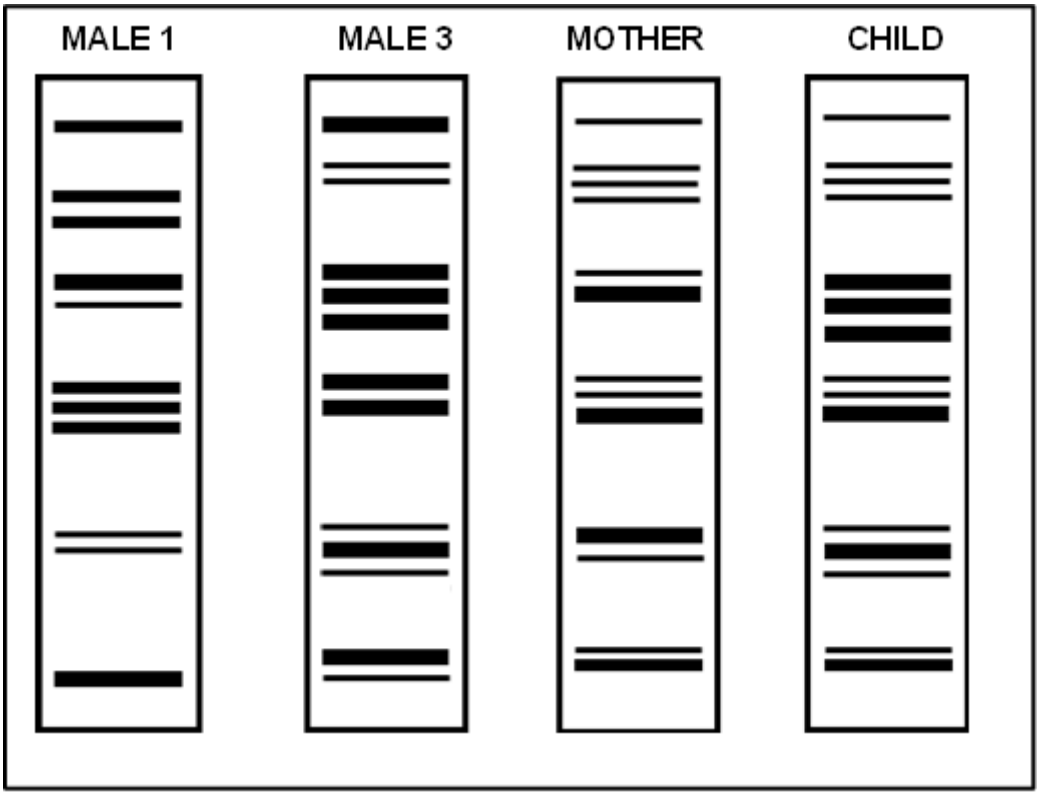
Explain her phenotype. (5)
(11)

ACTIVITY 3

3 In a paternity test, investigators first analysed the blood groups before they conducted DNA profiling. A paternity test was done for THREE males.

The results from the blood group analysis and DNA profiling are shown below.

	MALE 1	MALE 2	MALE 3	MOTHER	CHILD
BLOOD GROUP	B	O	A	AB	AB



3.1 Name ALL the possible genotypes for male **3**. (2)

3.2 Explain why the investigators excluded male **2** in the DNA profiling. (5)

3.3 Explain why the mother was included in the DNA profiling. (2)

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3.4 According to the DNA profiles, which male (**1** or **3**) is the father? (1)

(10)

ACTIVITY 4

4 Bt corn is a crop that has been genetically modified to be insect-resistant.

The table below shows the percentage of land used to grow Bt corn and the amount of insecticide used in a certain country between 1995 and 2010.

Year	Land used to grow Bt corn (%)	Amount of insecticide used (kg per hectare)
1995	0	0,2
2000	20	0,13
2005	40	0,05
2010	60	0,01

4.1 Describe how genetic engineering of Bt corn was done. (2)

4.2 Describe the relationship between the land used to grow Bt corn and the amount of insecticide used. (2)

4.3 State TWO other plant characteristics that are genetically engineered to increase food security. (2)

4.4 Draw a bar graph to represent the percentage of land used to grow Bt corn from 1995 to 2010. (6)

(12)

ACTIVITY 5

5 In humans, haemophilia is caused by a recessive allele on the X-chromosome ($\mathbf{X^h}$).

A woman, who is heterozygous for haemophilia, marries a man with haemophilia.

5.1 Use a genetic cross to show the percentage chance of the couple having a daughter who is homozygous for normal blood clotting. (7)

(7)

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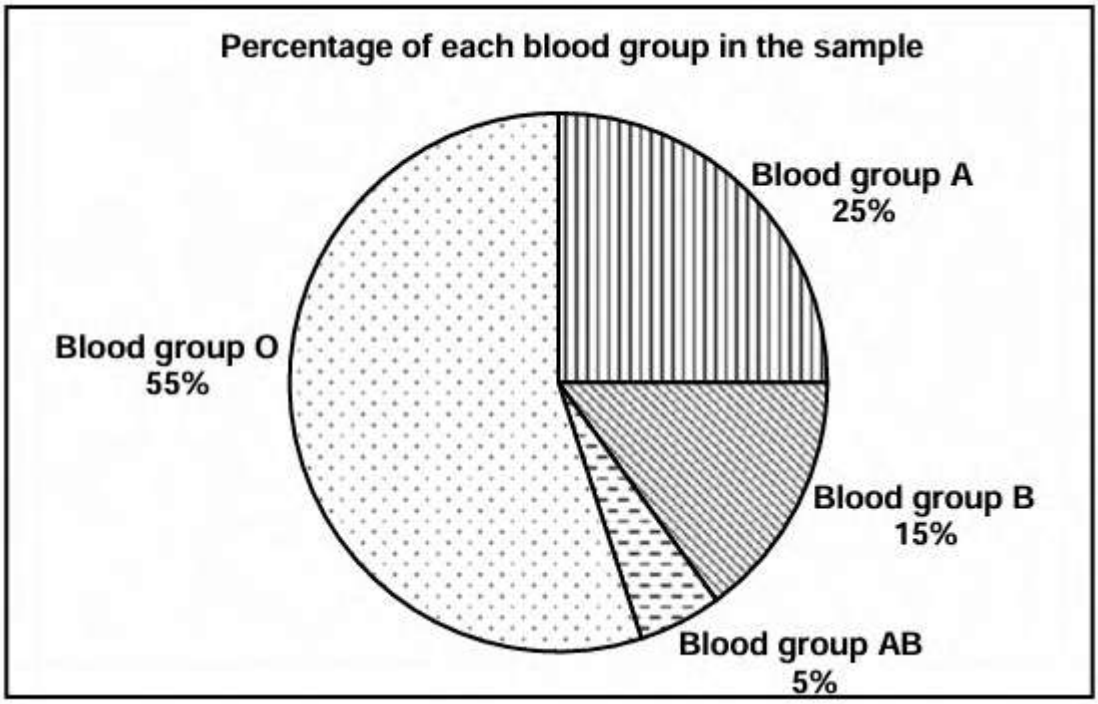
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ACTIVITY 6

6 Learners conducted an investigation to determine which blood group was the most common in their community.

They collected information about the blood groups of 200 blood donors in each of the three blood donor clinics in their community. They did not include first-time donors in the investigation.

The pie chart below shows the results of the investigation.



6.1 State the aim of the investigation. (2)

6.2 Calculate the number of participants that had blood group **B**. Show ALL workings. (3)

6.3 Give ALL the possible genotypes of the blood group represented by 25% of the donors. (2)

6.4 Explain the inheritance of blood group **AB**. (3)
(10)

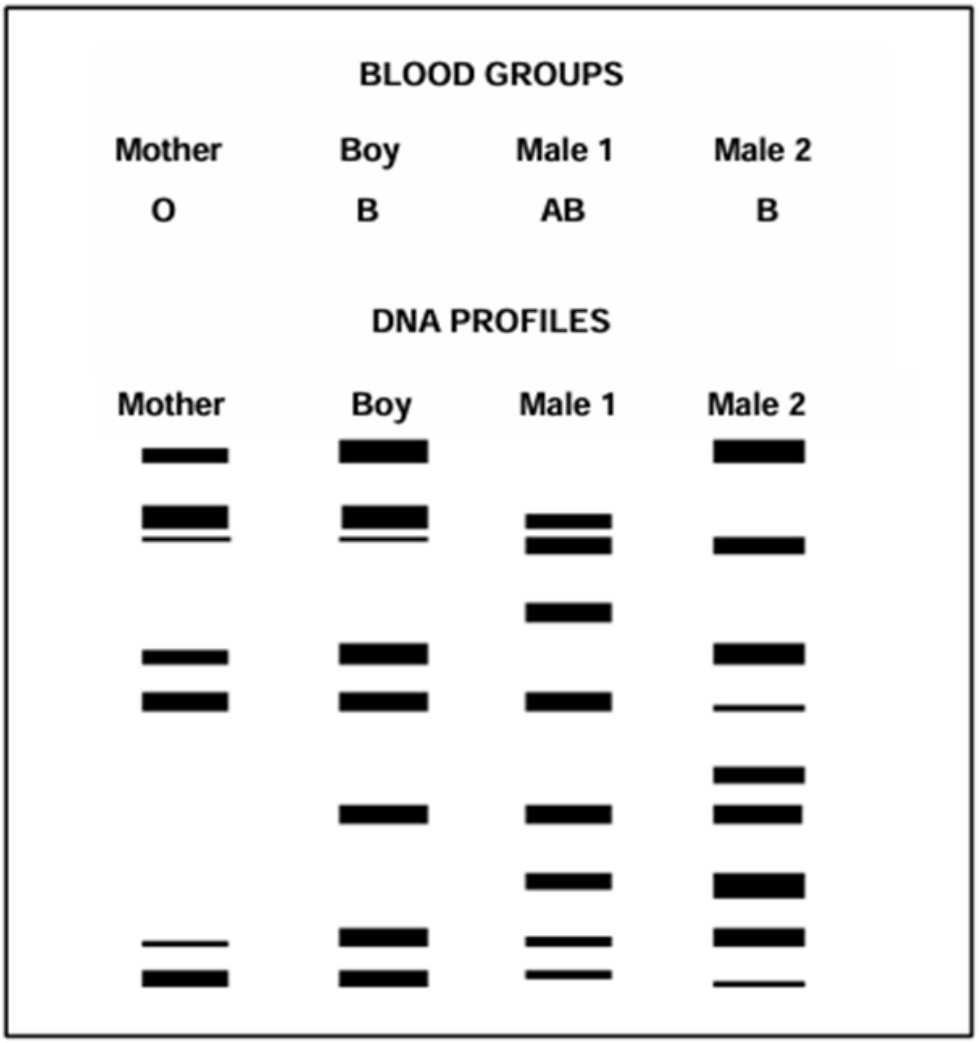
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ACTIVITY 7

7 A family wanted to identify the biological father of a boy. The mother of the boy is known. Blood groups and DNA profiles of the mother, the boy and two males were used to determine paternity.

The data below shows the results of the two procedures.



7.1 Explain why paternity of the boy could not be established using blood groups only. (5)

7.2 Who is the biological father of the boy according to the DNA profiles? (1)

7.3 Explain your answer to QUESTION 7.2. (3)
(9)

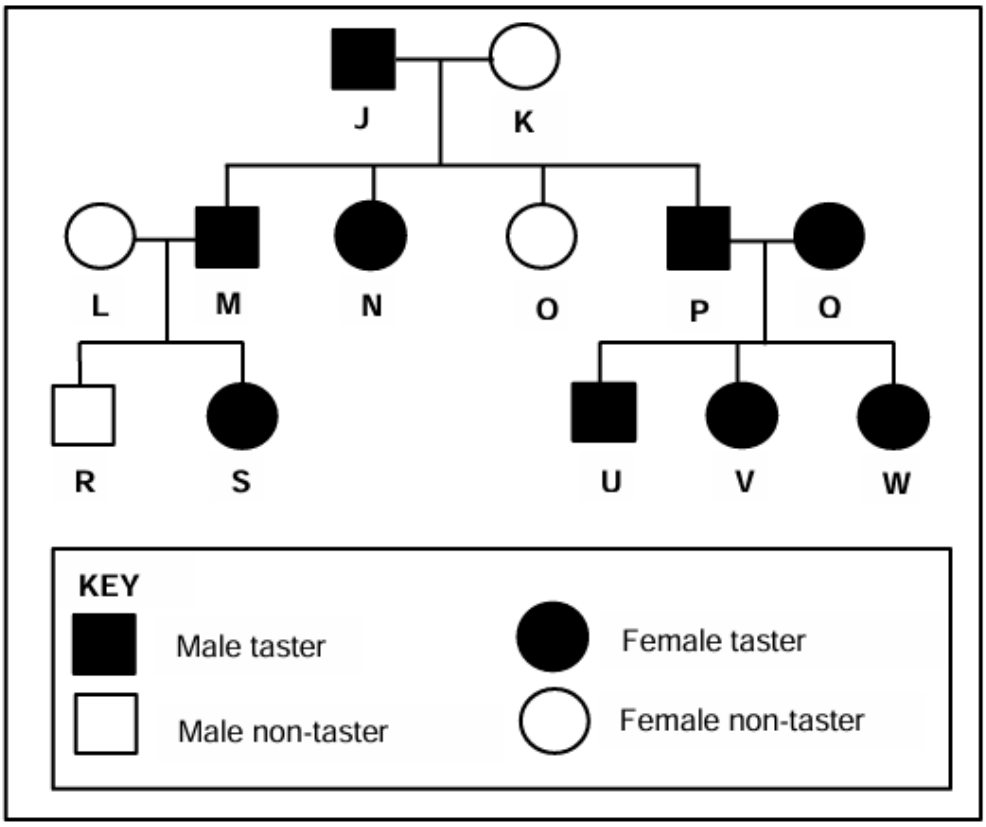
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ACTIVITY 8

8 In humans, the ability to taste a certain substance is inherited and is controlled by the dominant allele **T**. People who are able to taste this substance are called tasters, while those who cannot, are called non-tasters.

The pedigree diagram below shows the inheritance of this trait in a family.



8.1 Give the:

(a) Genotype of individual **J** (1)

8.2 Use evidence from the diagram to support your answer to QUESTION 8.1(a). (4)
(5)

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ACTIVITY 9

9 In birds, sex determination is controlled by sex chromosomes **Z** and **W**. Chromosome **W** is shorter than **Z**. Female birds have **ZW** chromosomes and male birds have **ZZ** chromosomes.

9.1 Use a genetic cross to show the percentage chance of having female offspring in birds. (6)

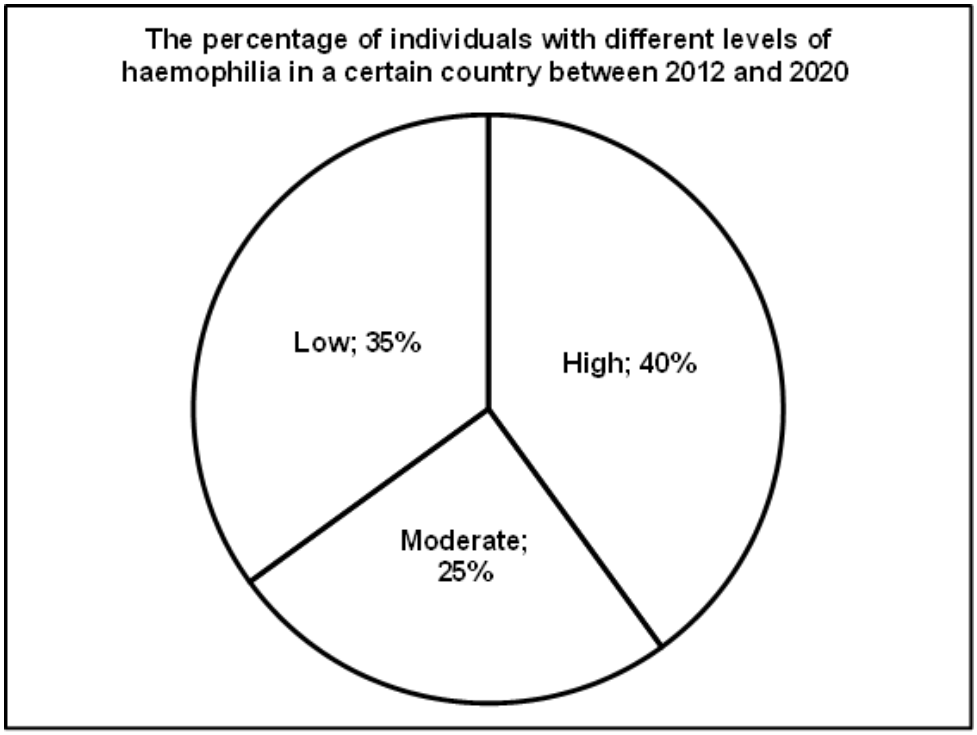
9.2 Use a genetic cross to show how gender in human offspring is determined by the sex chromosomes of the parents. (6)

9.3 Describe TWO structural differences between the sex chromosomes of birds and humans. (4)
(16)

ACTIVITY 10

10 In a certain country, 25 000 individuals were suffering from haemophilia between 2012 and 2020. Haemophilia is a genetic disorder that is caused by a mutation.

The pie chart below shows the percentage of individuals with different levels of haemophilia in this country.



10.1 Explain the effect of this mutation on an individual. (2)

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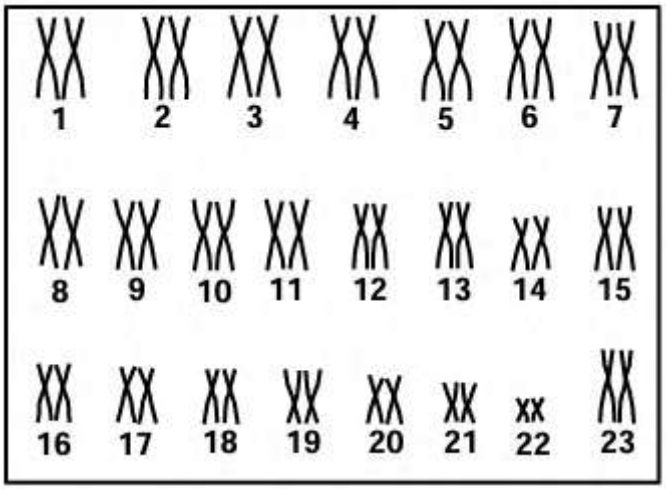
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10.2 Calculate the number of individuals who were moderately affected by haemophilia in this country. Show ALL working. (2)

10.3 Explain why it would be expected that most of the individuals affected by haemophilia will be males. (3)
(7)

ACTIVITY 11

11 The karyotype below represents the chromosomes of a person.



11.1 Give the collective term for the chromosomes numbered 1 to 22. (1)

11.2 State the gender of this person. (1)

11.3 Give ONE observable reason for your answer to QUESTION 11.2. (2)

11.4 State Mendel's principle of segregation. (2)

11.5 Describe how the karyotype of a person with Down syndrome would differ from the one above. (2)
(8)

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ACTIVITY 12

12 In rabbits, fur colour may be black, white or grey. The inheritance of fur colour is controlled by two alleles namely:

Black fur (**B**) and White fur (**W**)

12.1 Explain why fur colour in rabbits is an example of inheritance with incomplete dominance. (2)

12.2 Use a genetic cross to show the expected genotypes and phenotypes of the offspring when a grey male mates with a black female. (6)
(8)

ACTIVITY 13

13 Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

13.1 Name the type of dominance displayed in the inheritance of coat colour in palomino horses. (1)

13.2 Explain your answer to QUESTION 13.1. (2)

13.3 The breeding of horses with desired characteristics is a type of biotechnology.

(a) Name this type of biotechnology. (1)

(b) Name the TWO phenotypes of the horses that must be interbred for a 100% chance of palomino offspring. (2)

13.4 A horse with a cream-coloured coat was crossed with a palomino horse.

Use a genetic cross to show the expected phenotypic ratio of the offspring. (6)
(12)

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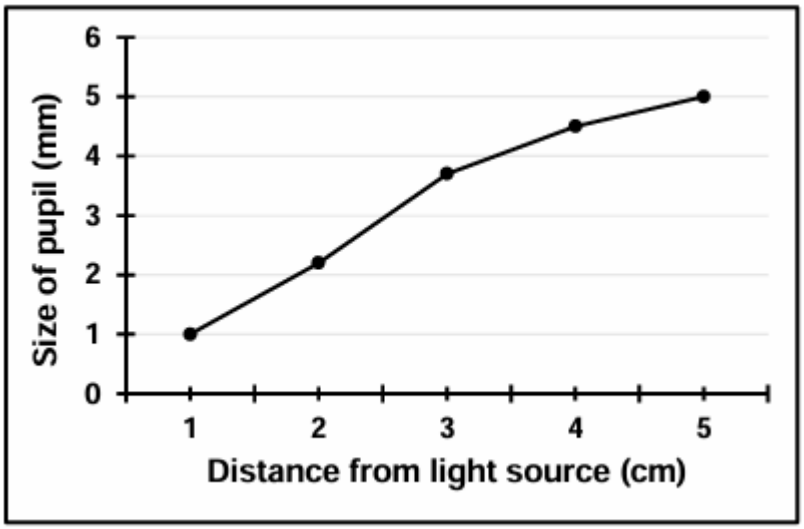
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TOPIC: RESPONDING TO THE ENVIRONMENT (HUMANS)

ACTIVITY 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 number (1.1 to 1.5) in the ANSWER BOOK, for example
1.6 D.

1.1 The graph below shows the results of an investigation done to determine the effect of light intensity on the size of the pupil.



Which ONE of the following statements is a conclusion that can be made from the results?

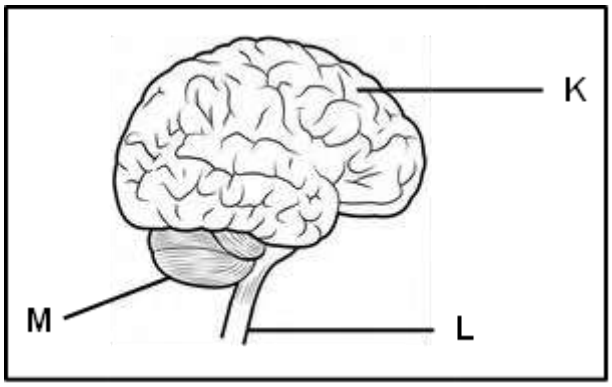
A As the distance from the light source increases, the size of the pupil increases.
B As the distance from the light source decreases, the size of the pupil increases.
C As the size of the pupil increases, the distance from the light source increases.
D As the size of the pupil decreases, the distance from the light source increases.

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1.2 After an accident, a person can still walk, but has poor control and coordination of the skeletal muscles.

The diagram below represents part of the central nervous system of this person.



Which parts of the central nervous system are probably damaged?

A **K**, **L** and **M**
B **K** and **L**
C **K** and **M**
D **L** and **M**

1.3 The following is a list of components associated with the nervous system:

(i) Parasympathetic nervous system
(ii) Spinal nerves
(iii) Sympathetic nervous system
(iv) Cranial nerves

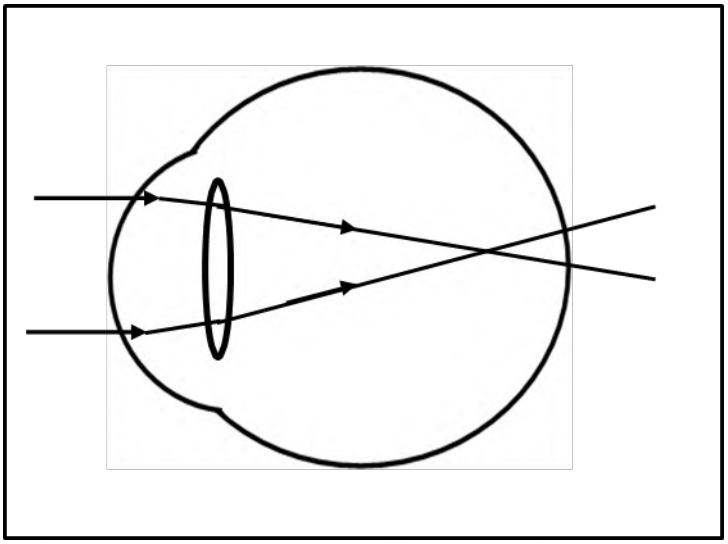
Which ONE of the following combination of components forms part of the peripheral nervous system?

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

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1.4 The diagram below represents a visual defect.



Which ONE of the following is the correct treatment of the visual defect shown above?

A Glasses with biconvex lenses
B Glasses with biconcave lenses
C Surgery to replace the cornea
D Surgery to replace the retina

1.5 Barotrauma is a common condition that occurs when pressure builds up in the middle ear. This causes the tympanic membrane to bulge. It is most common among deep-sea divers.

Divers are advised against diving when they have a middle-ear infection because the …

A auditory canal cannot equalise the pressure in the middle ear.
B Eustachian tube is blocked and air cannot enter the middle ear.
C Tympanic membrane is hardened and cannot pass the vibrations onto the middle ear.
D ossicles are fused together and cannot vibrate freely in the middle ear.

(5 x 2) **(10)**

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ACTIVITY 2

2 Good hand-eye coordination is essential to perform well in sports. Athletes can be trained to improve their hand-eye coordination.

An investigation was conducted to determine the effect of performance training on hand-eye coordination.
The procedure was as follows:

- Five girls, all 11 years old, were selected as participants.
- A ball-catch test was conducted to measure their hand-eye coordination where:
  - The girls bounced a rubber ball off a wall while standing 2 m away and they were required to catch the ball each time it bounced back
  - The number of successful catches in 30 seconds was recorded
  - The test was repeated three times and an average was calculated
- All the girls then participated in a performance-training programme for six weeks, with training sessions held twice a week.
- The ball-catch test was then repeated on completion of the performance training.

The results of the ball-catch tests are recorded in the table below.

PARTICIPANT	AVERAGE NUMBER OF SUCCESSFUL BALL CATCHES IN 30 SECONDS	
	BEFORE TRAINING	AFTER TRAINING
A	3	7
B	4	8
C	3	6
D	5	9
E	4	7

2.1 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

2.2 How many training sessions did each of the girls participate in? (1)

2.3 What was the purpose of the ball-catch test? (1)

2.4 State THREE ways in which the validity of the investigation was ensured. (3)

2.5 Describe ONE way in which reliability of the investigation can be improved. (1)

2.6 Explain the results of the investigation. (2)

2.7 State the conclusion for this investigation. (2)
(12)

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ACTIVITY 3

3 The table below shows the occurrence of multiple sclerosis (MS) in men and women in different age groups.

NUMBER OF PEOPLE IN DIFFERENT AGE GROUPS WITH MULTIPLE SCLEROSIS (per 100 000 people)		
AGE GROUP (YEARS)	**MEN**	**WOMEN**
14 to 19	0	0
20 to 29	40	70
30 to 39	150	250
40 to 49	235	450
50 to 59	290	620
60 to 69	400	600
70 to 79	150	240

3.1 Name:

(a) The specialised cells in the nervous system that are affected by MS (1)

(b) The part of the cells named in QUESTION 3.1(a) that are damaged (1)

3.2 Describe the relationship between age and the occurrence of MS in men up to the age of 69. (2)

3.3 Draw a histogram to represent the results in women aged 40 to 79. (6)
(10)

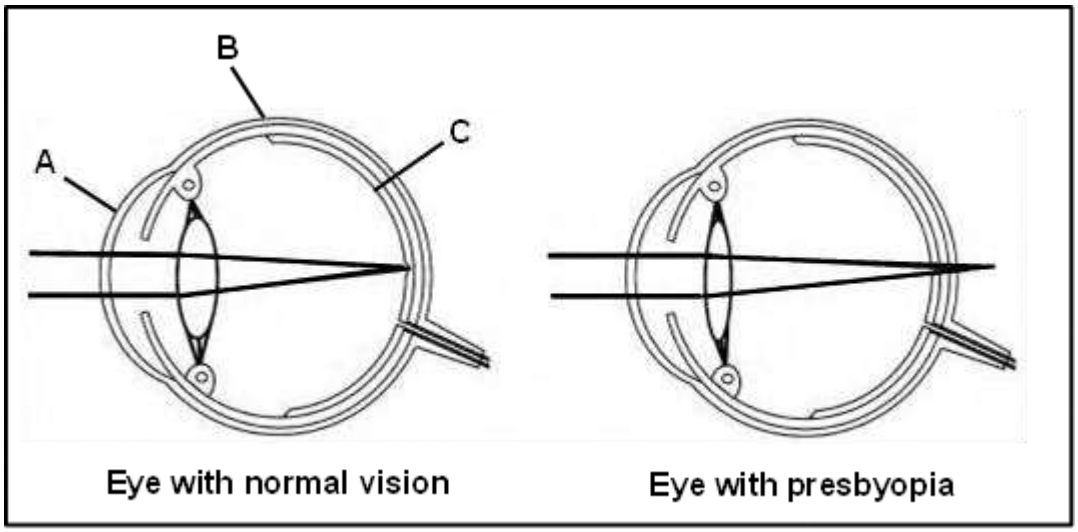
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ACTIVITY 4

4 After the age of 40, the lens of the eye becomes less flexible and is unable to change its shape. This makes it difficult to focus on nearby objects. This condition is called presbyopia.

The diagrams below show the eye of a person with normal vision and the eye of a person with presbyopia. Both eyes are focused on an object less than 6 m away.



4.1 Identify part:

(a) **A** (1)

(b) **B** (1)

4.2 Explain how layer **C** is structurally suited to its function. (2)

4.3 From the information, give ONE reason why accommodation becomes more difficult after 40 years of age. (1)

4.4 People with presbyopia develop long-sightedness. Reading glasses are prescribed to improve near vision.

(a) Explain why presbyopia leads to long-sightedness. (2)

(b) What type of lenses would be prescribed for a person with long-sightedness? (1)

(8)

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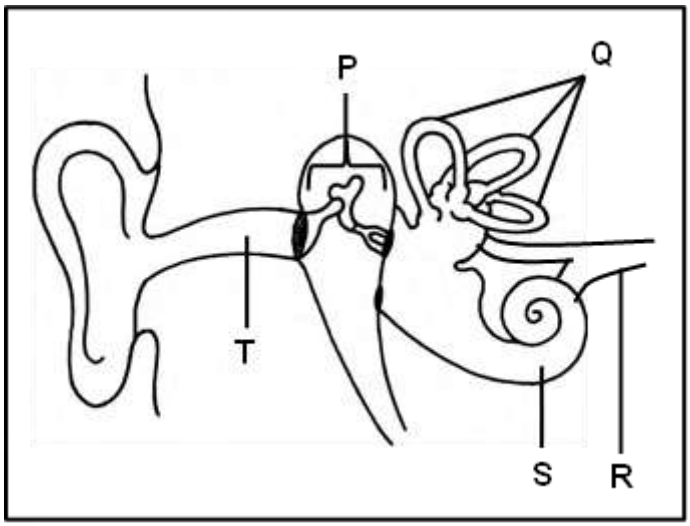
ACTIVITY 5

5 Read the extract below.

HEARING LOSS

There are two main types of hearing loss. Type **A** hearing loss occurs when there is a blockage in the transmission of sound waves and vibrations through the outer and middle ear. Type **B** hearing loss is caused by damage to the hearing receptors of the inner ear or to the nerves that carry sound impulses to the brain.

The diagram below represents the human ear.



5.1 Write down only the LETTERS of TWO parts EACH that may be damaged when a person suffers from:

(a) Type **A** hearing loss (2)

(b) Type **B** hearing loss (2)

5.2 Identify part **S**. (1)

5.3 Describe the role of the hearing receptors when they are stimulated by pressure waves. (2)

5.4 Explain why a person will suffer from hearing loss if the bones at **P** are fused. (4)
(11)

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ACTIVITY 6

6 Scientists investigated the effect of different doses of alcohol on reaction time in humans.

- A dose is the amount of alcohol given per kilogram of body mass.
- Reaction time is the time it takes a person to react once a stimulus is received.

The procedure was as follows:

Two 30-year-old male volunteers participated in the investigation which was conducted for a period of 7 days.

- They did not drink alcohol for a period of 24 hours prior to testing.
- They were given different amounts of alcohol on 4 different days.
- Their reaction times were determined 30 minutes after consuming the alcohol.

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

DAY OF INVESTIGATION	ALCOHOL DOSE (mg/kg body mass)	REACTION TIME (seconds)	
		MALE 1	MALE 2
1	0	1,86	1,82
3	200	1,91	1,94
5	400	2,02	2,06
7	600	2,11	2,15

6.1 For this investigation, state the:

(a) Independent variable (1)

(b) Dependent variable (1)

6.2 Name TWO variables that were controlled during the investigation. (2)

6.3 State TWO ways in which the reliability of the results can be improved. (2)

6.4 Explain why the participants only received alcohol every second day. (2)

6.5 Male 1 has a body mass of 93 kg. Calculate the amount of alcohol (in mg) that he consumed on day 7 of the investigation. Show ALL your working. (2)

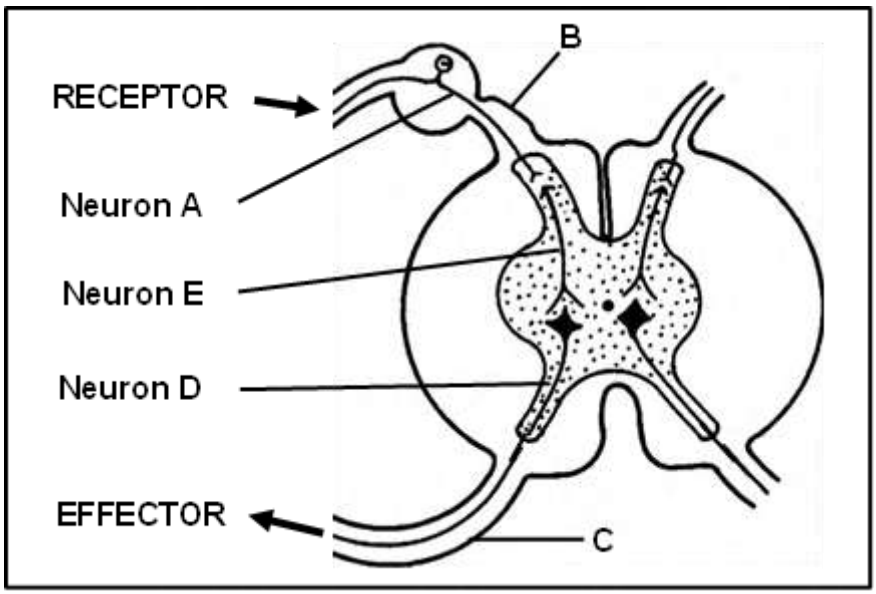
6.6 State a conclusion for this investigation. (2)
(12)

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ACTIVITY 7

7 The diagram below represents part of a reflex arc.



7.1 State the significance of a synapse. (1)

7.2 Explain the:

(a) Significance of a reflex action (2)

(b) Effect on the reflex arc if neuron **A** is cut (3)

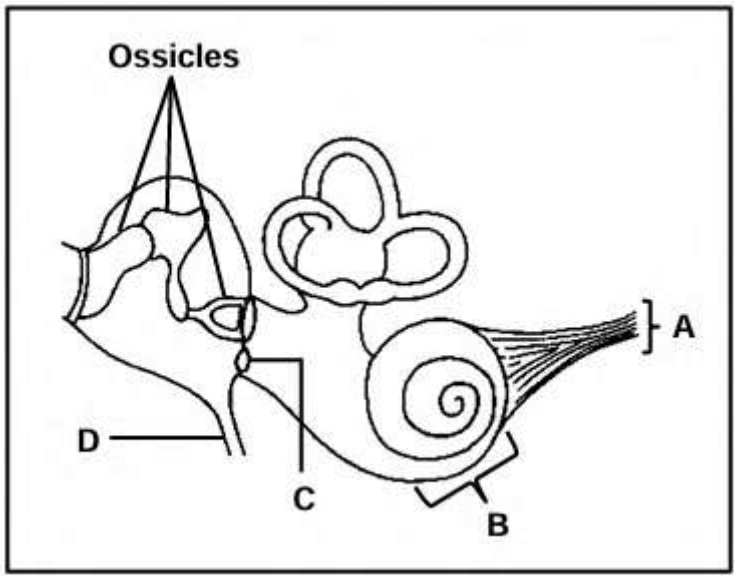
7.3 Draw a labelled diagram to show the detailed structure of neuron **D**. (5)
(11)

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ACTIVITY 8

8 The diagram below represents a part of the ear.



8.1 Otosclerosis is a medical condition that prevents the ossicles from vibrating.

Explain how this condition will affect hearing. (4)

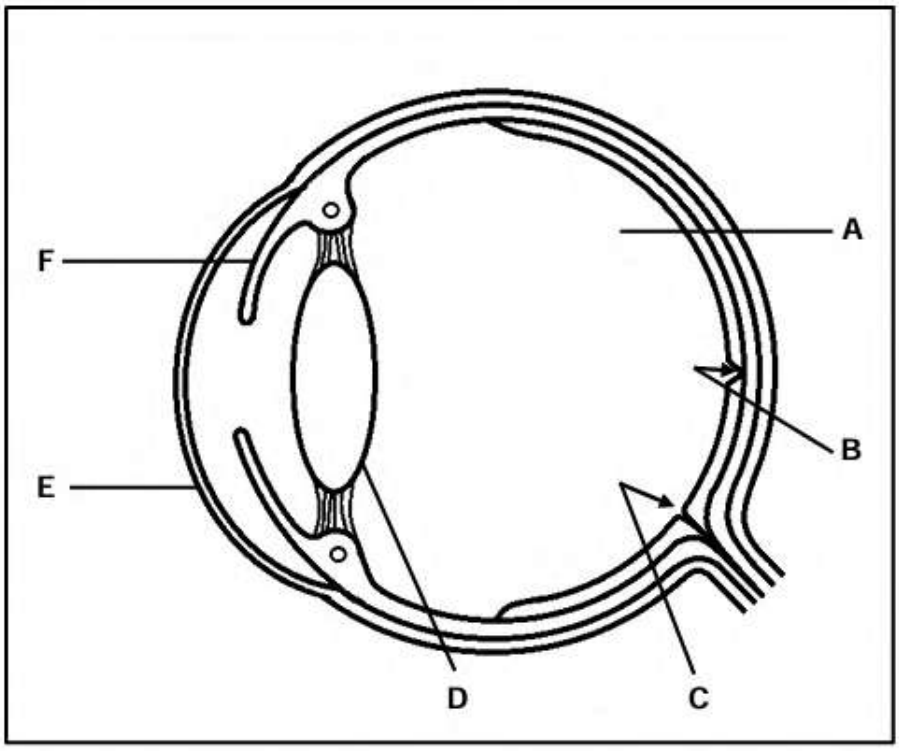
(4)

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ACTIVITY 9

9 The diagram below represents the structure of a human eye.



9.1 Identify structure **F**. (1)

9.2 State TWO functions of fluid **A**. (2)

9.3 Describe the structural difference between area **B** and area **C**. (2)

9.4 Name the visual defect that occurs when the curvature of part **E** is uneven. (1)

9.5 Explain how the:

(a) Shape of part **D** enables a person to read a book (3)

(b) Sight of a person will be affected if cataracts developed in part **D** (3)

9.6 Describe the process of accommodation that takes place when an object is less than 6 metres away from the eye. (6)
(18)

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ACTIVITY 10

10 Read the extract below.

THE DIFFERENCE BETWEEN HYPOREFLEXIA AND HYPERREFLEXIA

Hyporeflexia is a condition where the skeletal muscles have a decreased reflex response. It is caused by damage to parts of a reflex arc. The damage is usually to the motor neurons, which send messages from the spinal cord to the skeletal muscles. This can be due to a medical condition called Guillain-Barré syndrome.

Hyperreflexia is the result of damage to the motor neurons that send messages from the brain to the spinal cord. People suffering from multiple sclerosis (MS) usually demonstrate hyperreflexia and have loss of muscle control.

10.1 Name the part of a neuron that degenerates, leading to multiple sclerosis. (1)

10.2 Explain how damage to the part named in QUESTION 10.1 can lead to the symptoms of multiple sclerosis, as stated in the extract. (3)
(4)

ACTIVITY 11

11 Read the extract below.

Workers in some factories are constantly exposed to loud noise for long periods. This can destroy the hair cells in the organ of Corti and damage the auditory nerve, resulting in hearing loss.
A survey was conducted in a developing country from 2014 to 2018, to establish the number of factory workers who suffered from hearing loss.

The results are shown in the table below.

Year	Number of factory workers with hearing loss
2014	85 000
2015	100 000
2016	115 000
2017	120 000
2018	130 000

11.1 Name the structure in the ear where the organ of Corti is located. (1)

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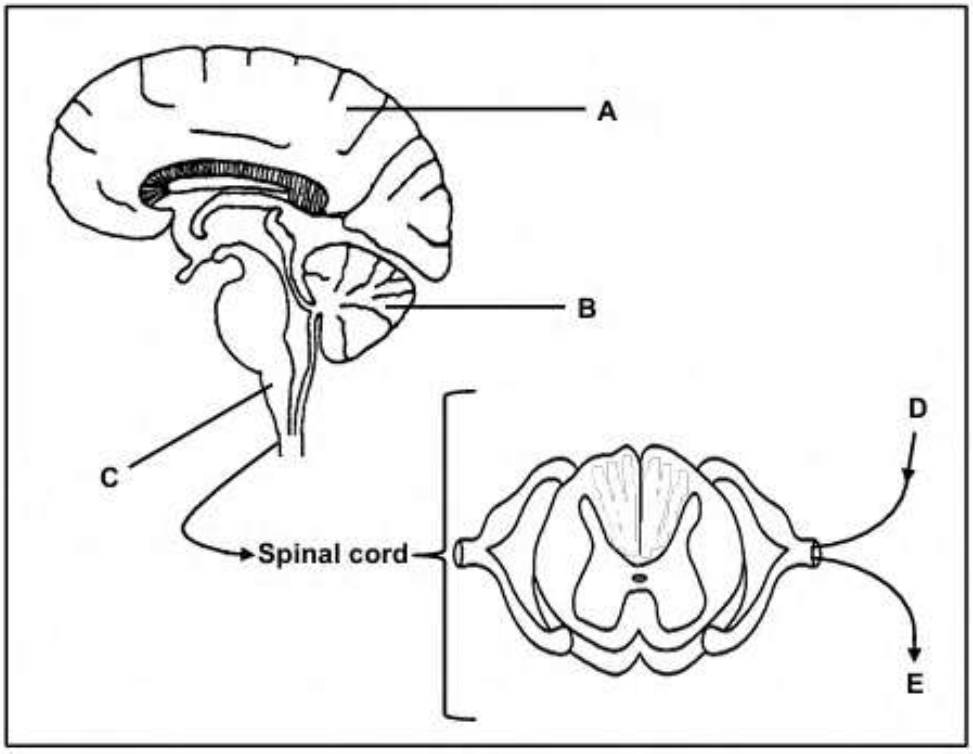
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11.2 Calculate the percentage increase in the number of factory workers with hearing loss between 2014 and 2018. Show ALL workings. (3)

11.3 Explain why damage to the auditory nerve may result in hearing loss. (2)
(6)

ACTIVITY 12

12 The diagrams below show parts of the human nervous system.



12.1 Name the branch of the nervous system represented by the parts shown. (1)

12.2 Give the LETTER and NAME of the part responsible for:

(a) Balance and coordination (2)

(b) Control of breathing (2)

(c) Control of skeletal muscles (2)

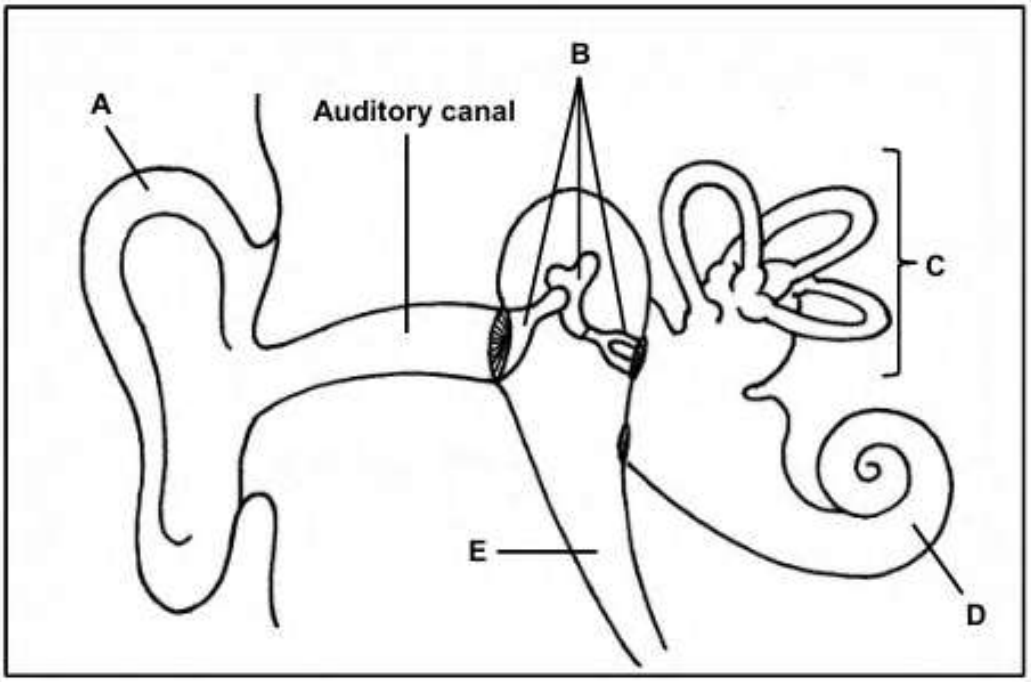
12.3 Describe the pathway of an impulse from part **D** through the spinal cord to part **E**, to bring about a reflex action. (6)
(13)

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ACTIVITY 13

13 The diagram below shows the structure of the human ear.



13.1 Identify part:

(a) **A** (1)

(b) **B** (1)

13.2 Give the LETTERS of TWO parts that are normally filled with fluid. (2)

13.3 Describe how balance is restored when there is a change in the speed and direction of head movement. (5)

13.4 When a person is exposed to loud noise over a long period, it may lead to noise-induced hearing loss (NIHL), which is caused by damage to the hair cells in the organ of Corti. These cells are not repaired when damaged. Placing earplugs in the auditory canal can prevent damage to the hair cells.

Explain how:

(a) Damage to the hair cells in the organ of Corti can lead to hearing loss (2)

(b) Earplugs can prevent damage to the hair cells in the organ of Corti (3)

(14)

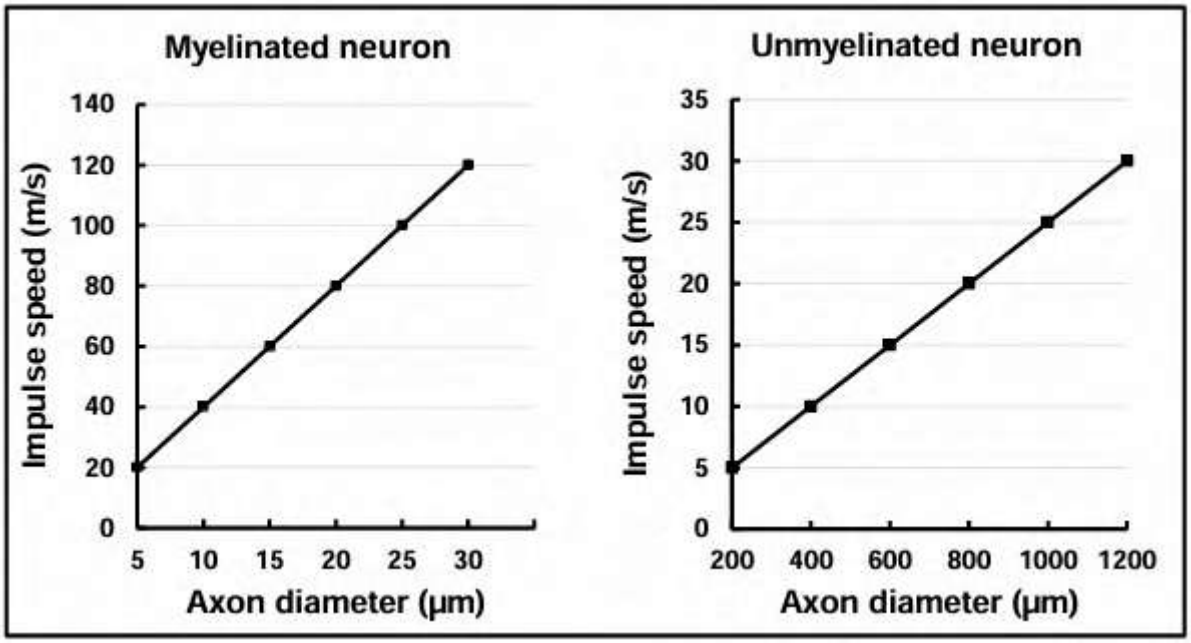
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ACTIVITY 14

14 In the human body, the axons of myelinated neurons have much smaller diameters than the axons of unmyelinated neurons.

The graphs below show the speed of nerve impulses in myelinated neurons and in unmyelinated neurons with different axon diameters.



14.1 Give the axon diameter (in µm) at which an impulse moves at 20 m/s in:

(a) A myelinated neuron (1)

(b) An unmyelinated neuron (1)

14.2 Use the graphs to describe the following:

(a) Difference in impulse speed for myelinated and unmyelinated neurons (2)

(b) Relationship between axon diameter and impulse speed (2)
(6)

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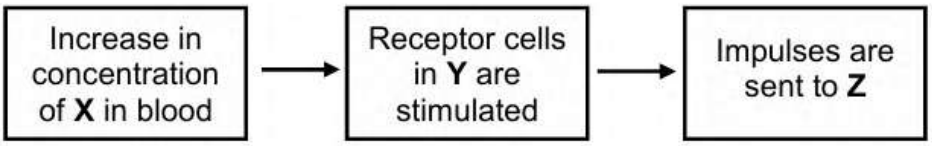
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TOPIC: ENDOCRINE AND HOMEOSTASIS

ACTIVITY 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 number (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

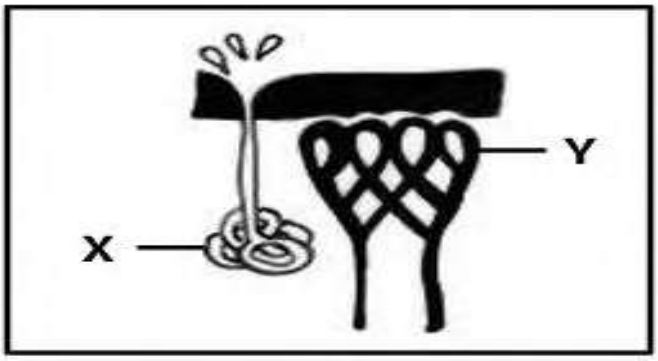
1.1. The flow diagram below represents a part of the homeostasis of compound **X**.



Which ONE of the following combinations is CORRECT?

	X	Y	Z
A	Carbon dioxide	Hypothalamus	Pituitary gland
B	Water	Hypothalamus	Medulla oblongata
C	Carbon dioxide	Carotid artery	Medulla oblongata
D	Water	Carotid artery	Pituitary gland

1.2 The diagram below shows parts of the skin involved thermoregulation.



When a person is exposed to high environmental temperatures, the hypothalamus stimulates …

A vasodilation in Y and decreased sweat secretion by X.
B vasoconstriction in Y and increased sweat secretion by X.
C vasodilation in Y and increased sweat secretion by X.
D vasoconstriction in Y and decreased sweat secretion by X

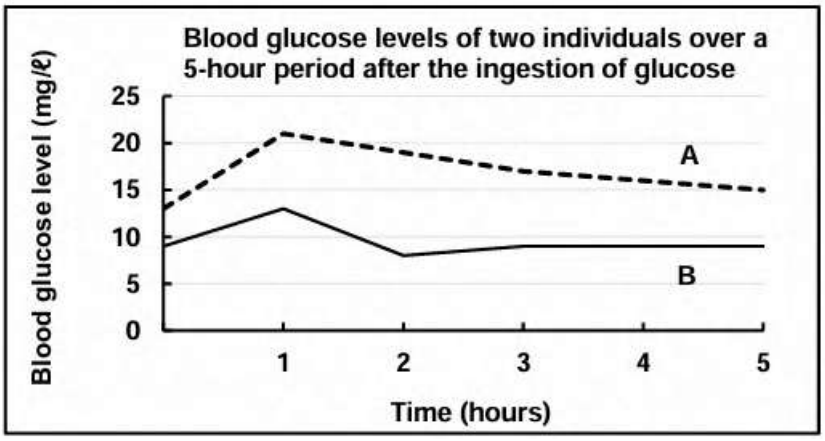
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1.3 Note the following for an investigation:

• Two individuals, A and B, had not eaten for four hours prior to the investigation.
• They then ingested 15 grams of pure glucose.
• One of the individuals has untreated diabetes mellitus.

The graphs below show the blood glucose levels of the two individuals over a period of 5 hours after the glucose has been ingested.



Which statement regarding the information in the graphs is CORRECT?

A The insulin levels of individual A will remain high.
B Individual B has diabetes mellitus because the glucose levels dropped to below 10 mg/ℓ.
C The insulin levels of individual B will remain constant.
D Individual A has diabetes mellitus because the glucose levels remain above 10 mg/ℓ.

1.4 When the carbon dioxide level in the blood increases above normal, the …

A rate and depth of breathing decrease.
B receptor cells in the diaphragm are stimulated.
C heart beats slower.
D receptor cells in the carotid artery in the neck are stimulated.

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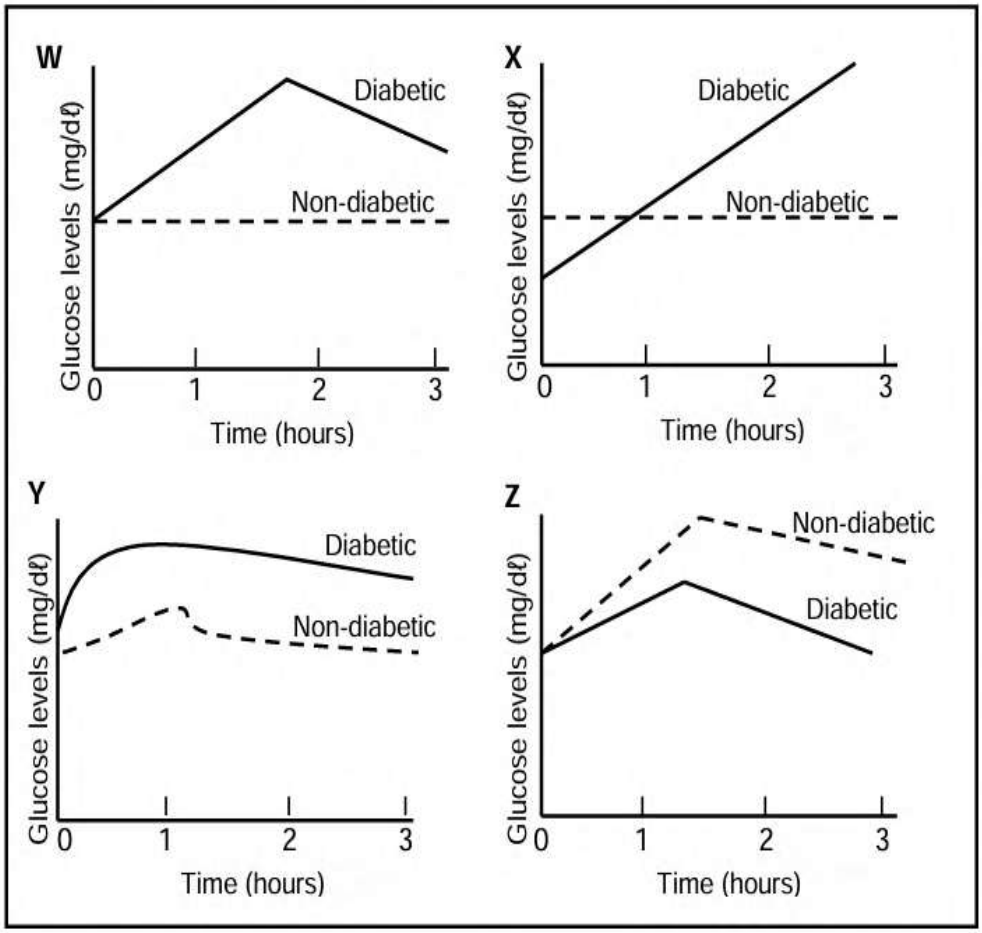
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1.5 A person produces a smaller volume of urine most probably because ..

A ADH levels are high in the blood and the renal tubules are more permeable to water.
B ADH levels are high in the blood and the renal tubules are less permeable to water.
C ADH levels are low in the blood and the renal tubules are more permeable to water.
D ADH levels are low in the blood and the renal tubules are less permeable to water.

1.6 Two men were given a glucose-rich meal at the same time (0 hours). One man is diabetic and the other is non-diabetic. The diabetic did not receive any medical treatment. Their blood glucose levels were measured over a period of 3 hours.

The graphs below show the possible blood glucose levels of the two men during this time.



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1.7 Which ONE of the following changes occurs under the influence of adrenalin?

A An increased blood supply to the skeletal muscles
B Decreased blood pressure
C Decreased muscle tone of skeletal muscles
D An increased blood supply to the digestive system

1.8 A person has a disorder where she is unable to secrete ADH.
It is most likely that …

A the renal tubules will become more permeable to water.
B the blood will have a higher volume of water.
C large volumes of urine will be produced.
D more water is reabsorbed by the renal tubules.

1.9 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

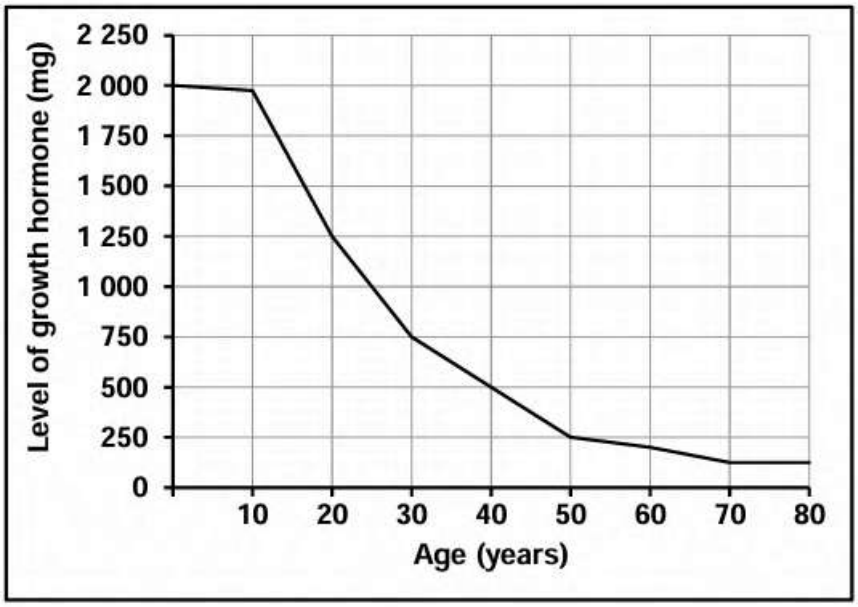
1.10 An over secretion of the hormone produced by the thyroid gland may result in a person …

A gaining weight, because of an increased metabolic rate.
B gaining weight, because of a decreased metabolic rate.
C losing weight, because of an increased metabolic rate.
D losing weight, because of a decreased metabolic rate.

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1.11 **QUESTIONS 1.11 AND 1.12 ARE BASED ON THE GRAPH BELOW SHOWING THE AVERAGE AMOUNT OF GROWTH HORMONE SECRETED IN HUMANS AT DIFFERENT AGES.**



Which ONE of the following statements describes the trend in the graph?

A The secretion of the growth hormone increases with age.
B The level of the growth hormone decreases more rapidly in the age group 50–70 years when compared to the age group 10–40 years.
C The level of the growth hormone decreases more rapidly in the age group 10–40 years when compared to the age group 50–70 years.
D The secretion of the growth hormone decreases at the same rate at all ages.

1.12 The percentage decrease in the level of growth hormone between the ages of 20 and 40 years is …

A 20%.
B 60%
C 150%.
D 250%.

(12 x 2) **(24)**

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ACTIVITY 2

2 Hyperaldosteronism is a disorder caused by the oversecretion of aldosterone and has been linked to high blood pressure in humans.

Scientists investigated the influence of increased aldosterone levels on blood pressure.

The procedure was done as follows:

- 1 688 healthy volunteers, aged 55, participated in the investigation.
- The participants' blood pressure was measured and recorded before the start of the investigation.
- The participants were injected with a dose of aldosterone in the morning and their blood pressure was measured every hour for 12 hours.
- This procedure was followed over four days for each individual and the average blood pressure was calculated.
- All participants followed the same diet during the period of the investigation.

2.1 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

2.2 Give TWO reasons why the results of the investigation may be considered reliable. (2)

2.3 Explain TWO reasons why it was important for the participants to follow the same diet during the investigation. (4)

2.4 Explain why the participants' blood pressure was measured before the start of the investigation. (2)

2.5 Explain why the levels of salt in the urine of participants is expected to decrease after being injected with aldosterone. (3)
(13)

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ACTIVITY 3

3 The table below shows the average rate of blood flow to the skin at different environmental temperatures.

ENVIRONMENTAL TEMPERATURE (°C)	AVERAGE RATE OF BLOOD FLOW TO THE SKIN (mℓ /100 mℓ tissue/min)
0	2,5
5	4
20	4,5
35	11
45	18
50	19

3.1 Give the environmental temperature at which there was the greatest average rate of blood flow to the skin. (1)

3.2 Describe the relationship between the environmental temperature and the average rate of blood flow to the skin. (2)

3.3 Calculate the percentage increase in blood flow to the skin between 5 °C and 35 °C. Show ALL your workings. (3)

3.4 Explain the average rate of blood flow to the skin between 20 °C and 45 °C. (4)

3.5 Frostbite is a condition where long term exposure to extremely cold conditions (0 °C or less) leads to the death of tissue in areas like the hands and feet.

Use the data from the table to explain why tissue may die. (2)

(12)

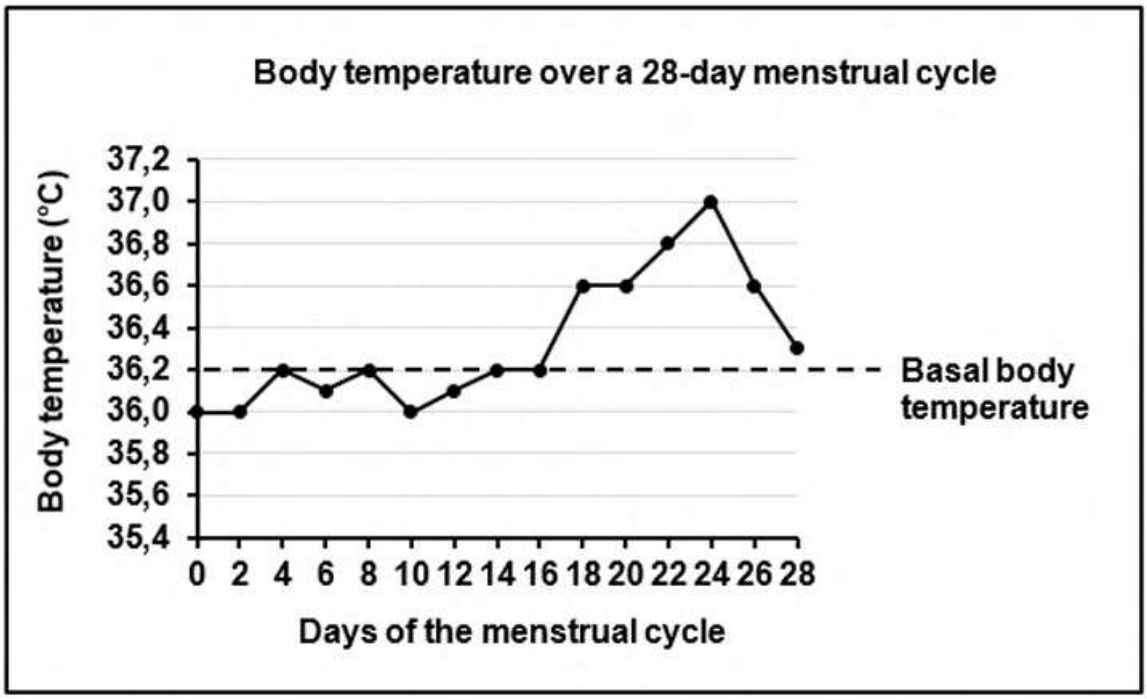
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ACTIVITY 4

4 Basal body temperature is the body temperature while a person is at rest. An increase above the basal body temperature occurs immediately after the day of ovulation. The basal body temperature method can be used by women who want to fall pregnant.

The graph below represents the body temperature chart of a woman with a 28-day menstrual cycle.



4.1 Use the graph to identify the following for this woman:
(a) Basal body temperature (1)
(b) Day of ovulation (1)

4.2 Using evidence in the graph, give a reason for your answer to QUESTION 4.1 (b). (2)

4.3 Progesterone is the hormone that causes an increase in the basal body temperature.

Explain why the increase in basal body temperature occurs only after ovulation. (2)

4.4 Explain why the basal body temperature is measured when a person is at rest. (2)
(8)

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ACTIVITY 5

5.1 Explain the effect of adrenalin on the heart and the respiratory system. **(5)**

ACTIVITY 6

6 Knowing the salt level in the blood of humans can provide information on their health and lifestyle. The normal salt level in the blood is between 136 mmol/ℓ and 145 mmol/ℓ. Salt levels in the blood below 136 mmol/ℓ are an indication of hyponatremia, and salt levels in the blood higher than 145 mmol/ℓ are an indication of hypernatremia.

A group of people with the same diet had their blood salt levels tested.

The table below shows the results.

SALT LEVELS IN THE BLOOD (mmol/ℓ)	NUMBER OF PEOPLE
Lower than 136	5
136 to 140	15
141 to 145	21
Higher than 145	4

6.1 Use data in the table to determine how many people have:

(a) Hypernatremia (1)

(b) Normal blood salt levels (1)

6.2 Describe how the human body increases a salt level lower than 136 mmol/ℓ to the normal level. (6)

6.3 Draw a histogram to show the results in the table. (6)
(14)

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ACTIVITY 7

7 Read the extract below.

HYPOTHYROIDISM IN CHILDREN

Hypothyroidism is a condition where the thyroid gland does not secrete enough thyroxin.

In a study, 265 children with hypothyroidism were checked for other effects and disorders.

The results showed that the most common effects included short stature (33%), loss of appetite (16%), weight gain (14%), tiredness (12%) and goitre (3%). Disorders included a vitamin D deficiency (37%), diabetes mellitus (22,3%) and Down syndrome (8,3%).

7.1 According to the extract, which effect is most common among children with hypothyroidism? (1)

7.2 Calculate the number of children in the group that had diabetes mellitus.

Show ALL your working and round off the answer to ONE decimal place. (3)

7.3 Apart from testing the thyroxin levels in the blood, explain why doctors may also test the TSH levels in the blood of children with hypothyroidism. (2)

ACTIVITY 8

8 Both the nervous and endocrine systems are involved in maintaining homeostasis in the human body.

8.1 Which ONE of the two systems is involved in maintaining the:

(a) Carbon dioxide levels (1)

(b) Water levels (1)

8.2 While doing strenuous exercise, the water level in a person's blood is low.

(a) Describe how osmoregulation will take place. (4)

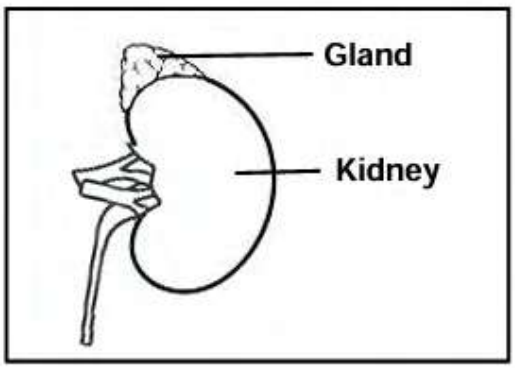
(b) Explain TWO reasons why this person needs to breathe faster. (5)

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ACTIVITY 9

The diagram below represents a gland that is located on top of the kidney.



9.1 Name the gland shown in the diagram. (1)

9.2 Name the hormone secreted by the gland, referred to in QUESTION 10.1 that:

(a) Prepares the body for an emergency (1)

(b) Maintains the salt levels in the body (1)

9.3 Explain the effect of the hormone, named in QUESTION 9.2 (a) on the:

(a) Blood vessels transporting blood to the digestive system (2)

(b) Liver (2)

9.4 Explain the effect that a secretion of the pituitary gland will have on kidney when a person experiences dehydration. (5)

9.5 Describe the interaction between the adrenal gland and kidney in maintaining homeostasis when salt levels in the blood are low. (5)

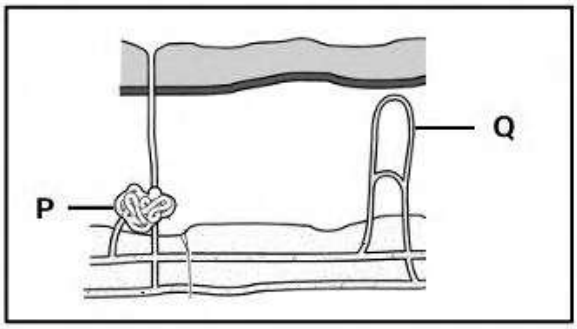
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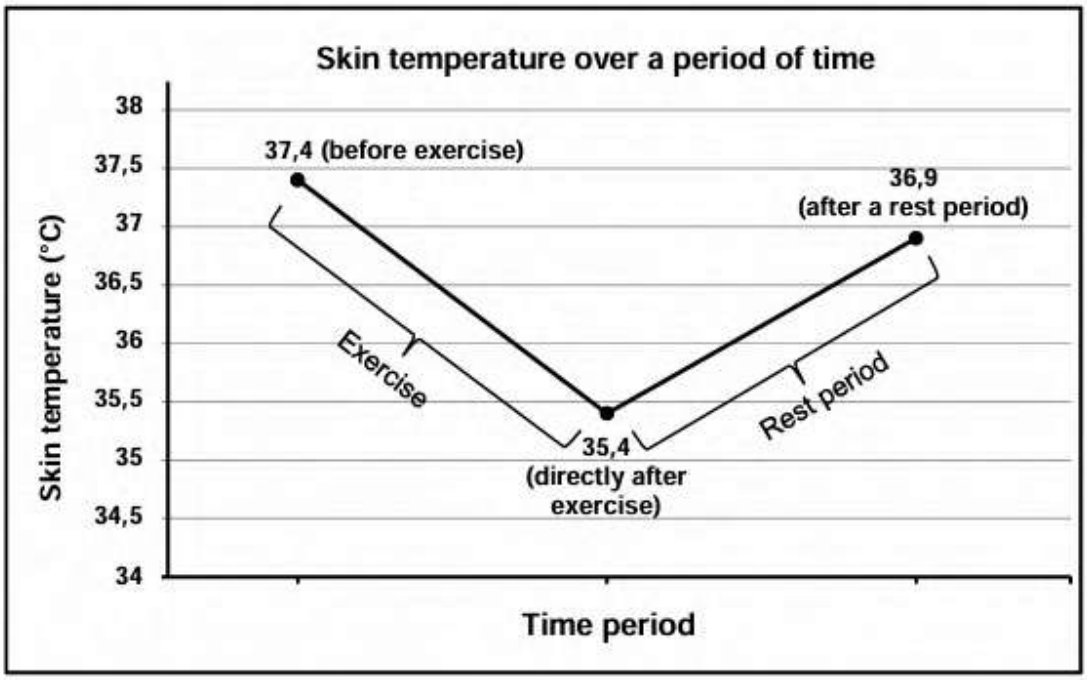
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ACTIVITY 10

10 A twelve-year-old boy participated in physical exercise for 45 minutes, followed by a 15-minute rest period. The skin temperature of the boy was measured and the results were recorded.
The diagram below represents the skin of the boy before exercise.



The graph below shows the changes in skin temperature over a period of time.



10.1 Calculate the percentage decrease in the average skin temperature of the boy before and directly after exercise. Show ALL working. (3)

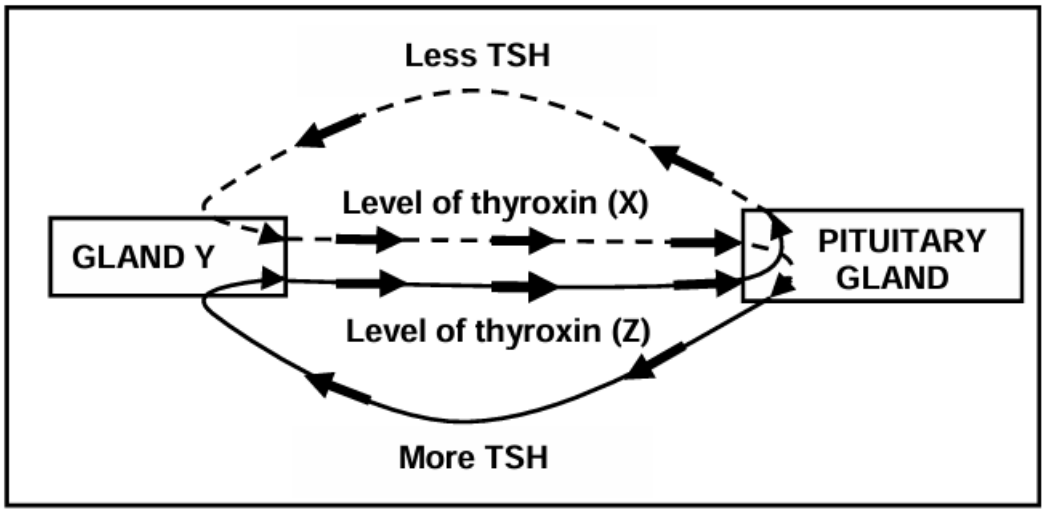
10.2 Explain the roles of part P and Q in the change in skin temperature from before exercise to directly after exercise. (3)
(6)

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ACTIVITY 11

11 The flow diagram below shows the homeostatic control of thyroxin in the human body.



11.1 Identify:

(a) The type of interaction represented by the diagram (1)

(b) Gland **Y** (1)

(c) The disorder that is characterised by the enlargement of gland **Y** (1)

11.2 State ONE function of thyroxin. (1)

11.3 Describe the role of the pituitary gland in correcting the level of thyroxin at **X**. (4)

11.4 Explain why a continuous undersecretion of thyroxin may lead to an increase in body mass. (2)

ACTIVITY 12

12 An investigation was conducted to determine the effect of insulin on blood glucose levels.
The procedure was as follows:

- Two groups of ten people each were selected.
- One of the groups consisted of healthy individuals and the second group, which served as a control, consisted of people with diabetes.
- Each group was given 75 g of glucose to ingest.
- Their blood was tested again after 60 and 90 minutes to determine the levels of glucose and insulin.

NOTE:

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- The normal level of glucose in the blood is between 3,9 mmol/ℓ and 5,6 mmol/ℓ.
- The normal level of insulin in the blood, 60 minutes after glucose ingestion, is between 18 mU/ℓ and 276 mU/ℓ.

The results are recorded in the table below.

	GROUP X			GROUP Y		
Time after glucose ingestion (minutes)	0	60	90	0	60	90
Average level of glucose in blood (mmol/ℓ)	6,8	8,9	8,7	4,5	6,2	4,5
Average level of insulin in blood (mU/ℓ)	4	2	2	8	142	108

12.1 State the purpose of the control group in this investigation. (2)

12.2 Describe TWO ways in which insulin decreases blood glucose levels. (4)

12.3 Which group (X or Y) consists of healthy individuals? (1)

12.4 Use data in the table to explain your answer to QUESTION 12.3. (3)
(10)

ACTIVITY 13

13 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.

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

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13.2 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)

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

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

(12)

ACTIVITY 14

14 14.1 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)**

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TOPIC: PLANT HORMONES

ACTIVITY 1

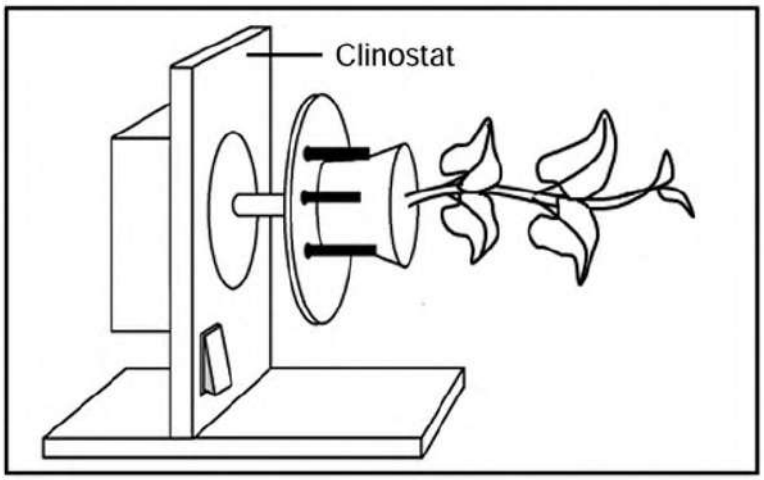
1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A to D) next to the question number (1.1 to 1.6) in the ANSWER BOOK, for example
1.6 D.

QUESTIONS 1.1 AND 1.2 REFER TO THE DIAGRAM BELOW THAT SHOWS AN INVESTIGATION DONE TO DETERMINE THE EFFECT OF AUXINS ON TROPISM.

The procedure was as follows:

- A pot plant was placed on a stationary clinostat.
- The plant was exposed to light from all directions.
- The growth was then observed after few days.

The diagram below shows the set-up of the investigation.



The results after a few days showed the stem growing upwards.

1.1 Which ONE of the following is an explanation of the results?

A Phototropism occurred because the auxins moved towards light, which inhibited growth on the lower side of the stem.
B Geotropism occurred because the auxins moved downwards, which stimulated growth on the lower side of the stem.
C Phototropism occurred because the auxins moved away from light, which stimulated growth on the upper side of the stem.
D Geotropism occurred because the auxins moved upwards, which inhibited growth on the upper side of the stem.

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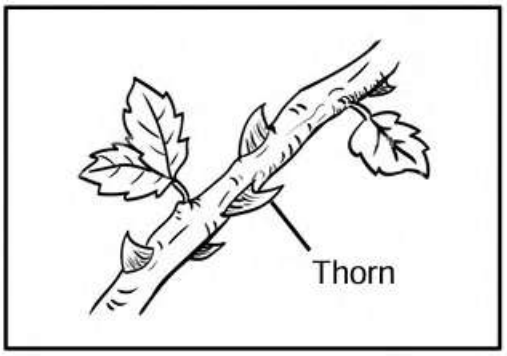
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1.2 A control for the same investigation was set up by putting an identical pot plant on a rotating clinostat.

Which ONE of the following would be the expected results observed after a few days?

A There will be no growth.
B The stem will grow upwards.
C The stem will grow downwards.
D The stem will grow horizontally.

1.3 The diagram below shows a part of the stem of a plant.



Which ONE of the following is shown by the stem of this plant?

A Apical dominance
B Dormancy of lateral buds
C Plant defence mechanism
D Fruit development

1.4 The following is a list of functions of plant hormones:

(i) Promotes seed dormancy
(ii) Acts as a weed killer
(iii) Causes the falling of leaves
(iv) Promotes cell division

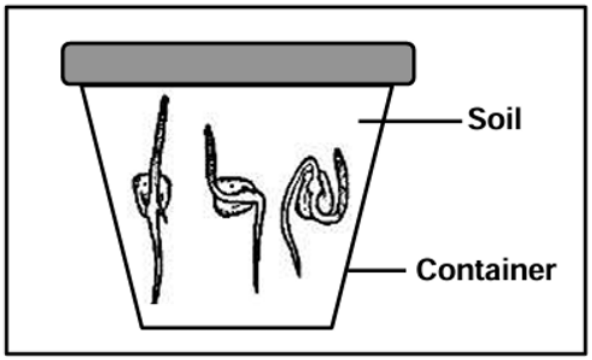
Which combination of functions describes the role of abscisic acid?

A i only
B i and ii only
C i and iii only
D i, ii, iii and iv

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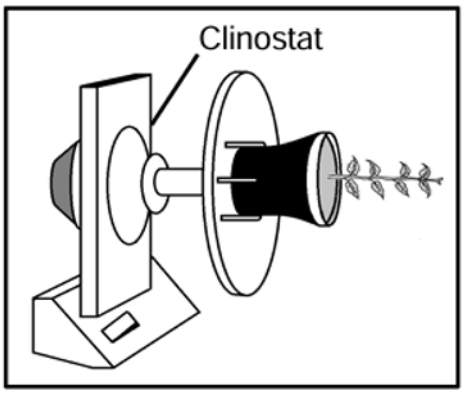
1.5 The diagram below shows germinating seeds in a non-transparent (opaque) container.



Which ONE of the following statements CORRECTLY describes the growth response of the seeds?

A Stems grow upwards due to apical dominance.
B Roots grow downwards due to geotropism.
C Stems grow upwards due to phototropism.
D Roots grow downwards due to phototropism.

1.6 An investigation was done in which a potted plant was placed horizontally on a clinostat, as shown in the diagram. The plant was exposed to uniform light from all directions.



(A clinostat is a device with a disc that rotates when switched on, allowing the attached plant to rotate as well.)

The stem grew vertically upwards, which indicates that the clinostat was …

A stationary and the stem showed negative geotropism.
B rotating and the stem showed positive geotropism.
C stationary and the stem showed negative phototropism.
D rotating and the stem showed positive phototropism.

(5 x 2) (10)

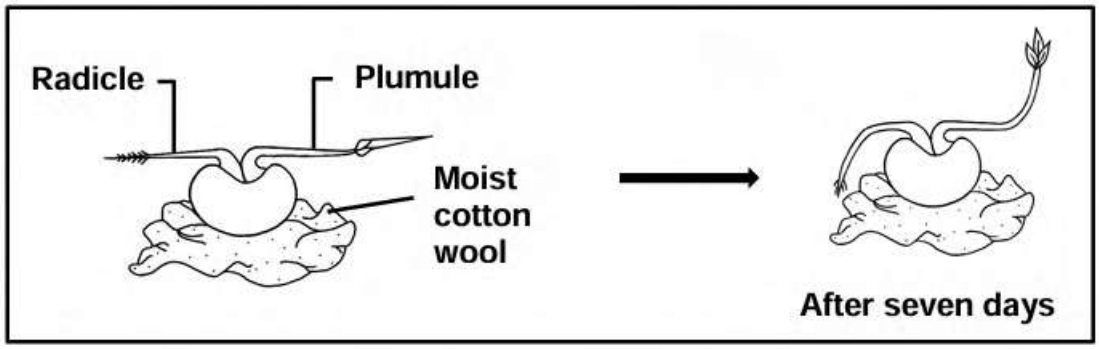
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ACTIVITY 2

2 An experiment was set up to investigate a plant growth response to a stimulus. A seedling has a radicle (young root) and a plumule (young stem).

This seedling was placed horizontally in a dark place and a growth response was observed after seven days, as shown in the diagram below.



2.1 Explain the growth response observed in the root of the seedling. (5)

2.2 Explain how a control set-up will be different from the above set-up. (2)
(7)

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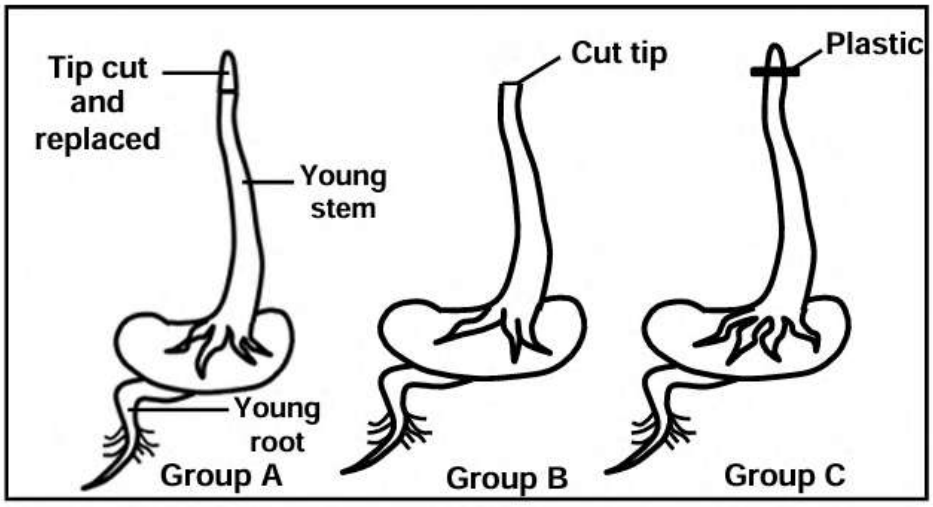
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ACTIVITY 3

3 A group of learners conducted an investigation to determine the effect of auxins on the growth of stems in bean seedlings. The procedure was as follows:

- 30 bean seeds were allowed to germinate for 5 days to produce seedlings.
- The seedlings were divided into 3 groups (A, B and C) of 10 seedlings each.
- The tips of all the seedlings were cut at the same length.
- In group **A**, the cut tip was placed back on top of the young stem.
- In group **B**, the tip was not placed back.
- In group **C**, a piece of plastic was placed on top of the cut surface and the tip was then placed on top of the plastic.
- The seedlings in all the groups were placed in a dark cupboard for a week.
- The growth of the stem was then observed.

The diagram below shows how the seedlings in each group were treated.



3.1 Identify the dependent variable in this investigation. (1)

3.2 Why did the learners cut the tips of the young stems? (1)

3.3 Give ONE reason why 10 bean seedlings were used in each group. (1)

3.4 Write down the LETTER(S) (**A, B** or **C**) of the group(s) where there will be no upward growth of the stem. (2)

3.5 Describe how auxins cause apical dominance. (3)
(8)

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ACTIVITY 4

4 Read the extract below.

AUXINS CAN BE USED AS SELECTIVE HERBICIDES

Auxins stimulate plant growth, however, a high concentration of auxins may cause the plant to grow too fast. The plant is not able to sustain this rapid growth and as a result, it will die.

Farmers spray artificially manufactured auxins onto the surface of weeds to kill them. This type of herbicide (weed killer) is selective as it kills mainly the broad-leafed dicotyledonous plants without having any effect on narrow-leafed monocotyledonous plants, such as wheat, maize and grass.

Auxin-based herbicides are more environmentally friendly. Other herbicides may kill some organisms and the chemicals from these herbicides accumulate in the food chains, thus disturbing the ecosystems.

4.1 Explain why farmers would want to kill the weeds in their fields. (2)

4.2 According to the extract, state ONE disadvantage of using herbicides that are not auxin-based. (1)

4.3 Give ONE reason for using auxin-based herbicides instead of physically removing the weeds. (1)

4.4 A farmer planted maize and beans (broad-leafed plants) in her field.

Explain why the farmer should not use an auxin-based herbicide in her field. (2)
(6)

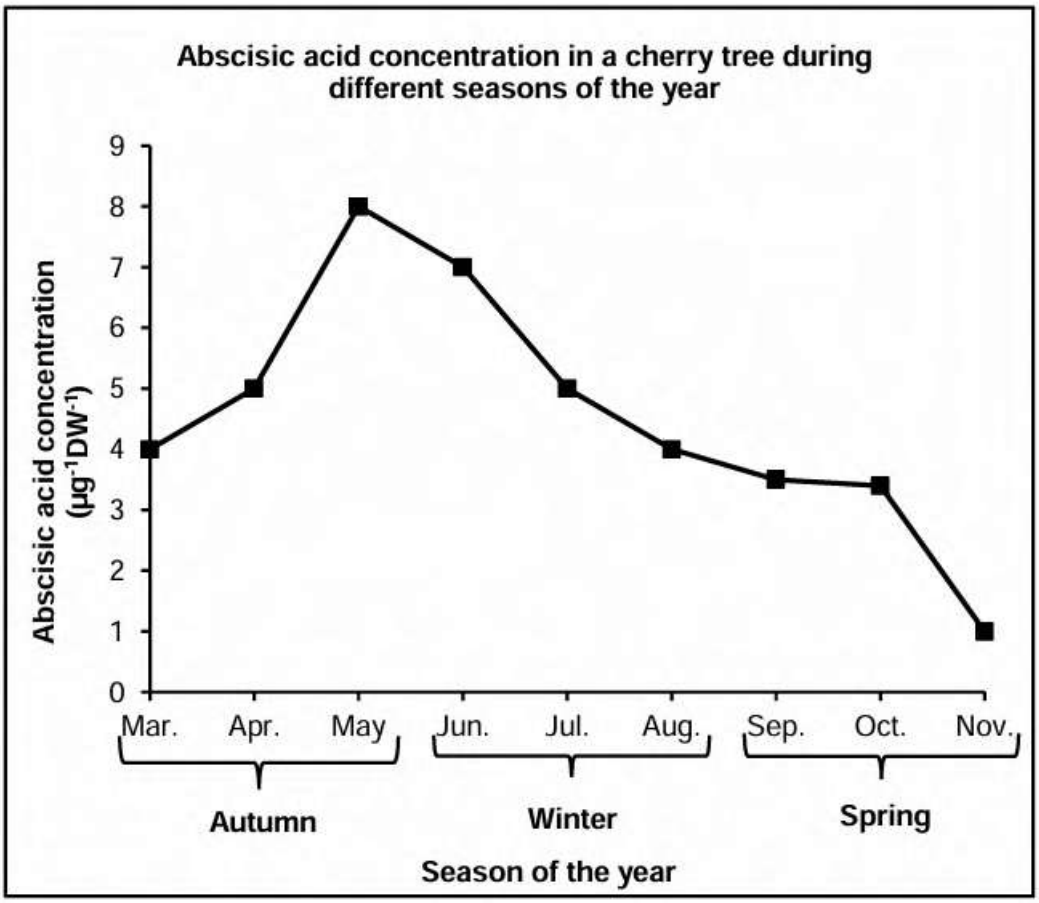
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ACTIVITY 5

5 The graph below shows the concentration of abscisic acid in a cherry tree during different seasons of the year.

This tree species loses all its leaves in autumn and goes into a state of dormancy during the winter months.



5.1	During which month was the abscisic acid concentration the lowest?	(1)
5.2	Explain the trend of the graph from March to May.	(3)
5.3	Suggest ONE reason for the dormancy in cherry trees during the winter months.	(2)
		(6)

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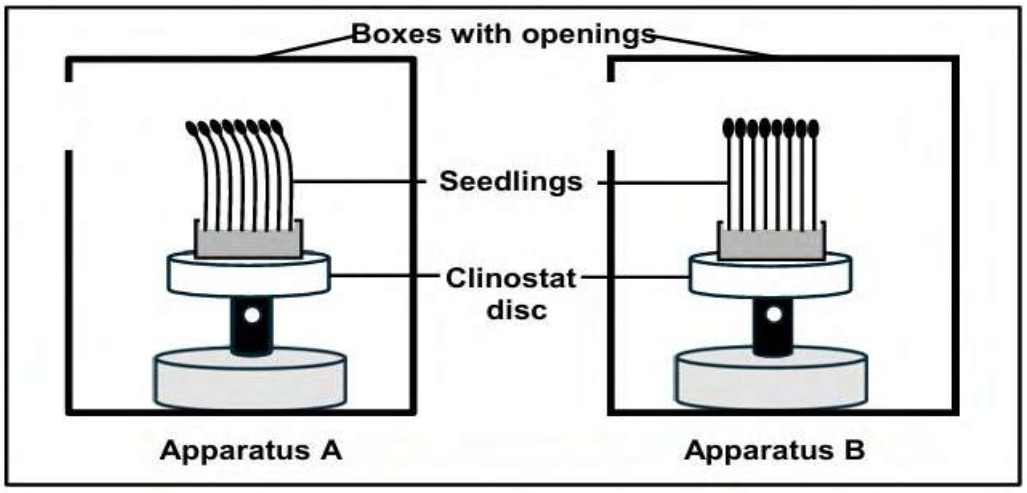
ACTIVITY 6

6 An investigation was conducted to determine the response of plant seedlings to light.

The procedure was as follows:

- Grain seeds were allowed to germinate into seedlings.
- One half of the seedlings were planted in one small pot and the other half in another small pot.
- When the stems reached a height of approximately 1 cm, the pots were placed on the discs of two clinostats. A clinostat is an apparatus consisting of a slowly rotating disc when switched on.
- Both sets of apparatus (A and B) were placed inside boxes with openings on one side only for light to enter (unilateral light).
- One clinostat was switched on and the other one was switched off.
- The apparatus was left for two weeks.

The results after two weeks are represented in the diagram below.



6.1 Identify the plant growth response demonstrated by the results. (1)

6.2 In which apparatus (**A** or **B**) was the clinostat switched on and the disc rotating slowly? (1)

6.3 Explain your answer to QUESTION 6.2 (2)

6.4 Explain the growth response of the seedlings in apparatus **A**. (5)
(9)

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ACTIVITY 7

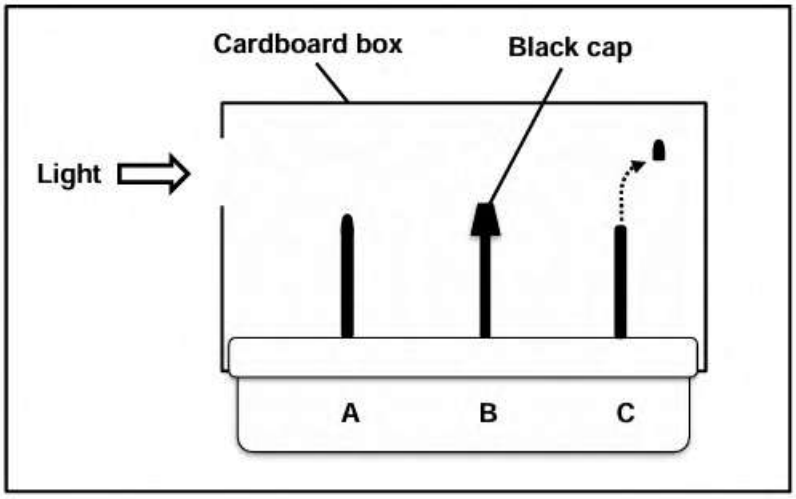
7 Scientists conducted an experiment to investigate a growth response in plants.

They used three plants and the stem tip of each plant was treated as follows:

PLANT	TREATMENT
A	The stem tip was left untreated.
B	The stem tip was covered with a black cap.
C	The stem tip was removed.

They placed the plants in a cardboard box with a small opening on one side to allow light through.

The plants were left in this cardboard box for five days. The diagram below represents the experimental set-up at the start of the investigation.



7.1 Name the growth response that was investigated. (1)

7.2 Name the hormone that causes the growth response referred to in QUESTION 7.1 (1)

7.3 Explain why the stem tip was removed in plant **C**. (2)

7.4 Draw a diagram to show the appearance of ALL THREE stem tips at the end of the investigation. (3)
(7)

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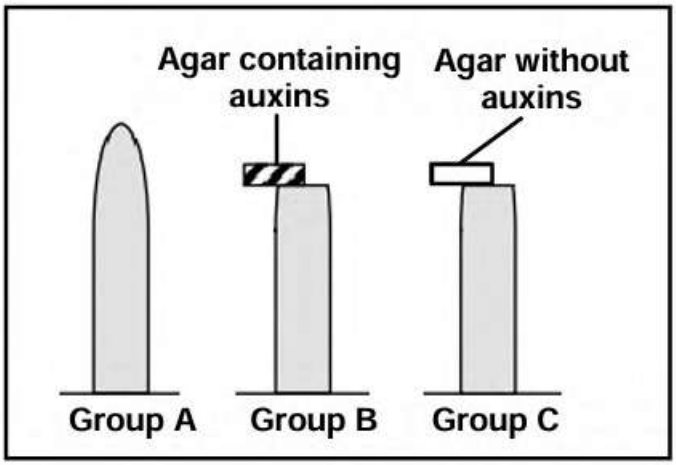
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ACTIVITY 8

8 An investigation was conducted to determine the effect of auxins on plant tropism. The investigation was conducted as follows:

- Twelve plants of the same species were divided into three groups (group A, B and C), of four plants each.
- All the plants were kept in darkness for 72 hours during the investigation.
- The growing tips of group A received no treatment.
- The growing tips of group B were cut off and replaced by a piece of agar that contained auxins (agar is a jelly-like substance through which other substances can diffuse).
- The growing tips of group C were cut off and replaced by a piece of agar without auxins.

The diagram below shows how the growing tips of the three groups were treated.



8.1 For this investigation give:

(a) The independent variable (1)

(b) TWO variables that were controlled (2)

8.2 Give the expected results of the plants in:

(a) Group **A** (1)

(b) Group **C** (1)

8.3 How was the reliability of this investigation ensured? (2)

8.4 After 72 hours, the stems of the plants in group **B** bent towards the right side. Explain the results. (4)
(11)

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ACTIVITY 9

9 Read the extract below.

> Auxins control different aspects of growth and development in plants. They are known to influence the growth of stems and they also stimulate the development of new roots on stem cuttings in plant propagation.
>
> During plant propagation, a stem of a plant is cut and is then placed in water containing small quantities of artificial auxins. The auxins stimulate root development in the cuttings.

9.1 State TWO ways in which auxins cause an increase in the length of stems. (2)

9.2 Name ONE other plant hormone that causes an increase in the length of stems. (1)

9.3 Explain how auxins can be used in plant propagation to the advantage of nature conservation. (2)

(5)

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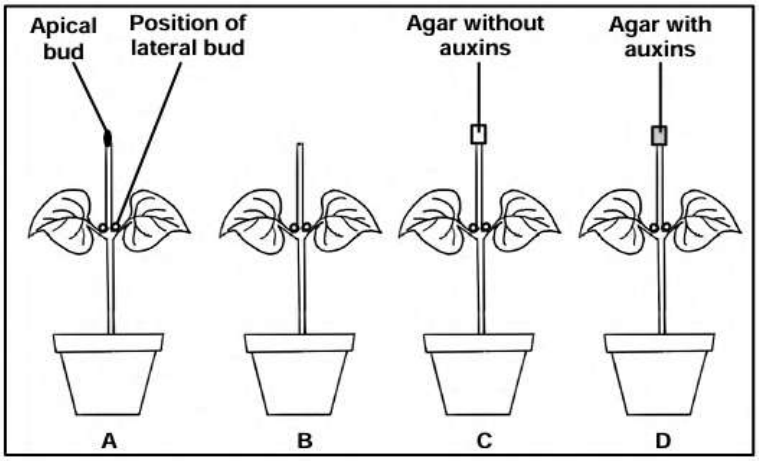
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ACTIVITY 10

10 An investigation was done to determine the effect of auxins on the growth of lateral branches. (The elongation of lateral buds results in the growth of lateral branches.) The procedure was as follows:

- Four potted plants (**A, B, C** and **D**) of the same species were used.
- Plant A was left untreated.
- The apical bud of plant **B** was removed.
- The apical bud of plant **C** was removed and replaced with agar jelly (a jelly-like substance through which other substances can diffuse).
- The apical bud of plant **D** was removed and replaced with agar jelly containing auxins.
- The plants were exposed to the same environmental conditions.
- The length of the lateral buds of each plant was measured at the beginning of the investigation and again after three weeks.

The diagram below shows the setup of the investigation at the beginning.



The results are shown in the table below.

Plant	Length of the lateral buds (mm)	
	At the beginning	After three weeks
A	7,0	7,3
B	6,9	10,4
C	7,2	10,3
D	7,1	7,2

10.1 For this investigation, state the:

(a) Independent variable (1)

(b) Dependent variable (1)

10.2 Explain why all the plants were exposed to the same environmental conditions. (2)

10.3 Explain why agar without auxins was used in plant C. (3)

10.4 State a conclusion for this investigation. (2)

(9)

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TOPIC: EVOLUTION

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 number (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 Which ONE of the following indicates the type of variation for each of the human characteristics given?

	Height	Skin colour	Ear lobe types
A	discontinuous	continuous	discontinuous
B	continuous	continuous	discontinuous
C	discontinuous	discontinuous	continuous
D	discontinuous	continuous	continuous

1.1.2 Below is a list of reproductive isolating mechanisms

(i) Species-specific courtship behaviour
(ii) Prevention of fertilisation
(iii) Adaptation to different pollinators

Which ONE of the following combinations refer to reproductive isolating mechanisms in plants?

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

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1.1.3 An investigation was done to determine the change in antibiotic resistance in bacteria over a number of generations

The results are shown in the table

NUMBER OF GENERATIONS OF BACTERIA	ANTIBIOTIC-RESISTANT BACTERIA IN A POPULATION (%)
5	1
50	5
500	20
5 000	40
50 000	70

How many times did the percentage of antibiotic-resistant bacteria in a population increase between the 50th and 5000th generation?

A 8
B 35
C 45
D 700

1.1.4 Which one of the following is a feature of punctuated equilibrium?

A Individual organisms adapt to changes in the environment
B The inheritance of acquired characteristics
C There are long periods of little or no change in a population
D The more a structure is used, the more it develops.

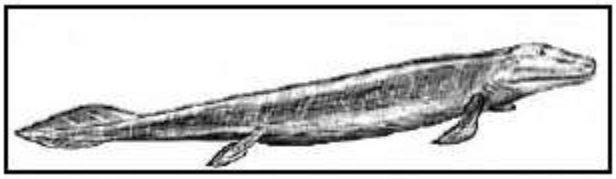
1.1.5 Variation within a species is introduced through …

A random mating and asexual reproduction.
B mitosis and random fertilisation.
C random mating and random fertilisation.
D mitosis and meiosis.

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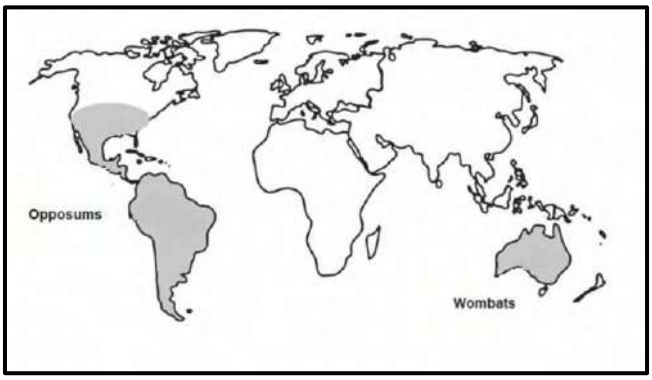
1.1.6 The diagram below shows *Tiktaalik roseae,* a fish that may be the ancestor of the first organisms to live on land.



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

1.7 The opossums and wombats have believed to have originated from a common ancestor. The shaded parts of the diagram below show the distribution of these species.



The type of evidence for evolution that is represented above is…

A Biogeography
B Modification by descent
C Genetics
D Cultural

1.1.8 Analysis of mitochondrial DNA is an example of this line of evidence:

A Fossil evidence
B Modification by decent
C Biogeography
D Genetic evidence

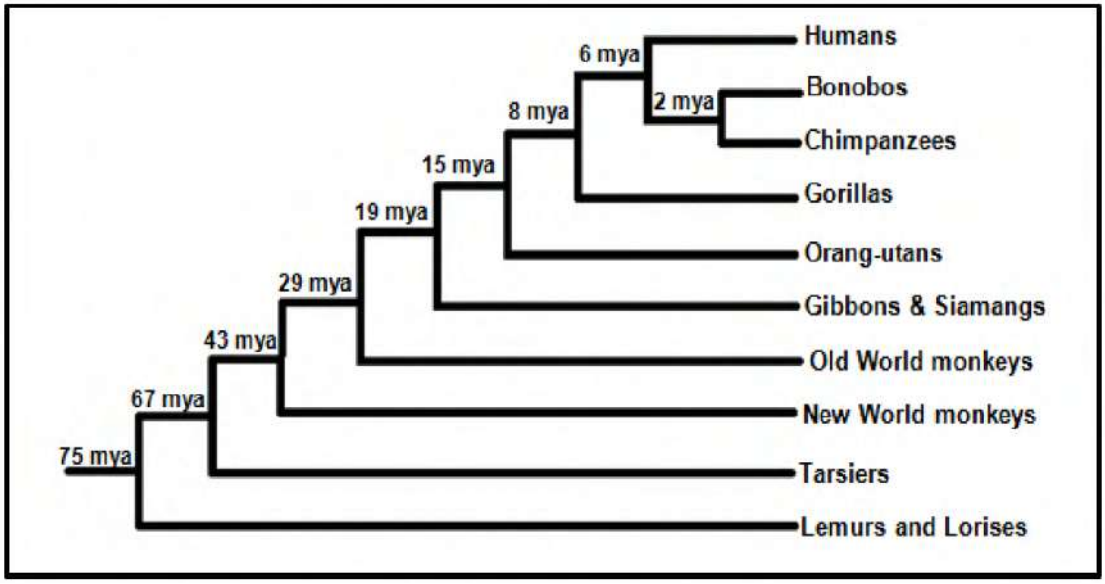
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1.9 After the discovery of a fossil, scientists classified it as an African ape because it had a …

A large cranium, a prognathous jaw and large canines.
B small cranium, a non-prognathous jaw and large canines.
C small cranium, a prognathous jaw and large canines
D large cranium, a prognathous jaw and small canines.

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



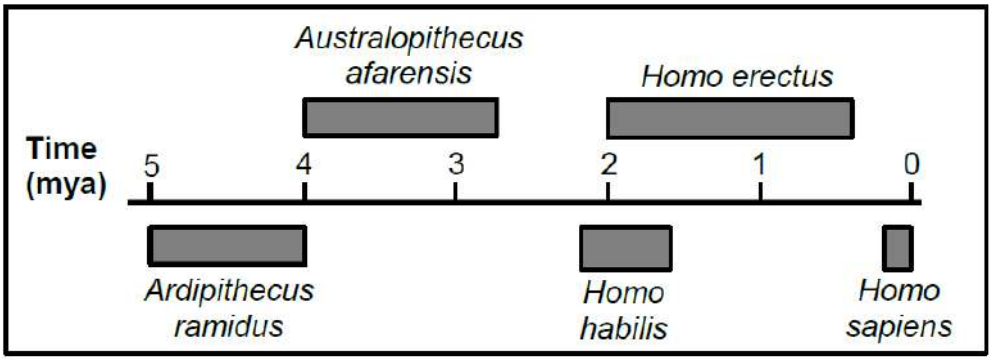
According to the phylogenetic tree, the most recent common ancestor of

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

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QUESTIONS 1.11 AND 1.12 ARE BASED ON THE TIMELINE BELOW SHOWING THE POSSIBLE EVOLUTION OF SOME HOMINIDS.



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

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

1.12 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

1.13 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

(13 x 2) **(26)**

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ACTIVITY 2

2. Read the passage below

GENETICALLY MODIFIED MAIZE

The bacterium *Bacillus thuringiensis* produces a toxin, called Bt, that kills insects. This bacterium is used to genetically modify maize to contain the Bt toxin. This Bt maize is toxic to insects.

2.1 Describe how the Bt maize is genetically modified to be insect resistant. (3)

2.2 Explain TWO reasons why farmers might want to grow Bt maize. (4)
(7)

ACTIVITY 3

3 Dogs have been selected and bred over many years to produce approximately 340 different dog breeds. They have been bred for certain characteristics desirable to humans. An analysis of 736 base pairs of the cytochrome-b gene showed that grey wolves are the only direct ancestor to present-day dog breeds. All dog breeds belong to the species *Canis familiaris*.
The table below shows some dog breeds and their desirable characteristics

Grey wolf	Dog breeds	Characteristics
	 Poodle	Intelligent
	 Pug	Loving, affectionate and playful
	 Saint Bernard	Outgoing and adventurous
	 Rhodesian ridgeback	Strong, athletic and fast

3.1 Name the process whereby the different breeds of dogs were produced. (1)

3.2 Describe how humans carried out the process named in QUESTION 3.1. (3)

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3.3 Explain how it can be confirmed that all these dog breeds belong to the same species. (2)

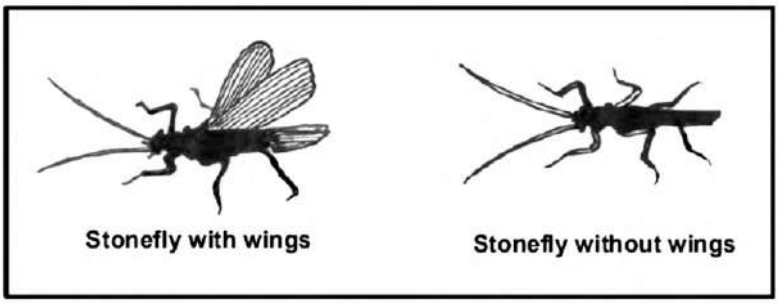
3.4 Explain which of the dog breeds shown would best be used for hunting (2)

3.5 Explain how present-day dog breeds may be disadvantaged in relation to their common ancestor. (3)

(11)

ACTIVITY 4

4. Insects on islands without trees are likely to be wingless because flying is dangerous for them in an area with strong winds.
A certain island was once covered with tall trees. Over the years there has been deforestation in some areas of the island. On this island, insects called stoneflies, have undergone natural selection. Some have wings and some do not have wings, depending on the area where they are found.
The diagram below shows stoneflies with and without wings.



Scientists wanted to determine the relationship between tall trees and the presence of wings on stone flies.

- They selected six locations, of which three had tall trees and three were without trees.
- Using a specialised net, they collected thousands of stoneflies in each location.
- The samples were labelled according to the area of collection.
- These samples were collected in the morning during summer.

The number of stoneflies with wings and without wings at each location were counted and recorded.

4.1 Identify the

(a) Independent variable (1)

(b) Dependent variable (1)

4.2 State

(a) TWO factors that were kept constant during the investigation (2)

(b) TWO ways in which reliability of the investigation was ensured. (2)

4.3 Describe how Lamarck would have explained the evolution of stoneflies without wings in areas without trees. (5)

(11)

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ACTIVITY 5

5. A group of researchers conducted an investigation to determine the influence of the type of milk on the height of children drinking the milk. (The investigation was conducted over a period of 7 years from age 3 to age 10). They:
   - Selected 4 146 healthy 3-year-old children of the same race and gender
   - Divided the children into two equal groups:
     - One group was given 1 litre of cow's milk to drink daily
     - The other group was given 1 litre of soy milk to drink daily
   - Ensured that each group had:
     - The same additional diet
     - Similar daily activities
     - Similar living conditions
   - Provided the milk from the same supplier
   - Measured the children's height at the end of the investigation and calculated the average

   The table below shows the results at the end of the investigation compared to the expected average height of 10-year-olds.

EXPECTED AVERAGE HEIGHT OF CHILD (cm)	AVERAGE HEIGHT OF A CHILD ON COW'S MILK (cm)	AVERAGE HEIGHT OF A CHILD ON SOY MILK (cm)
149,86	151,4	147,4

5.1 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

5.2 Name the type of variation displayed by the height of a person. (1)

5.3 State TWO planning steps the researchers had to consider at the beginning of this investigation. (2)

5.4 State THREE ways in which the validity of this investigation was Ensured (3)

5.5 State ONE factor that could have negatively affected the validity of this investigation (1)

5.6 How did the researchers ensure the reliability of the results? (1)

5.7 State the conclusion for this investigation (2)

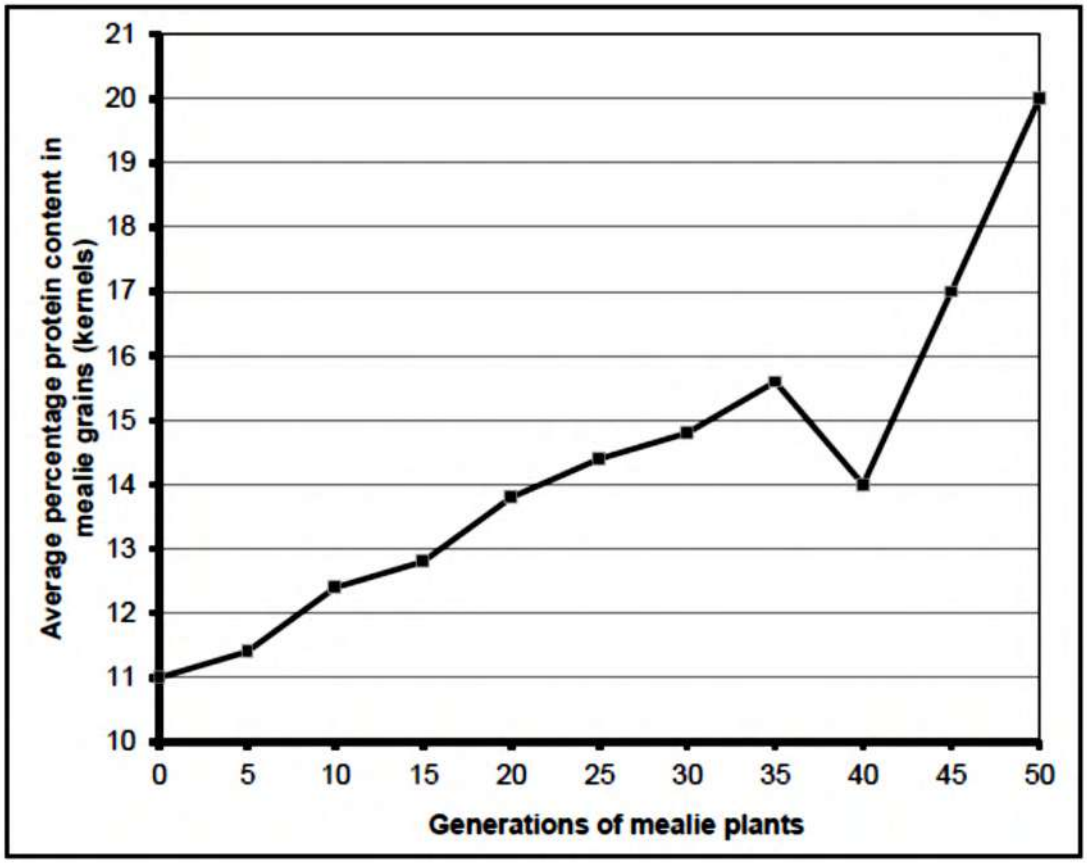
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ACTIVITY 6

6 The graph below shows the results of artificial selection for protein content in mealie plants over 50 generations.



6.1 Describe how this farmer did artificial selection of the mealie plant. (3)

6.2 What was the average percentage of the protein content in the mealie grains (kernels) at the 15th generation? (1)

6.3 By how many times did the average percentage of the protein content in the mealie grains (kernels) increase between the 40th and 50th generation? Show ALL working. (2)

6.4 Describe ONE way in which the process of artificial selection is different from genetic engineering. (2)

(8)

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ACTIVITY 7

7 The fat content of cow's milk may vary between 2,6% and 5%.
A farmer has found that there is a high demand for low-fat milk (milk with a fat content of 3% or less).
He determined the fat content in the milk produced by the cows on his farm.
The results of his survey are given in the table below.

FAT CONTENT (%)	NUMBER OF COWS
2,6–3,0	11
3,1–3,5	66
3,6–4,0	93
4,1–4,5	61
4,6–5,0	15

7.1 Draw a histogram to represent the results of the survey (6)

7.2 Calculate the percentage of the farmer's cows that produce low-fat milk. Show ALL your working (3)

7.3 State the type of variation that occurs in the cows, based on the evidence in the table (1)

7.4 Give an explanation for your answer to QUESTION 7.3 (1)
(11)

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ACTIVITY 8

8. A population of lizards on an island, Island **A,** were well suited to feed mainly on insects. Scientists moved five adult pairs of this lizard species to a neighbouring island, Island **B**. Here they reproduced and a new population formed. Island **B** has a large supply of plants with tough fibrous leaves and fewer insects. Exposure to this new environment may have caused the lizards to undergo evolution.
Thirty-six years later, scientists returned to Island **B** to conduct further investigations on the lizard population there. They observed that the jaw size of the lizards had increased. Scientists also analysed the stomach content of the lizards and found that it was mainly plant-based. They also confirmed that the two populations still belong to the same species.

8.1 Describe how the scientists could confirm that there was a change in jaw size between the lizards of Island **A** and the lizards of Island **B**. (3)

8.2 Explain how the larger jaws of the lizards on Island **B** would be structurally suited to eat tough fibrous leaves (3)

8.3 How did the scientists determine that the two populations of lizards on both islands still belong to the same species? (2)

8.4 Explain the possible effect that the evolution of the lizards has on biodiversity. (2)

8.5 Use Darwin's theory of natural selection to explain the evolution of lizards with larger jaws. (7)

(17)

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ACTIVITY 9

9 Modern-day whales are aquatic mammals, spending their entire lives in the ocean. They are thought to have evolved from four-legged ancestors, as represented below.

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

9.1 Which ancestor of whales most likely lived both in water and on land? (1)

9.2 Give ONE reason for your answer to QUESTION 9.1 (2)

9.3 Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales. (2)

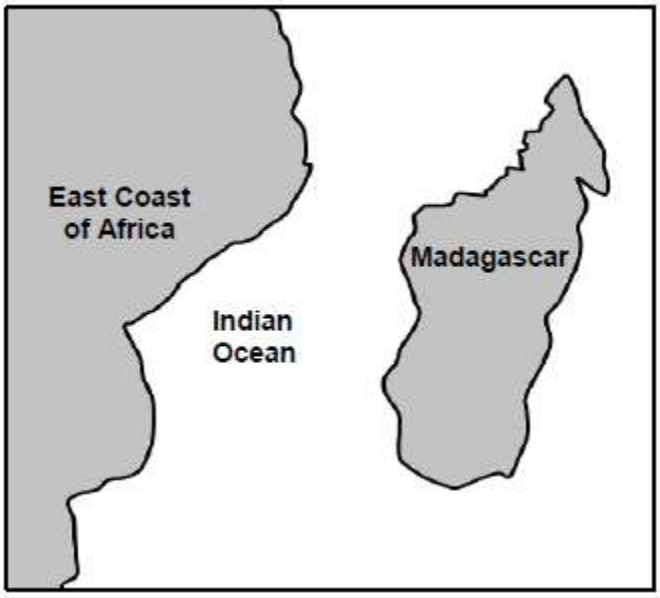
9.4 Explain, according to Lamarck, why modern-day whales do not have legs. (3)
(8)

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ACTIVITY 10

10 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.



10.1 Explain how continental drift could have affected the distribution of the common ancestor. (4)

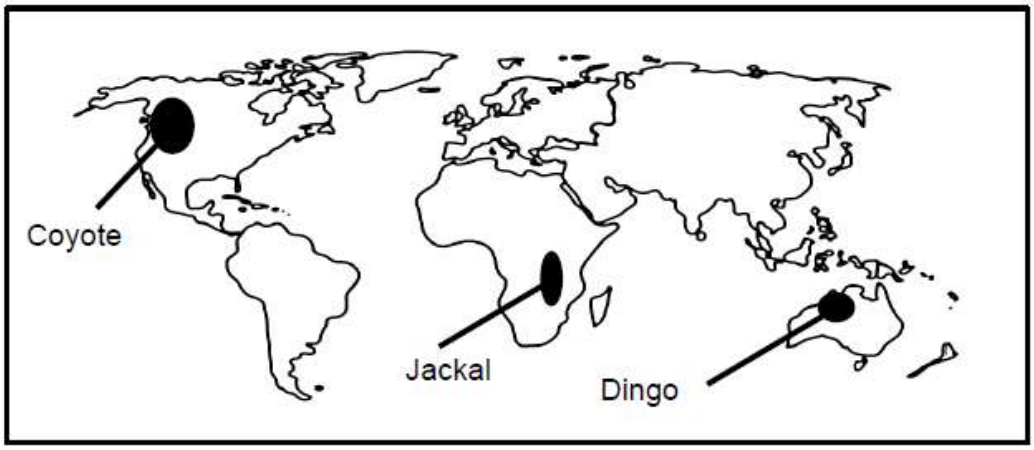
10.2 Describe the speciation of the pottos and lemurs to become different species. (6)
(10)

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ACTIVITY 11

11 The present-day distribution of three closely related species of the dog family, the coyote, jackal and dingo, is shown on the world map below.



11.1 What type of evidence for evolution is represented here? (1)

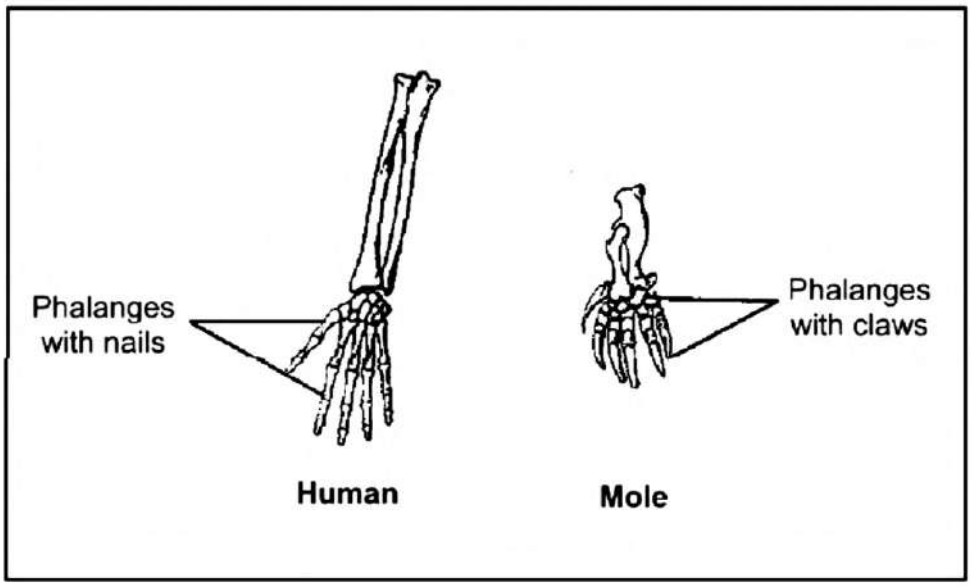
11.2 What is a *biological species*? (3)

11.3 Describe how these three species could have evolved from a common ancestor. (7)

(11)

ACTIVITY 12

12 The diagram below shows the forelimb of a human and a mole.



12.1. Explain how these structures are used as evidence for evolution. (3)

12.2. State ONE way in which the forelimb of the mole is

(a) Modified for digging through soil (1)

(b) Different from the forelimb of an African ape (1)

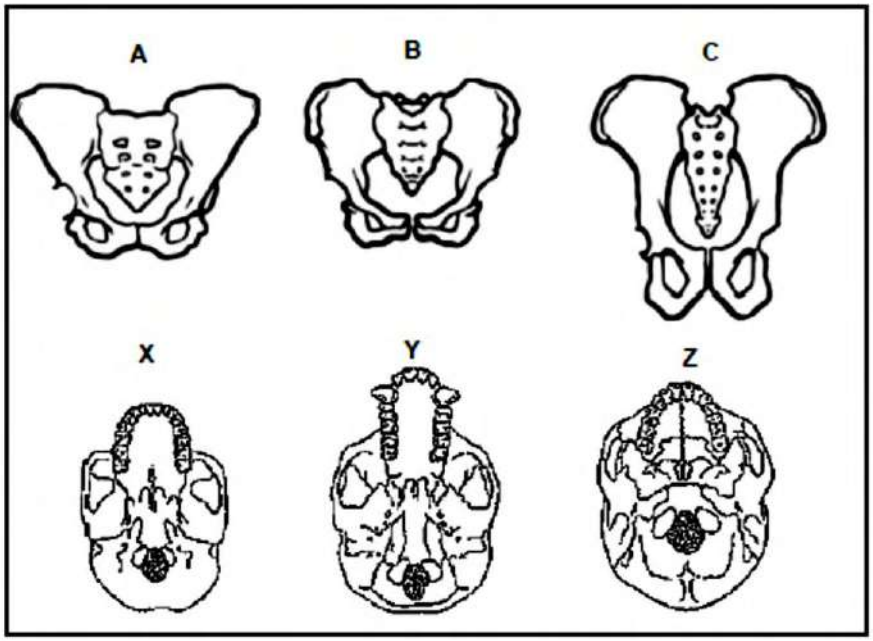
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ACTIVITY 13

13 The diagram below represents the pelvic structure and the ventral view of the skulls of three organisms. The diagrams are drawn to scale.



13.1. Write down the LETTER(S) of the diagram(s) that represent the

(a) Skulls of bipedal organisms (2)

(b) Pelvic structure of a quadrupedal organism (1)

13.2 Give a reason for your answer to QUESTION 2.1(b). (2)

13.3 Describe ONE other structural difference between a *bipedal* and a *quadrupedal* organism (3)

(8)

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ACTIVITY 14

14 The table below shows some of the hominid fossils found in different parts of the world that are used as evidence for the 'Out of Africa' hypothesis.

SPECIES	FOSSIL	AGE OF THE FOSSIL (million years)	SITE OF DISCOVERY
Australopithecus africanus	Mrs Ples	2,5	Sterkfontein (South Africa)
Homo erectus	Turkana boy	1,9	Kenya (Africa)
	Java man	0,035	Java (Asia)
Homo sapiens	Florisbad man	0,26	Florisbad (South Africa)
	Liujiang	0,015	Guanxi (Asia)

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

14.2 Use the information in the table to describe how the fossils of *Homo erectus* and *Homo sapiens* support the 'Out of Africa' hypothesis. (4)

(6)

ACTIVITY 15

15 The table below shows the average brain volume of different hominid species.

SPECIES	AVERAGE BRAIN VOLUME (mℓ)
Ardipithecus ramidus	350
Australopithecus africanus	461
Homo habilis	609
Homo erectus	959
Homo sapiens	1 330

15.1 How many genera are represented in the table? (1)

15.2 Give the average brain volume (ml) of the species that was the first to use tools. (1)

15.3 Calculate the percentage increase in the average brain volume between Homo habilis and Homo sapiens. Show all working and round off to TWO decimal places. (3)

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15.4 The brain decomposes after the organism dies.

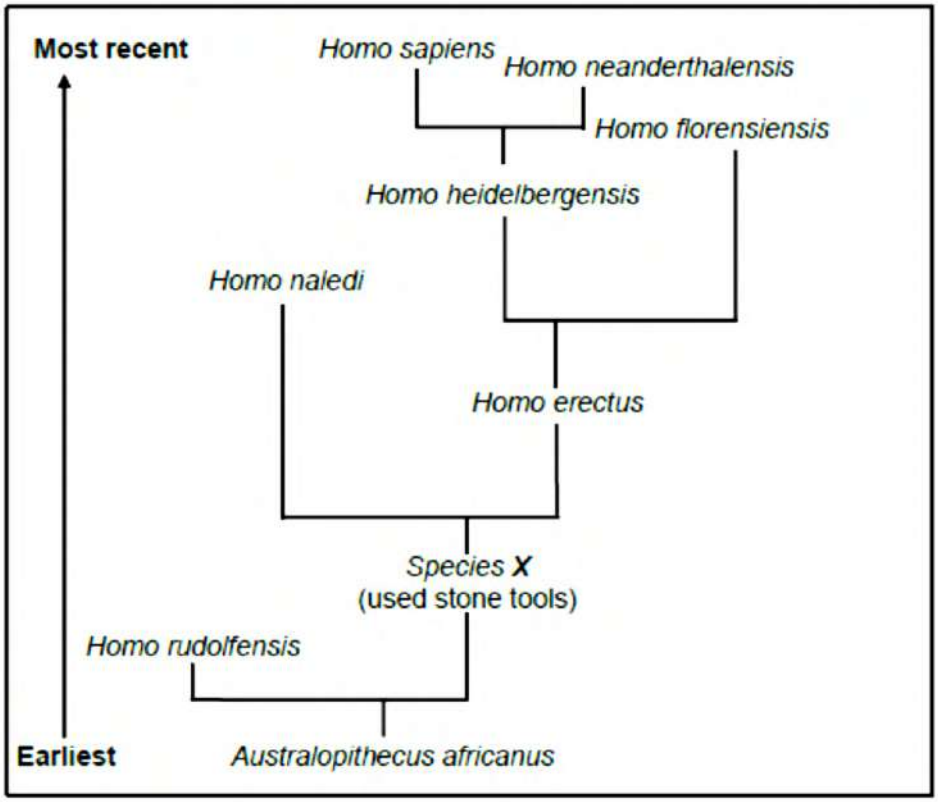
Explain how scientists are able to determine the brain volume of fossils. (3)

15.5 Explain the relationship between average brain volume and cultural evidence for human evolution. (3)

(11)

ACTIVITY 16

16 The diagram below represents one model of the evolution of some hominids



16.1 Identify the type of diagram shown. (1)

16.2 How many genera are represented by the diagram? (1)

16.3 Name the species:

(a) Represented by **X** on the diagram (1)

(b) That shares a common ancestor with *Homo erectus* (1)

16.4 Which species of the genus *Homo* is the only one in existence today? (2)

16.5 Name TWO forms of evidence that would have been used to support the information in the diagram. (2)

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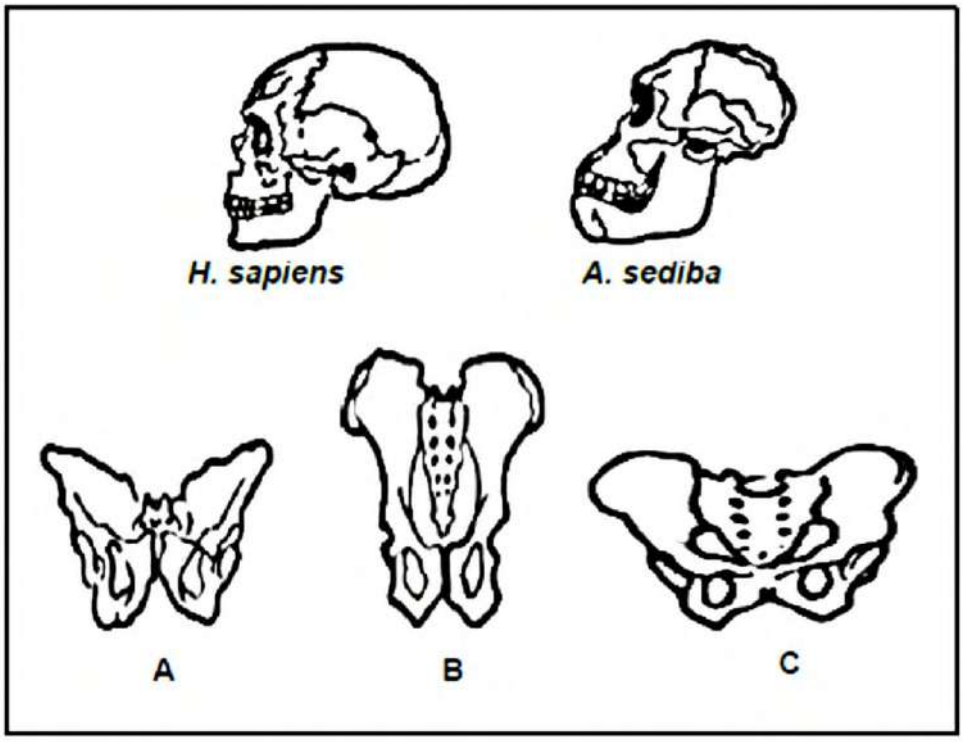
16.6 The average cranial capacity of *Homo sapiens* is 1 500 cm^3 compared to 520 cm^3 in *Australopithecus africanus*.
Explain the significance of the difference in cranial capacity. (3)

16.7 Explain how the fossils of *Australopithecus africanus*, *Species **X*** and *Homo erectus* are used to support the 'Out of Africa' hypothesis (4)

(14)

ACTIVITY 17

17 The diagrams below show the skulls and pelvises of different hominids



17.1 Describe the shape of the spine of *H. sapiens*. (1)

17.2 *A. sediba* is thought to be a transitional species.
State what is meant by a *transitional species* (2)

17.3 Give the LETTER of the pelvis that would be representative of *A. sediba.* (1)

17.4 Explain your answer to QUESTION 6.4 (2)

17.5 Explain the significance of the change in prognathism from *A. sediba* to *H. sapiens* (5)

(11)

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ACTIVITY 18

18 Theories of human evolution are based on the similarities between humans and African apes and also on the anatomical differences between them.

18.1 State TWO characteristics related to vision that humans share with African apes. (2)

18.2 Describe TWO differences between the jaws of humans and African apes. (4)

18.3 Explain the significance of the position of the foramen magnum, the shape of the spine and the size of the pelvis in bipedalism. (6)

(12)

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