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Department:
Education
PROVINCE OF KWAZULU-NATAL

CURRICULUM GRADE 10 -12 DIRECTORATE

NCS (CAPS)

LEARNER SUPPORT DOCUMENT

GRADE 12

LIFE SCIENCES

STEP AHEAD PROGRAMME

2021

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PRIYANKA GOVENDER
12A

PREFACE

This support document serves to assist Life Sciences learners on how to deal with curriculum gaps and learning losses as a result of the impact of COVID-19 in 2020. It also captures the challenging topics in the Grade 10 -12 work. Activities should serve as a guide on how various topics are assessed at different cognitive levels and also preparing learners for informal and formal tasks in Life Sciences. It will cover the following topics:

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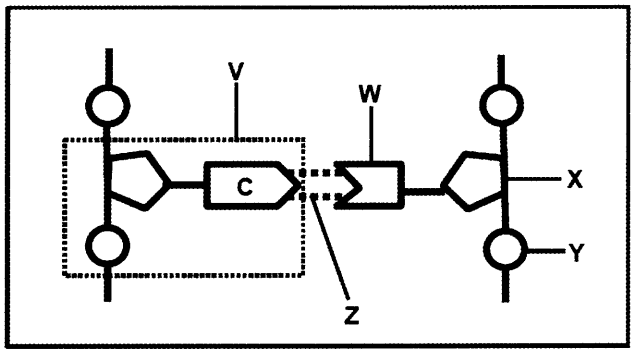
Nucleic Acids

Question 1

The diagram represents a portion of a nucleic acid.



1.1 Name the nucleic acid. (1)

1.2 Name TWO places in animal cells where this nucleic acid may be found. (2)

1.3 Identify:

(a) Portion **V** (1)

(b) Nitrogenous base **W** (1)

(c) Molecule **Y** (1)

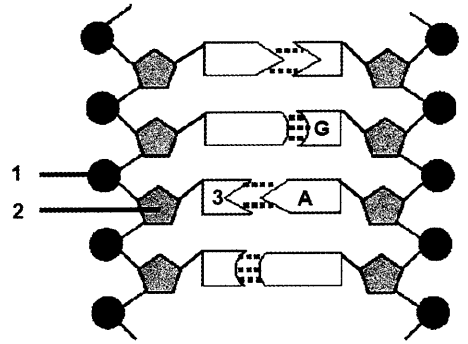
(d) Bond **Z** (1)

1.4 What is the natural shape of this molecule? (1)

1.5 Name the process during which this molecule makes a copy of itself. (1)
(9)

Question 2

Study the diagram below which represents a part of a nucleic acid molecule and answer the questions that follow.



KEY:

A – Adenine
G – Guanine

Part of a nucleic acid molecule

2.1 Identify the nucleic acid shown in the diagram above. (1)

2.2 Label the following:

(a) Part **1**

(b) Part **2**

(c) The nitrogenous base **3** (3)

2.3 What is the collective name for the parts numbered **1**, **2** and **3**? (1)
(5)

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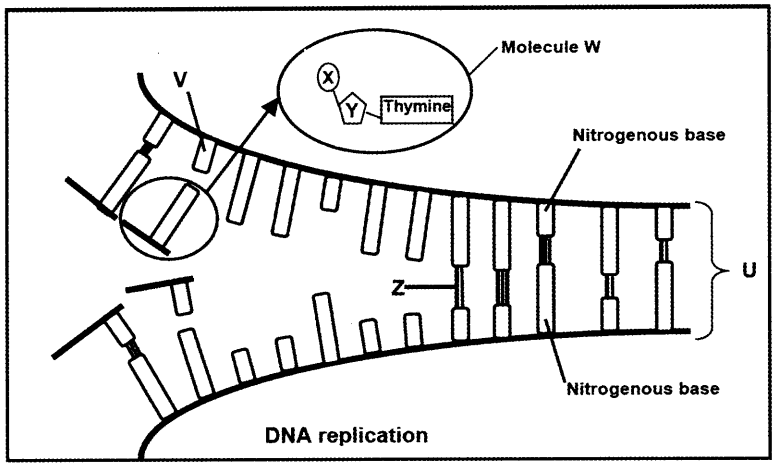
Question 3

The diagram below represents DNA replication.



3.1 Identify the following:

(a) Molecules **W** and **U** (2)

(b) Parts of molecule **W** labelled **X** and **Y** (2)

(c) Bond **Z** (1)

(d) Nitrogenous base **V** (1)

3.2 Where in the cell does this process take place? (1)

3.3 Name the phase of the cell cycle where replication takes place. (1)
(8)

Question 4

Errors that occur during DNA replication may sometimes lead to mutations.

4.1 Describe *DNA replication*. (5)

4.2 Describe how an error in DNA replication may lead to a gene mutation. (2)
(7)

Question 5

Describe the location, structure and functions of the DNA molecule and the process whereby copies of this molecule are made.

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

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

Question 6

The questions below are based on DNA profiling/fingerprinting.

6.1 What is *DNA profiling*? (1)

6.2 DNA evidence of a murder suspect was found at the scene of a crime.

Give TWO possible reasons why the suspect might be found not guilty in court, by referring to the DNA evidence. (4)
(5)

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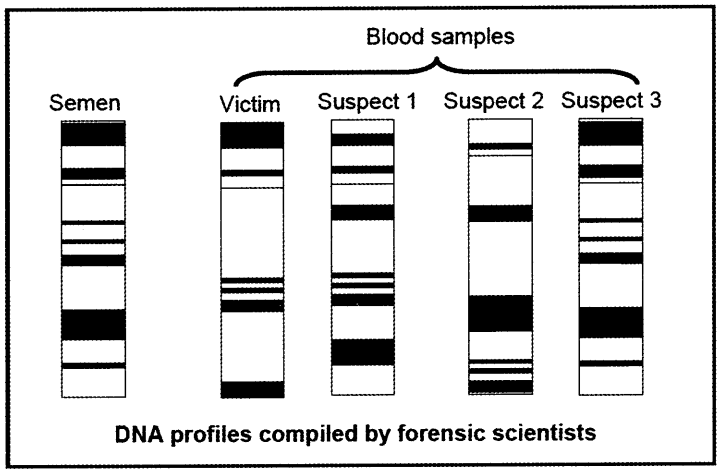
Question 7

Study the diagram below which shows the following DNA profiles/genetic fingerprints:

- Blood of a raped female victim
- Blood of three suspects
- Semen found on the female victim



DNA profiles compiled by forensic scientists

7.1 Which suspect was most likely the rapist? (1)

7.2 Explain your answer to QUESTION 7.1 (2)

7.3 Give ONE reason why this evidence may be considered reliable. (1)

7.4 Give TWO reasons why this evidence may not be considered reliable. (2)

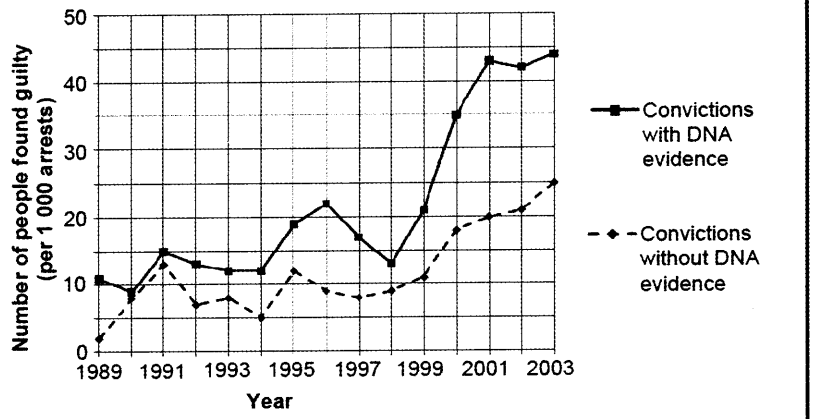
7.5 Name TWO benefits of DNA profiling other than for solving crimes. (2)

(8)

Question 8

The graph below represents the results of an investigation which compares the conviction (number of people found guilty) of criminals with the use of DNA evidence and without the use of DNA evidence from 1989 to 2003.

COMPARISON OF THE CONVICTIONS WITH THE USE OF DNA EVIDENCE AND WITHOUT THE USE OF DNA EVIDENCE, FROM 1989 TO 2003



[Adapted from http://www.mindfully.org]

8.1 Formulate a hypothesis for this investigation. (2)

8.2 State the dependent variable in this investigation. (1)

8.3 How many more successful convictions per 1 000 arrests were made in 2003 with the use of DNA evidence? Show ALL calculations. (2)

A DNA database is a collection of the DNA profiles of all the citizens of a country.

8.4 Explain how you would use the information in the graph to convince the government to create a DNA database. (4)

(9)

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Question 9

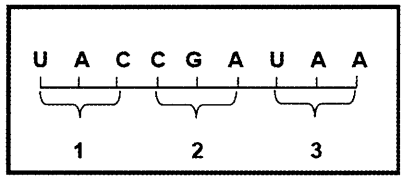
Describe the structure of RNA in a cell and the involvement of the different types of RNA in protein synthesis.

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

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

Question:10

The diagram below shows part of a mRNA (messenger RNA) molecule.



10.1 How many codons are shown in the diagram of this section of mRNA? (1)

10.2 Write down the complementary base sequence of the DNA strand that formed codon 1 of the mRNA strand in the above diagram. (1)

10.3 Explain the purpose of a specific sequence of codons in a mRNA molecule. (2)

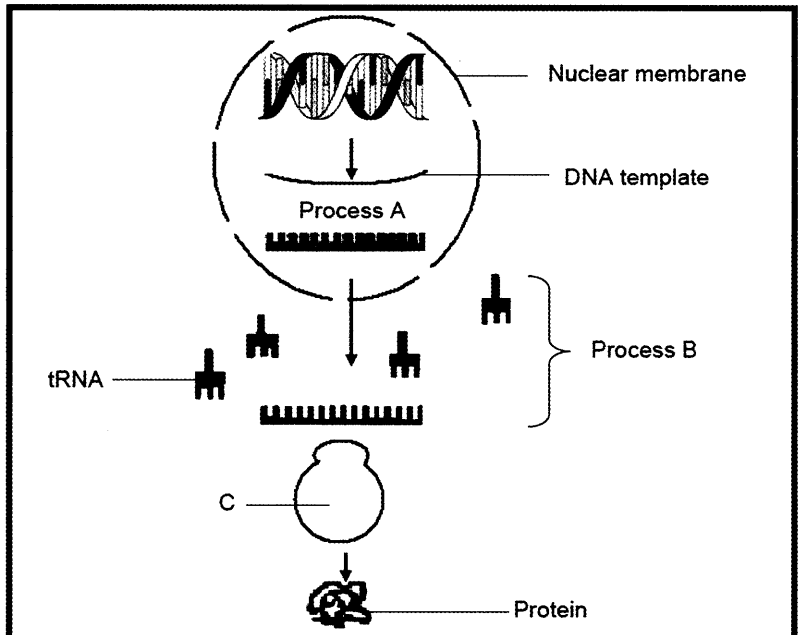
10.4 A tRNA (transfer RNA) molecule carries complementary bases for a particular codon.

(a) Write down the complementary base sequence of a tRNA for codon 1 in the mRNA sequence shown in the above diagram. (1)

(b) Briefly describe the role of tRNA molecules in the translation process of protein synthesis. (3)
(8)

Question 11

The following diagram represents protein synthesis.



Schematic representation of protein synthesis

11.1 Name the following processes:

(a) A (1)

(b) B (1)

11.2 Name the organelle labelled C. (1)

11.3 Explain how the mRNA is made from the DNA template during process A. (5)

(8)

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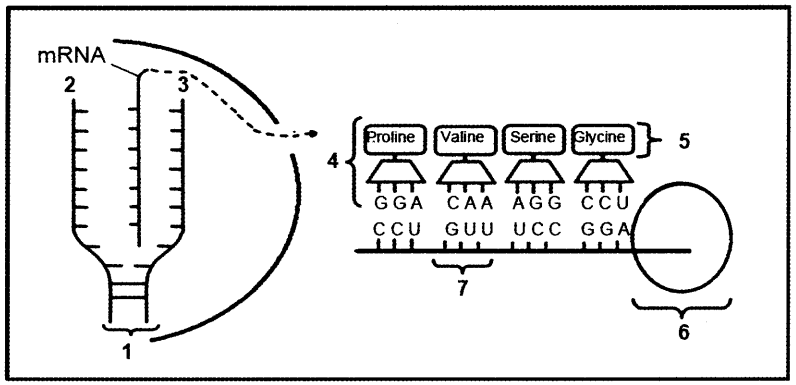
Question 12

The diagram below represents two stages of protein synthesis.



12.1 Provide labels for:

(a) Molecule **1** (1)

(b) Organelle **6** (1)

12.2 Give only the NUMBER of the part which represents a:

(a) DNA template strand (1)

(b) Monomer of proteins (1)

(c) Codon (1)

12.3 Describe *translation* as it occurs at organelle **6**. (4)

12.4 Provide the:

(a) DNA sequence that codes for glycine (2)

(b) Codon for proline (2)

12.5 State TWO differences between a *DNA nucleotide* and an *RNA nucleotide*. (4)
(17)

Question 13

The sequence of amino acids in a protein molecule is coded for by DNA and RNA. The table below shows some mRNA codons and the corresponding amino acids.

mRNA CODONS	AMINO ACID
AGC	Serine
GAU	Aspartate
CUA	Leucine
UAU	Tyrosine
UUC	Phenylalanine
AGU	Serine
GAC	Aspartate
UUU	Phenylalanine
CUC	Leucine
GAG	Glutamic acid

13.1 According to the table, how many codons code for phenylalanine? (1)

13.2 What is the anticodon for glutamic acid? (1)

A section of mRNA has the following base sequence and is read from left to right:

GAU CUC GAC AGC AUG ACC

13.3 Give the:

(a) DNA base triplet for the LAST codon on this section of mRNA (1)

(b) FIRST amino acid coded for by this section of mRNA (1)

13.4 A mutation occurred which resulted in the following base sequence on the mRNA molecule:

GAU CUC GAC AGU AUG ACC

(a) Describe the mutation that occurred. (2)

(b) Explain the effect that the mutation described in QUESTION 13.4 (a) will have on the resulting protein. (2)

13.5 Name and describe the process occurring in the nucleus which results in the formation of an mRNA molecule. (6)
(14)

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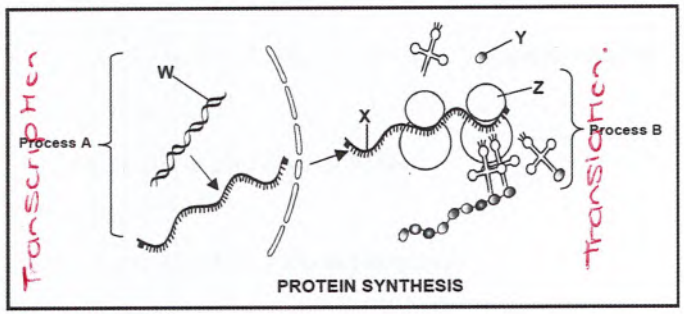
Question 14

The diagram below shows the process of protein synthesis.



14.1 Identify the following molecules:

(a) **W** (1)

(b) **Y** (1)

14.2 Name the part of protein synthesis indicated by process **A**. (1)

14.3 Describe how a mutation on molecule **W** will affect the structure of the protein formed by process **B**. (4)

14.4 The following sequence represents a part of the nitrogenous base sequence on molecule **X**.

AGA	AUG	GGA
triplet 1	triplet 2	triplet 3

(a) Write down the base sequence of the anticodon of triplet **1** shown above. (1)

(b) The table below shows the amino acids that correspond with different DNA codes.

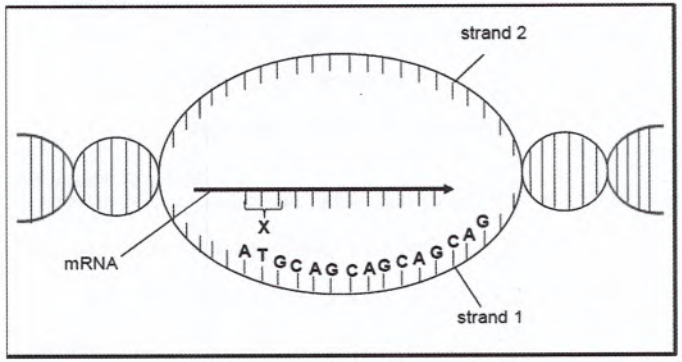
AMINO ACID	DNA CODE
Arginine	TCT
Glycine	CCT
Methionine	TAC

Write down the correct sequence of amino acids for triplets **1** to **3**. (3)
(11)

Question 15

The mutation that causes Huntington's chorea occurs when the **CAG** base triplet on the DNA molecule is repeated more than **35** times. This mutation results in the formation of a 'Huntington's protein', which causes the degeneration of neurons in the brain.

The diagram below shows the process whereby an mRNA molecule is formed from the DNA molecule.



15.1 Name the process represented in the diagram. (1)

15.2 Where in the cell does this process occur? (1)

15.3 Give the:

(a) Complementary bases on DNA strand **2** for a **CAG** triplet (1)

(b) Sequence of bases at **X** (1)

15.4 The table below shows the amino acids coded for by mRNA codons.

mRNA CODON	AMINO ACID
UAC	Tyrosine
AUG	Methionine
CAG	Glutamine
GUC	Valine

Which amino acid will occur more than 35 times in a 'Huntington's protein'? (2)

15.5 Explain how a mutation results in the formation of a different protein. (3)
(9)

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Question 16

A species of bacteria contains a type of protein, called protein **1**. A mutation occurred which resulted in the formation of a second type of protein called protein **2**, instead of protein **1.**

Scientists determined the amino acid sequence of each protein. They then used the amino acid sequence to find the DNA base sequences that coded for portions of these proteins.

The results are shown in the tables below.

PORTION OF PROTEIN 1				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Cysteine
DNA BASE SEQUENCE	TTT	TCA	GGT	ACG

PORTION OF PROTEIN 2				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Tryptophan
DNA BASE SEQUENCE	TTT	TCA	GGT	ACC

16.1 Give the:

(a) DNA triplet for the third amino acid from the left in the sequence for protein **2** (1)

(b) Codon for lysine (1)

(c) Anticodon for serine (1)

16.2 Protein **1** is made up of 66 amino acids.

How many of EACH of the following is involved in the formation of this protein?

(a) Genes (1)

(b) RNA nucleotides (1)

(c) Codons (1)

16.3 Describe how the mutation caused a change in the structure of the protein. (4)
(10)

Question 17

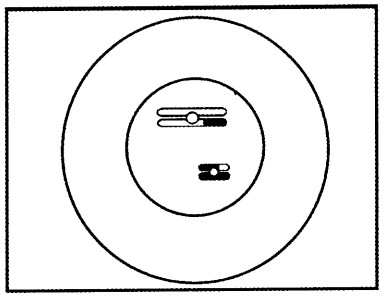
Describe the process of protein synthesis and the way in which this process would be affected by a gene mutation.

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

MEIOSIS

Question 1

The diagram below represents one of the two cells that formed during Telophase I of meiosis in an organism.



Draw a labelled diagram to show the cell during Anaphase II of meiosis. **(5)**

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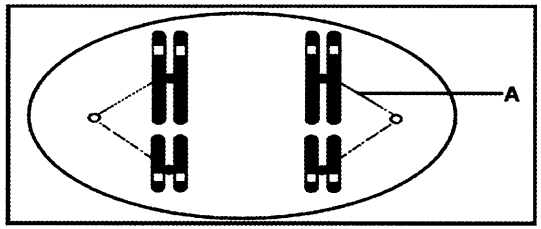
Question 2
QP: P2 May-Jun 2017 Q 3.1

The diagram below shows the arrangement of two pairs of homologous chromosomes in a cell undergoing meiosis.



2.1 State TWO characteristics of homologous chromosomes. (2)

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

2.3 How many of EACH of the following is present in the diagram?

(a) Chromatids (1)

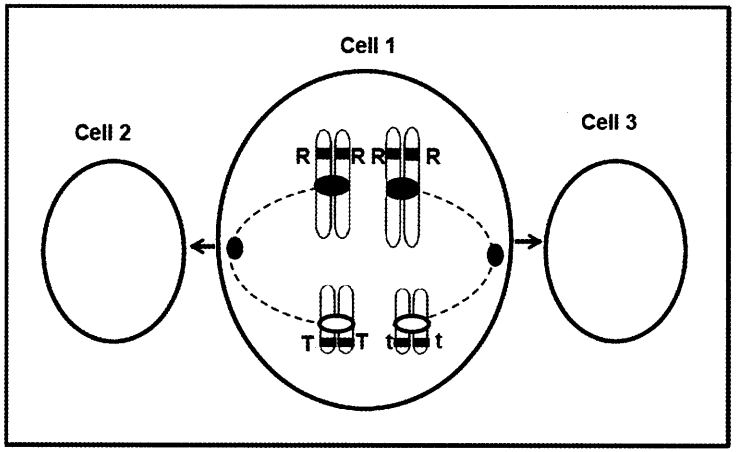
(b) Centromeres (1)

2.4 Draw a labelled diagram to show ONE of the cells that would be formed at the end of telophase **I**. (6)

Question 3

The diagram below represents a phase in meiosis.

Cell **1** undergoes division to give rise to cells **2** and **3**. Some alleles are indicated by letters.



3.1 Explain why cell **1** does NOT belong to a human. (2)

3.2 How many chromosomes would be present in:

(a) Cell **2** at the end of telophase **I** (1)

(b) The daughter cells produced by cell **3** after meiosis **II** (1)

3.3. Draw a labelled diagram of a gamete that will result from cell **2**. (5)
(9)

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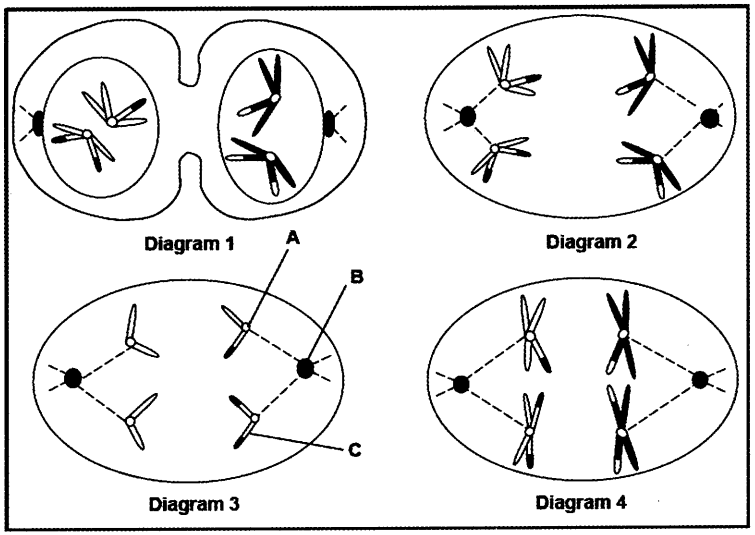
Question 4

The diagrams below represent some phases of meiosis in an animal cell.



4.1 Identify the following parts in Diagram 3:

(a) **A** (1)

(b) **B** (1)

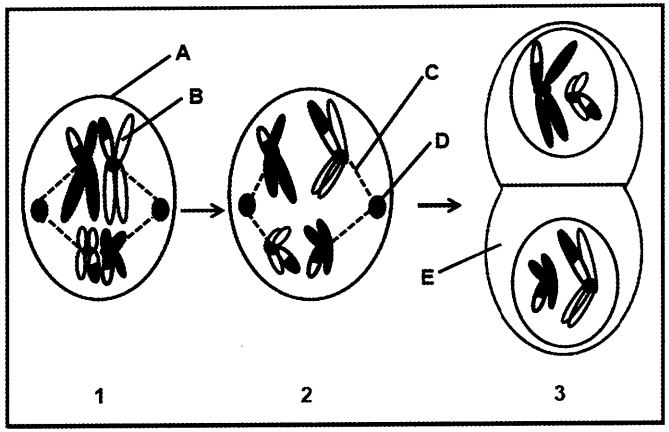
(c) **C** (1)

4.2 Using the diagram NUMBERS (1, 2, 3, 4) showing some of the phases, arrange the diagrams above in the sequence as they occur during meiosis. (2)

4.3 How many chromosomes were in the cell before meiosis began? (1)
(6)

Question 5

Diagrams **1** to **3** below represent some of the phases of meiosis shown in the correct order.



5.1 Identify the phase represented by diagram:

(a) **1** (1)

(b) **3** (1)

5.2 Give the LETTER only of the part that:

(a) Contains DNA (1)

(b) Attaches to the centromeres of chromosomes (1)

(c) Forms the spindle fibres (1)

5.3 Name the organ in a human male where meiosis occurs. (1)
(6)

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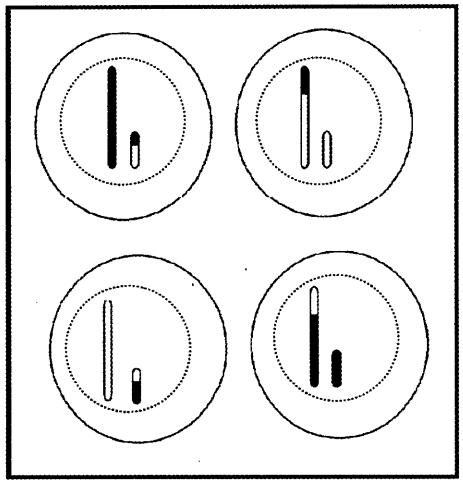
Question 6

Study the diagram of a phase during meiosis below.



6.1 Identify the phase in the diagram above. (1)

6.2 Give TWO visible reasons for your answer to QUESTION 5.1 (2)

6.3 How many chromosomes:

(a) Are present in EACH cell in the diagram (1)

(b) Were present in the original cell at the start of meiosis (1)

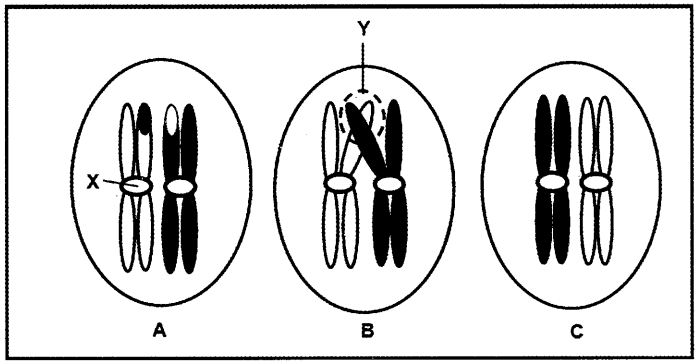
6.4 The cells in the diagram are NOT identical.

(a) Name TWO processes during meiosis that lead to the cells being different from one another. (2)

(b) Explain the significance to a species of the cells being different from one another. (3)
(10)

Question 7

The diagrams below represent a chromosome pair in a female human cell. The cells (**A**, **B** and **C**) show different events in a phase of meiosis, which are not necessarily in the correct sequence.



7.1 How many pairs of chromosomes occur in a normal human cell? (1)

7.2 Give labels for:

(a) Structure **X** (1)

(b) Area **Y** (1)

7.3 Name the organ in the human female where meiosis occurs. (1)

7.4 Name the:

(a) Process occurring in diagram **B** (1)

(b) Phase represented by the diagrams above (1)

(c) Type of cells that would result from meiosis of this cell (1)

7.5 Arrange the letters **A**, **B** and **C** to show the correct sequence of the events. (1)
(8)

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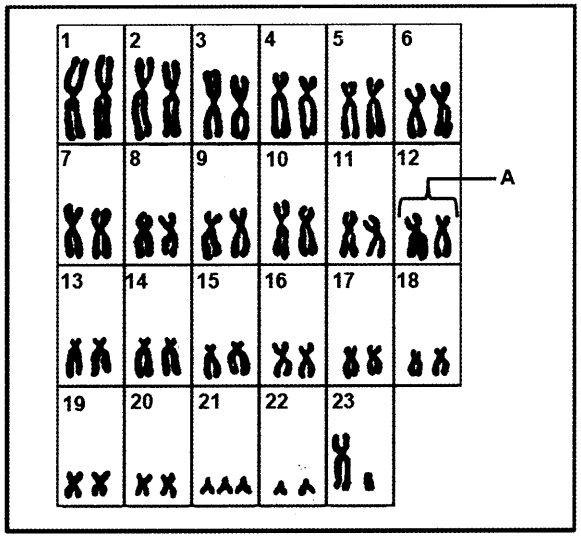
Question 8

The karyotype below shows the chromosomes of a person with Down syndrome.



8.1 Give the label for **A**. (1)

8.2 How many autosomes are there in a nucleus of this cell? (1)

8.3 Name the type of chromosomes at position **23**. (1)

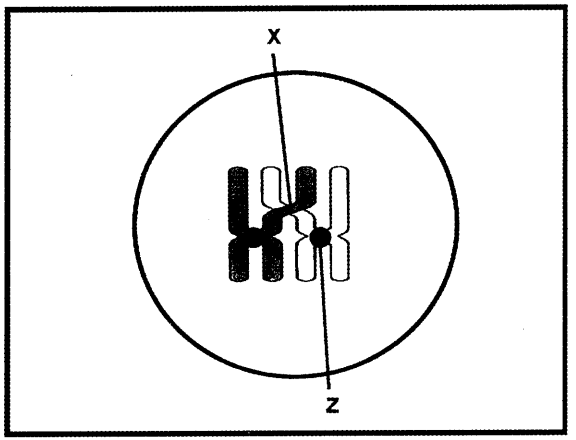
8.4 What evidence suggests that this is a karyotype of a male? (1)

8.5 Name the type of mutation represented in the diagram. chromosomal (1)

8.6 Describe the events that led to Down syndrome. (6)
(11)

Question 9

The diagram below shows crossing over in a pair of homologous chromosomes.



9.1 Identify the point **X** and part **Z** respectively. (2)

9.2 Give ONE observable reason why the chromosomes above are regarded as homologous. (1)

9.3 Give ONE reason why crossing over is important. (1)

9.4 Name ONE other process occurring during meiosis that has the same importance as crossing over. (1)

9.5 If a mouse egg cell contains 20 chromosomes, how many chromosomes will there be in its skin cell? (1)
(6)

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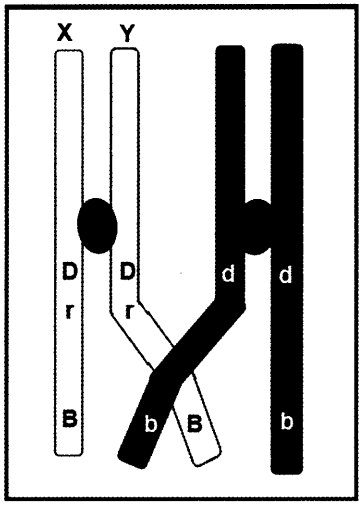
Question 10

The diagram below shows crossing over during meiosis.



10.1 Name the phase of meiosis during which the process represented above takes place. (1)

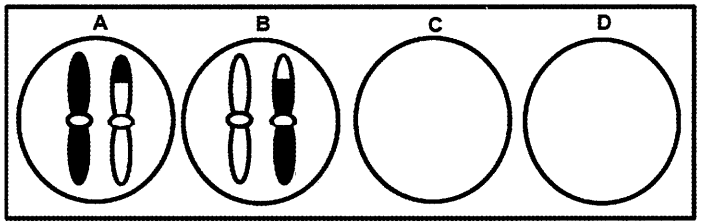
10.2 Describe the process of *crossing over*. (3)

10.3 Explain the importance of crossing over. (2)

10.4 Draw a diagram, giving the position of the alleles, to show the structure of chromatid **Y** after crossing over. (2)
(8)

Question 11

The diagrams below represent the distribution of chromosome pair 21 as it appears in gametes at the end of meiosis **II** in a human male.



11.1 Explain why the gametes represented by diagrams **C** and **D** do not have any chromosomes. (3)

11.2 If gamete **A** is involved in fertilisation, describe how this may result in Down syndrome. (3)

11.3 Due to the process of crossing over, the chromosomes in diagrams **A** and **B** appear different to each other.

(a) Identify the phase of meiosis during which crossing over occurs. (1)

(b) Describe the events during crossing over. (3)

(c) Explain the significance of crossing over in natural selection. (3)
(13)

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Question 12

An investigation was conducted on the chances of women of different ages having a baby with Down syndrome as a result of errors in Meiosis I and Meiosis II.

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

Maternal age (years)	Incidence of Down syndrome (per 1 000 births)	
	Error in Meiosis I	Error in Meiosis II
<25	0,4	0,1
25–29	0,5	0,2
30–34	0,8	0,3
35–39	1,2	0,5
40+	5,9	1,9

[Adapted from *Developmental Biology Online: Human Meiosis 2014*]

12.1 Draw a histogram to represent the information in the table above regarding the error occurring in Meiosis II that leads to Down syndrome. (6)

12.2 Name the error during meiosis that could eventually result in a child with Down syndrome. (1)

12.3 According to the information in the table, is the error mentioned in QUESTION 12.2 more likely to occur during Meiosis I or Meiosis II? (1)

12.4 Over a five-year period a hospital recorded a total of 44 Down syndrome babies born to mothers who were forty years and older. How many of these babies were likely to have had the error that caused Down syndrome occurring during Meiosis II? Show ALL working. (3)
(11)

Question 13
QP: P2 NOV 2017 Q 4

Describe the structure and arrangement of chromosomes making up the normal human karyotype. Also describe the behaviour of the chromosomes during the different phases of meiosis I.

Content: (17)
Synthesis: (3)

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

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REPRODUCTIVE STRATEGIES

Question 1
Give the correct biological term for each of the following descriptions. Write only the term next to the question number (1.1 to 1.5) in the ANSWER BOOK.

1.1 A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum outside the body of the female

1.2 The reproductive strategy when hatchlings are able to move and feed themselves

1.3 A type of egg where the embryo develops inside a fluid-filled sac which is surrounded by a shell

1.4 The type of development in birds where offsprings are born helpless, unable to move or feed themselves

1.5 A method of reproduction involving the hatching of eggs in the female reproductive system

5x1=5

Question :2

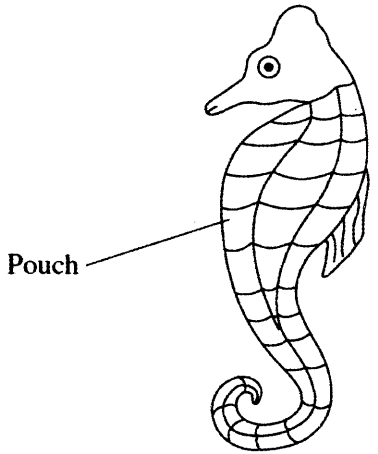
Indicate whether each of the statements in COLUMN I applies to A ONLY, B ONLY, BOTH A AND B or NONE of the items in COLUMN II. Write A only, B only, both A and B or none next to the question number (2.1 to 2.7) in the ANSWER BOOK

	COLUMN I	COLUMN II	
2.1	Embryo is nourished with yolk found in the egg	A:	Ovipary
		B:	Vivipary
2.2	Reserve source of food in amniotic egg	A:	Chorion
		B:	Yolk
2.3	Foetus is attached to the mother's uterus	A:	Ovipary
		B:	Vivipary
2.4	The development in birds where the hatchlings can move soon after being born	A:	Precocial development
		B:	Altricial development
2.5	Shell-less fertilized eggs remain in the female's oviduct until embryo is developed, then female gives birth to live young	A:	Vivipary
		B:	Ovovivipary
2.6	High degree of parental care	A:	Birds
		B:	Duck
2.7	The membrane that transfers nutrients from the albumen to the embryo in birds	A:	Chorion
		B:	Amnion

7x2=14

Question 3

The diagram shows a seahorse. A seahorse is a fish. During reproduction the female seahorse transfers her unfertilised eggs to the male's pouch. The male seahorse fertilises the eggs while they are inside his pouch.
The fertilised eggs stay in the pouch where they develop into young seahorses.



3.1 State ONE way in which reproduction in seahorse increases the chances of:

(a) Fertilisation (1)

(b) Survival of young seahorse (1)

3.2 State whether fertilisation in seahorses is external or internal. (1)

3.3 Give a reason for your answer in QUESTION 3.2 (1)
(4)

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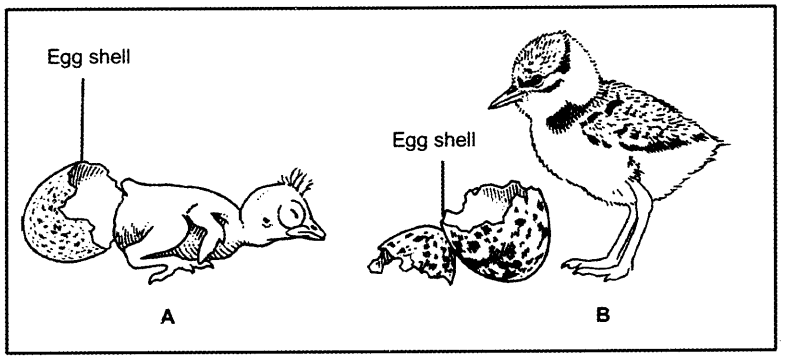
Question 4

Study the diagram of one-day-old hatchlings **A** and **B** below. The diagram is not drawn to scale.



4.1 State TWO visible features in hatchling **A** which indicate altricial development. (2)

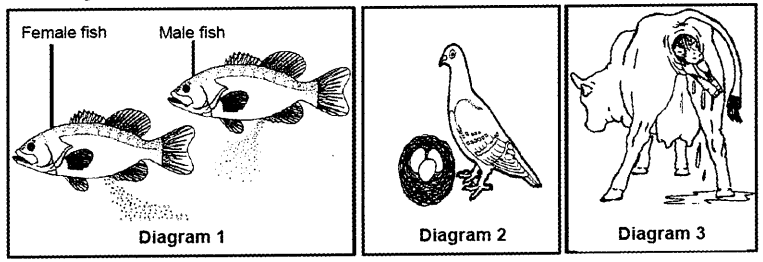
The diagram represents ovipary.

4.2 Explain ONE possible advantage of vivipary when compared to ovipary. (2)

4.3 Explain why you would expect that the yolk content of the egg of hatchling **B** was more than that of hatchling **A**. (2)
(6)

Question 5

The diagrams below represent organisms with different reproductive strategies.



5.1 Which diagram(s) (**1**, **2** or **3**) represent(s) organism(s):

(a) Where external fertilisation takes place (1)

(b) Where extra-embryonic membranes develop to assist with the protection and nutrition of the embryo (2)

(c) Which is/are oviparous (2)

5.2 Name the type of egg produced by the organism represented in Diagram **2**. (1)
(6)

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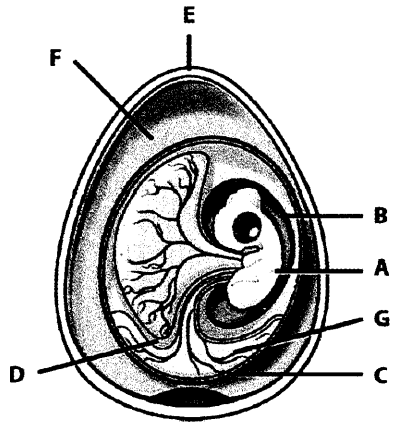
Question 6

Study the representation of an amniotic egg below and answer the questions that follow.



6.1 Identify the membrane label **E** (1)

6.2 Give ONE function of part labelled **E**. (1)

6.3 Identify the LETTER only representing the membrane that :

(a) Protects the embryo during development. (1)
(b) Transfers nutrients from the albumen to the embryo. (1)
(c) Is responsible for respiration and for waste disposal from embryo. (1)
(5)

Question 7

Protection, nourishment and gaseous exchange are important requirements for the successful development of an embryo.

Describe how gaseous exchange and the nourishment of the embryo occur in an amniotic egg

(Any 4) (4)

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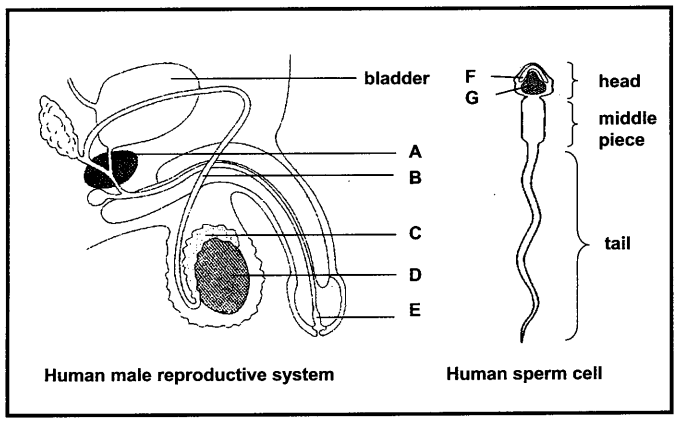
HUMAN REPRODUCTION

Question 1

Study the diagrams below and answer the questions that follow.



1.1 Provide labels for A, B, E and G. (4)

1.2 State ONE function each of C and F, respectively. (2)

1.3 State the LETTER and NAME of the part where sperm are produced. (2)

1.4 Explain why it is necessary for part D to 'hang outside' the body of the male. (2)

1.5 Name the following:

(a) The cells that secrete a male sex hormone (1)

(b) The hormone that stimulates the development of secondary sexual characteristics in males (1)

1.6 During a vasectomy, part B is surgically cut.

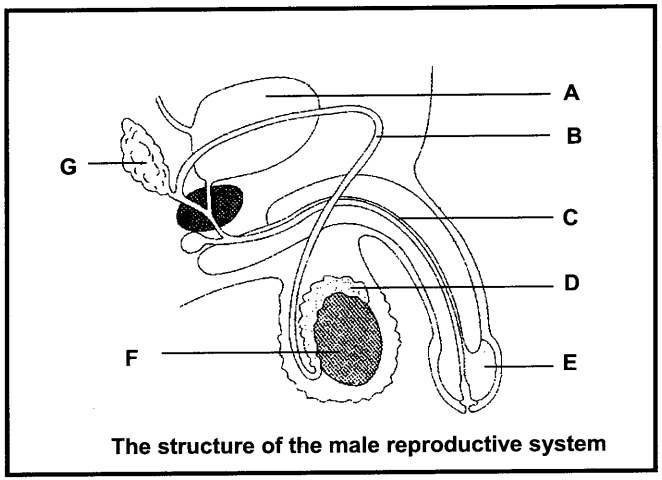
(a) Explain how this procedure will act as a method of contraception. (2)

(b) Will it be possible for a man who is HIV positive to pass the HI virus to another person after he undergoes a vasectomy? (1)

(c) Explain your answer to QUESTION 1.6 (b) . (2)
(17)

Question 2

Study the diagram of the male reproductive system below.



2.1 Write down the LETTER (A to G) and the NAME of the following:

(a) The part where meiosis takes place (2)

(b) The part that transports semen and urine to the outside of the body (2)

(c) The part where immature sperm cells are stored (2)

2.2 Name the male hormone that is responsible for the development of secondary sexual characteristics during puberty. (1)

2.3 Write down the LETTER (A to G) of the following:

(a) The part where the hormone mentioned in QUESTION 2.2 is produced (1)

(b) The part which is cut surgically during male sterilisation (1)
(9)

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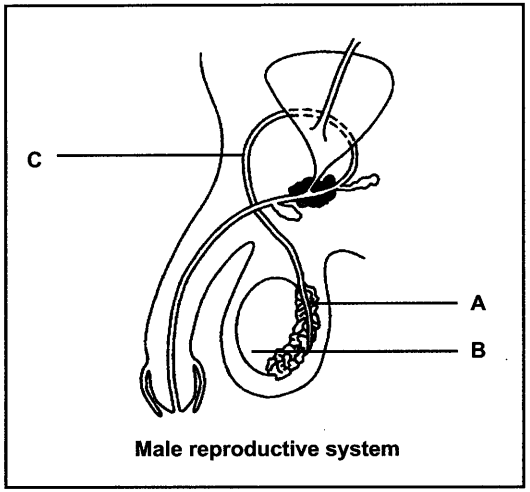
Question 3

Study the diagram below.



Male reproductive system

3.1 Give labels for each of the following:

(a) A (1)

(b) B (1)

(c) C (1)

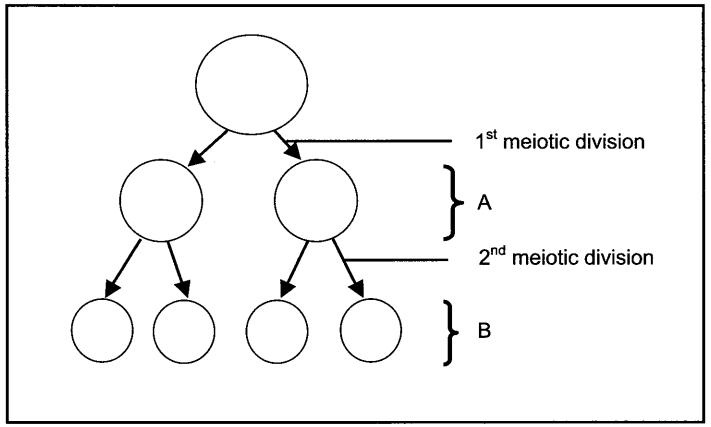
3.2 State ONE function of part **A**. (1)

3.3 Explain the consequences for reproduction if part **C** is surgically cut. (3)

3.4 Explain why it would still be possible for an HIV positive man to infect another person during sexual intercourse after part **C** is surgically cut. (2)
(9)

Question 4

Study the diagram below, which shows a process occurring in a human male.



4.1 Name the process by which male gametes in humans are formed through meiosis. (1)

4.2 Name the organ in males where the process mentioned in QUESTION 4.1 takes place. (1)

4.3 How many chromosomes will be found in each cell at:

(a) A (1)

(b) B (1)

4.4 Name TWO processes occurring during the 1st meiotic division that contribute to the genetic variation of cells **A**. (2)

4.5 How many cells at **B** will carry the Y-chromosome? (1)

4.6 What are the mature cells at **B** called? (1)
(8)

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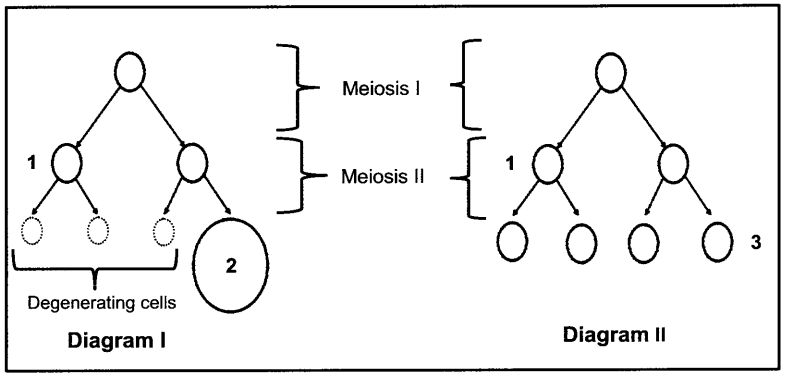
Question 5

Diagrams **I** and **II** below represent gametogenesis in human males and females (not in any particular sequence).

The diagrams are NOT drawn to scale.



5.1 Identify the specific type of gametogenesis in Diagram **I**. (1)

5.2 Explain your answer to QUESTION 5.1 by referring to a visible difference between Diagram **I** and Diagram **II**. (2)

5.3 Where in the human body does the type of gametogenesis shown in Diagram **II** take place? (1)

5.4 Give the chromosome number of:

(a) The cells at **1** (1)

(b) Cell **2** (1)

5.5 Name TWO processes that take place during Meiosis I that lead to genetic variation in the four cells shown at **3** in Diagram **II**. (2)

5.6 Explain the implication for the human population size if the three cells referred to in Diagram **I** did not degenerate, but remained as gametes. (2)
(10)

Question 6

Read the passage below and answer the questions that follow.

EXERCISE AND SPERM COUNT

Research was conducted to determine the effect of lifestyle on the sperm count of young males. In this study, 189 young male students from a university in New York filled out questionnaires on their physical activity, diet, stress and other lifestyle factors. Each male student then provided a semen sample.

The results showed that the male students who exercised for more than 15 hours a week had a sperm count 73 percent higher than those who exercised fewer than 5 hours a week.

A second investigation showed that men who watched more than 20 hours of TV per week instead of exercising had a 44 percent lower sperm count than men who watched little or no TV.

A person who exercises, secretes more antioxidant enzymes that can prevent a natural process called oxidative stress from damaging cell membranes in the body. This damage can disrupt the formation of new sperm. When watching TV or sitting, the scrotum gets pushed against their body, making the region of the testis hotter and possibly preventing new sperm from being produced.

[Adapted from *National Geographic News*, February 2013]

6.1 Name the specific meiotic process responsible for the production of sperm cells. (1)

6.2 Explain why a high temperature in the region of the testis may prevent the production of new sperm. (2)

6.3 State a general conclusion that can be drawn from the results in the first investigation. (2)

6.4 State ONE way in which the reliability of this study can be increased. (1)

6.5 Draw a labelled diagram to show the structure of a sperm cell. (4)
(10)

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Question 7

The diagram below represents a sperm cell.

A **B** **C** **D**

7.1 Identify part:

(a) **B** (1)

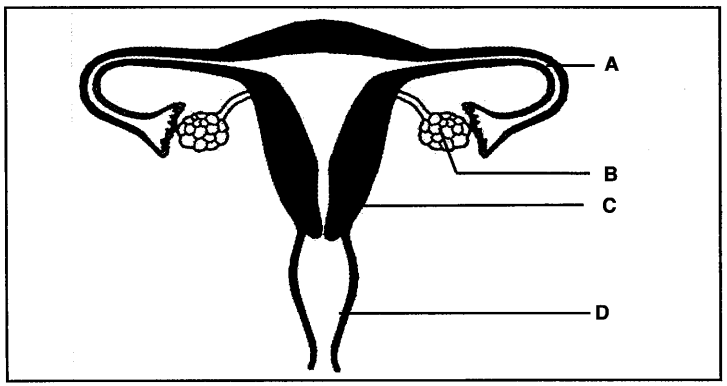
(b) **D** (1)

7.2 Explain ONE way in which the sperm cell is adapted to ensure effective movement towards the Fallopian tubes. (2)

7.3 Explain the consequences for reproduction if a sperm cell did not have part **A**. (3)
(7)

Question 8

The diagram below shows the structure of the female reproductive system.



Give the LETTER and NAME of:

8.1 The part that breaks down when the levels of progesterone and oestrogen drop (2)

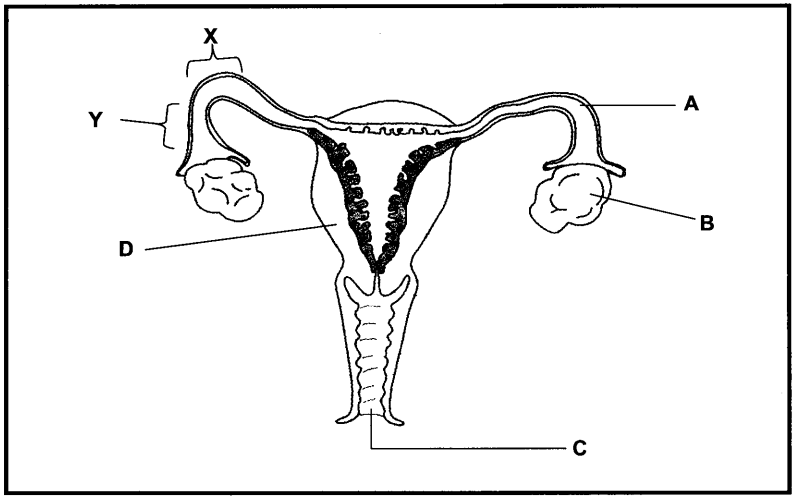
8.2 The part that plays a role during copulation (2)

8.3 The part where the zygote will be formed (2)

8.4 The part where the Graafian follicles develop (2)
(8)

Question 9

The diagram below represents the female reproductive system.



9.1 Label structures **A**, **B** and **C**. (3)

9.2 State THREE functions of **D**. (3)

9.3 Fertilisation usually takes place at **Y**. Why will a blockage at **X**:

(a) Prevent fertilisation at **Y** (1)

(b) Not necessarily lead to infertility (2)
(9)

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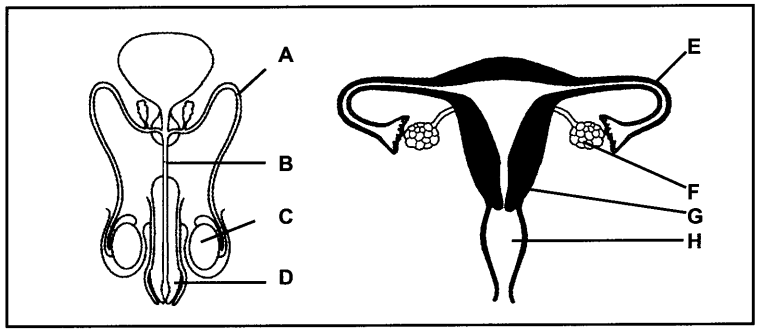
Question 10

The diagrams below show the human male and female reproductive systems.



Write the LETTER (A–H) and NAME of the part:

10.1 Which transports urine to the outside of the body (2)

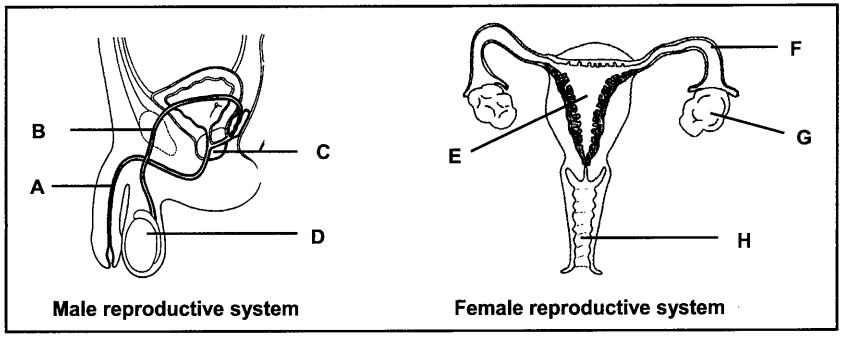
10.2 Where fertilisation occurs (2)

10.3 Where sperms are produced (2)

10.4 Where ova are produced (2)
(8)

Question 11

Study the diagrams below showing the male and female reproductive systems.



11.1 Identify parts **A**, **B** and **F** respectively. (3)

11.2 State ONE function of each of the following:

(a) The fluid produced by part **C** (1)

(b) Part **E** (1)

11.3 Give the LETTER ONLY of the organ where meiosis takes place in the:

(a) Male reproductive system (1)

(b) Female reproductive system (1)

11.4 Name the type of gametogenesis that takes place in the:

(a) Male reproductive system (1)

(b) Female reproductive system (1)

11.5 State TWO functions of part **H**. (2)

11.6 Explain why it is necessary for part **D** to be 'outside' the body in males. (2)
(13)

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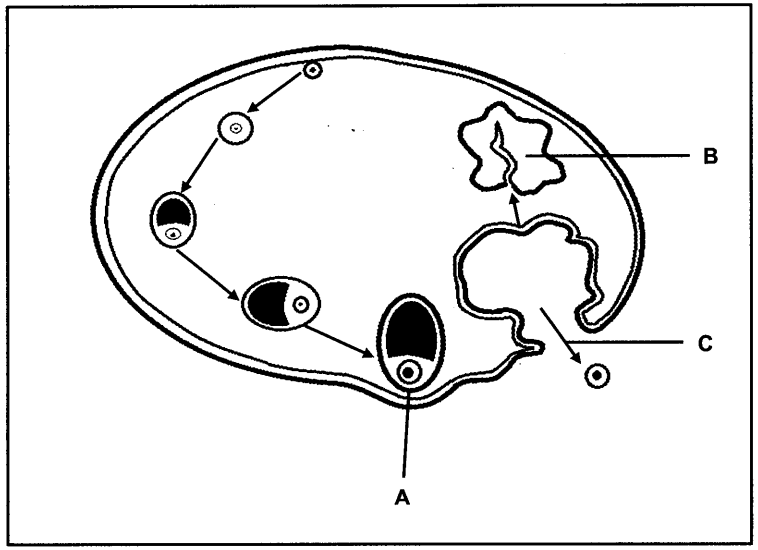
Question 12

The diagram below represents the sequence of events that takes place during the ovarian cycle of a female.



12.1 Give the name of the:

(a) Hormone that controls the development of structure **A** (1)

(b) Process taking place at **C** (1)

12.2 Describe the change that takes place in the uterus as the result of the hormone secreted by structure **A**. (2)

12.3 Structure **B** degenerates if fertilisation does not take place.

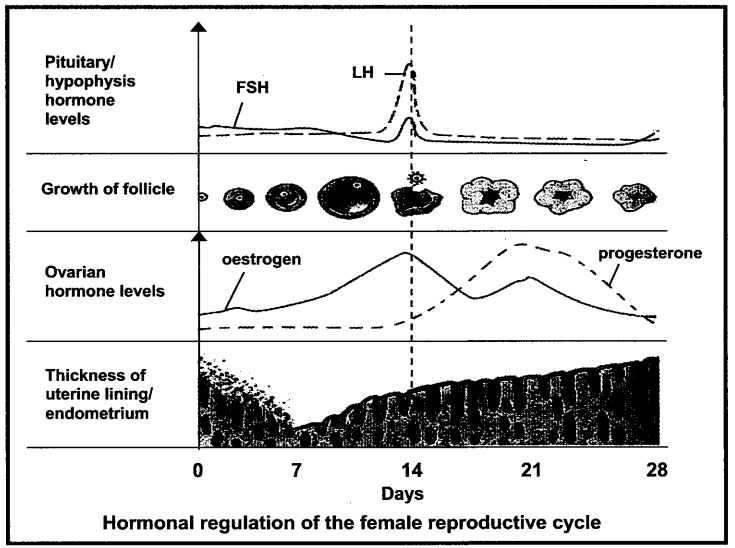
Explain the implications of this for the:

(a) Ovarian cycle (3)

(b) Uterine cycle (3)
(10)

Question 13

Study the graph below which shows the menstrual cycle and the influence of the different hormones on it.



Hormonal regulation of the female reproductive cycle

13.1 On which day does ovulation take place? (1)

13.2 Between which days does menstruation take place? (1)

13.3 State any ONE function of luteinising hormone (LH). (1)

13.4 Describe the changes in the level of LH shown in the graph. (3)

13.5 Describe the relationship between the level of oestrogen and the endometrium from day 7 to day 14. (2)

13.6 Explain why it is necessary for the level of progesterone in the blood to increase after ovulation. (2)

13.7 Did fertilisation take place in the 28-day cycle illustrated in the graph? (1)

13.8 Explain your answer to QUESTION 13.7. (2)
(13)

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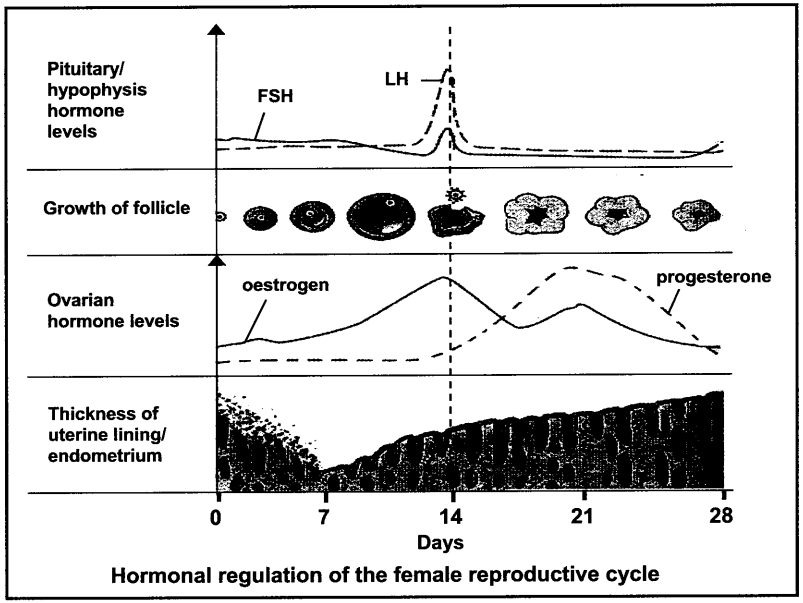
Question 14

Study the graph below of a menstrual cycle and the influence of the different hormones on it.



Hormonal regulation of the female reproductive cycle

14.1 On which day does ovulation take place? (1)

14.2 Between which days does menstruation take place? (1)

14.3 State ONE function of FSH during the menstrual cycle. (1)

14.4 Describe the functional relationship between progesterone and FSH. (2)

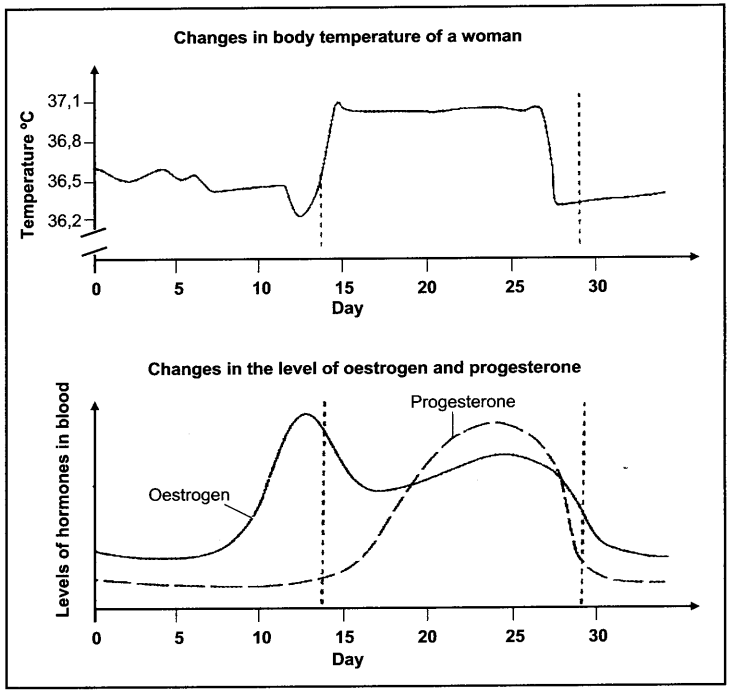
14.5 Account for the change in the thickness of the endometrial lining between day 14 and day 21. (2)

14.6 Did fertilisation take place within the 28-day cycle illustrated in the graph? (1)

14.7 Give TWO reasons for your answer to QUESTION 14.6. (2)
(10)

Question 15

The following two graphs show the changes in temperature in a woman's body and the level of the hormones oestrogen and progesterone during the menstrual cycle. The release of the ovum takes place when there is a very small increase in body temperature.



15.1 What was the temperature of the woman on day 15? (2)

15.2 Calculate by how many degrees Celsius her temperature varied in one menstrual cycle. Show ALL workings. (2)

15.3 From the graph, name THREE factors that indicate that ovulation occurred. (3)

15.4 Explain the importance of the higher level of progesterone from day 15 onwards. (2)

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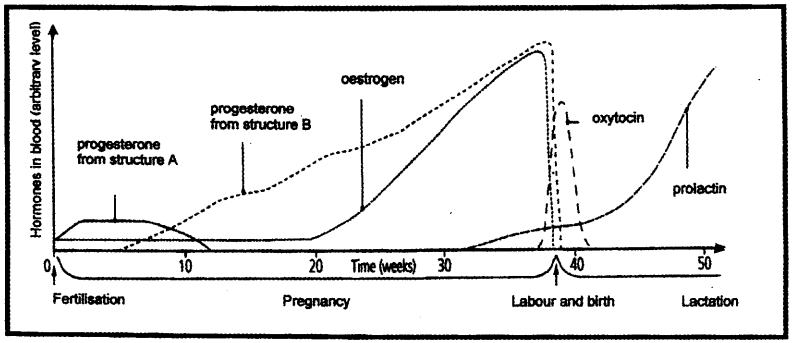
Question 16

Study the graph below showing the hormonal changes during pregnancy.



16.1 Identify the following structures:

(a) A

(b) B (2)

16.2 State the following:

(a) Where prolactin is produced

(b) The function of prolactin (2)

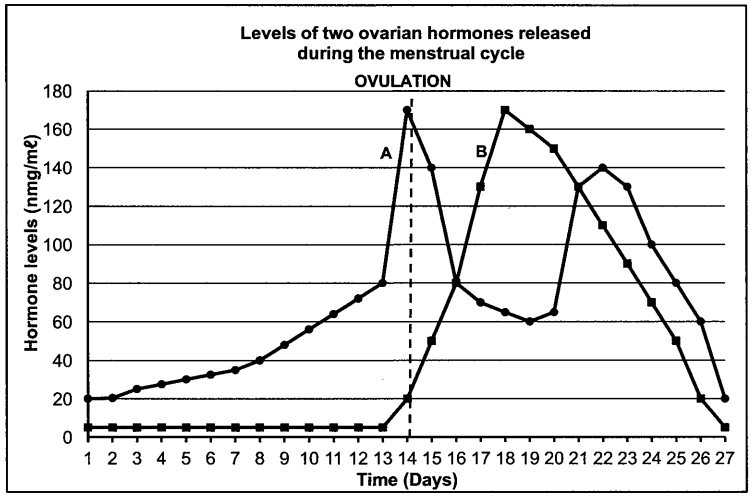
16.3 Explain the significance of the levels of oestrogen and progesterone dropping towards the end of pregnancy. (2)

16.4 Explain what will happen if structure **A** breaks down at the end of the first week of pregnancy. (2)

16.5 Suggest the role of oxytocin around week 40 of pregnancy. (1)
(9)

Question 17

Study the graph below.



17.1 Identify:

(a) Hormone **A** (1)

(b) Hormone **B** (1)

17.2 What effect does an increase in hormone **A** have on the endometrium? (2)

17.3 Ovulation is indicated on the graph.

(a) Define *ovulation*. (2)

(b) On which day did ovulation take place? (1)

(c) Which hormone secreted by the pituitary gland stimulates ovulation? (1)

17.4 Explain why high levels of hormone **B** prevent the development of new follicles. (2)

17.5 Explain evidence in the graph that indicates that no fertilisation took place during the menstrual cycle shown above. (3)
(13)

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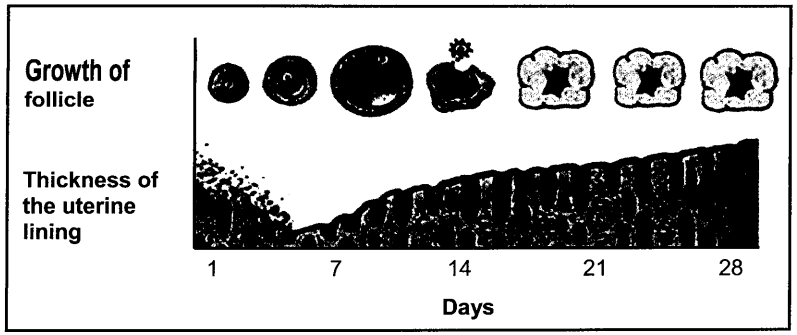
Question 18

The diagram below shows some of the changes that take place during the menstrual cycle.



18.1 The menstrual cycle is controlled by hormones. Name ONE hormone which will increase in level between day 2 and day 10. (1)

18.2 Give ONE observable reason for your answer to QUESTION 18.1. (2)

18.3 Explain evidence from the diagram which indicates that fertilisation took place. (3)

18.4 Describe the developmental changes in the fertilised ovum until implantation occurs in the uterus. (5)

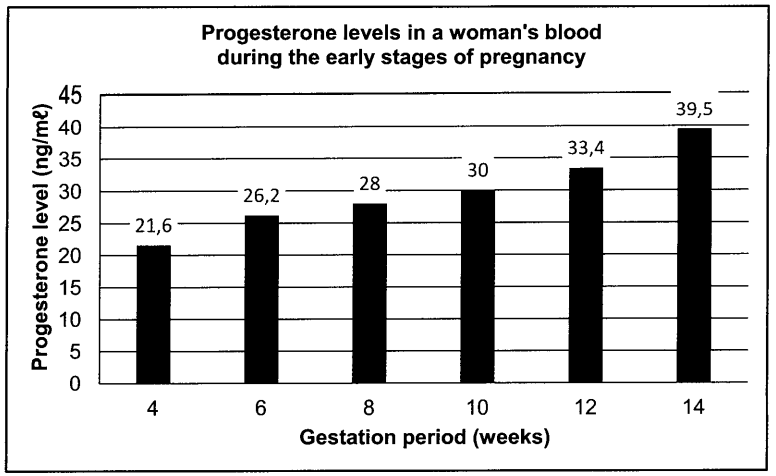
18.5 Some females use an ovulation monitor so that they can be aware of the days when they are fertile. These monitors measure the level of hormones in the blood.

(a) Why would females want to know when they are fertile? (1)

(b) Explain which hormone is likely to be monitored by the ovulation monitor. (3)
(15)

Question 19

The graph below shows the concentration of progesterone in a woman's blood during the early stages of pregnancy.



19.1 Name TWO structures responsible for producing progesterone during pregnancy. (2)

19.2 Describe the general trend in the change in progesterone levels in the woman's blood during the early stages of pregnancy. (1)

19.3 Describe the negative feedback mechanism that occurs between progesterone and FSH during pregnancy. (2)

19.4 State the importance of the negative feedback mechanism described in QUESTION 19.3. (1)

19.5 Calculate the percentage increase in progesterone levels between week **4** and week **14**. Show ALL calculations. (3)

19.6 The woman's progesterone level in week 16 was 25 ng/mℓ.

(a) Explain why this woman should be concerned about the decrease in progesterone levels. (2)

(b) Suggest ONE way in which this problem could possibly be treated by a doctor. (1)
(12)

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Question 20

Describe the menstrual cycle and how it is influenced by different hormones.

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

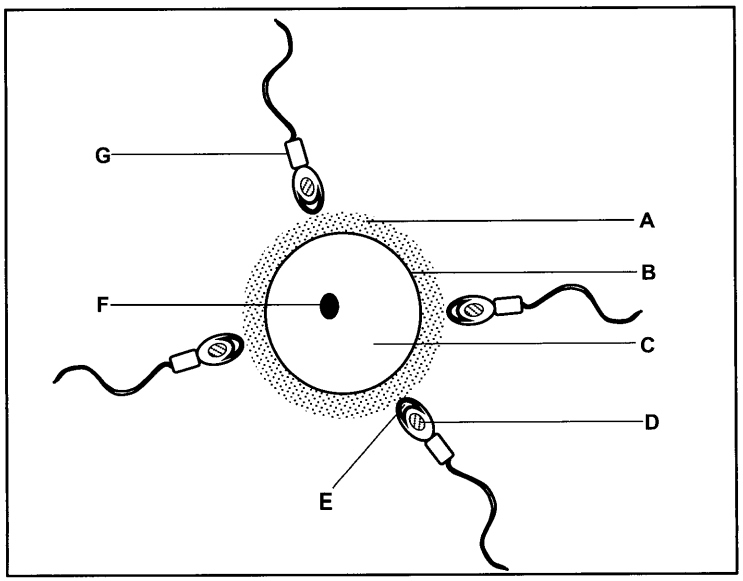
Question 21

One contraceptive method for females is to take a daily oral pill that contains progesterone.

Explain how this pill functions to prevent pregnancy. **(4)**

Question 22

The schematic diagram below shows a human ovum that is about to be fertilised. The diagram is not drawn to scale.



22.1 Identify part:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

(d) **F** (1)

22.2 Give the LETTER and NAME of the part that:

(a) Contains the mitochondria (2)

(b) Contains enzymes required to penetrate the ovum (2)

(c) Will enter the ovum during fertilisation (2)
(10)

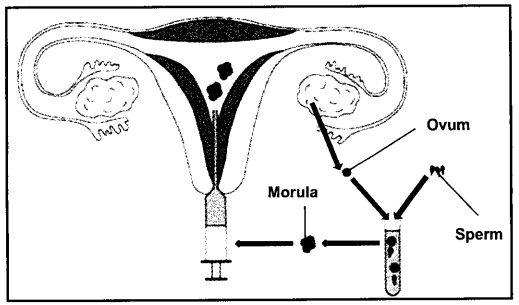
Question 23

Anele found out that she had scar tissue blocking both her Fallopian tubes and therefore could not have a baby. She decided to try in vitro fertilisation (IVF).

The IVF procedure was performed as follows:

- Anele was given hormone supplements to stimulate the production of ova in the ovaries.
- The mature ova were then collected and placed in a test tube.
- Her partner was then asked to release his semen into a special container.
- The ova and the semen were then mixed in a test tube.
- The morulas that developed after a few days were then inserted into Anele's uterus.

The diagram below is a representation of how the procedure was done.



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23.1 Explain why Anele's condition had prevented her from falling pregnant. (2)

23.2 Name ONE hormone that was:

(a) Given to Anele to ensure that ova were produced in the ovaries (1)

(b) Produced by the developing follicles in the ovaries, as the ova were maturing (1)

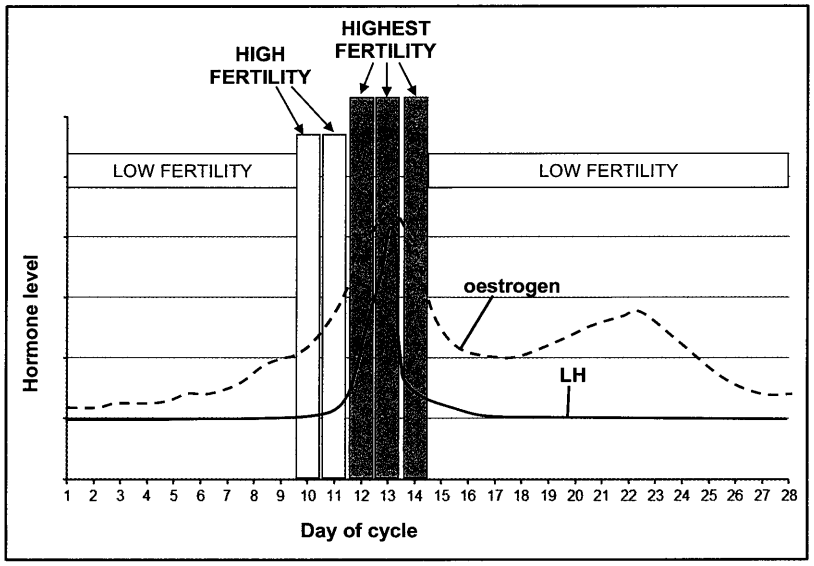
23.3 Describe the events that take place in the test tube after fertilisation, until a blastocyst is formed. (4)

23.4 Explain ONE possible consequence for the developing embryo if the corpus luteum disintegrates immediately after implantation. (3)
(11)

Question 24

A fertility monitor measures the concentration of oestrogen and luteinising hormone (LH) in a woman's urine. A fertile period is the time when the ovum is ready to be fertilised.

The graph below appears on the information sheet that is provided with the fertility monitor.



24.1 Name the gland that secretes LH. (1)

24.2 Explain why the fertility monitor measures the concentration of LH. (2)

24.3 Explain why some women would use a fertility monitor. (2)

24.4 What evidence in the graph indicates that a healthy follicle is developing in the ovary during the first half of the cycle? (2)

24.5 If a woman using the fertility monitor finds that her LH level peaks on day 17, between which days does she experience the 'highest fertility'? (2)

24.6 Explain why the fertility monitor does not measure the progesterone level in the blood to predict fertile days. (3)
(12)

Question 25

Explain the structural suitability of the sperm cell for its function and describe its involvement in the formation of a zygote and the development of this zygote until implantation.

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

Question 26

Sperm is produced, transported and then combined with secretions from the accessory glands to form semen. The semen is then transferred into the body of the female where it meets the ovum.

Describe all the processes referred to in the statement above and explain THREE structural adaptations of the sperm for fertilisation.

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

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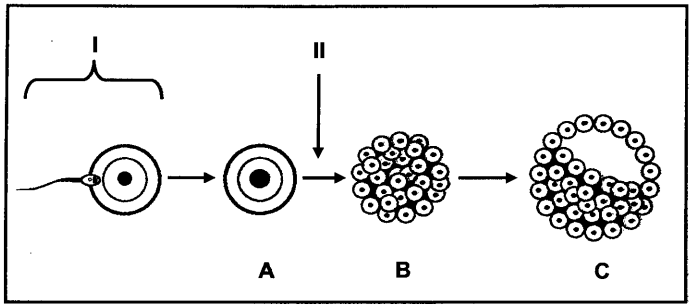
Question 27

The diagram below represents a sequence of events that may take place inside the human female reproductive system.



27.1 Identify the process taking place at **I** in the diagram above. (1)

27.2 State the type of cell division that takes place at **II** in the diagram above. (1)

27.3 Name TWO functional extra-embryonic membranes that are produced by structure **C**. (2)

27.4 Identify the stage of development indicated by:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

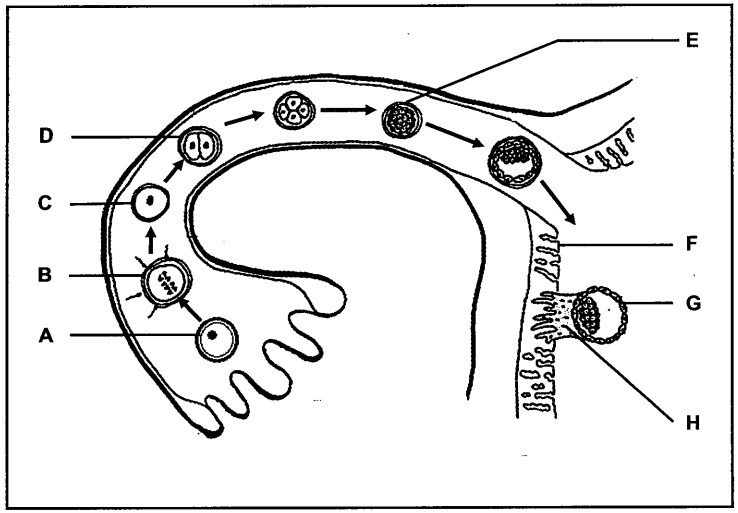
27.5 Name the part of the female reproductive system where the events in the diagram above usually take place. **(1)**

27.6 Give the chromosome number of the cell at **A** if this cell is going to develop into a child with Down syndrome. (1)
(9)

Question 28

Study the diagram below of the sequence of events that takes place from the fertilisation of the ovum to the development of the embryo in a part of the human female reproductive system.

The arrows indicate the direction of development of one ovum after fertilisation.



28.1 Identify:

(a) Structure **C** (1)

(b) The stage of embryo development at **E** (1)

(c) The structure that develops from a combination of parts **F** and **H** (1)

28.2 Name the process that takes place:

(a) At **B** (1)

(b) When **G** attaches to part **F** (1)

28.3 Give the chromosome number of:

(a) The cells at **D** (1)

(b) Cell **A** (1)
(7)

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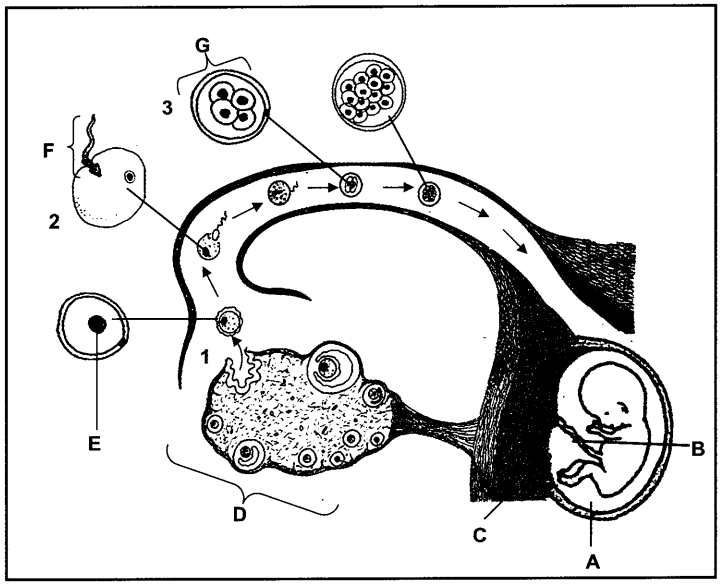
Question 29

The diagram below shows part of the female reproductive system. Structures **B** to **G** and processes **1**, **2** and **3**, occurring in the Fallopian tube and uterus, are magnified.



29.1 Label **C** and **D**. (2)

29.2 State which processes are taking place at **1**, **2** and **3** respectively. (3)

29.3 State how many chromosomes are present in the following structures:

(a) **E** (1)

(b) Each cell of structure **G** (1)

29.4 Draw an enlarged labelled diagram of structure **F** to show its details. (5)

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

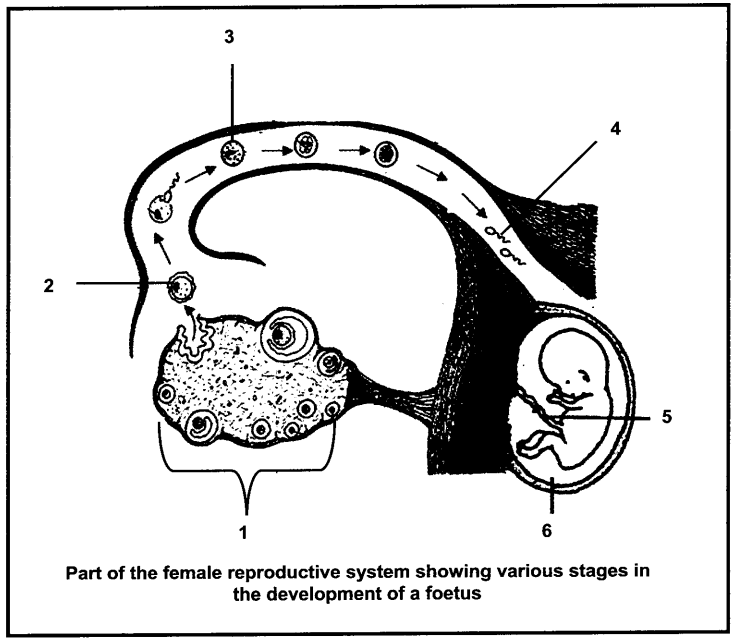
29.6 Structure **B** transports substances to and from the foetus.

(a) Name ONE useful substance transported to the foetus. (1)

(b) Name ONE waste product transported from the foetus. (1)
(16)

Question 30

The diagram below represents the events leading to the development of the foetus in the human uterus.



Part of the female reproductive system showing various stages in the development of a foetus

Identify the following:

30.1 Part labelled **1**
30.2 Cell labelled **2**
30.3 Cell labelled **3**
30.4 Structure labelled **4**
30.5 Part labelled **5**
30.6 Fluid labelled **6** **(6)**

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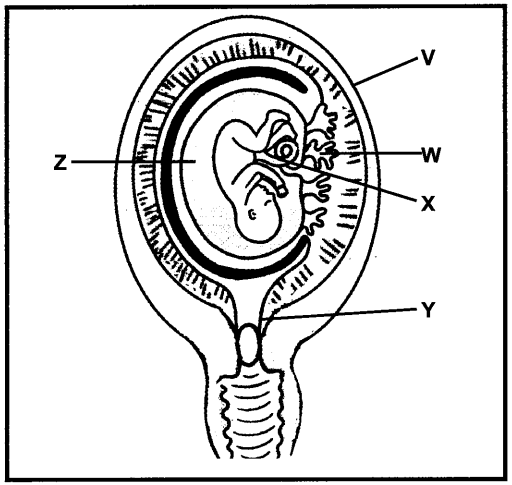
Question 31

The diagram below represents a developing foetus in a human body.



31.1 Identify the parts labelled:

(a) X (1)

(b) Y (1)

31.2 State ONE function of the fluid labelled **Z**. (1)

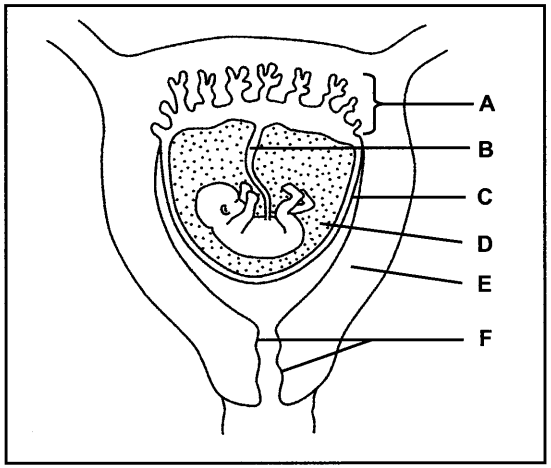
31.3 Explain how the part labelled **V** is structurally suited to perform its function during the process of birth. (2)

31.4 Name TWO systems in the baby's body that take over the functions of part **W** once the baby is born. (2)

31.5 Explain what prevents another ovum from being produced while the foetus is developing in a human body. (2)
(9)

Question 32

Study the diagram below.



Match the structures (A to F) with the descriptions (32.1 to 32.5) below, for example 32.6 G. A letter may be used more than once, or not at all.

32.1 Where gaseous exchange occurs between the mother and the foetus (1)

32.2 Removes excretory products from the foetus (1)

32.3 Contains strong muscles which will push the foetus out during birth (1)

32.4 Clamped and cut after the baby is born (1)

32.5 Acts as a shock absorber for the developing foetus (1)
(5)

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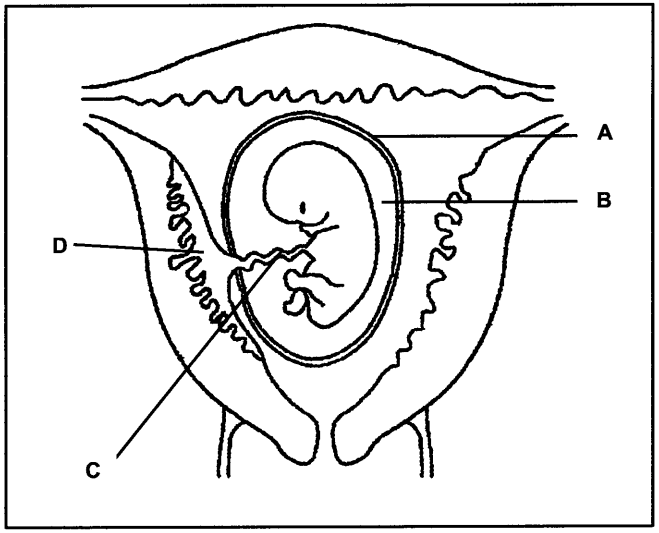
Question 33

The diagram below represents a developing foetus in a human body.



33.1 Identify:

(a) **A** (1)

(b) **C** (1)

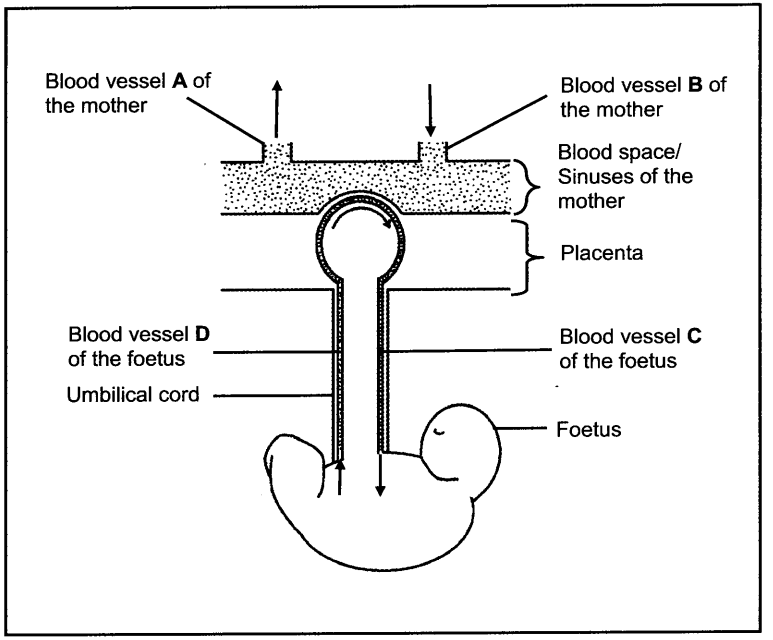
33.2 State TWO functions of the fluid in part **B**. (2)

33.3 Name ONE system in the baby's body that takes over the function of part **D** once the baby is born. (1)

33.4 Explain ONE negative impact on foetal development if part **D** is reduced significantly. (2)
(7)

Question 34

The diagram below represents the relationship between the blood system of the foetus and that of the mother. The arrows indicate the direction of blood flow in the blood vessels.



34.1 Apart from playing a role in the diffusion of substances from the mother's blood to the foetus' blood, and vice versa, state TWO other functions of the placenta. (2)

34.2 Blood vessel **D** is an artery.

Tabulate TWO differences between the composition of blood found in blood vessel **C** and blood found in blood vessel **D**. (5)

34.3 Explain ONE consequence for the foetus if blood vessel **D** becomes blocked preventing blood flow. (2)

34.4 If the blood of the mother and the blood of the foetus come into contact with each another, it could lead to the death of the foetus.

Describe why this would occur. (2)
(11)

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Question 35

The unicellular zygote undergoes many developmental changes until it becomes a multicellular foetus, nourished and protected by the mother.

Describe the changes that allow the zygote to eventually develop into a foetus and how this foetus is nourished and protected during the period of pregnancy.

Content: **(17)**
Synthesis: **(3)**

Question 36

An investigation was conducted to determine the relationship between the ages of women, the number of pregnancies per month and the chances of miscarriages.

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

AGES OF WOMEN	PREGNANCIES PER MONTH (%)	MISCARRIAGES (%)
22	25	10
28	24	11
34	18	15
40	6	24
46	2	50

[Adapted from http://www.children.gov.on.ca]

36.1 Draw a line graph to show the relationship between the ages of the women and the percentage of pregnancies per month. (6)

36.2 Describe the relationship that exists between the ages of women and the chances of them miscarrying. (2)

36.3 According to the data obtained, if there are 12 pregnant women who are 46 years old, how many of them are likely to miscarry? Show ALL working. (2)
(10)

Question 37

Protection, nourishment and gaseous exchange are important requirements for the successful development of an embryo.

Describe how gaseous exchange and the nourishment of the embryo occur in an amniotic egg and how gaseous exchange and nourishment as well as protection of the foetus occur in humans.

Content: (17)
Synthesis: (3)

GENETICS

Question 1

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

1.1.1 A genetic cross involving two characteristics at a time

1.1.2 The exchange of genes between homologous chromosomes that brings about variation

1.1.3 All the genes in all the chromosomes of a particular species

1.1.4 An allele that is not shown/expressed in the phenotype when found in the heterozygous condition.

1.1.5 An allele that is always expressed in the phenotype

1.1.6 The position of a gene on a chromosome

1.1.7 The process by which genetically identical organisms are formed using biotechnology

1.1.8 A segment of a chromosome that codes for a particular characteristic

1.1.9 Type of inheritance where none of the two alleles is dominant over the other and an intermediate phenotype is produced

1.1.10 An individual having two non-identical alleles for a characteristic

1.1.11 Alternative forms of a gene in the same position on homologous chromosomes

1.1.12 The process of finding a desirable gene, isolating it and then moving it into the cells of another organism

1.1.13 The type of inheritance involving alleles that equally determine the phenotype of heterozygous offspring

1.1.14 Organisms having two identical alleles at a given locus

1.1.15 A genetic cross involving one characteristic only

Question 2

2.1 A boy's mother had a patch of white hair called a 'white forelock' which is caused by a dominant allele **H**. The mother is heterozygous for this trait. His father does not have a 'white forelock'. The symbol for the recessive allele is **h**.

Represent a genetic cross to determine the possible genotypes and phenotypes of the children. **(6)**

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Question 3

3.1 A grey (**G**) male rabbit was mated with an albino (**g**) female rabbit. The entire F_1 generation was grey.

Use a genetic cross to show the phenotypic ratio of their offspring if one of the males of the F_1 generation was mated with an albino female. **(7)**

Question 4

A farmer has an orchard of apple trees. Each apple produced expressed red and yellow colour equally (red-yellow apples). To extend his apple orchard, the farmer collected seeds from the red-yellow apples and grew them.

When the new trees matured, he found that some of the trees produced red apples (**R**), others produced yellow apples (**Y**) and the rest produced apples that were red-yellow.

4.1 Use a genetic cross to explain his results in the F_1 generation. (6)

4.2 What proportion of apples in the F_1 generation will be red-yellow apples? (1)

4.3 The farmer saw that the red-yellow apples sell the best. Name the phenotypes of the trees that he should cross in the future in order to ensure that any new trees will definitely produce only red-yellow apples. (2)
(9)

Question 5

Mendel observed some characteristics of the pea plant (*Pisum sativum)* which he suggested were controlled by inherited factors. He conducted a series of experiments in which he crossed pea plants with contrasting phenotypes to obtain the offspring of the **F_1** generation. At first his crosses were simple and involved only one pair of characteristics.

Mendel counted the number of offspring showing each of the variations.

His results are shown in the table below.

PLANT PART	CHARACTERISTIC	P_1 GENERATION	F_1 GENERATION
Seed	Seed texture	Round x wrinkled	All round
	Seed colour	Yellow x green	All yellow
Pod	Pod texture	Full x constricted	All full
	Pod colour	Green x yellow	All green
Flowers	Flower colour	Violet x white	All violet
Stem	Location of flower on stem	Axial x terminal	All axial
	Height of stem	Tall x short	All tall

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5.1 Give the term for:

(a) The *inherited factors* that Mendel referred to (1)

(b) A cross involving only ONE characteristic (1)

5.2 Name the female structure of the flower where meiosis occurs. (1)

5.3 Use the information in the table above to give the NUMBER of EACH of the following:

(a) Characteristics of pods (1)

(b) Alleles for seed characteristics (1)

5.4 Give the characteristic that is:

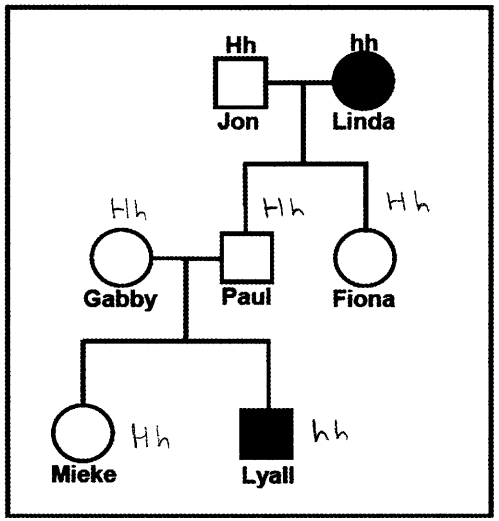
(a) Dominant for flower colour (1)

(b) Recessive for stem height (1)

5.5 If the individuals of the F_1 generation are crossed, how many phenotypes for seed colour would be expected in the F_2 generation? (1)
(8)

Question 6

The diagram below shows the pattern of inheritance of deafness in a family. The letter **H** represents the allele for hearing and **h** represents the allele for deafness.



6.1 How many of EACH of the following are represented in this diagram?

(a) Males (1)

(b) Generations (1)

6.2 Give the:

(a) Phenotype of Jon (1)

(b) Genotype of Paul (1)

Both Lyall's parents can hear, yet he is deaf.

6.3 Explain how he inherited deafness. (2)

6.4 Lyall marries a woman who is homozygous dominant for hearing. Use a genetic cross to show the percentage chance of them having a deaf child. (7)
(13)

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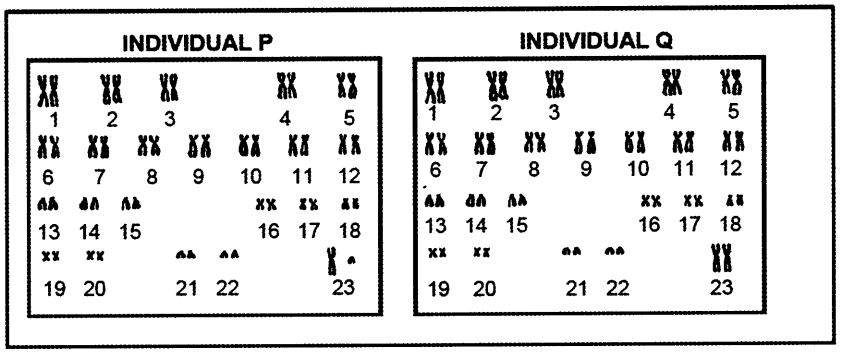
Question 7

7.1 Lindiwe has two sons and she is now pregnant for the third time.

Use a genetic cross to show the percentage chance that this child could be a boy. **(6)**

Question 8

The diagram below shows the karyotypes of two individuals.



8.1 What term is given to the chromosomes numbered:

(a) **1** to **22** (1)

(b) **23** (1)

8.2 State the gender of individual **P**. (1)

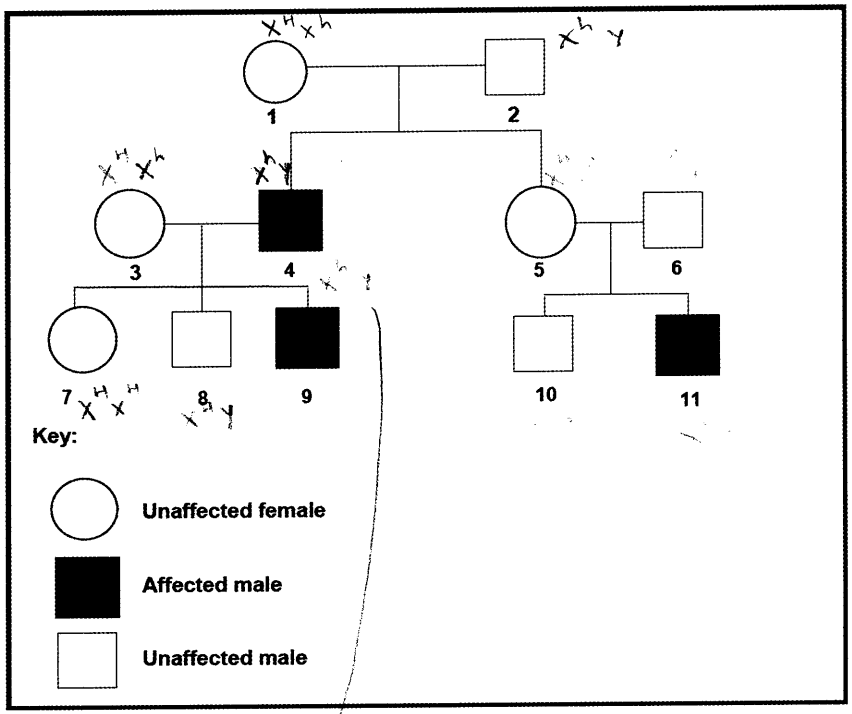
8.3 Give ONE observable reason for your answer to QUESTION 8.2 . (2)

Each of the pairs shown is a homologous pair of chromosomes.

8.4 State the origin of each chromosome in a homologous pair of chromosomes. (2)
(7)

Question 9

The pedigree diagram below traces the inheritance of haemophilia in a family.



He must get the Y from his father and the h from his mother because he is male.

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9.1 How many family members not affected by haemophilia are carriers? (1)

9.2 Explain why this disorder affects mostly males in this family. (3)

9.3 Use the possible alleles X^H, X^h and Y to determine the genotype of the following:

(a) Individual 1 (2)

(b) Individual 4 (2)

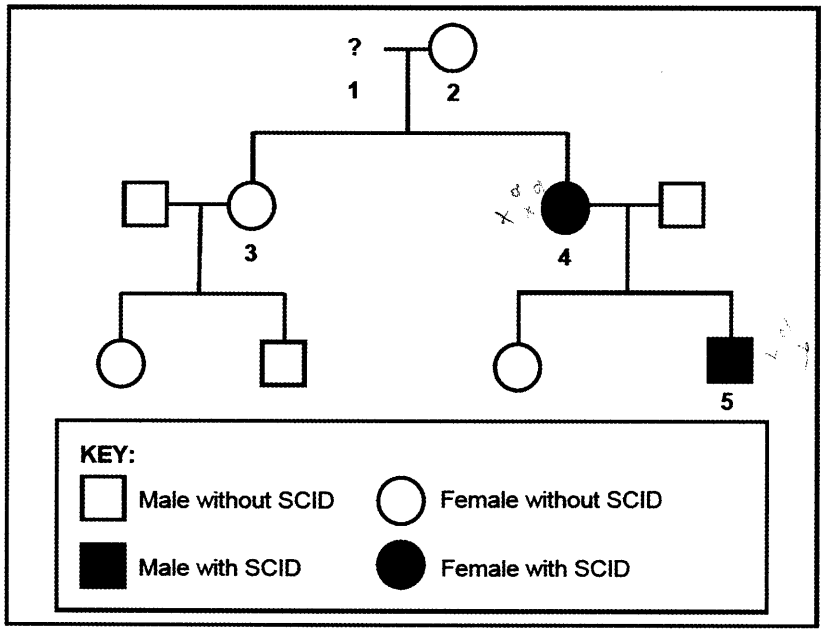
9.4 What are the chances of individual 10 and his wife, who is a carrier (not shown in the pedigree), having a son who is affected? (2)

9.5 Give TWO reasons why individual 9 and his partner should undergo genetic counselling before starting a family. (2)
(12)

Question 10

Severe combined immune deficiency syndrome (SCID) is a disorder affecting the immune system. It is caused by a sex-linked recessive allele (X^d).

The diagram below shows the inheritance of the disorder in a family. It is not known if individual **1** has the disorder or not.



10.1 Give the:

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

(b) Phenotype of individual **1** (1)

(c) Genotype of individual **3** (2)

10.2 Explain how individual **5** inherited the disorder. (2)
(6)

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Question 11

The table below shows the percentage distribution of blood groups in a province in South Africa.

BLOOD GROUPS			
A	B	AB	O
35	15	10	40

11.1 How many genes control the blood groups shown above? (1)

11.2 Explain how it is genetically possible to have four blood groups in a population. (2)

11.3 Draw a pie chart using the information in the table above. Show ALL calculations. (8)
(11)

Question 12

The table below shows the percentage frequency of human blood groups in the populations of two different cities in South Africa.

Human blood groups	% frequency in population	
	City 1	City 2
A	25	45
B	20	10
AB	10	5
O	45	40

12.1 Which blood group has:

(a) The highest frequency in City **1** (1)

(b) The lowest frequency in City **2** (1)

Question 13

The table below shows the percentage of the populations with different blood groups for two countries.

BLOOD GROUP	PERCENTAGE OF POPULATION	
	COUNTRY Q	COUNTRY R
O	40	20
A	10	35
B	45	40
AB	5	5

13.1 Which blood group shows the greatest percentage difference between the two countries? (1)

The population size of country **Q** is 5 million people.

13.2 Calculate the number of people who have blood group **O**. Show ALL your working. (3)

13.3 Explain how the inheritance of blood group **AB** is an example of co-dominance. (2)

13.4 Explain why blood groups are considered an example of discontinuous variation. (2)

13.5 In the inheritance of blood groups, give the:

(a) Recessive allele (1)

(b) Phenotype of an individual who is homozygous recessive (1)
(10)

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Question 14

A baby was kidnapped from a hospital immediately after she was born. Fifteen years later it was discovered that Mr and Mrs Thomas, who were raising her, were not her biological parents. Mr and Mrs George, whose baby was born around the same time, claimed that she was their child.

The blood groups of both families are shown in the table below.

INDIVIDUAL	BLOOD GROUPS
Child	O
Mr Thomas	O
Mrs Thomas	AB
Mr George	B
Mrs George	A

14.1 How many genes control the inheritance of blood groups? (1)

14.2 Name the individual whose blood group shows co-dominance. (1)

14.3 Explain why Mr and Mrs George could possibly be the parents of this child. (3)
(5)

Question 15

Mr and Mrs Phonela are concerned that their baby girl does not appear to resemble either of them. They suspect that the baby they were given at the hospital was not theirs. Mr Phonela is blood type **AB**, Mrs Phonela is blood type **B** and the baby they were given is blood type **O**.

15.1 Give the possible genotypes of:

(a) Mrs Phonela (2)

(b) The baby girl (1)

15.2 Explain why the baby girl with blood type **O** cannot be Mr and Mrs Phonela's daughter. (3)

15.3 Explain why the use of blood type for paternity testing is not conclusive. (2)

15.4 Using your knowledge of sex chromosomes, explain why the sex of a child is determined by the male gamete. (5)
(13)

Question 16

In a plant species two characteristics, flower colour and plant height, were studied. Each of these characteristics has two variations: flowers may be red or white in colour and the plants may be tall or short.

Plants that are heterozygous for flower colour have red flowers and plants that are homozygous recessive for plant height are short.

The alleles for each characteristic are shown in the table below.

CHARACTERISTIC	DOMINANT ALLELE	RECESSIVE ALLELE
Flower colour	F	f
Plant height	H	h

16.1 What is the term given for a genetic cross involving two characteristics? (1)

16.2 Give the:

(a) Dominant phenotype for flower colour (1)

(b) Recessive phenotype for plant height (1)

(c) Phenotype of a plant that is heterozygous for flower colour and homozygous dominant for plant height (2)

(d) Genotype of a white flowering, short plant (2)

16.3 State Mendel's Law of Dominance. (3)
(10)

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Question 17

Flower colour (purple or white) in a particular plant species is controlled by two alleles, **D** and **d**.

Four crosses were carried out to determine which allele is dominant. Forty (40) offspring were produced in each cross. The phenotypes of the parents and offspring in each cross were recorded.

The results are shown in the table below.

CROSS	PHENOTYPE		
	PARENT 1	PARENT 2	OFFSPRING
1	purple	white	40 purple
2	purple	purple	31 purple, 9 white
3	white	white	40 white
4	purple	white	21 purple, 19 white

17.1 State the dominant flower colour. (1)

17.2 Use cross **1** to explain your answer to QUESTION **17.1** (2)

17.3 State Mendel's Law of Segregation. (3)

17.4 Use a genetic cross to show how the crossing of two purple flowering plants can produce white offspring, as in cross **2**. (6)
(12)

Question 18

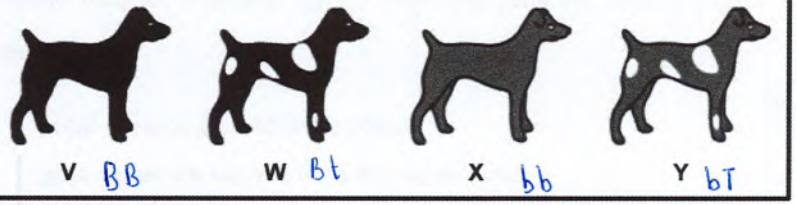
In dogs, coat appearance is controlled by two genes; one for coat colour and one for coat pattern (presence or absence of white patches).

The alleles for each characteristic are shown in the table below.

CHARACTERISTIC	ALLELES	
Coat colour	Black **(B)**	Grey **(b)**
Coat pattern	Without white patches **(T)**	With white patches **(t)**

In a cross between two dogs, the four offspring, **V**, **W**, **X** and **Y**, had the phenotypes as shown in the diagram below.

Phenotypes of the F_1 generation



18.1 What is the term given to a genetic cross involving two characteristics? (1)

18.2 Give the phenotype of:

(a) The dominant coat colour (1)

(b) Dog **V** (1)

(c) A dog that is homozygous recessive for both characteristics (1)

18.3 Explain why all dogs with the phenotype of dog **W** may not have the same genotype. (2)

The two characteristics are inherited in accordance with Mendel's principle of independent assortment.

18.4 State this principle. (3)
(9)

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Question 19

A geneticist wanted to find out which corn colour is dominant in a species of maize. The species has two phenotypes for colour, yellow and white. She performed four genetic crosses and recorded the colour of the offspring as shown in the table below.

Genetic crosses	Parent phenotypes	Offspring phenotypes
1	yellow x yellow	all yellow
2	white x white	51 white and 17 yellow
3	white x yellow	32 white and 34 yellow
4	white x white	all white

19.1 According to the results, which colour is dominant? (1)

19.2 Which ONE of the genetic crosses (1, 2, 3 or 4) from the table allows the conclusion suggested in QUESTION **19. 1** (1)

19.3 Give a reason for your answer to QUESTION **19.2** (2)

19.4 Use the symbols **G** and **g** to represent genetic cross 2. Also indicate the proportions of the F_1 phenotypes. (6)
(10)

Question 20

Read the extract below.

Stem cell surgery has been performed for the first time in South Africa at a Cape Town hospital. A patient became paralysed in a diving accident. He had no movement or feeling in any of his limbs because his nerve cells were damaged. Embryonic stem cells were used in an attempt to correct a defect in the spinal cord of the patient. He has now developed partial sensation throughout the body.

20.1 Explain why stem cells are suitable cells to use for the treatment of this patient. (3)

20.2 Explain why some people prefer the use of umbilical cords as a source of stem cells rather than the use of human embryos. (2)
(5)

Question 21

Read the extract below.

The first cloned animal in Africa, a calf named Futhi, was born in North West in South Africa on 19 April 2003. No fertilisation was involved in the production of Futhi. She was produced from a single cell taken from the ear of a donor cow named LMJC 865. The donor cow had a high average milk yield of 78 litres a day. Cloning allows for the production of organisms with desired characteristics.

Some people argue that cloning reduces genetic variation in the offspring, with no further genetic improvement. Cloning is an expensive procedure and may not be economical for commercial agriculture.

21.1 According to the extract, state ONE:

(a) Advantage of cloning (1)

(b) Disadvantage of cloning (1)

21.2 State why the donor cell was taken from LMJC 865 and not from any other cow. (1)

21.3 State why an ear cell was used and not an ovum. (2)

21.4 Briefly describe the process of *cloning*. (4)
(9)

Question 22

Genetically modified organisms (GMO) bring new hope for medical cures, promise to increase yields in agriculture and have the potential to help solve the world's pollution and resource crisis.

There are also many objections to GMO, some stating that they are expensive and a threat to our biodiversity.

22.1 Give TWO reasons why:

(a) The initial cost of production of GMO is high (2)

(b) GMO are considered a threat to biodiversity (2)

22.2 Apart from those in the text, state THREE objections that some people have against the production of GMO. (3)
(7)

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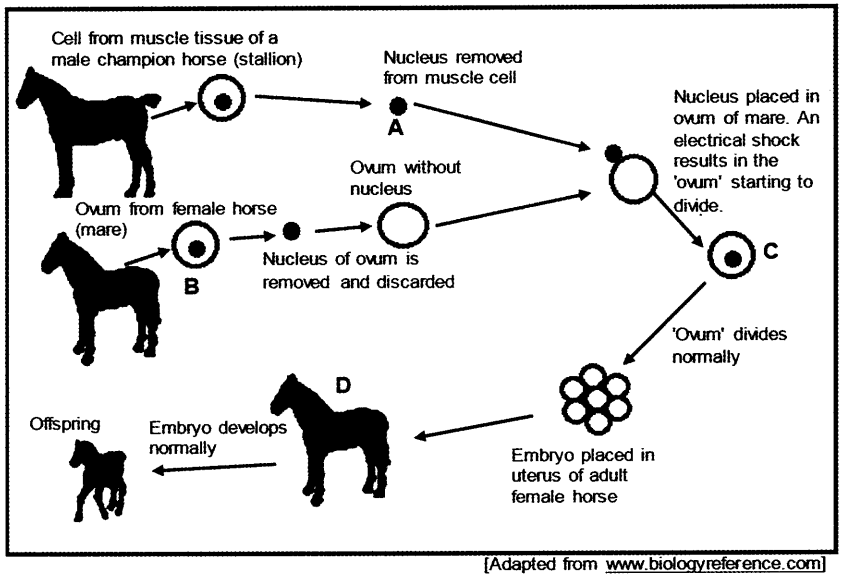
Question 23

The diagram below shows a genetic engineering process. A donor cell was taken from the muscle cell of a male champion horse (stallion) to create a new offspring.



[Adapted from www.biologyreference.com]

23.1 Name the:

(a) Genetic engineering process shown in the diagram above (1)

(b) Process that produced ovum **B** (1)

23.2 Why is the donor cell extracted from a champion horse? (2)

23.3 Explain why only the nucleus of the donor cell is used. (2)

A somatic cell in a horse contains 64 chromosomes.

23.4 How many chromosomes would there be in:

(a) Structure **A** (1)

(b) Ovum **B** (1)

(c) A muscle cell in organism **D** (1)

23.5 Explain why the 'ovum' labelled **C** cannot be considered a gamete. (2)
(11)

Question 24

An investigation was done by Grade 12 learners to determine which chickens grow faster: chickens that are selectively bred for laying eggs or chickens that are selectively bred for meat production.

The following steps were carried out:

The learners bought 30 one-day-old chickens from a commercial supplier. Fifteen of the chickens had been selectively bred for laying eggs and 15 of the chickens had been selectively bred for meat production.

All the chickens were kept under the same environmental conditions. This included being fed the same chicken feed, made mostly from cereal grains and protein sources.

The chickens were weighed regularly for a period of 45 days.

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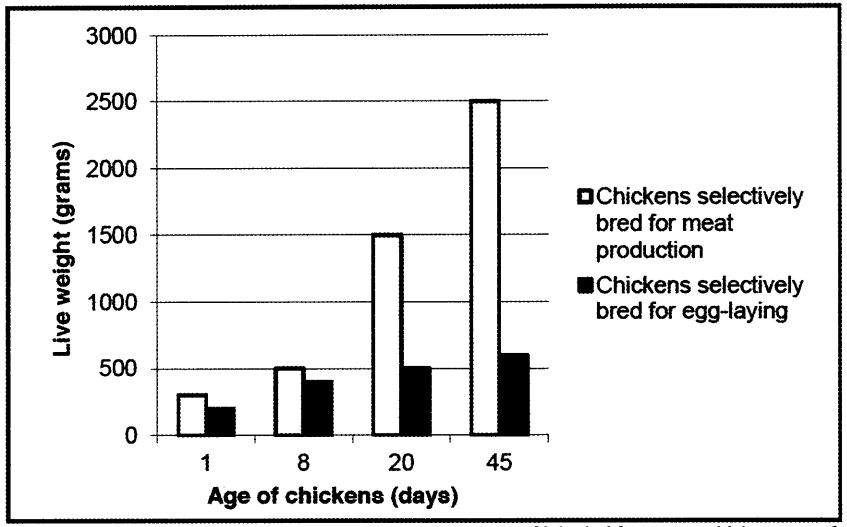
The results of the investigation are shown in the graph below.



[Adapted from www.chicken.org.au]

24.1 Formulate a hypothesis for this investigation. (2)

24.2 State the independent variable in this investigation. (1)

24.3 Calculate the percentage weight increase of the chickens that were selectively bred for meat between day 8 and day 45. Show ALL working. (2)

24.4 State ONE advantage of repeating the investigation with 100 chickens. (2)

24.5 State THREE factors that the learners should keep constant in this investigation. (3)

24.6 Write a suitable conclusion for the investigation based on the results in the graph. (2)

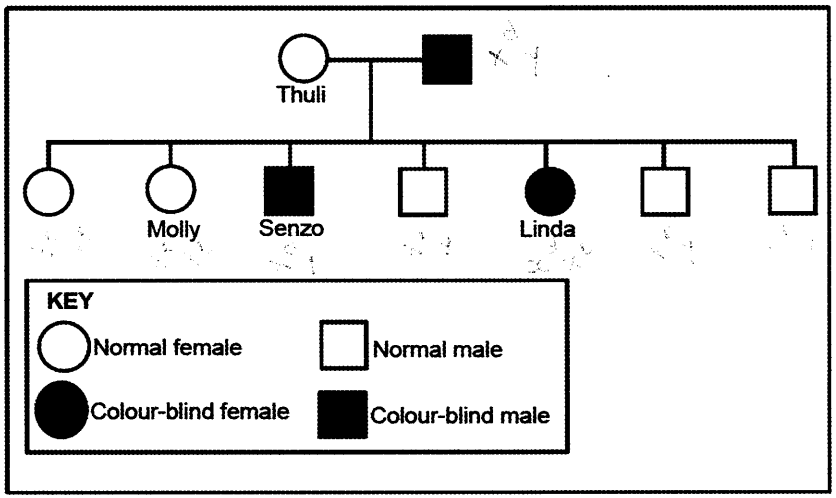
24.7 State TWO benefits of the selective breeding of chickens, other than for increasing meat production. (2)

24.8 Explain ONE reason why selective breeding of chickens for better meat production may not be an advantage for the chickens if they were to live in the wild. (2)
(16)

Question 25

Colour-blindness (Daltonism) is a sex-linked disorder caused by a recessive allele (X^d).

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



25.1 Give the:

(a) Phenotype of Senzo (1)

(b) Genotype of Thuli (1)

25.2 Describe how Linda inherited colour-blindness. (2)

25.3 Explain why there are generally more males than females with colour-blindness in a population. (4)

25.4 Molly married a 'normal male'. Use a genetic cross to show the possible genotypes and phenotypes of their children. (6)
(14)

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Question 26

The inheritance of fur colour in cats is sex-linked. The tortoise-shell colour of cats is a combination of black and orange fur. The allele for black fur is represented by X^B and the allele for orange fur is represented by X^O.

A female cat with a tortoise-shell colour mates with an orange male cat.

HINT: The sex chromosomes/gonosomes in cats are the same as in humans.

26.1 Use the symbols X^B, X^O and **Y** to represent a genetic cross of the mating stated above. Also indicate the proportion of the F_1 phenotypes. (7)

26.2 Explain why the male kittens can never have the tortoise-shell colour. (2)

26.3 Explain why the female kittens can have the tortoise-shell colour. (2)
(11)

Question 27

The table below shows the birth weight and the number of babies that survive at the different weights.

Birth weight (kg)	Number of babies surviving
1,0–1,5	100
1,6–2,0	200
2,1–2,5	300
2,6–3,0	1 300
3,1–3,5	2 300
3,6–4,0	1 200
4,1–4,5	250
4,6–5,0	150

[Source: *Basic Genetics, A Human Approach*, 1991]

27.1 Draw a histogram using the information in the table above. (7)

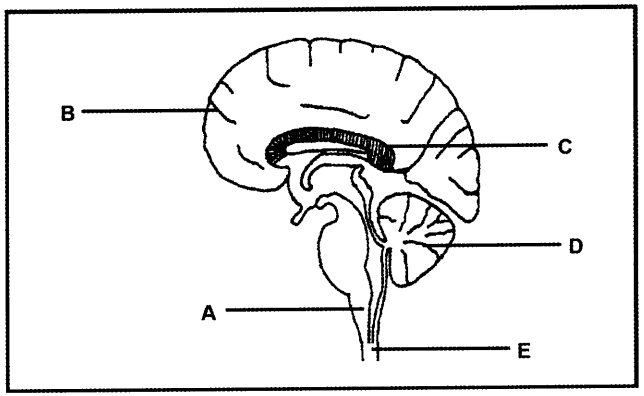
27.2 Name the type of inheritance that is controlled by many genes, such as in birth weight. (1)

27.3 How is the type of inheritance mentioned in QUESTION 27.2 different from that of inheritance due to one gene? (2)
(10)

NERVOUS CO-ORDINATION

Question 1

The diagram below represents the central nervous system in a human.



1.1 Identify part:

(a) **A** (1)

(b) **C** (1)

(c) **D** (1)

1.2 State THREE functions of part **B**. (3)
(6)

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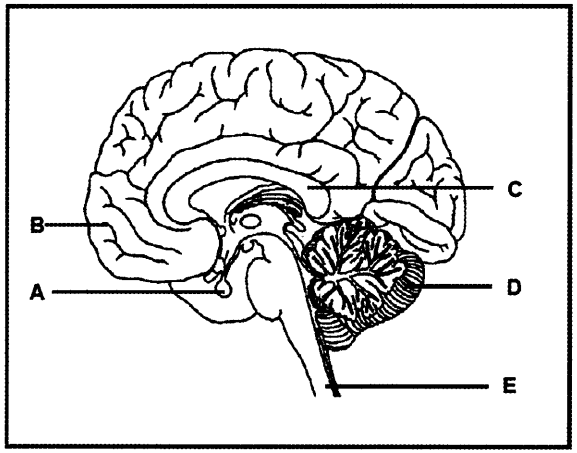
Question 2

The diagram below represents a human brain.



2.1 Memorising a cellular phone number (2)

2.2 Coordinating all voluntary movements (2)

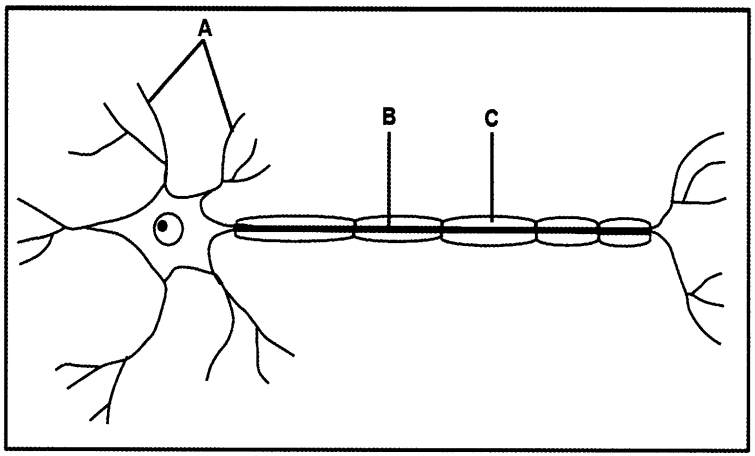
2.3 Secreting hormones (2)

2.4 Connecting the two hemispheres of part **B** (2)

2.5 The reflex action that occurs when stepping barefooted on a sharp object (2)
(10)

Question 3

The diagram below represents a neuron in a human.



3.1.1 Identify the type of neuron represented in the diagram. (1)

3.1.2 State ONE function of part **B**. (1)

3.1.3 Explain the role of part **C** in the functioning of the neuron. (2)

3.1.4 Explain the consequence for a reflex action if the neuron shown in the diagram is damaged. (2)
(6)

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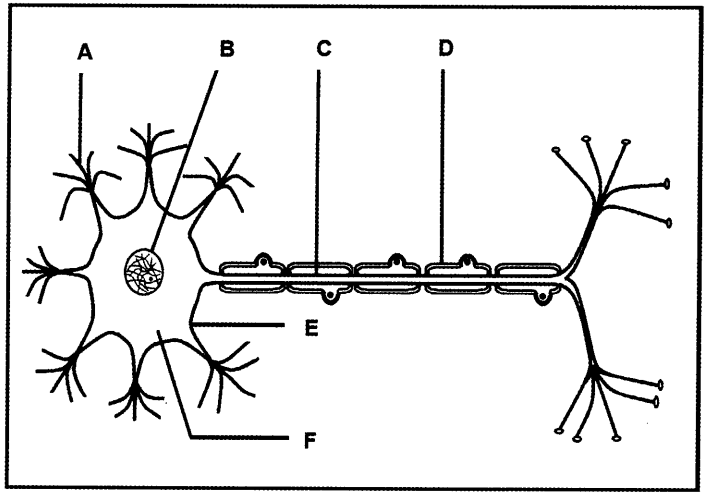
Question 4

The diagram below represents the structure of a neuron.



4.1 Name the type of neuron in the diagram above. (1)

4.2 Identify part:

(a) **B** (1)

(b) **F** (1)

(c) **A** (1)

4.3 Give the LETTER and NAME of the part that:

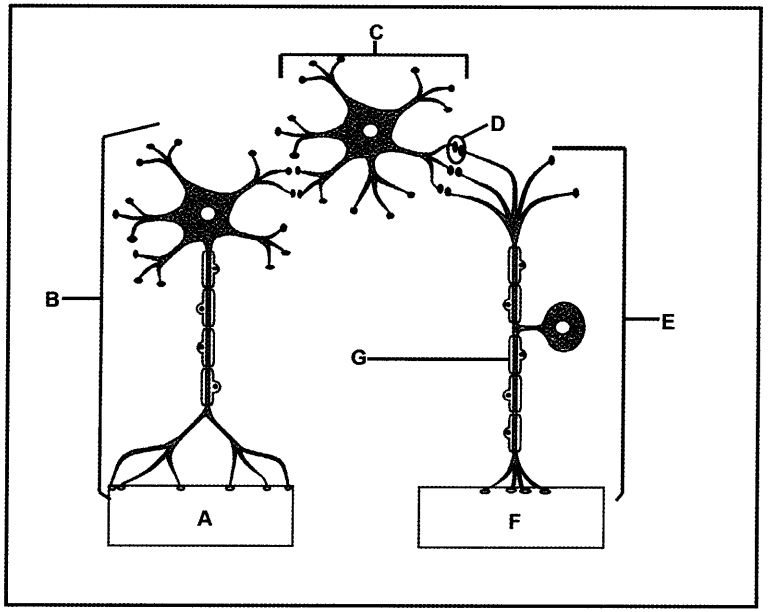
(a) Transmits impulses away from the cell body (2)

(b) Insulates and speeds up the transmission of impulses (2)

4.4 Name the condition caused by the progressive degradation of part **D**. (1)
(9)

Question 5

The diagram below represents a possible 'path' followed by an impulse when a person touches a hot plate.



5.1 Name the 'path' represented in the diagram. (1)

Identify the type of neuron represented by:

(a) **B** (1)

(b) **C** (1)

(c) **E** (1)

5.2 Give the LETTER only of the part that represents the:

(a) Receptor (1)

(b) Effector (1)

5.3 Give the LETTER and NAME of the:

(a) Region where the impulse is transmitted chemically (2)

(b) Part that has an insulating function (2)
(10)

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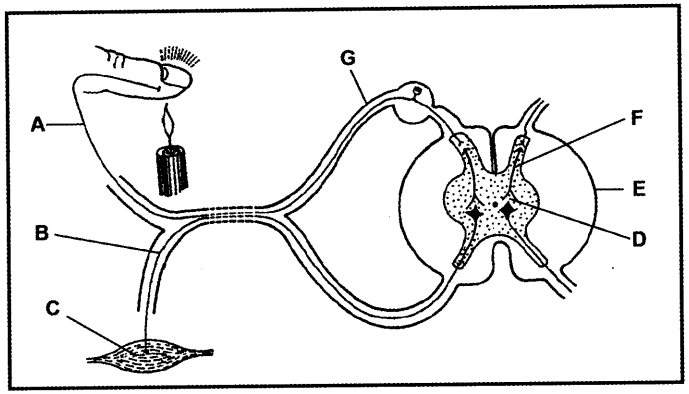
Question 6

The diagram below shows a part of the central nervous system.



6.1 Give labels for each of the following:

(a) **C**

(b) Microscopic gap **D**

(c) **E**

(d) **F**

(e) **G** (5)

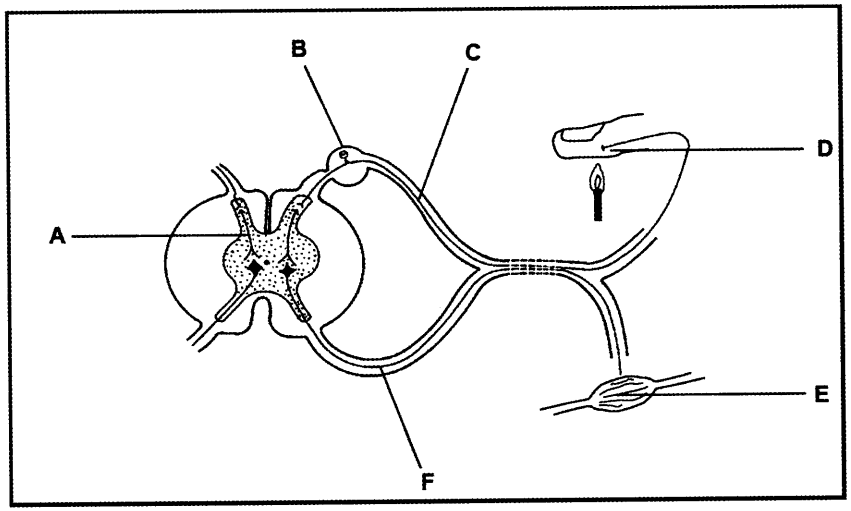
6.2 Explain ONE consequence for the body if **A** is damaged. (2)

6.3 Give TWO examples of reflex actions. (2)

6.4 Draw a labelled diagram of neuron **B** to show its structure. (5)
(14)

Question 7

The diagram below shows a reflex arc.



7.1 Give ONLY the LETTER of the part that represents the:

(a) Effector (1)

(b) Interneuron/Connector neuron (1)

(c) Sensory neuron (1)

7.2 Give the LETTER and NAME of the neuron in the diagram that is probably damaged if a person is able to detect the stimulus, but cannot respond. (2)

7.3 State if the nerve impulse travels from **D** to **E** or from **E** to **D**. (1)
(6)

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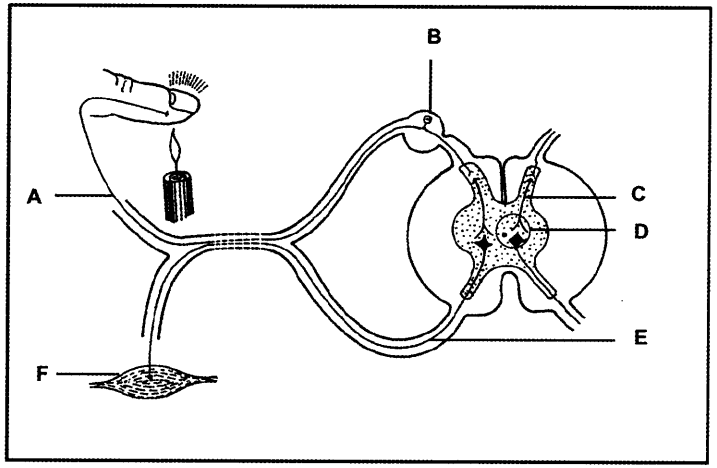
Question 8

The diagram below represents a reflex arc.



8.1 Give the LETTER and NAME of the part that:

(a) Controls one-directional transmission of impulses (2)

(b) Transmits impulses from the sensory neuron to the correct motor neuron (2)

(c) Transmits impulses to the cell body (2)

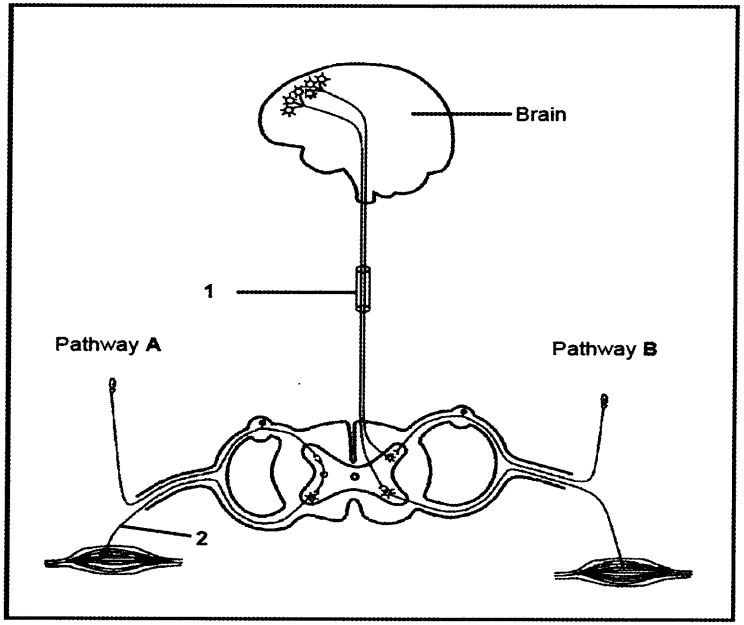
8.2 Give only the LETTER of the:

(a) Neuron that is damaged when a person is able to feel pain, but cannot react to the stimulus (1)

(b) Effector (1)
(8)

Question 9

The diagram below represents two possible pathways, A and B, which a nerve impulse may follow in the human body.



9.1 **Which pathway, A or B, represents a reflex arc?** (1)

9.2 **Give a visible reason in the diagram for your answer to QUESTION 9.1** (1)

9.3 **Describe the importance of a reflex action in the human body.** (3)

9.4 **Identify the part of the nervous system represented by 1.** (1)

9.5 **Explain ONE way in which the myelin sheath is important in the functioning of neurons.** (2)

9.6 **Describe how the person would be affected if the axon of neuron 2 was cut.** (2)

9.7 **Describe pathway B.** (6)
(16)

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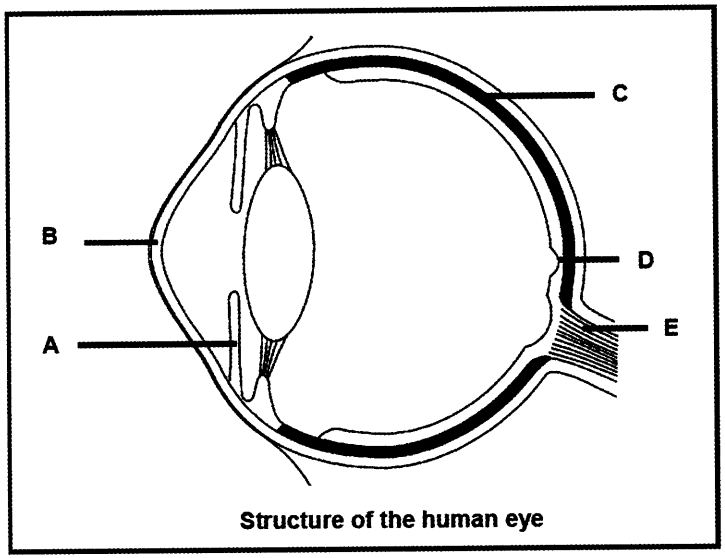
Question 10

The diagram below represents the structure of the human eye.



Structure of the human eye

Give the LETTER and the NAME of the part which:

10.1 Regulates the amount of light entering the eye (2)

10.2 Supplies food and oxygen to the eye (2)

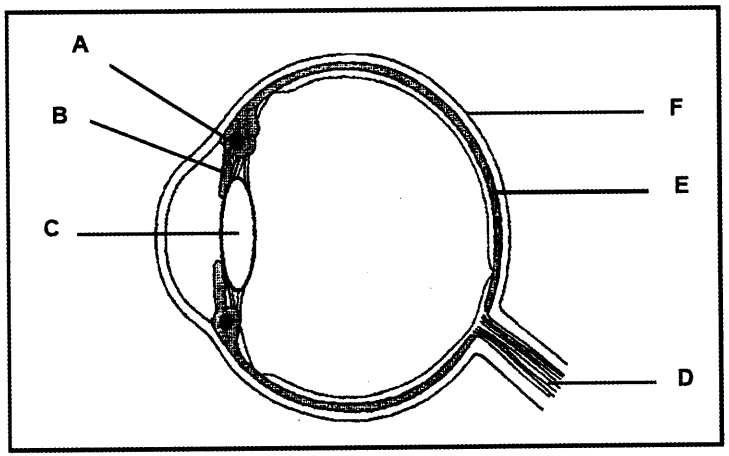
10.3 Transmits impulses to the brain (2)

10.4 Contains cones and is the area of clearest vision (2)

10.5 Assists in the refraction of light rays (2)
(10)

Question 11

Study the diagram of a longitudinal section through a human eye below.



11.1 Label parts **A**, **B** and **E**. (3)

11.2 Give the LETTER only of the part which:

(a) Protects the delicate internal structures (1)

(b) Transmits impulses to the cerebrum (1)

(c) Becomes cloudy or opaque as a person gets older, leading to decreased vision (1)

(d) Contracts or relaxes when the distance of an object from the eye changes (1)
(7)

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Question 12

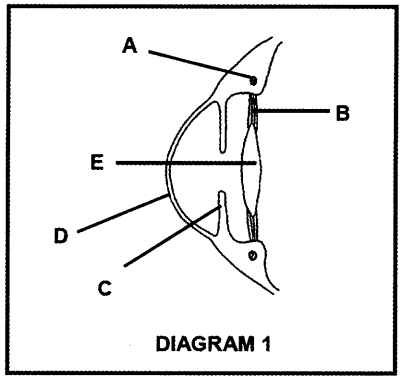


DIAGRAM 1

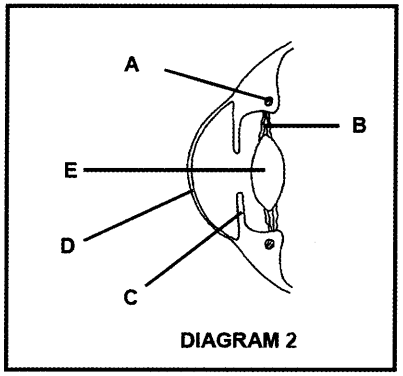


DIAGRAM 2

12.1 Give the LETTER and NAME of the part that:

(a) Contracts to change the shape of the lens (2)

(b) Controls the amount of light that enters the eye (2)

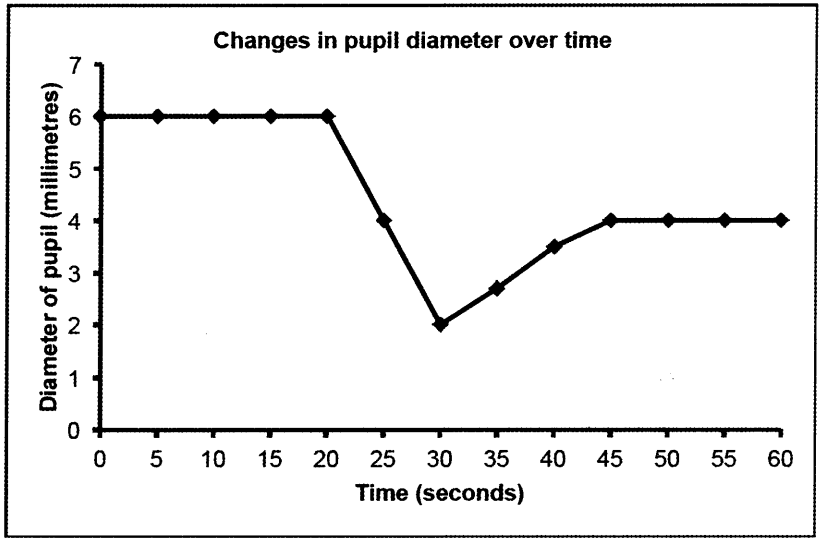
(c) Is protected by the conjunctiva (2)

12.2 Study DIAGRAM **1** and DIAGRAM **2**. What process is responsible for the change in the shape of the part **E**? (1)

12.3 Which diagram (**1** or **2**) represents the state of the eye when a person is reading a book? (1)
(8)

Question 13

The graph below indicates the changes in diameter of the pupil of the human eye.



13.1 Which structure in the human eye is responsible for the changes indicated in the graph? (1)

13.2 During which period of time was the person moving from **dim light** to **bright light**? (1)

13.3 Describe the changes that took place in the eye that led to the diameter change indicated from 30 to 35 seconds. (3)

13.4 Draw a labelled diagram of the front view of the eye to show the exact size of the pupil at 20 seconds, as indicated in the graph. (4)
(9)

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Question 14

Jabu took part in an experiment on the eye's response to light. A lamp was placed at seven positions from Jabu's face. The diameter of Jabu's pupil was measured at each position.

The results are shown in the table below.

POSITION OF THE LAMP	DIAMETER OF THE PUPIL (mm)
1	1,2
2	1,8
3	2,4
4	3,0
5	3,6
6	4,2
7	4,8

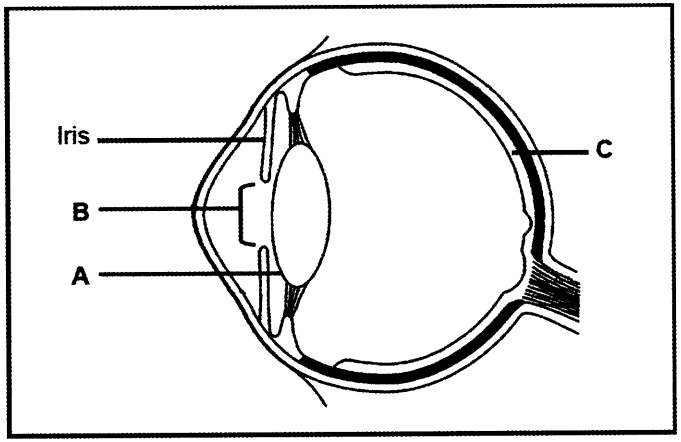
14.1 (a) At which position was the lamp furthest from the eye? (1)

(b) Explain your answer to QUESTION 14.1 (a) (2)

14.2 When the lamp was moved from position 1 to position 2, describe the mechanism that caused the change in the diameter of the pupil. (4)
(7)

Question 15

The diagram below represents the structure of the human eye.



15.1 State ONE function of part:

(a) **A** (1)

(b) **C** (1)

15.2 Nocturnal animals sleep during the day and are active at night.

Explain how part:

15.3 (a) **B** of nocturnal animals will differ from that found in animals that are active during the day (2)

(b) **C** of nocturnal animals will differ from that found in animals that are active during the day (2)

15.4 Describe how the iris controls the amount of light entering the eye when a person is exposed to bright light. (4)
(10)

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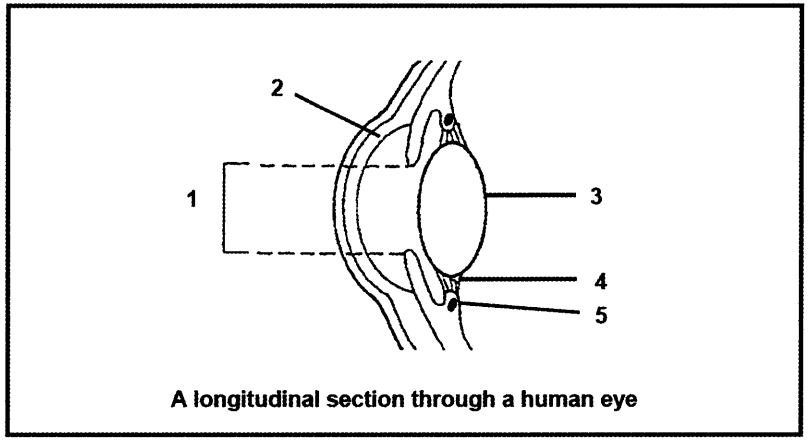
Question 16

Study the diagram below showing a longitudinal section through an eye.



A longitudinal section through a human eye

16.1 Label parts **2**, **3**, **4** and **5** respectively. (4)

16.2 Name and describe the process that causes part **1** to dilate. (6)

16.3 State how the following defects can be treated to improve vision:

(a) Long-sightedness
(b) Astigmatism
(c) Cataract
(d) Short-sightedness (4)

Question 17

Topsie did an investigation to determine the effect of distance on the curvature (thickness) of the lens of the human eye.

- She sat in a well-lit room.
- She covered her one eye with an eye patch.
- A pencil was held in front of her uncovered eye for 10 seconds.
- She focussed on the pencil until a clear image could be seen and at the same time the curvature of the lens of her eye was measured with an optical instrument.
- The pencil was then moved to different distances from the eye and the curvature of the lens of the eye was measured each time.

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

DISTANCE OF THE PENCIL FROM THE EYE (cm)	CURVATURE OF THE LENS OF THE EYE (mm)
10	4,0
20	3,6
30	3,2
50	2,9
100	2,7
150	2,6
200	2,6

17.1 In this investigation:

(a) Which is the dependent variable? (1)

(b) Which is the independent variable? (1)

17.2 State TWO factors that must be kept constant during the investigation. (2)

17.3 Explain why the factors named in QUESTION 17.2 must be kept constant. (2)

17.4 Describe the relationship between the distance of the pencil from the eye and the curvature of the lens of the eye. (3)

17.5 Name TWO structures in the eye that are responsible for the changes in the curvature of the lens. (2)
(11)

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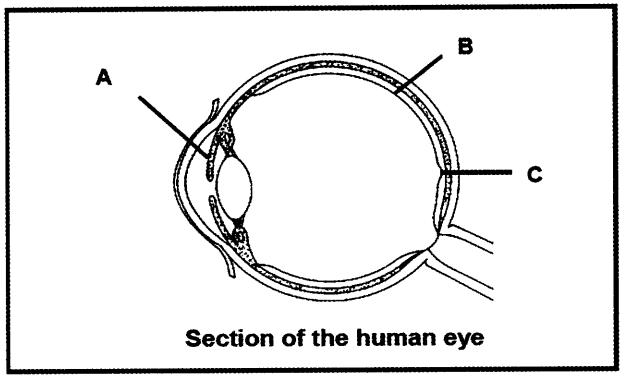
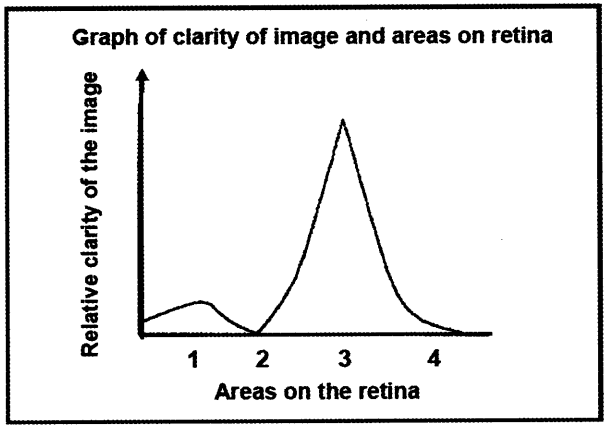
Question 18

Study the diagram and the graph below and answer the questions that follow



Section of the human eye



18.1 Explain ONE way in which part **B** is suitable for its function. (2)

18.2 Explain how and why the part labelled **A** makes adjustments when a person moves from bright light into a dark room. (5)

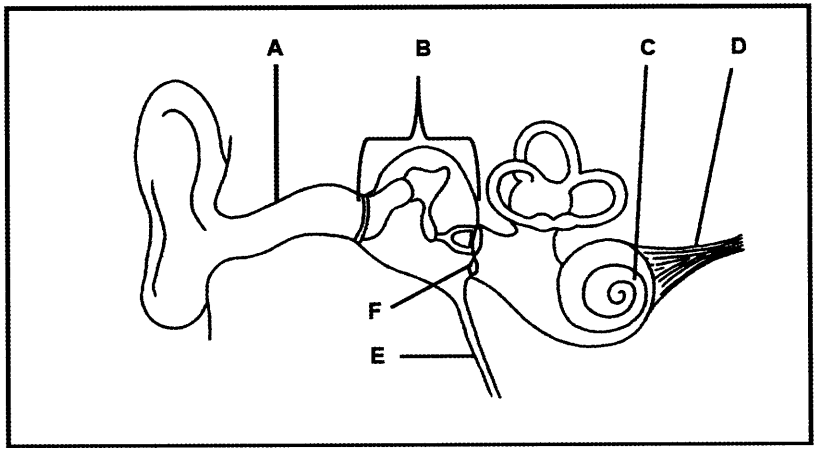
18.3 Which NUMBER (1–4) on the graph represents **C** in the diagram? (1)

18.4 Give a reason for your answer to QUESTION 18.3. (1)

18.5 Name the part of **B** in the diagram which corresponds to number **2** on the graph. (1)
(10)

Question 19

Study the diagram below.



19.1 Give ONE function of part:

(a) **A** (1)

(b) **E** (1)

(c) **F** (1)

19.2 Write down only the LETTER of the part where sound is transmitted in the form of:

(a) A pressure wave in a liquid (1)

(b) An electrical impulse (1)

19.3 Explain the effect if the receptors in region **C** are damaged. (3)

19.4 Describe how the parts of the middle ear, including the membranes, assist with amplifying sounds. (3)

19.5 Describe the role of the semi-circular canals in maintaining balance. (4)
(15)

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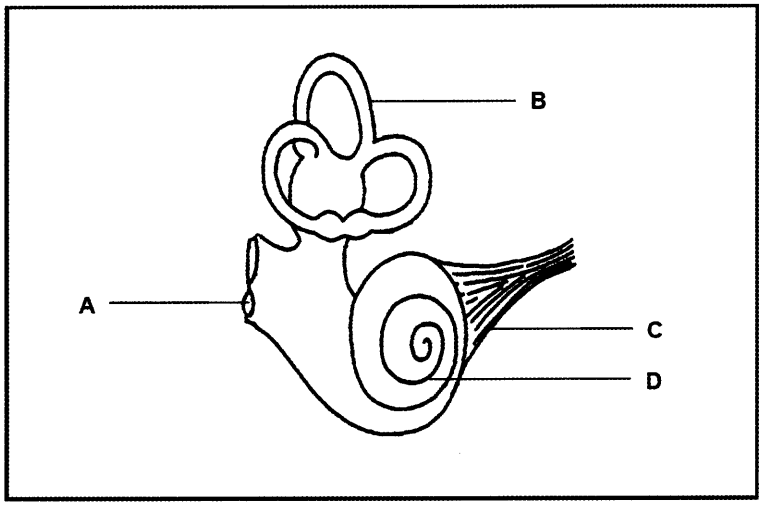
Question 20

The diagram below represents a part of a human ear.



20.1 Identify part:

(a) **A** (1)

(b) **D** (1)

20.2 Name the receptors that are found in part **B.** (1)

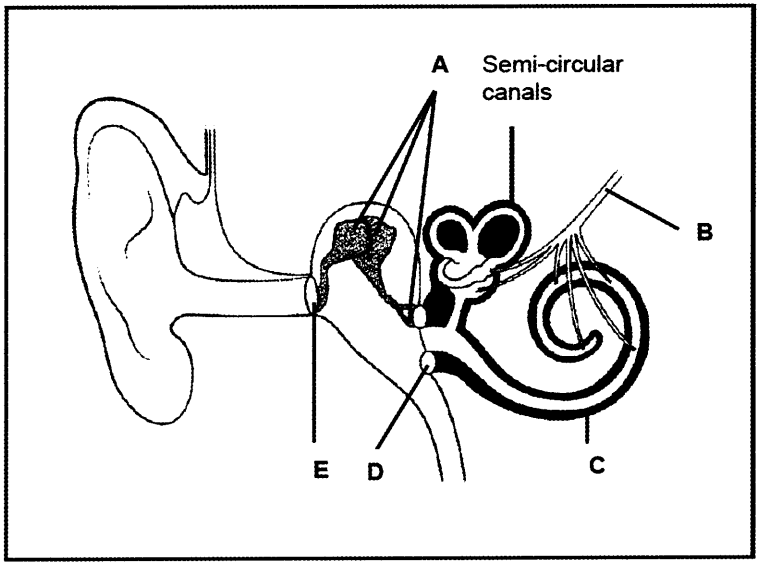
20.3 Explain the consequence to the human body if:

(a) Part **C** is damaged (2)

(b) Part **A** becomes hardened (2)
(7)

Question 21

Study the diagram of the human ear below.



21.1 Identify:

(a) **B** (1)

(b) **D** (1)

21.2 Which part of the brain will receive impulses from part **C**? (1)

21.3 Describe the role of the semi-circular canals in maintaining balance. (5)

21.4 Describe how an increased production of mucus in the nose and throat may lead to the bursting of part **E**. (3)

21.5 Explain why fusion of the structures at **A** may lead to hearing loss. (2)
(13)

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Question 22

A goalkeeper in a soccer match prevented a goal from being scored when he dived to his right after the ball was kicked towards him. Just before he dived, he heard his team-mate shout, 'your ball'.

Describe how his eyes adjusted to see the ball as it travelled towards him and describe how he heard his team-mate and maintained his balance as he dived to save the ball.

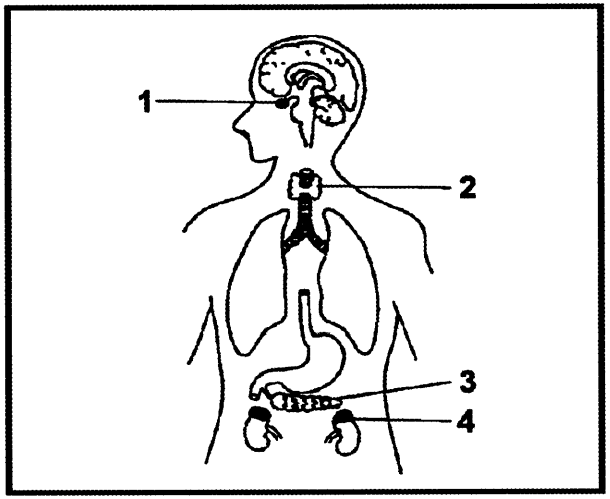
Content: **(17)**
Synthesis: **(3)**

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

ENDOCRINE SYSTEM

Question 1

Study the diagram below and answer the questions that follow.



1.1 Label the parts numbered **1** and **4**. (2)

1.2 Write down only the NUMBER of the gland that:

(a) Produces the hormone glucagon
(b) Produces a hormone that controls the growth of long bones
(c) Produces an iodine-containing hormone
(d) Produces a hormone that is involved in the re-absorption of some salts by the kidneys (4)

1.3 State TWO similarities between hormones and nerves with regard to their functions. (2)

1.4 State ONE functional difference between hormones and motor nerves. (2)
(10)

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Question 2

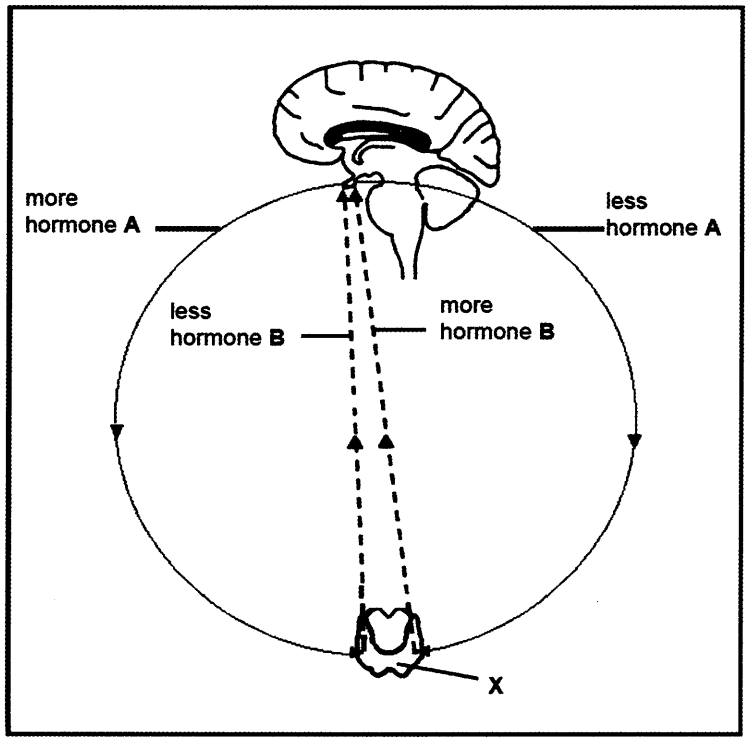
The endocrine system plays a role in helping a person to cope during a dangerous situation.

2.1 Name the hormone that is secreted in the person's body in response to a dangerous situation. (1)

2.2 State THREE effects that the hormone in QUESTION 2.1 has on the body. (3)
(4)

Question 3

The diagram below shows the hormones involved in the homeostatic control of metabolism in the human body. **X** is a gland found around the larynx in the neck.



3.1 Identify EACH of the following:

(a) The gland that secretes hormone **A** (1)

(b) Hormone **B** (1)

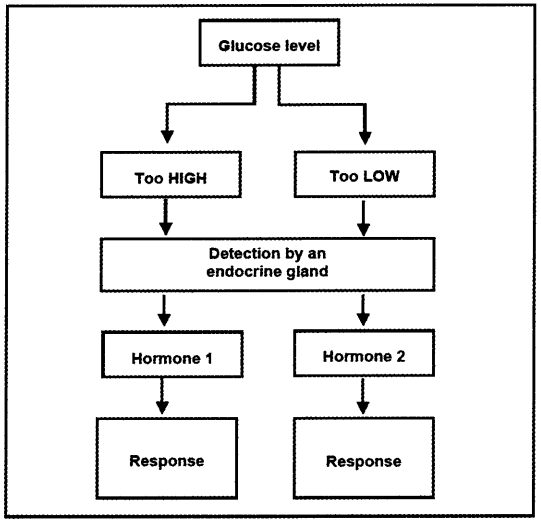
3.2 Name the mechanism in the diagram that regulates the level of hormone **B**. (1)

3.3 Half of gland **X** was surgically removed in a person.

State TWO possible effects that this would have on the secretion of the hormones referred to in the diagram above. (2)
(5)

Question 4

Study the flow diagram below showing the response of an endocrine gland to changes in the amount of glucose found in the blood.



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4.1 Define the term *endocrine gland.* (2)

4.2 Identify:

(a) Hormone 1 (1)

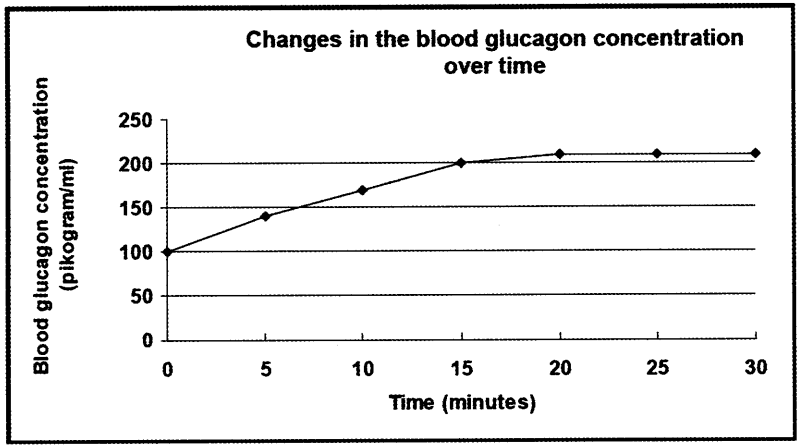
(b) Hormone 2 (1)

4.3 Name the gland that releases hormone 1 and hormone 2. (1)

4.4 Explain the consequences for a person if the gland mentioned in QUESTION 4.3 fails to release hormone 1. (4)
(9)

Question 5

Study the graph below showing the changes in the glucagon concentration during exercise.



5.1 Describe the trend for the changes in the glucagon level over time. (3)

5.2 Explain the changes in the level of glucagon from 0 to 10 minutes. (3)

5.3 Taking into account the pattern for glucagon concentration from 0 to 10 minutes in the graph above, what will you expect to happen to the insulin concentration for the same period? (1)

5.4 Explain why people with diabetes mellitus have very little glycogen in their liver and muscle cells. (3)
(10)

Question 6

Diabetes mellitus is usually linked to the body mass index (BMI), which is calculated as follows:

$$\text{BMI} = \frac{\text{mass (kg)}}{\text{height}^2\ (\text{m}^2)}$$

An investigation was done to determine the relative risk of developing diabetes mellitus in females for each BMI.

The results are shown in the table below.

Body mass index (BMI) (kg/m^2)	Relative risk of developing diabetes mellitus in females (%)
<20	7,5
20–25	18,0
26–30	37,5
31–35	57,0
>35	74,5

[Adapted from American Diabetics Association, March 2007]

6.1 Draw a histogram using the data in the table above. (6)

6.2 Name the hormone that results in diabetes mellitus when it is deficient. (1)

6.3 Name the organ that secretes the hormone mentioned in QUESTION 6.2 (1)

6.4 State TWO other hormones (except the one mentioned in QUESTION 6.2 that influence the glucose level of the blood. (2)
(10)

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Question 7

Name and state the functions of FOUR hormones secreted by the pituitary gland in humans. Describe how the pituitary gland controls the functioning of the thyroid gland using negative feedback.

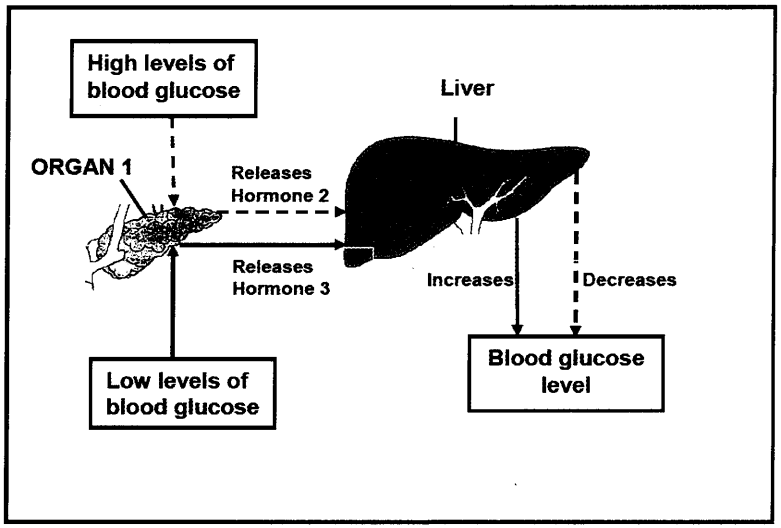
Content (17)
Synthesis (3)
(20)

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

HOMEOSTASIS

Question 1

Study the flow diagram below.



Identify:

1.1 Organ **1** (1)

1.2 Hormone **2** (1)

1.3 Hormone **3** (1)

1.4 The disorder caused when organ **1** fails to release sufficient amounts of hormone **2** (1)

1.5 The mechanism that controls the levels of glucose in the body (1)
(5)

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Question 2

Describe the homeostatic control of blood glucose levels in a person who consumed a drink with a large amount of sugar. **(5)**

Question 3

An investigation was carried out to determine the influence of alcohol on the volume of urine produced.

12 healthy, 23-year-old males of similar height and mass participated in the investigation.

The investigation was conducted as follows:

- The men were divided into two groups of six each, Group **A** and Group **B**.
- The two groups ate the same food and did the same exercise for the 24-hour-period before testing.
- Each group was given the following to drink after the 24-hour-period:
  - Group **A**: 1 litre of alcohol-free beer (beer that does not contain alcohol)
  - Group **B**: 1 litre of alcoholic beer
- Urine was collected from each man every hour.

Assume that the volume of urine collected is equal to the volume of urine produced.

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

TIME OF COLLECTION	AVERAGE VOLUME OF URINE COLLECTED (mℓ)	
	GROUP A	GROUP B
After 1 hour	599	643
After 2 hours	413	504
After 3 hours	112	132

3.1 State:

(a) The dependent variable in this investigation (1)

(b) TWO planning steps the investigators had to take before the investigation could start (2)

(c) TWO factors that need to remain constant, other than the ones already mentioned (2)

(d) TWO steps that the investigators took to ensure the reliability of the investigation (2)

3.2 Based on the results, explain how the intake of alcohol influences the secretion of ADH and consequently the volume of urine that is produced by the kidneys. (4)
(11)

Question 4

The table below shows the change in the concentration of carbon dioxide (CO_2) in a person's veins, as exercise levels increase.

The person in the investigation was asked to ride a bicycle which generated electricity, measured in watts. The faster the person cycled, the more watts he generated.

EXERCISE (watt)	CO_2 CONCENTRATION IN VENOUS BLOOD (mol/mℓ)
0	0,50
50	0,51
100	0,53
150	0,55
200	0,55
250	0,54

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4.1 What is a normal carbon dioxide concentration in the venous blood for this person? (1)

4.2 Explain the significance of measuring the carbon dioxide concentration in the blood when the person is not doing any exercise. (2)

4.3 Explain why the carbon dioxide concentration in the veins increased during strenuous exercise. (2)

4.4 Describe the homeostatic response that takes place in the body to reduce the carbon dioxide concentration when exercising between 200 and 250 watts. (6)
(11)

Question 5

The table below shows how body temperature is regulated by the hypothalamus by influencing heat production and heat loss.

BODY TEMPERATURE (°C)	HEAT PRODUCTION (JOULES PER SECOND)	HEAT LOSS (JOULES PER SECOND)
36,4	320	5
36,6	260	5
36,8	150	35
36,9	90	90
37,0	90	100
37,2	90	180
37,4	90	310

[Adapted from *Cambridge Biology*, 2002]

5.1 Are the blood vessels that supply blood to the skin constricted or dilated when the body temperature is 36,4 °C? (1)

5.2 Explain the advantage of the diameter of the blood vessels (constricted/dilated) mentioned in your answer to QUESTION 5.1. (4)

5.3 Heat loss is the greatest at 37,4 °C. Explain how the body is able to increase heat loss. (4)
(9)

Question 6

An increase in the metabolic rate during strenuous exercise causes a decrease in the glucose level and an increase in the CO_2 level in the blood.

Describe the mechanism that leads to an increase in the metabolic rate and the mechanisms involved in increasing the glucose level and decreasing the CO_2 level back to normal.

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

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

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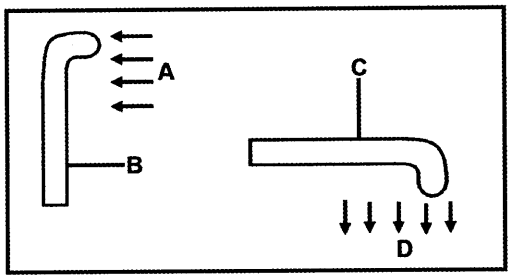
PLANT HORMONES

Question 1

The diagrams below represent the growth responses of two different plant organs to external stimuli.



1.1 Name the group of plant hormones that is responsible for the growth responses observed in the diagrams. (1)

1.2 Name the external stimulus at:

1.3 (a) **A** (1)

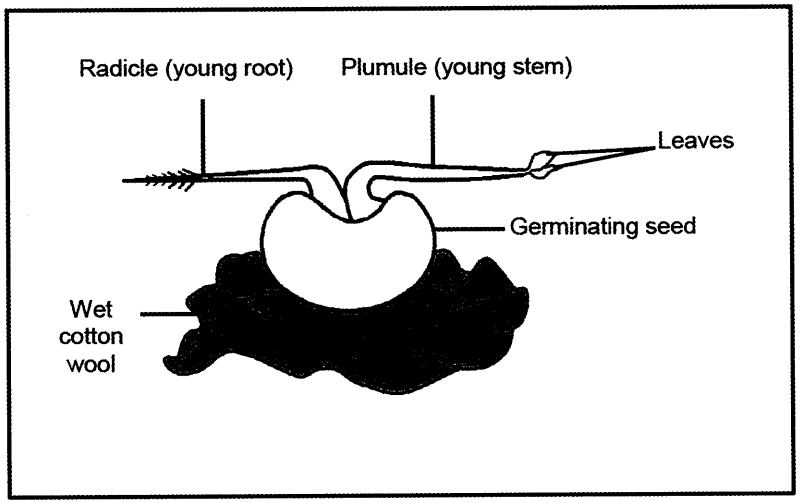
(b) **D** (1)

1.4 Give ONE observable reason why plant organ **B** is a stem. (1)

Explain the growth response observed in plant organ **C**. (3)
(7)

Question 2

The diagram below represents a germinating seed. Assume that the radicle and plumule were exposed to uniform light from all directions.



2.1 Define *tropism*. (2)

2.2 Draw a labelled diagram to show the position of the radicle and plumule in the seedling one week later. (4)
(6)

2.3 Auxins influence the growth of stems and roots.

2.3.1 State where auxins are produced in a plant. (1)

2.3.2 Describe the effect of auxins on a plant stem that is exposed to unilateral light. (4)
(5)

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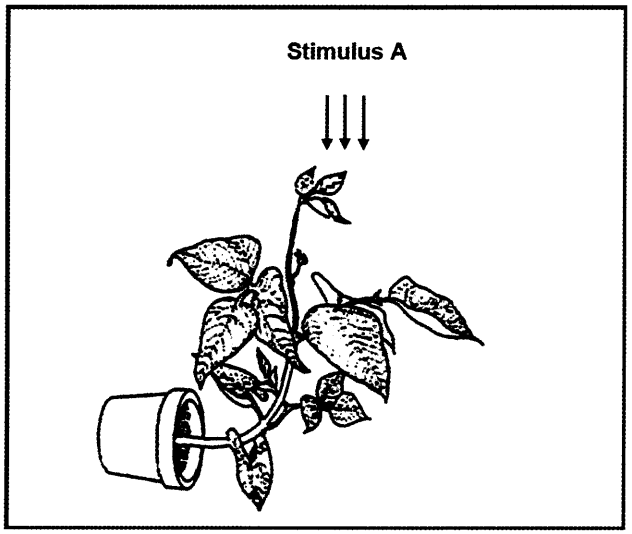
Question 3

The diagram below shows the growth movement of a part of a plant toward a stimulus.



3.1 What growth movement is represented in the diagram? (1)

3.2 Identify the stimulus labelled **A**. (1)

3.3 Name the growth hormone that is responsible for the growth movement named in QUESTION 3.1 (1)

3.4 Will a high concentration of the growth hormone named in QUESTION 3.3 **stimulate** or **inhibit** growth in the roots? (1)

3.5 Name the phenomenon where the buds at the tip of the plant regulate the growth of the lateral branches. (1)
(5)

Question 4

Diagram **A** shows an upright pot plant. Diagram **B** shows the same pot plant one week after falling over. The plant was exposed to uniform light from all directions before and after falling over.

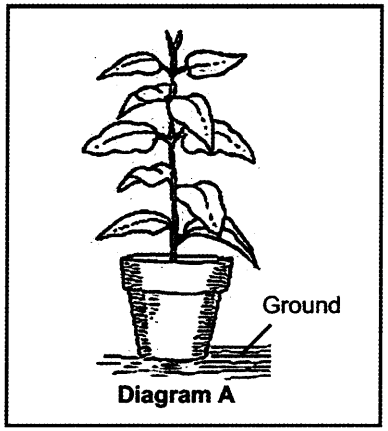


Diagram A

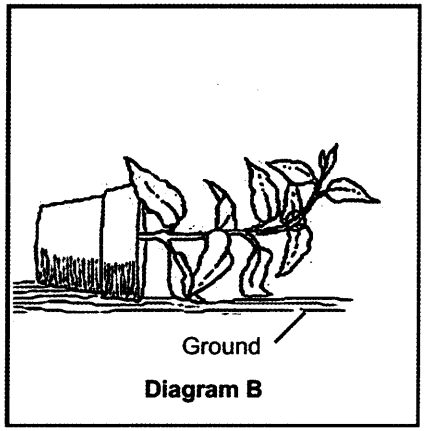


Diagram B

4.1 Which type of tropism is illustrated in diagram **B**? (1)

4.2 Explain why the stem of the plant bent upwards, as illustrated in diagram **B**. (4)

4.3 Explain the advantage that the upward bending of the stem could have for the plant. (2)

4.4 State how the roots in diagram **B** would react. (1)
(8)

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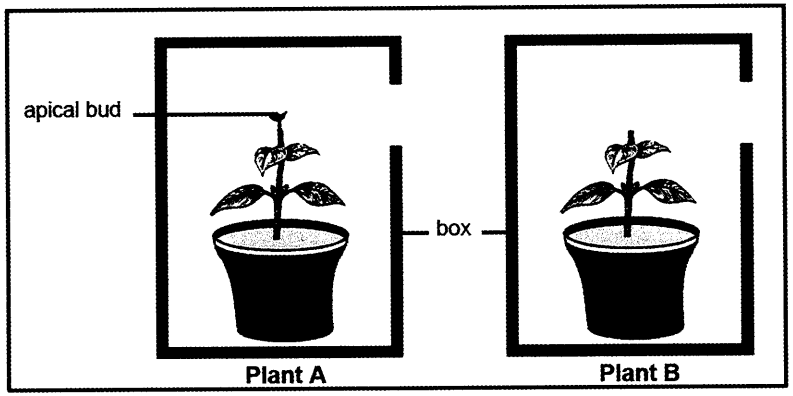
Question 5

The diagram below shows two plants (**A** and **B**) at the start of an investigation. The plants were treated in the following ways:

- No changes were made to plant **A**.
- The apical bud of plant **B** was removed.
- Each plant was covered with a box with a single opening, as shown in the diagram, and placed in a lit room.

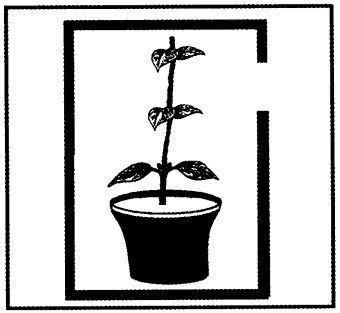


5.1 State the role of the boxes in the investigation. (1)

5.2 Name the hormone that is removed by cutting off the apical bud from plant **B**. (1)

5.3 Tabulate TWO differences between plants **A** and **B** you would expect after two weeks. (5)

5.4 The diagram below shows plant **B** seven days after being sprayed with gibberellins.



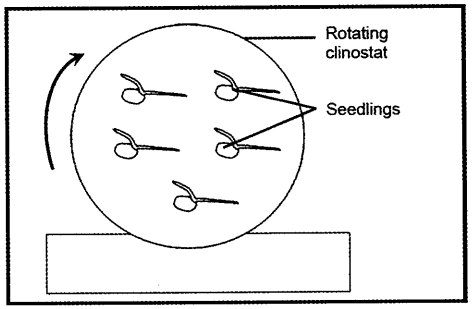
Explain the effect that the gibberellins had on the plant by referring to the changes observed in the diagram. (2)
(9)

Question 6

A learner conducted an investigation to determine the effect of auxins and the effect of gravity on root growth in pea seedlings. He used the following procedure:

- He germinated pea seeds for seven days.
- He then took a sample of 15 seedlings and divided them into 3 groups (A to C) of 5 seedlings each.
- In each group the 5 seedlings were placed **horizontally** on 3 different clinostats.

A clinostat is a device which has a disc that rotates at a constant speed.
A diagram of a clinostat is shown below.



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- He removed the root tips of all 5 seedlings at the same length in group B.
- In groups A and B the clinostats were left stationary (no rotation).
- In group C the clinostat was allowed to rotate.
- All 3 clinostats were placed in a dark cupboard.

A summary of the learner's procedure is shown in the table below.

GROUP A	GROUP B	GROUP C
Root tips present	No root tips	Root tips present
Stationary clinostat	Stationary clinostat	Rotating clinostat

After two days the direction of root growth was observed.

6.1 Which TWO groups were used to obtain information about:

(a) The effect of auxins on root growth (1)

(b) The effect of gravity on root growth (1)

6.2 Explain why the apparatus was placed in a dark cupboard. (2)

6.3 Describe the expected results for each of groups **B** and **C** in this investigation. (2)

6.4 Explain the expected results for group **A**. (3)

6.5 State THREE ways in which the learner ensured a high level of validity for this investigation. (3)
(12)

Question 7

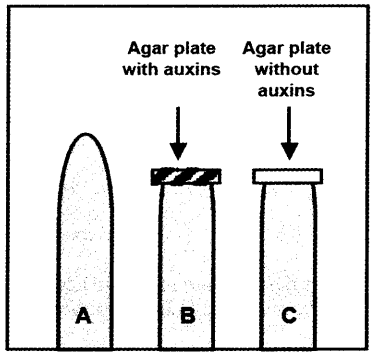
Thobeka investigated the effect of auxins on the growth of three plant shoots (**A**, **B** and **C**). The plant shoots were treated as follows:

- Shoot **A** – Not treated in any way
- Shoot **B** – Tip removed and agar plate with auxins placed on top
- Shoot **C** – Tip removed and agar plate without auxins placed on top

All shoots were exposed to the same light conditions.

NOTE: Agar is a jelly-like substance that allows auxins to diffuse through it.

The diagram below illustrates the set-up at the beginning of the investigation.



7.1 Identify the independent variable in this investigation. (1)

7.2 State TWO factors that must be kept constant in this investigation. (2)

7.3 Explain the results observed in:

(a) Shoot **B** after a few days (3)

(b) Shoot **C** after a few days (2)

7.4 Suggest TWO ways in which Thobeka could have improved the reliability of her investigation. (2)
(10)

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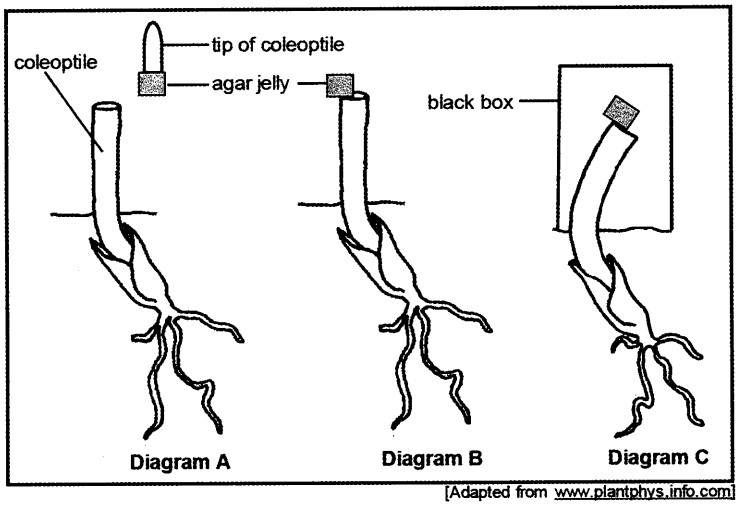
Question 8

An investigation was carried out to determine the effect of auxins on the growth of coleoptiles.

The procedure was as follows:

- The tip of one coleoptile (young shoot) was removed and placed on a block of agar jelly, as shown in diagram **A**.
- After two hours the agar jelly was placed on the cut surface of the original coleoptile, as shown in diagram **B**.
- The coleoptile was covered with a black box and allowed to grow for two days, as shown in diagram **C**.



[Adapted from www.plantphys.info.com]

8.1 Explain why the tip of the coleoptile was placed on the agar jelly for two hours at the start of the investigation. (2)

8.2 Describe what occurred in diagram **C** to cause the coleoptile to bend even though no light was present. (4)

8.3 Describe a control for this investigation. (2)
(8)

Question 9

The table below shows the concentration of abscisic acid and gibberellins in germinating seeds over 10 days.

TIME (DAYS)	HORMONE CONCENTRATION IN GERMINATING SEEDS (ARBITRARY UNITS)	
	ABSCISIC ACID	GIBBERELLINS
0	20	0
2	8	1
4	4	4
6	3	7
8	2	10
10	1	12

[Adapted from *Biology Cambridge*, 2013]

9.1 Draw a line graph to show the changes in the concentration of abscisic acid over the period of the investigation. (6)

9.2 State what happened to the concentration of each of the following hormones over the period of the investigation:

(a) Abscisic acid (1)

(b) Gibberellins (1)
(8)

9.3 Explain the growth response of a plant when the stem is exposed to light coming from one side only. **(4)**

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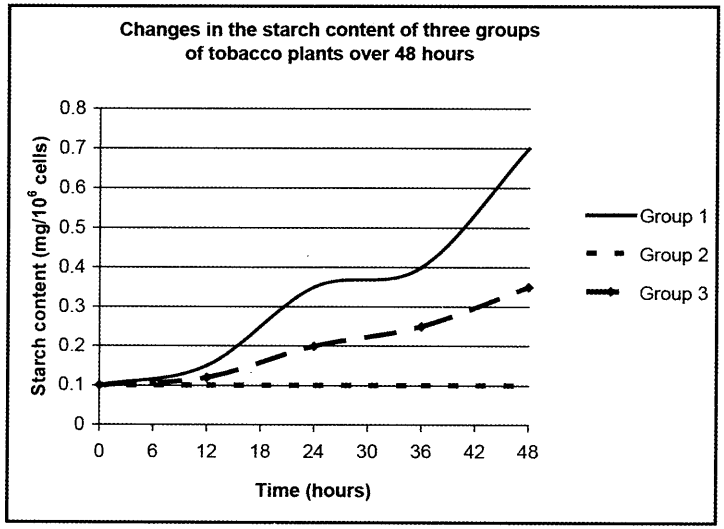
Question 10

An investigation was carried out to determine the effect of two plant hormones (**A** and **B**) on the accumulation of starch in the cells of tobacco plants.

The investigation was set up as follows:

- 30 tobacco plants of the same species, size and age were used.
- They were divided into 3 groups, each treated in a different way as follows:
  - Group 1: 10 plants were treated with hormone A
  - Group 2: 10 plants were treated with hormone B
  - Group 3: 10 plants were given no hormone treatment
- All the plants were then left under the same conditions. The starch content in the cells was measured after every 6 hours for each group.

The graph below shows the results of the treatments for a period of 48 hours.



10.1 Explain the purpose of Group 3 in the investigation. (2)

10.2 Using the results, indicate the function of:

(a) Plant hormone A (2)

(b) Plant hormone B (2)
(6)

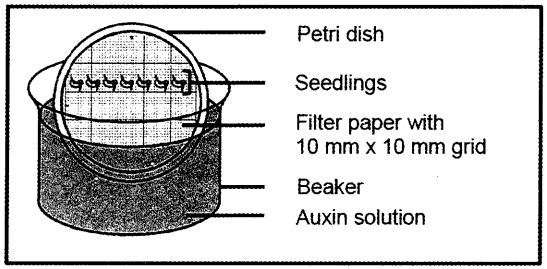
Question 11

A group of Grade 12 learners investigated the influence of different concentrations of auxins on plumule growth. A plumule is a young stem that grows from a seed.

The procedure was as follows:

- 35 bean seeds were germinated.
- The seedlings were then divided into five groups of seven seedlings each.
- In each group the seven seedlings were attached with Prestik to filter paper on which a 10 mm x 10 mm grid was drawn.
- The filter paper with seedlings was then glued to the inside of a petri dish.
- Each of these five petri dishes was placed in a beaker containing a different concentration of auxins.

The diagram below shows the set-up of a single beaker.



- All five beakers were placed inside a dark cupboard for three days.
- After three days the increase in the length of each plumule was measured.
- The average increase in length of the plumule in each beaker was calculated and recorded in the table below.

The table below shows the results of the investigation after three days.

BEAKER NUMBER	AUXIN CONCENTRATION IN PARTS PER MILLION (ppm)	AVERAGE INCREASE IN PLUMULE LENGTH (mm)
1	0,1	1,5
2	1	3,2
3	10	4,8
4	50	2,3
5	100	0

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11.1 For this investigation identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

11.2 State the purpose of the grid that was placed inside each petri dish. (1)

11.3 Explain why the beakers were placed in a dark cupboard. (2)

11.4 State ONE way in which the learners ensured the reliability of this investigation. (1)

11.5 State THREE factors, not indicated in the procedure, that should be kept constant during this investigation. (3)

11.6 State the conclusion that can be made from the results in the table. (2)
(11)

Question 12

Read the extract below and answer the questions that follow.

AUXINS AS HERBICIDES

There are many different herbicides (chemicals used as weed killers). Most herbicides that do not contain hormones damage the plant parts above the ground only, that is the leaves and stems. These herbicides are also poisonous to other organisms.

Hormone-based herbicides are usually a solution to this problem. They kill the plant as a whole and they are selective about which plants they target.

Usually auxins are used as herbicides because of their selective nature in the type of plant they affect. They are most effective against 'broad-leafed' dicotyledonous plants.

[Adapted from www.herbicidesymptoms.ipm.ucanr.edu]

12.1 Name ONE place in a plant where the auxins are naturally produced. (1)

12.2 State ONE function of auxins which results in the growth of a plant. (1)

12.3 Describe TWO disadvantages of using the herbicides that are NOT made of plant hormones. (4)

12.4 Explain why it would be a disadvantage for a farmer to use auxin herbicides in a field planted with beans that are dicotyledonous. (2)
(8)

Question 13

Plants and animals are both able to sense and respond to light. Explain how plant stems respond to unilateral light and describe the path taken by light through the human eye until it is converted into an impulse.
Content: (17)
Synthesis: (3)

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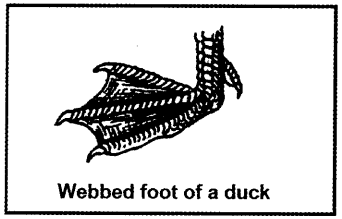
EVOLUTION

Question 1

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

Question 2

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



Webbed foot of a duck

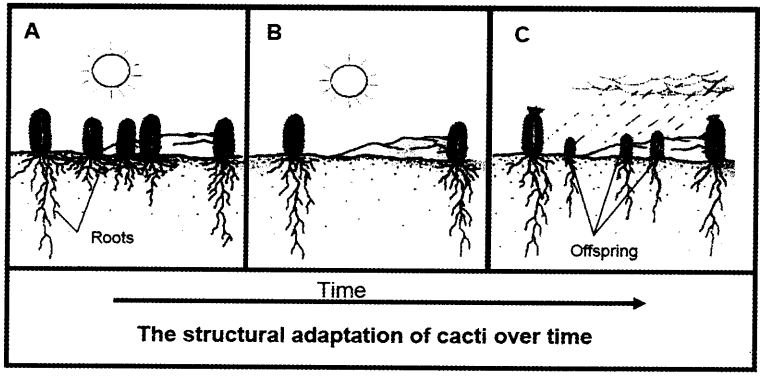
Ancestors of ducks did not have webbed feet. In terms of natural selection, explain how the webbed feet could have evolved. (7)

Question 3

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

Question 4

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



The structural adaptation of cacti over time

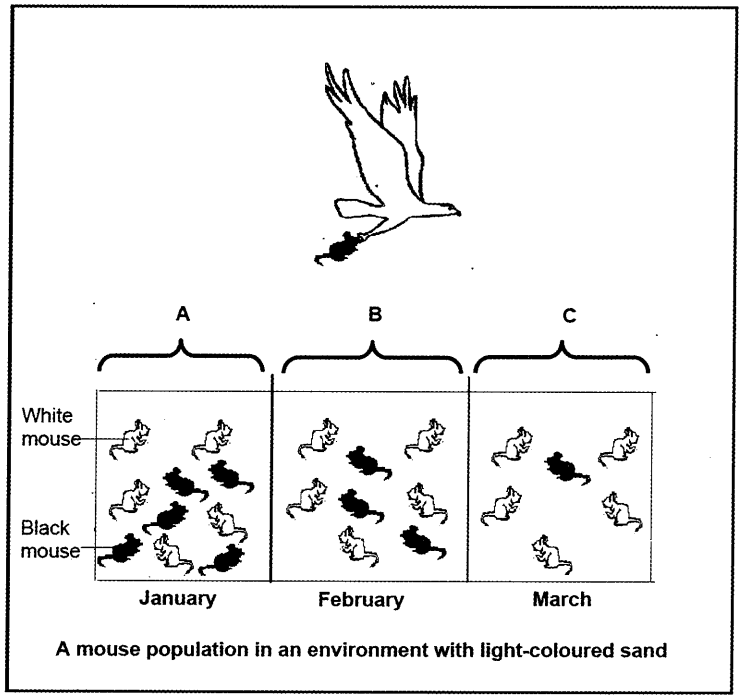
4.1 From a comparison of pictures A and B, describe the feature of the cacti that have enabled them to survive long periods of hot, dry weather conditions. (1)

4.2 Name the mechanism put forward by Darwin to explain his theory of evolution that is illustrated in these diagrams. (1)

4.3 Use the three diagrams above to explain the mechanism mentioned in QUESTION 4.2 (5)

Question 5

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



A mouse population in an environment with light-coloured sand

5.1 What phenomenon is illustrated in the diagram? (1)

5.2 Describe how the sequence of events labelled A. B and C represents the phenomenon named in QUESTION 5.1 (5)

5.3 Will the next generation of mouse population more likely be all white or all black? (1)

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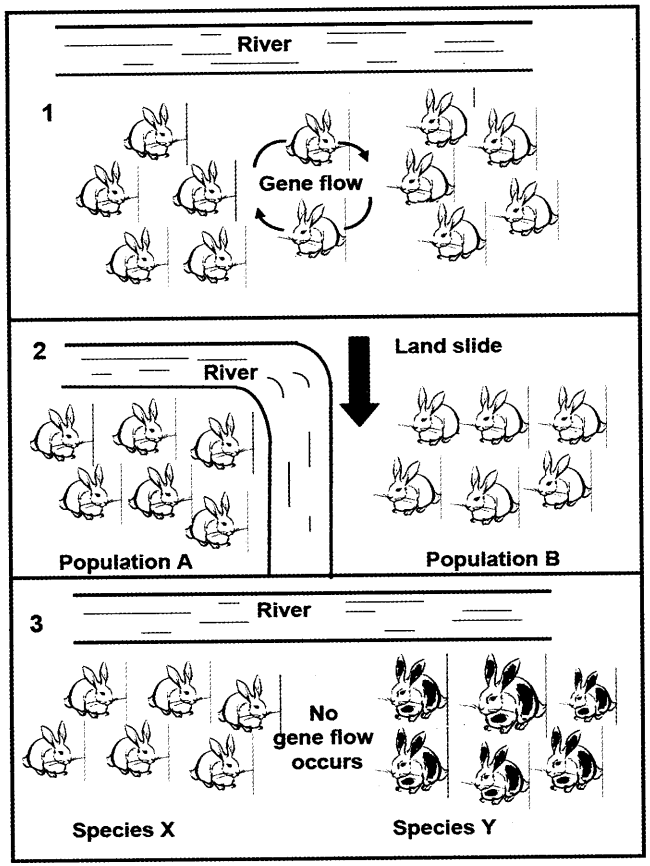
Question 6

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

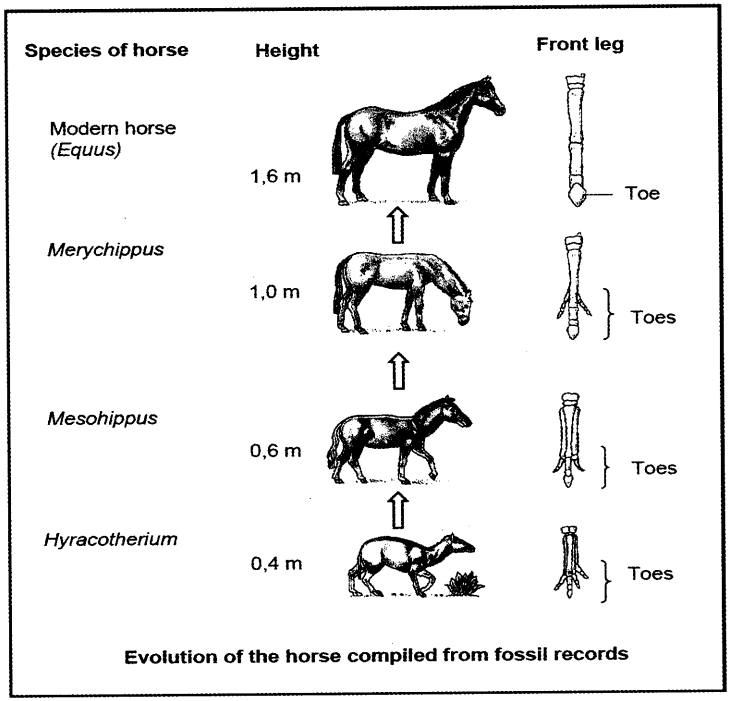


6.1 Name the evolutionary process represented by the sequence of events shown in DIAGRAMS 1, 2 and 3 above. (1)

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

Question 7

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



Evolution of the horse compiled from fossil records

7.1 How many times is the modern horse taller than its earliest ancestor? Show your working. (3)

7.2 What happened to the appearance of the feet of the horse over time? (2)

7.3 Palaeontologists suggest that ancient horses lived in forests, but modern horses live in open grassland. Explain ONE way in which the modern horse is adapted to open grassland. (2)

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Question 8

Read the extract below.

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

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

8.1 Define *punctuated equilibrium.* (3)

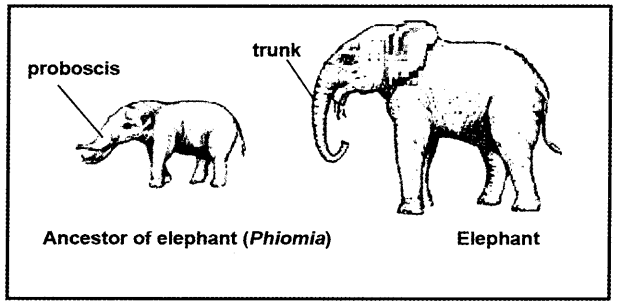
8.2 What characteristic of the toad species protects it from predation? (1)

8.3 Explain how the change in jaw size helped the snakes to survive. (3)

8.4 How would Lamarck have explained the development of a small jaw size in the snakes? (4)

Question 9

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



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

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

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

Question 10

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

Content: **(17)**
Synthesis: **(3)**

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

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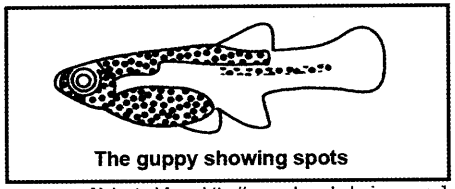
Question 11

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

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

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

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



The guppy showing spots

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

The procedure of the investigation was as follows:

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

The result of the investigation was:

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

11.1 How could the validity of this investigation be increased? (2)

11.2 Identify the:

(a) Independent variable (1)

(b) Dependent variable (1)

11.3 Explain why the scientist included pond **2** in this investigation. (3)

11.4 Describe how Darwin's theory of natural selection can be used to explain why the guppies in pond **1** had fewer spots. (5)
(12)

Question 12

Study the extract and the information below.

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

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

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

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

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

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

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12.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

12.2 State TWO ways in which the scientists could have improved the reliability of the investigation. (2)

12.3 Describe how the scientists calculated the percentage survival of clover. (2)

12.4 Explain if the hypothesis will be accepted or rejected. (3)

12.5 Based on information in the passage, apart from temperature, explain ONE other way in which the survival rate of clover plants is increased. (2)

12.6 Refer to Darwin's theory of natural selection and explain how the mutation affected the survival of the clover plants at lower temperatures. (6)
(17)

Question 13

Study the extract and the information provided.

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

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

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

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

In an investigation to test this hypothesis, they:

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

The results are given in the table below:

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

13.1 Give the:

(a) Independent variable (1)

(b) Dependent variable (1)

13.2 State THREE factors that were kept constant in this investigation. (3)

13.3 Give TWO reasons why the scientists' results may not be reliable. (2)

13.4 State a conclusion for this investigation. (2)
(9)

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Question 14

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

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

They conducted the investigation as follows:

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

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

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

[Adapted from http//.hhmi.org/biolactive]

14.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

14.2 Explain the effect of the mutation on the survival of the red lizards. (2)

14.3 Explain why the scientists had to conduct this investigation over 30 generations. (2)

14.4 State TWO ways in which the scientists could have improved the validity of the investigation. (2)

14.5 Use the theory of natural selection to explain the higher percentage of black lizards in the population of the 30th generation. (6)

14.6 Draw a bar graph to compare the percentage of the brown and the black lizards in the initial population and the 30th generation. (6)
(20)

Question 15

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

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

Content: (17)
Synthesis: (3)

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

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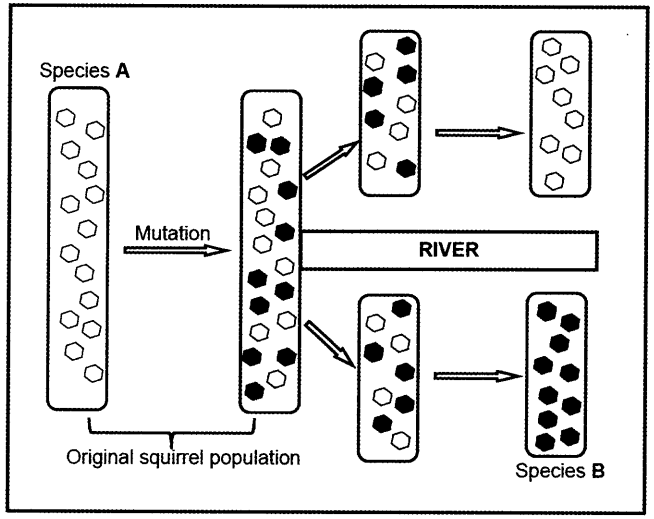
Question 16

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



16.1 Define a *population*. (2)

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

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

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

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

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

Question 17

Read the extract below.

> Long before the development of agricultural crops, South African villagers would pick the sweetest and largest fruits of the marula tree and scatter them around their camps. The seeds of these fruit would germinate and grow into fruit-bearing trees. The best fruit would then be chosen from these trees and the process would be repeated.
>
> In recent times, farmers use a process called marcotting. This involves peeling away the bark in one area around a branch. This area is stimulated to form roots. The branch is then removed from the tree and planted in the soil to produce more marula trees.

17.1 Name the characteristics that the villagers were selecting. (2)

17.2 Explain how this practice is an example of artificial selection. (3)

17.3 Give ONE environmental factor that could affect the characteristics named in QUESTION 17.3. (1)

17.4 Explain ONE disadvantage of a plantation of marula trees grown through marcotting compared to a population of marula trees that have reproduced naturally. (2)

17.5 Explain whether the fruits from marcotted marula trees could be classified as genetically modified (GM). (2)

17.6 State TWO benefits of genetic modification. (2)

Question 18

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

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

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

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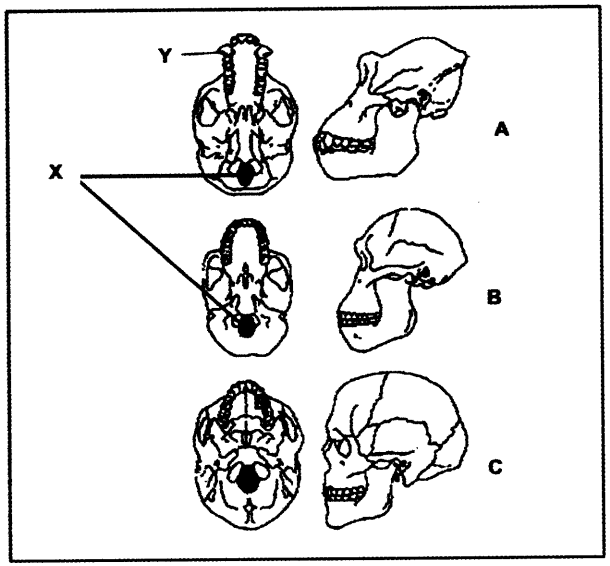
Question 19

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



19.1 Label part **X** and the type of teeth at **Y**. (2)

19.2 Explain the significance of the location of structure **X** in organism **C**. (3)

19.3 Which of the skulls (**A**, **B** or **C**) belongs to:

(a) An *Australopithecine* (1)

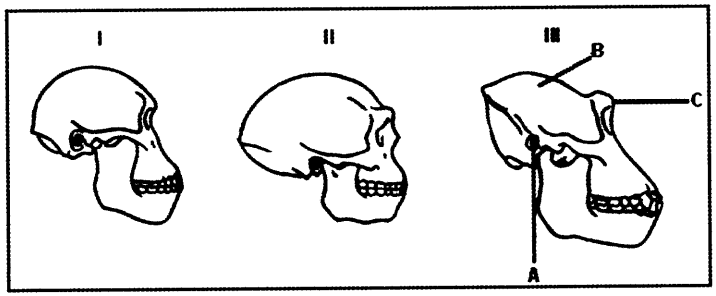
(b) A quadrupedal primate (1)

19.4 Explain how the change in the skull from **B** to **C** could indicate a change in intelligence. (3)

19.5 Tabulate TWO observable differences, other than those mentioned in QUESTION 19.2 and 19.4 between skulls **B** and **C** that represent trends in human evolution. (5)
(15)

Question 20

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



20.1 Name parts **B** and **C** respectively. (2)

20.2 Name the type of teeth that is larger in genus **III** compared to that of genera **I** and **II**. (1)

20.3 Give only the NUMBER(S) (**I**, **II** or **III**) of the skull(s) that:

(a) Most likely belongs to a bipedal primate (2)

(b) Has the largest brain size (1)

(c) Is attached to a C-shaped vertebral column (1)

(d) Is most prognathous (1)

20.4 Give only the LETTER of the structure that is more pronounced in organism **III** than in organisms **I** and **II**. (1)

20.5 Give the correct sequence of the organisms (**I**, **II** and **III**), from most primitive to most evolved. (2)
(11)

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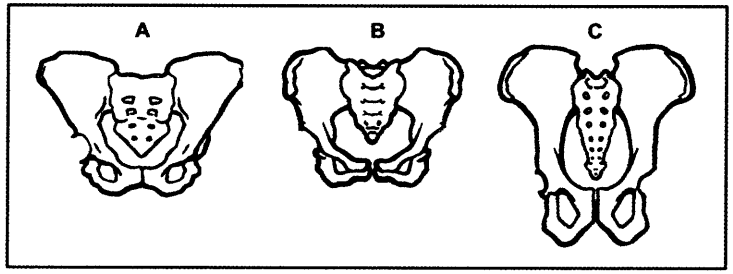
Question 21

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



21.1 What term is used to describe organisms that are able to walk upright permanently? (1)

21.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 21.1 (2)

21.3 Explain your answer to QUESTION 21.2 (2)

21.4 State ONE feature of the spine of the organism represented by **C**. (1)
(6)

Question 22

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

22.1 Name FIVE characteristics that humans share with African apes. (5)

22.2 Describe how each of the following structures is different between humans and apes:

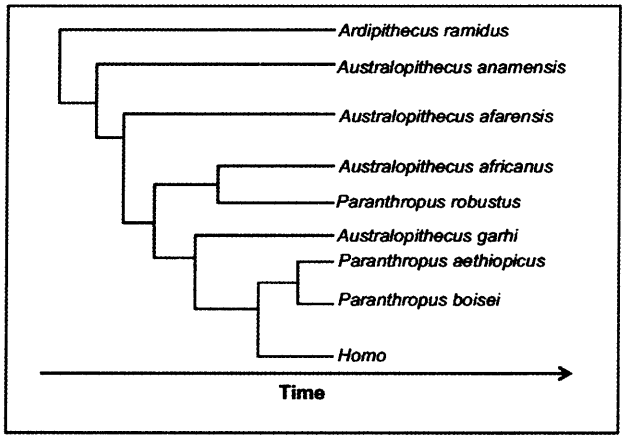
(a) Spine (2)

(b) Pelvic girdle (2)

22.3 Explain the significance of the changes to the teeth of humans that show progression in evolution. (4)
(13)

Question 23

The diagram below shows possible evolutionary relationships betweer hominids.



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

23.1 What is this type of diagram called? (1)

23.2 How many genera are shown in the diagram above? (1)

23.3 According to this diagram, which:

(a) Genus is most recently evolved (1)

(b) Genus is the oldest (1)

(c) Hominid share a common ancestor with *Australopithecus africanus* (1)

23.4 Give ONE example of an *Australopithecus africanus* fossil found in South Africa. (1)

23.5 Name TWO *Homo* species, besides *Homo sapiens*, that were found in Africa. (2)
(8)

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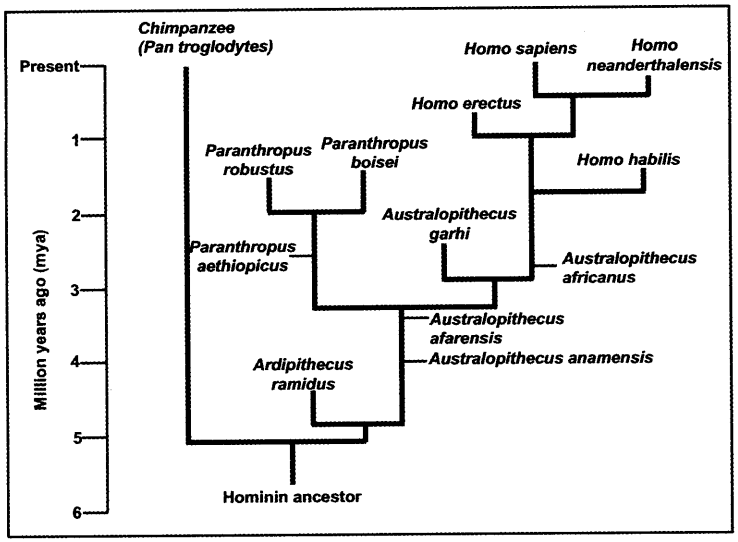
Question 24

The diagram below shows possible evolutionary relationships among some hominids.



24.1 What is this type of diagram called? (1)

24.2 How many of EACH of the following are represented in the diagram:

(a) Genera (1)

(b) *Homo* species (1)

24.3 Name the species that have *Paranthropus aethiopicus* as a common ancestor. (2)

24.4 When did:

(a) *Ardipithecus ramidus* become extinct (1)

(b) *Homo erectus* first appear (1)

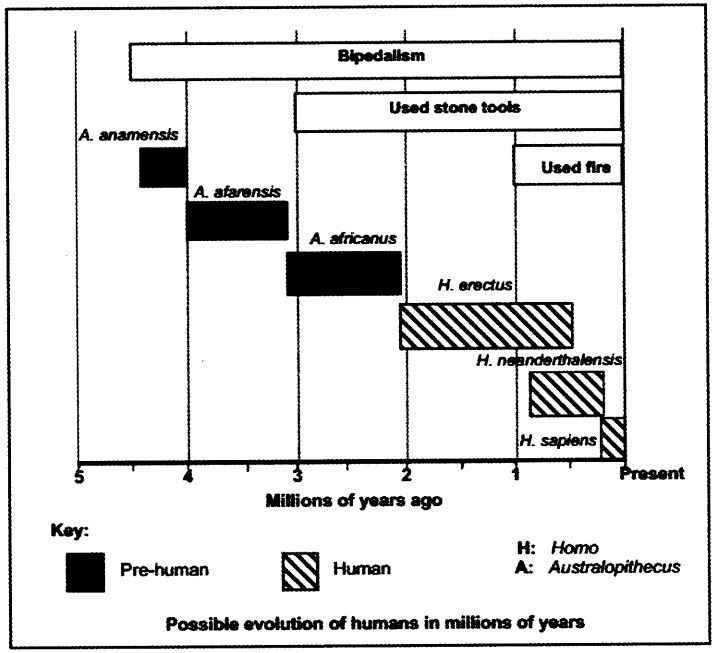
24.5 Name the:

(a) Hominid species that existed at the same time as *Homo sapiens* (1)

(b) First *Homo* species to use tools (1)
(9)

Question 25

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



25.1 Use the diagram above and identify TWO bipedal organisms that did not use stone tools or fire. (2)

25.2 How long after developing the ability to walk on two feet did pre-humans develop the ability to use stone tools? Show ALL working. (3)

25.3 Explain the significance of the characteristic of the skull which allowed for the development of the ability to use tools in the *Homo* species. (2)

25.4 Explain the relationship between the use of fire and changes in dentition in the *Homo* species. (2)
(9)

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Question 26

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

The results are shown in the table below.

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

26.1 Apart from fossil evidence, give TWO other types of evidence for human evolution. (2)

26.2 Which primate became extinct first? (1)

The brain of an organism is not preserved as a fossil.

26.3 How do scientists determine the brain volume of extinct primates? (2)

26.4 Calculate the difference in brain volume (in cm^3) between the two living primates. Show ALL calculations. (2)

26.5 Give evidence in the table that suggests that:

(a) *Homo habilis* and *Homo erectus* may have existed at the same time (1)

(b) *Ardipithecus* was the most primitive of all the primate genera (1)

26.6 Draw a bar graph to show the average brain volume of EACH of the species of the genus *Homo*. (6)
(15)

Question 27

Read the passage below.

NEW HOMININ SPECIES DISCOVERED

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

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

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

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

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

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

27.1 Define the term *transitional fossil*. (2)

27.2 Name a characteristic from the passage that *Homo naledi* shared with both *Australopithecus* and *Homo*. (1)

27.3 State ONE other characteristic from the passage that *Homo naledi* shared only with *Australopithecus*. (1)

27.4 Explain TWO characteristics of a skeleton which are adaptations for bipedalism. (4)

27.5 Give ONE possible reason why there was a change to smaller teeth in modern humans. (3)
(11)

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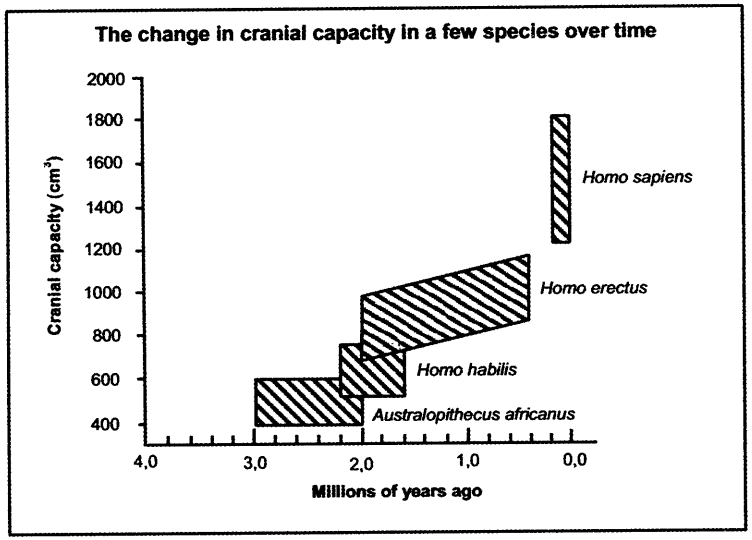
Question 28

Study the graph below.



28.1 Name the family to which all these species belong. (1)

28.2 What is the largest cranial capacity (in cm^3) of *Australopithecus africanus*? (1)

28.3 When did *Homo habilis* become extinct? (1)

28.4 Name TWO *Australopithecus* fossils found in South Africa. (2)

28.5 Which of the organisms represented above has the greatest range in cranial capacity? (1)
(6)

Question 29

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

Some characteristics of *Australopithecus sediba*:

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

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

29.1 Write down THREE characteristics from the list above that also apply to the *Homo* species. (3)

29.2 State TWO advantages of *A. sediba* being bipedal. (2)

29.3 Professor Berger called *Australopithecus sediba* a transitional fossil. Using the information in the list above, explain why he called *A. sediba* a species in transition. (2)
(7)

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Question 30

The passage below refers to human evolution.

> Research, using DNA evidence, suggests that all modern humans arose from a single group of *Homo sapiens* that migrated from Africa 2 000 generations ago and spread throughout Europe and Asia over thousands of years.
>
> [Source: http://images.sciencedaily.com]

30.1 Name the hypothesis on human evolution that is described in the passage. **(1)**

30.2 Name the type of DNA outside the nucleus that is analysed in support of the hypothesis named in QUESTION 30.1 **(1)**

30.3 Explain how the type of DNA named in QUESTION 30.2 is used to provide evidence for the hypothesis named in QUESTION 30.1 **(3)**

30.4 Apart from DNA evidence, state ONE other line of evidence that may be used to support the hypothesis mentioned in QUESTION 30.1 **(1)**
(6)

Question 31

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

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

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

Question 32

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

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

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

HUMAN IMPACT

Question 1

Study the extract and the table below.

> **EMISSIONS FROM ELECTRICITY PRODUCTION**
>
> Most of the electricity in South Africa is produced by burning coal. Coal burning is a very 'dirty' or inefficient way of producing energy because for every unit of electricity produced, more CO_2 is released than with other fuels or methods.
>
> The cleanest methods of producing electricity are the ones using renewable energy sources. Solar energy, hydroelectric energy (falling water drives turbines which generate electricity) or wind power are examples of renewable energy sources. These renewable energy sources do not burn any fuel. Less than 1% of South Africa's electricity comes from renewable sources.
>
> Nuclear power production also avoids greenhouse gas emissions. However, unlike renewable energy, nuclear power results in hazardous nuclear waste and high safety and security risks.
>
> [Source: Climate change, Ethekweni Municipality Environmental Management Department, 2007, http://www.durban.gov.za/durban/municipality/environment]

The table below shows the amount of CO_2 emitted when producing energy from different sources.

ENERGY SOURCE	CO_2 EMISSION (kg CO_2/kW)
Coal	0,30
Petrol	0,24
Diesel	0,25
Paraffin	0,20
Solar, wind, hydro power	0,0

1.1 State why coal, petrol, diesel and paraffin are not renewable energy sources. (1)

1.2 State why the burning of coal to produce electricity is considered to be 'dirty' compared to using renewable sources or nuclear power. (1)

1.3 Name ONE greenhouse gas, other than CO_2. (1)