



education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

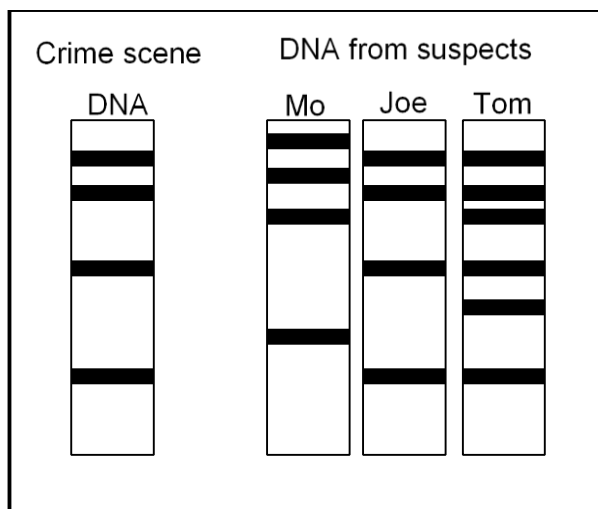
LIFE SCIENCES
EASY TO SCORE MANUAL
PAPER 2
OCTOBER 2021

This manual consists of 47 pages.

QUESTION 1
MULTIPLE CHOICE**DNA: CODE OF LIFE**

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

QUESTIONS 1.1.1 TO 1.1.2 ARE BASED ON THE DIAGRAM BELOW, SHOWING THE RESULTS OF A PARTICULAR PROCEDURE.



- 1.1.1 The procedure shown above is called ...

A cloning.
B DNA replication.
C DNA profiling.
D fingerprinting.

- 1.1.2 The evidence in the diagram shows that ...

A only Tom was present at the scene of the crime.
B Tom and Joe were present at the scene of the crime.
C only Mo was present at the scene of the crime.
D none of the three individuals were at the scene of the crime.

1.1.3 Below is a list of possible uses of the procedure shown in the diagram above:

- (i) Paternity testing
- (ii) Matching of tissues for organ transplants
- (iii) Identification from fingerprints
- (iv) Screening for genetic disorders

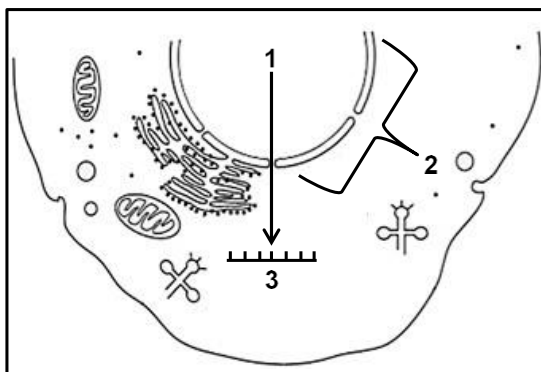
Which combination shows the CORRECT uses of the procedure?

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

1.1.4 In a DNA molecule ...

- A guanine pairs with adenine.
- B adenine pairs with thymine.
- C cytosine pairs with adenine.
- D guanine pairs with thymine.

1.1.5 The diagram below shows some of the processes, molecules and structures that are involved in protein synthesis in a cell.



- A
- B
- C
- D

PROCESS 1	STRUCTURE 2	MOLECULE 3
Transcription	ribosome	tRNA
translation	ribosome	mRNA
transcription	nucleus	mRNA
translation	nucleus	tRNA

1.1.6 A sample of DNA has 60 guanine bases and 30 adenine bases. How many phosphate molecules would you expect in this sample of DNA?

- A 30
- B 90
- C 180
- D 270

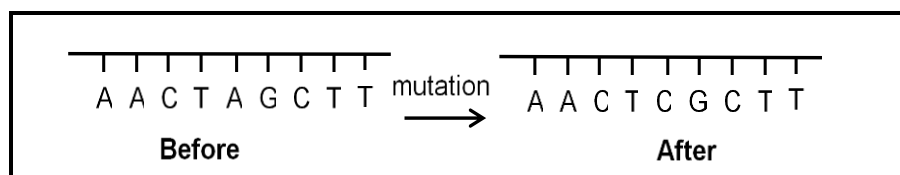
1.1.7 Study the following effects:

- (i) The double helix DNA will not unwind during DNA replication
- (ii) mRNA will not form
- (iii) DNA replication will not take place
- (iv) Translation in protein synthesis will not take place

Which ONE of the following combinations of effects will result if the hydrogen bonds in DNA were strong?

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

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE DIAGRAM BELOW SHOWING PART OF A DNA MOLECULE BEFORE AND AFTER A MUTATION.



1.1.8 The mutation...

- A will result in an extra chromosome.
- B will produce the same protein if a different amino acid is coded for.
- C will produce a different protein if a different amino acid is coded for.
- D is the result of an extra chromosome.

1.1.9 Which ONE of the following best describes the mutation?

- A More than one nitrogenous base was changed.
- B Adenine was changed to cytosine.
- C Adenine was changed to thymine.
- D Cytosine was changed to adenine

MEIOSIS

1.1.10 Which ONE of the following is an example of non-disjunction?

- A Colour-blindness
- B Gene mutations
- C Down syndrome
- D Haploid gametes

1.1.11 Which ONE of the following may result in Down syndrome in humans?

- A A gene mutation on chromosome 21
- B Failure of chromosome pair 21 to separate during anaphase I
- C Failure of the gonosomes to separate during meiosis II
- D A gene mutation occurs on the X chromosome

GENETICS AND INHERITANCE

1.1.12 When an individual that is homozygous dominant for a particular characteristic is crossed with an individual that is homozygous recessive for the characteristic, all the offspring would be ...

- A homozygous dominant.
- B homozygous recessive.
- C heterozygous.
- D pure-bred.

1.1.13 The genotype for an individual with blood group A is ...

- A $I^A I^A$ only.
- B $I^A I^A$ or $i i$.
- C $I^A i$ only.
- D $I^A I^A$ or $I^A i$.

1.1.14 Study the statements about alleles below:

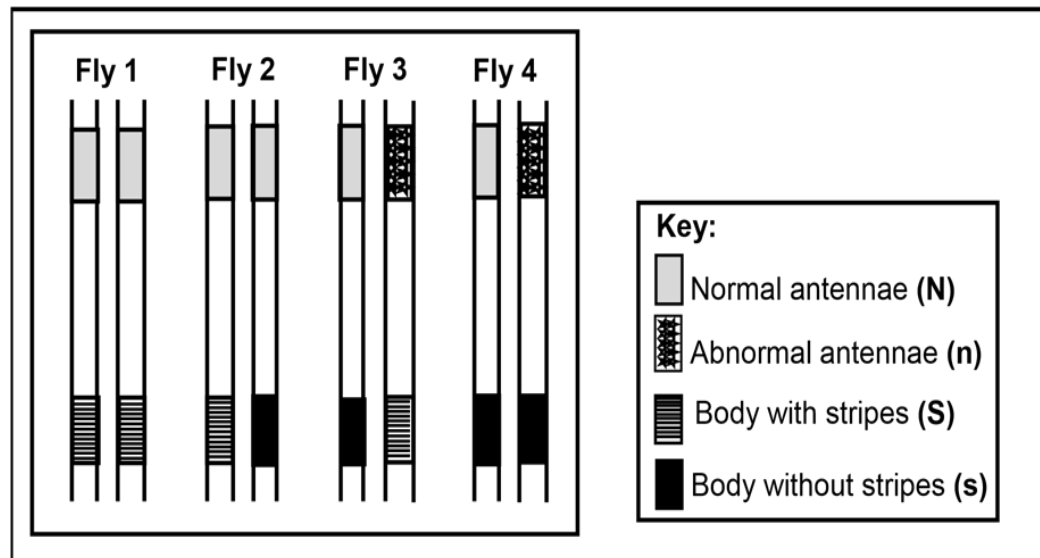
- (i) Alternate forms of a gene are called alleles.
- (ii) There is always only two alleles for a given characteristic.
- (iii) The alleles for a particular characteristic are given in a genotype.
- (iv) Alleles are found at corresponding positions on homologous chromosomes.

Which combination of statements is CORRECT?

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

QUESTIONS 1.1.15 TO 1.1.17 ARE BASED ON THE DIAGRAM BELOW.

The diagram shows one pair of homologous chromosomes found in each of four fruit flies. The alleles for antenna shape (normal or abnormal) and body pattern (with stripes or without stripes) are indicated on the chromosomes.



1.1.15 Which fly is homozygous for antennae shape and heterozygous for body pattern?

- A Fly 4
- B Fly 3
- C Fly 2
- D Fly 1

1.1.16 What is the genotype of Fly 3?

- A NnSS
- B NNSs
- C NnSs
- D NNss

1.1.17 Which ONE of the following will represent the possible gametes for Fly 4?

- A Ns, NS
- B NS
- C nS
- D Ns, ns

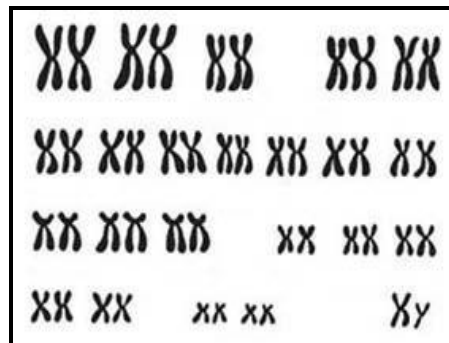
1.1.18 A genetic cross where both alleles of a gene are equally dominant is an example of

- A codominance.
- B a dihybrid cross.
- C incomplete dominance.
- D complete dominance.

1.1.19 The principles of inheritance were first outlined by ...

- A Gregor Mendel.
- B Charles Darwin.
- C Robert Broom.
- D Watson and Crick.

1.1.20 The diagram below shows the karyotype of an organism.



Study the following descriptions:

- (i) There are 46 chromosomes.
- (ii) There are 46 autosomes.
- (iii) The 2 gonosomes are different from each other.
- (iv) The 2 gonosomes are identical.

Which combination of descriptions can be used to identify this karyotype as belonging to a normal, human male?

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

QUESTIONS 1.1.21 AND 1.1.22 ARE BASED ON THE INFORMATION BELOW.

Two rose plants with pink flowers were crossed and it was found that although most of the offspring had pink flowers, some had red and some had white flowers

- 1.1.21 If 152 plants were produced in the F₁-generation, how many of these plants were expected to have pink flowers?

A 38
B 114
C 76
D 152

- 1.1.22 Breeders prefer to produce red roses. If the allele for red is **R** and the allele for white is **W**, which ONE of the following crosses would give the highest proportion of red roses?

A RR x WW
B RW x RW
C WW x RW
D RR x RW

- 1.1.23 A mother has blood group **B** and a father has blood group **O**. They have three biological children and an adopted child. The blood groups of all the children are represented in the table below.

CHILDREN	BLOOD GROUP
Nobuhle	O
William	B
Milly	AB
Patrick	O

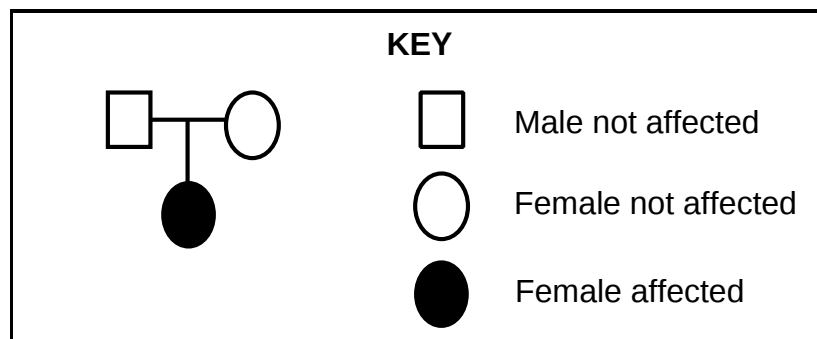
Which child is adopted?

A Nobuhle
B William
C Milly
D Patrick

QUESTIONS 1.1.24 AND 1.1.25 ARE BASED ON THE INFORMATION BELOW.

In a certain species of rabbits, body colour is controlled by two allele where black (**B**) is dominant to white (**b**). Ear shape is controlled by a second gene. The allele for wide ears (**E**) is dominant to the allele for narrow ears (**e**).

- 1.1.24 What is the possible genotype for a black rabbit with narrow ears?
- A BbEe
 - B bbee
 - C BBEe
 - D Bbee
- 1.1.25 What is the possible genotype of gametes produced by a white rabbit with narrow ears?
- A bbee
 - B be
 - C BE, Be, bE and be
 - D bE and be
- 1.1.26 The diagram below shows the pattern of inheritance of a disorder.



One can conclude that the disorder is caused by a ...

- A recessive allele, with both parents heterozygous.
- B dominant allele, with both parents heterozygous.
- C recessive allele, with one parent homozygous recessive while the other is heterozygous.
- D dominant allele, with one parent heterozygous while the other is homozygous recessive.

- 1.1.27 A homozygous purple flowering plant (**P**) is crossed with a pink flowering plant (**p**) to produce the F_1 -generation. One of the F_1 plants is crossed with the pink flowering parent to produce the F_2 generation.

Which ONE of the following is the CORRECT phenotypic ratio of the F_2 generation?

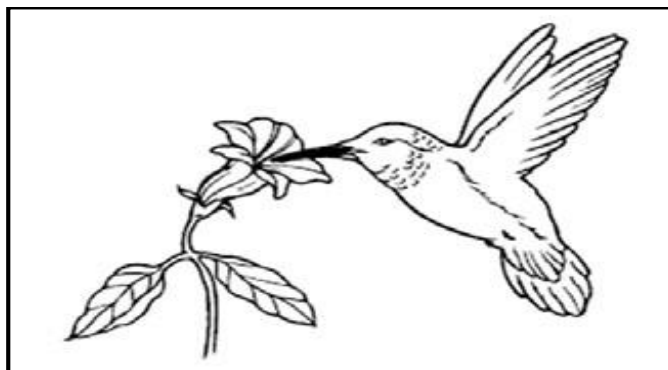
- A 1 purple : 1 pink
- B 1 purple : 3 pink
- C 3 purple : 1 pink
- D 1 purple : 2 pink

EVOLUTION

- 1.1.28 The theory of evolution by natural selection was first described by ...

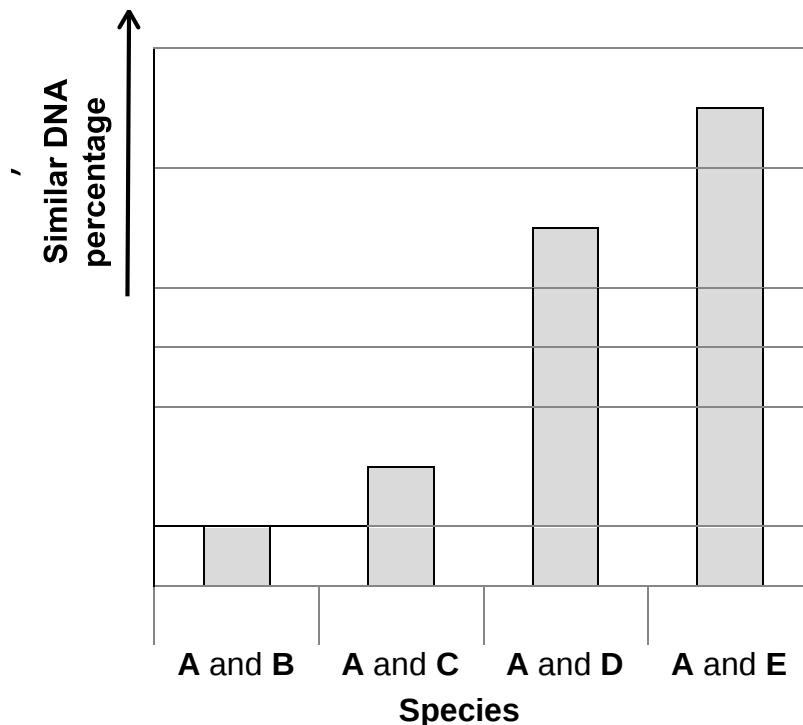
- A Gregor Mendel.
- B Watson and Crick.
- C Jean Baptiste de Lamarck.
- D Charles Darwin.

- 1.1.29 A hummingbird uses its long beak to feed on the nectar in flowers. The reason that Lamarck would have provided for the long beak of the hummingbird is that ...



- A all hummingbirds have the same beak length.
- B there is natural variation in beak length and some birds are therefore better suited to feed on nectar.
- C the more the hummingbird used its beak, the longer it grew.
- D hummingbirds with shorter beaks were more fit for survival.

QUESTIONS 1.1.30 AND 1.1.31 ARE BASED ON THE GRAPH BELOW, WHICH SHOWS THE COMPARISON OF DNA BETWEEN SPECIES A AND SPECIES B, C, D AND E.



1.1.30 Which statement is a valid conclusion that can be drawn from this graph?

Species **A** is most closely related to ...

- A species **B**.
- B species **C**.
- C species **D**.
- D species **E**.

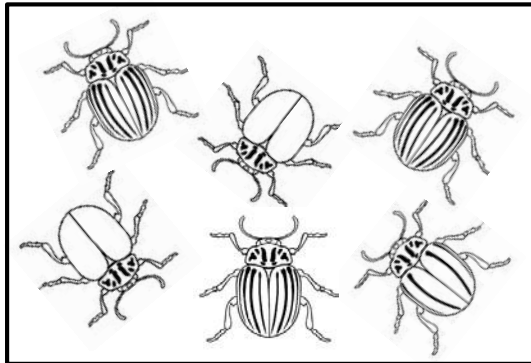
1.1.31 The percentage DNA similarities between species could be used to show the following:

- (i) Similarities in protein synthesis
- (ii) Evidence for evolution
- (iii) Common ancestry

Which combination shows the CORRECT application of the use of similarities in DNA between species?

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

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



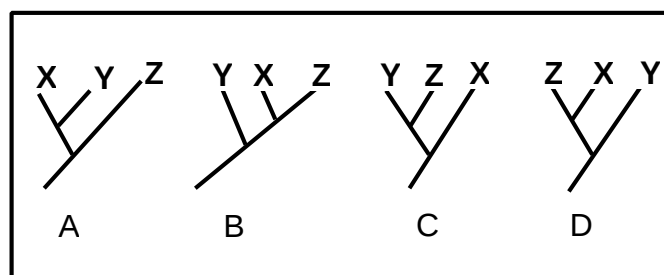
Which ONE of his observations is represented in the diagram above?

- A Limited environmental resources
 - B Populations remain stable over time
 - C Individuals within a population may vary widely
 - D Only the fittest will survive
- 1.1.33 Antibiotic resistance in bacteria is an example of evolution in present times.

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

- A The bacteria acquire resistance to the antibiotic by being exposed to it.
 - B There is variation in the bacteria and the resistant bacteria survive.
 - C The greater the number of bacteria, the higher the resistance.
 - D The greater the number of bacteria, the lower the resistance.
- 1.1.34 Three related species, X, Y and Z, share a common ancestor. Species Y and Z share the MOST RECENT common ancestor.

Which phylogenetic tree most accurately represents their evolutionary relationship?



1.1.35 Which ONE of the following is a reproductive isolating mechanism?

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

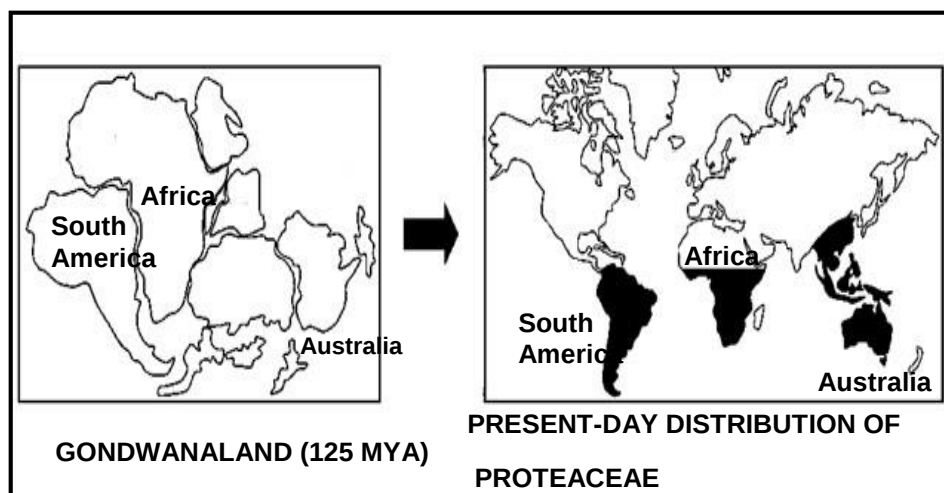
1.1.36 The list below describes features of evolutionary theories.

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

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

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

QUESTIONS 1.1.37 AND 1.1.38 ARE BASED ON THE DIAGRAM BELOW.



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

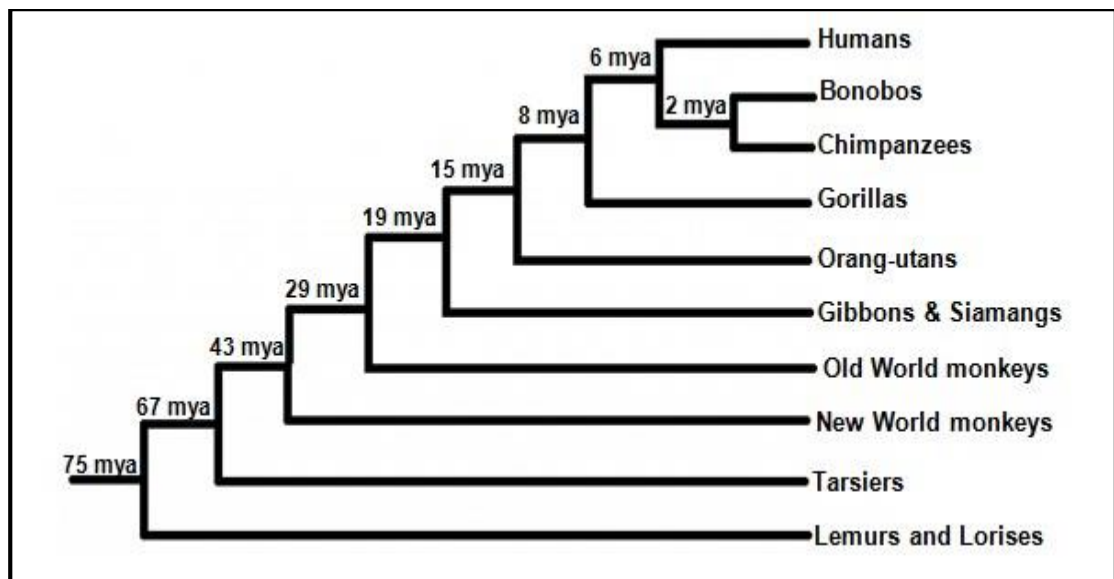
1.1.37 This type of evidence for evolution is called ...

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

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

- A belong to the same species.
- B are found in the Southern Hemisphere.
- C became extinct when Gondwanaland separated.
- D are equally distributed on all continents.

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



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

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

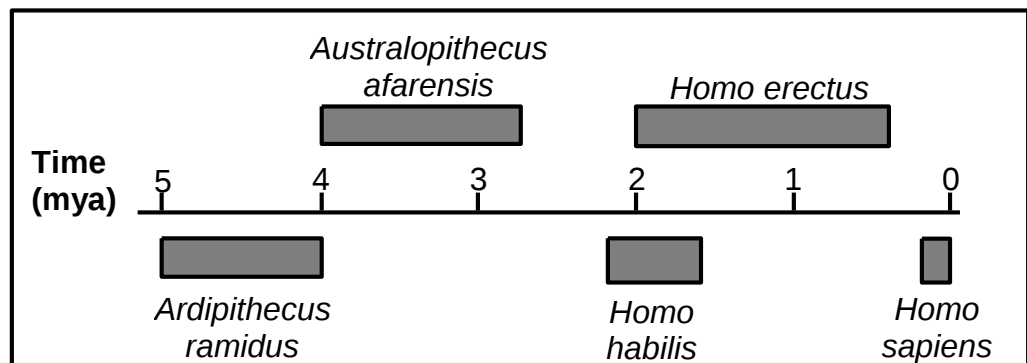
1.1.40 What is the scientific name of the fossil, Mrs Ples?

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

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

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

QUESTIONS 1.1.42 AND 1.1.43 ARE BASED ON THE TIMELINE BELOW SHOWING THE POSSIBLE EVOLUTION OF SOME HOMINIDS.



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

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

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

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

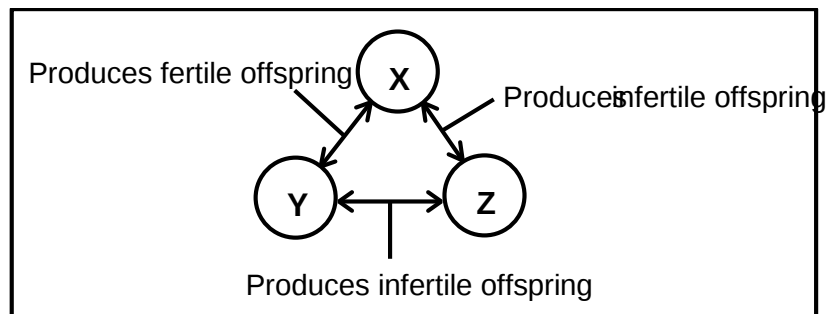
1.1.44 The list below describes some evolutionary events.

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

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

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

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



Which ONE of the following statements is CORRECT?

- A All three populations are of the same species.
 - B Populations **X** and **Z** are of the same species, but populations **X** and **Y** are different species.
 - C Populations **Y** and **Z** are different species, but populations **X** and **Y** are of the same species.
 - D Populations **X** and **Y** are different species, but populations **Y** and **Z** are of the same species.
- 1.1.46 Which ONE of the following refers to a gradual change in the structure of organisms over time?
- A Natural selection
 - B Mutation
 - C Evolution
 - D Speciation
- 1.1.47 Study the mechanisms below:
- (i) Species-specific courtship behaviour
 - (ii) Infertile offspring
 - (iii) Adaptation to different pollinators
 - (iv) Breeding at the same time of the year

Which ONE of the following combinations represents reproductive isolating mechanisms?

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

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

Which ONE of the following represents the statement above?

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

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

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

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

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

- 1.1.50 Variation within a species is introduced through ...

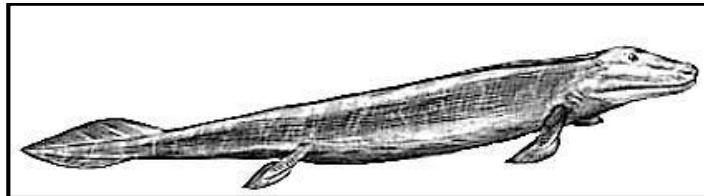
- A random mating and asexual reproduction.
- B mitosis and random fertilisation.
- C random mating and random fertilisation.
- D mitosis and meiosis.

- 1.1.51 African apes and humans are similar. Both have ...

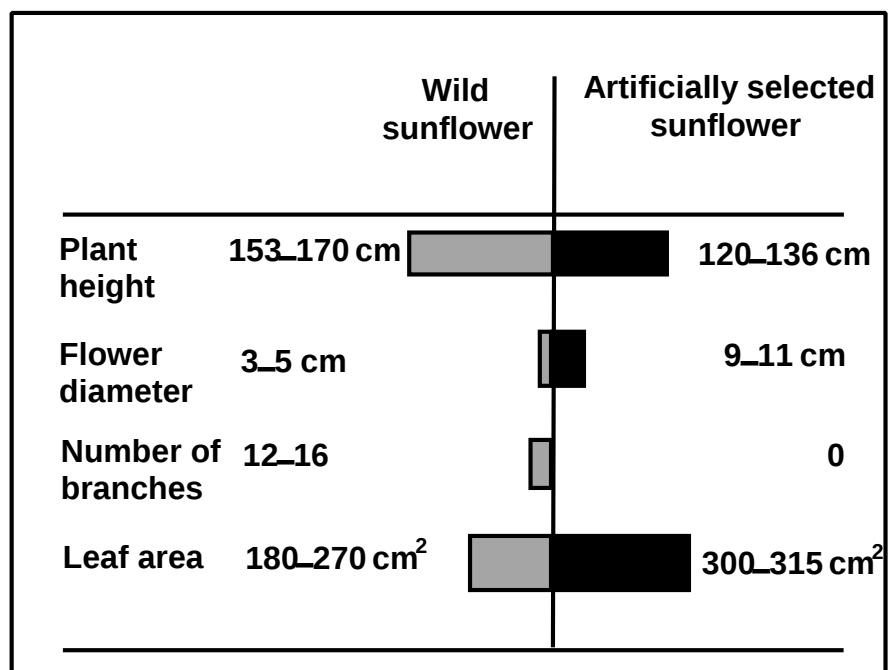
- A small jaws and well-developed brow ridges.
- B opposable thumbs and bare fingertips.
- C gaps between their teeth and eyes in front.
- D an upright posture and a cranial ridge

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

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



- A undergoing natural genetic mutations which caused the fins to develop into legs
 B the process of natural selection.
 C passing on the acquired characteristic of fins to their offspring.
 D stretching its fins and using them for 'walking'.
- 1.1.53 The diagram below compares characteristics of wild sunflowers with sunflowers that have been artificially selected.



Which ONE of the following characteristics was found undesirable by humans?

- A Number of branches and leaf area
 B Plant height and leaf area
 C Plant height and flower diameter
 D Plant height and number of branches

1.1.54 Punctuated equilibrium suggests the following:

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

1.1.55 A group of students observed that the long-term use of antibiotics results in the decreased control of bacterial infections.

From this observation the students stated that:

Antibiotic resistance in bacteria is caused by the long-term use of antibiotics.

This statement is a/an ...

- A theory.
- B aim.
- C hypothesis.
- D conclusion

1.1.56 Which ONE of the following scientists discovered fossils of *Homo sapiens* and *Ardipithecus sp*?

- A Raymond Dart
- B Lee Berger
- C Louis Leakey
- D Tim White

QUESTION 2

BIOLOGICAL TERMS

2.1 Give the correct biological term of each of the following descriptions. Write down only the term next to the question numbers.

2.1.1 The organelle in the cytoplasm which is the site of protein synthesis

2.1.2 The name of the bond that forms between amino acids in a protein

2.1.3 The process by which a DNA molecule makes identical copies of itself

2.1.4 The name of the process when homologous chromosome pairs fail to separate during meiosis

2.1.5 The permanent disappearance of a species from earth

2.1.6 A testable statement that may be accepted or rejected

- 2.1.7 The type of nucleic acid that carries a specific amino acid
- 2.1.8 Nitrogenous base found only in RNA molecules
- 2.1.9 The use of biological processes, organisms or systems to improve the quality of human life
- 2.1.10 Type of variation within a population in which there is a range of intermediate phenotypes
- 2.1.11 An upright posture and walking only on two legs
- 2.1.12 A sugar molecule found in a nucleotide of DNA
- 2.1.13 Genetic disorder resulting in the abnormal clotting of blood
- 2.1.14 Study of fossils
- 2.1.15 Present-day distribution of living organisms across the continents
- 2.1.16 Family to which humans belong
- 2.1.17 The position of a gene on a chromosome
- 2.1.18 The genus of the fossil ' Little Foot'
- 2.1.19 A diagram showing the inheritance of genetic disorders over many generations
- 2.1.20 The bond that forms between two amino acids
- 2.1.21 The phase in the cell cycle during which DNA replication occurs
- 2.1.22 The first *Homo* species to use tools
- 2.1.23 Undifferentiated cells that can develop into any cell type
- 2.1.24 The bond that forms between two amino acids
- 2.1.25 The bonds between nitrogenous bases in a DNA molecule
- 2.1.26 All the genes that make up an organism
- 2.1.27 The type of evidence for human evolution that includes tool-making
- 2.1.28 The process whereby new species are formed
- 2.1.29 An inherited disorder where blood fails to clot properly
- 2.1.30 The opening in the base of the skull through which the spinal cord

- 2.1.31 Two or more alternative forms of a gene at the same locus
- 2.1.32 The type of variation in a population with no intermediate
- 2.1.33 Chromosomes involved in sex determination
- 2.1.34 The nitrogenous base found in messenger RNA but not in DNA
- 2.1.35 An explanation describing evolution as consisting of long phases of little change alternating with short phases of rapid change
- 2.1.36 The permanent disappearance of a species from Earth
- 2.1.37 Genus to which Little Foot and Mrs Ples belongs
- 2.1.38 The cell organelle to which mRNA attaches during protein synthesis
- 2.1.39 The position of a gene on a chromosome
- 2.1.40 The sugar that forms part of a nucleotide in RNA
- 2.1.41 The use of living organisms and their biological processes to improve the quality of human life
- 2.1.42 Similar structures in different organisms indicating descent with
- 2.1.43 Large, pointed teeth in African apes that are used for tearing food
- 2.1.44 The part of the skull that houses the brain
- 2.1.45 The non-sex chromosomes in humans
- 2.1.46 The network of genetic material found in the nucleus
- 2.1.47 The number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell
- 2.1.48 Having a protruding jaw

QUESTION 3**MATCH COLUMNS**

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 (1.3.1 to 1.3.5) in the ANSWER BOOK.

COLUMN I	COLUMN II
3.1.1 The selection and breeding of organisms with desirable characteristics by humans	A: Natural selection B: Artificial selection
3.1.2 An allele that is not shown/expressed in the phenotype when found in the heterozygous condition	A: Dominant B: Recessive
3.1.3 Pairing of nitrogenous bases	A: DNA B: RNA

COLUMN I	COLUMN II
3.1.4 Feature of chimpanzee skulls	A: Prognathism B: Forward position of foramen magnum
3.1.5 Similarity between humans and African apes	A: Opposable thumb B: A short and wide pelvis
3.1.6 Discovered the fossil called 'Little Foot'	A: Raymond Dart B: Ron Clarke

COLUMN I	COLUMN II
3.1.7 Proposed by Lamarck	A: 'Law' of use and disuse B: 'Law' of inheritance of acquired characteristics
3.1.8 Inheritance of haemophilia	A: Sex-linked inheritance B: Complete dominance
3.1.9 Results in genetic variation	A: Mitosis B: Cloning

COLUMN I	COLUMN II
3.1.10 Type of inheritance where both alleles are expressed equally in the phenotype	A: Co-dominance B: Complete dominance
3.1.11 Evidence of evolution	A: Modification by descent B: Fossil record
3.1.12 Discovered the structure of the DNA molecule	A: Watson and Crick B: White and Dart

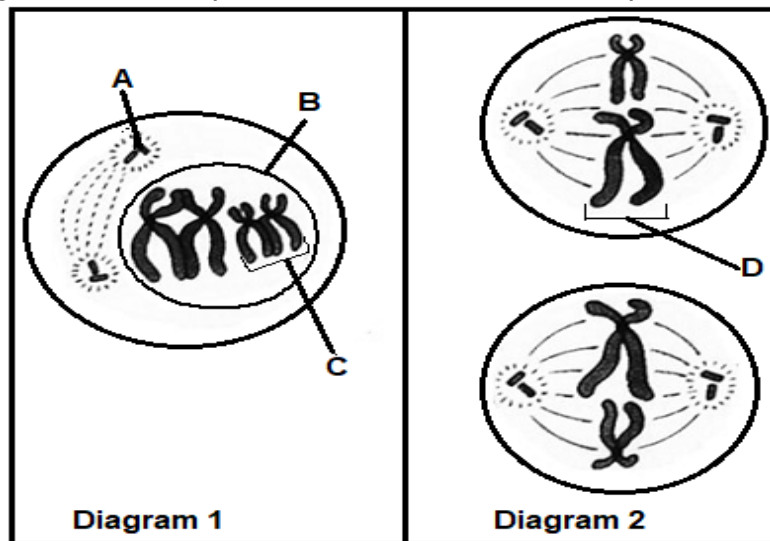
COLUMN I	COLUMN II
1.3.13 Location of DNA in a human	A: Mitochondrion B: Nucleus
1.3.14 Inheritance of acquired characteristics	A: Mendel B: Darwin
1.3.15 First to discover the double helix structure of DNA	A: Mendel and Watson B: Watson and Crick

COLUMN I	COLUMN II
1.3.16 Long and narrow pelvis	A: African apes B: Humans
1.3.17 The point of attachment of two overlapping chromatids	A: Locus B: Chiasma
1.3.18 Variation in human height	A: Continuous B: Discontinuous
1.3.19 Two chromosomes in the same cell which have genes for the same characteristic in corresponding positions	A: Homozygous B: Homologous
1.3.20 A full set of chromosomes with all the genes of an organism	A: Karyotype B: Genome
1.3.21 A possible explanation to a problem being investigated	A: Hypothesis B: Theory
1.3.22 Reproduction between organisms from two populations with different gene pools	A: Interbreeding B: Outbreeding

COLUMN I		COLUMN II
1.3.23	Discovered the shape of the DNA molecule	A: Francis Crick B: James Watson
1.3.24	Each gamete receives only one allele for each characteristic	A: Mendel's principle of segregation B: Darwin's theory of natural selection
1.3.25	An advantage of genetic modification	A: Increases shelf life of food B: Increases resistance to disease
1.3.26	An example of a reproductive isolating mechanism	A: Species-specific courtship behaviour B: Infertile offspring
1.3.27	Type of variation represented by skin colour in humans	A: Continuous variation B: Discontinuous variation
1.3.28	A group of similar organisms that can interbreed to produce fertile offspring	A: Species B: Genus
1.3.29	Structure of RNA	A: Guanine pairs with cytosine B: Contains deoxyribose sugar
1.3.30	The genotype of blood group AB	A: $I^A i$ B: $I^B i$

MEIOSIS

4.1 The diagrams below represent a cell in two different phases of meiosis.



4.1.1 Which phase is represented in:

(a) Diagram 1 (1)

(b) Diagram 2 (1)

4.1.2 Provide labels for:

(a) A (1)

(b) B (1)

(c) C (1)

4.1.3 Give the functions of the parts labelled:

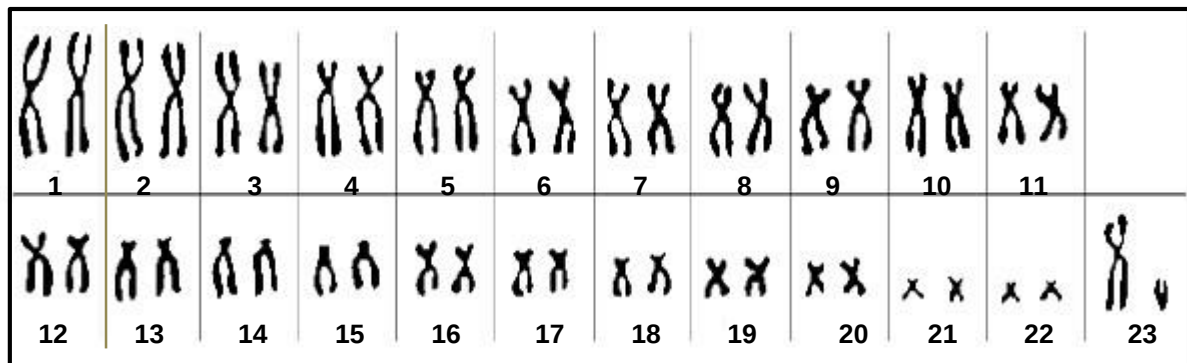
(a) A (2)

(b) D (1)

4.1.4 Are the cells in Diagram 2 haploid or diploid? (1)

4.1.5 Name the process that would have caused variation in structure D. (1)
(10)

4.2 The diagram below shows a karyotype.



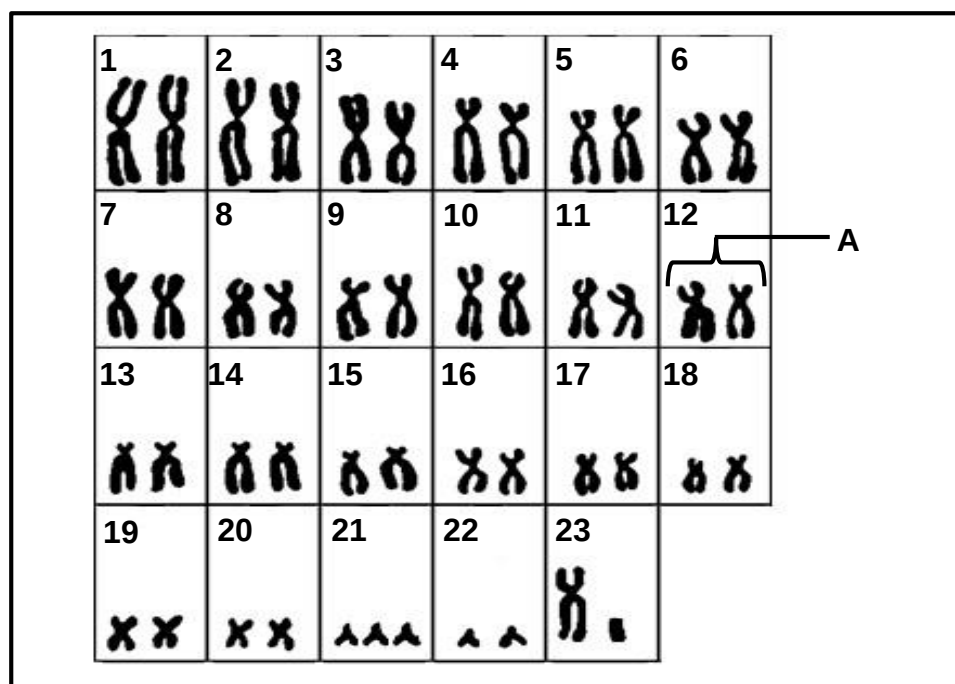
4.2.1 How many of the following are present in the karyotype:

- (a) Chromosomes (1)
- (b) Autosomes (1)
- (c) Gonosomes (1)

4.2.2 How many chromosomes would be present in the gametes produced by this individual? (1)

4.2.3 Is the karyotype in the diagram that of a male or a female? (1)
(5)

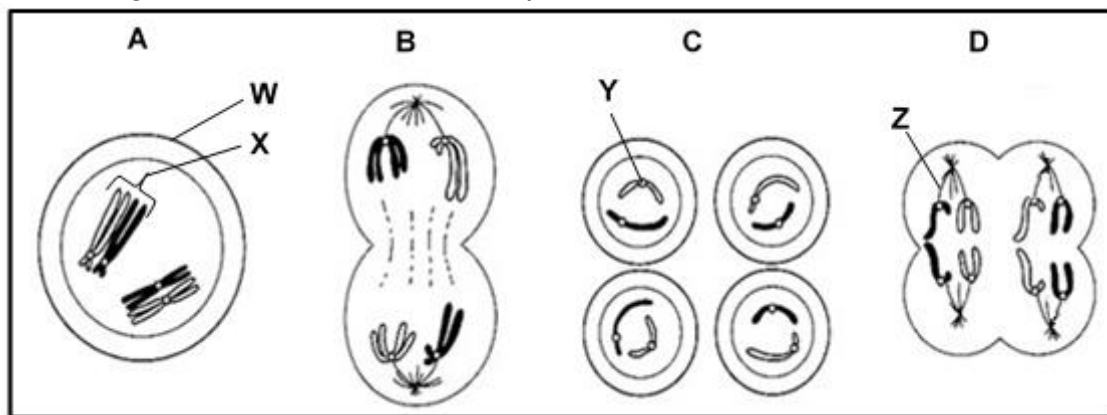
4.3 The karyotype below shows the chromosomes of a person with Down syndrome.



- 4.3.1 Give the label for **A**. (1)
- 4.3.2 How many autosomes are there in a nucleus of this cell? (1)
- 4.3.3 Name the type of chromosomes at position **23**. (1)
- 4.3.4 What evidence suggests that this is a karyotype of a male? (1)
- 4.3.5 Name the type of mutation represented in the diagram. (1)
- 4.3.6 Describe the events that led to Down syndrome. (6)

(11)

4.4 The diagrams below show different phases in meiosis.



- 4.4.1 Label the structures **W** and **X**. (2)

4.4.2 How many chromosomes are present in each cell in:

- (a) Phase **A** (1)
- (b) Phase **C** (1)

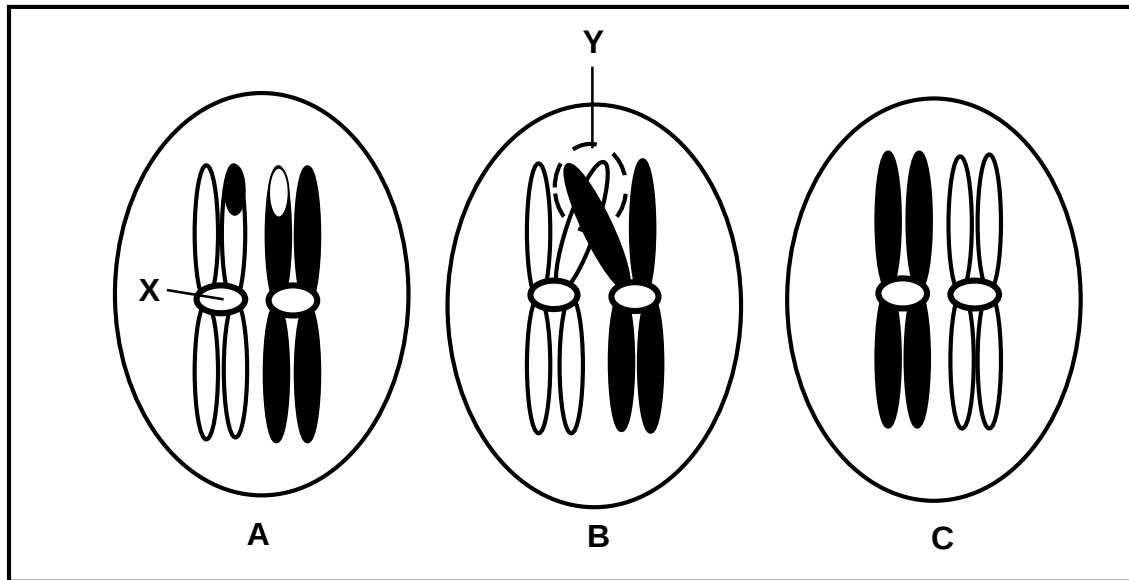
4.4.3 Give only the LETTER of the diagram that represents anaphase II. (1)

4.4.4 State the function of structure **Y** and structure **Z**. (2)

4.4.5 Identify phase **C**. (1)

(8)

4.5 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.



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

4.5.2 Give labels for:

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

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

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

4.5.4 Name the:

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

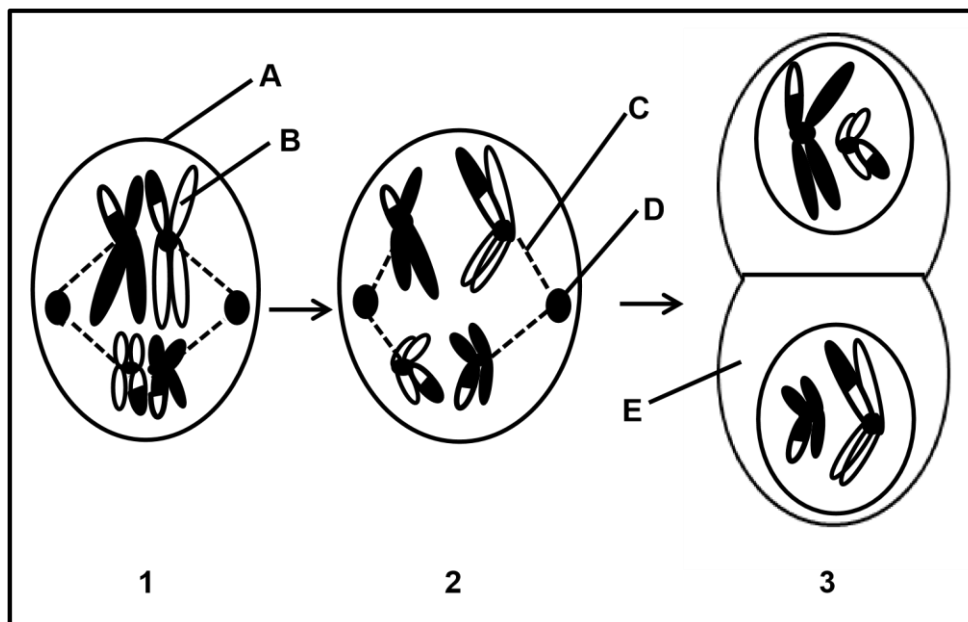
(b) Phase represented by the diagrams above (1)

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

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

(8)

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



4.6.1 Identify the phase represented by diagram:

(a) **1** (1)

(b) **3** (1)

4.6.2 Give the LETTER only of the part that:

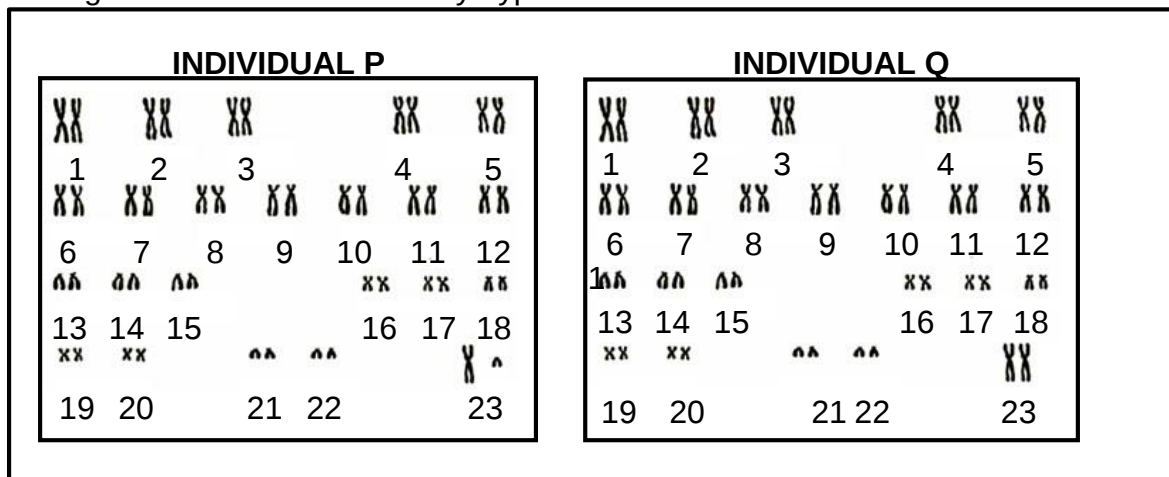
(a) Contains DNA (1)

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

(c) Forms the spindle fibres (1)

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

4.7 The diagram below shows the karyotypes of two individuals.



4.7.1 What term is given to the chromosomes numbered:
(a) **1 to 22** (1)

(b) **23** (1)

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

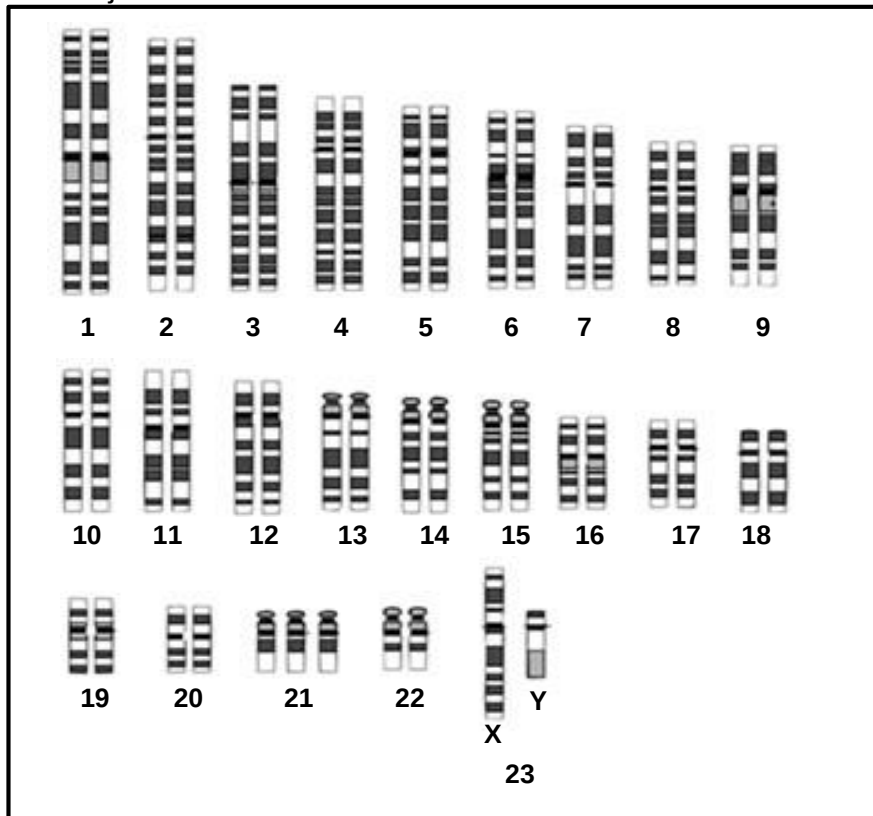
4.7.3 Give ONE observable reason for your answer to QUESTION 4.7.2.(2)

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

State the origin of each chromosome in a homologous pair of chromosomes.

(2)
(7)

4.8 The diagram below shows the karyotype of an individual with a disorder caused by non-disjunction.



4.8.1 Name:

- (a) This disorder (1)
- (b) The phase in meiosis when non-disjunction occurs (1)
- (c) The type of mutation that is a result of non-disjunction (1)

4.8.2 Identify the type of chromosomes numbered **1** to **22**. (1)
(4)

1 GENETICS

5.1 The size and colour of unripe fruit in a plant species is genetically controlled. The allele for small fruit (**b**) is recessive to the allele for big fruit (**B**). The allele for yellow fruit colour (**g**) is recessive to the allele for green fruit (**G**).

5.1.1 State:

(a) The phenotype of the plant with the genotype **BbGg** (2)

(b) ALL possible genotypes of the gametes produced by the plant mentioned in QUESTION 5.1.1(a) (2)

5.1.2 In a cross between two plants with genotypes **BBGG** and **bbgg** what percentage of the offspring will be homozygous for both characteristics? (2)
(6)

5.2 In rabbits, black fur is produced by the allele (**B**) and white fur by the allele (**b**).

The table below shows the genotypes of some rabbits.

RABBIT	GENOTYPE
1	BB
2	Bb
3	bb

5.2.1 What is the phenotype:

(a) Produced by the recessive allele (1)

(b) Of rabbit 2 (1)

5.2.2 Give the NUMBER only (**1**, **2** or **3**) of the rabbit(s) that is/are:

(a) Pure-bred

(b) Homozygous dominant (3)

(5)

- 5.3. In rice plants the allele for high yield (H) is dominant over the allele for low yield (h). The allele for a tall stem (T) is dominant over the allele for a short stem (t).

There are two varieties of rice plants, A and B.

The genotype of variety A is HHtt.

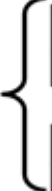
The genotype of variety B is hhTT.

A plant breeder wants to produce a rice plant variety with a high yield and a short stem.

- 5.3.1 Give the phenotype of variety A. (2)
- 5.3.2 Give ALL the possible genotypes of the gametes of variety B. (1)
- 5.3.3 Give the genotype(s) of the variety the plant breeder wants to produce. (2)
- 5.3.4 Explain why the plant breeder would want to produce a rice plant with a short stem. (1)
- 5.3.5 Describe how the plant breeder would be able to produce rice plants with a high yield and short stems only. (2)
- (8)**

- 5.4 Coat colour in mice is controlled by two alleles, black (**B**) and grey (**b**). Tail length is controlled by two alleles, long (**T**) and short (**t**).

The Punnett square below shows a part of the cross between two mice. Genotype **(i)** has been left out.

		Parent 1				
						
Parent 2		Gametes	BT	Bt	bT	bt
		Bt	BBTt	BBtt	BbTt	Bbtt
		Bt	BBTt	BBtt	BbTt	Bbtt
		Bt	BBTt	BBtt	(i)	Bbtt
		Bt	BBTt	BBtt	BbTt	Bbtt

5.4.1 Give the:

- (a) Genotype of parent **1** (2)
- (b) Phenotype of parent **2** (2)
- (c) Genotype of offspring **(i)** (1)

5.4.2 What percentage of the offspring above is grey with short tails? (1)

5.4.3 State the genotypes of TWO gametes from the table above that will result in offspring that are heterozygous for both traits, if fertilisation occurs. (2)
(8)

5.5 Human blood groups are controlled by multiple alleles.

5.5.1 How many alleles control blood groups? (1)

5.5.2 Which TWO alleles are codominant in the inheritance of blood groups? (2)

5.6 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 **F₁** 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

5.6.1 Give the term for:

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

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

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

5.6.3 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)

5.6.4 Give the characteristic that is:

(a) Dominant for flower colour (1)

(b) Recessive for stem height (1)

5.6.5 If the individuals of the **F₁** generation are crossed, how many phenotypes for seed colour would be expected in the **F₂** generation? (1)
(8)

5.7 Mutations result in genetic variation.

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

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

5.8 THREE babies (**X**, **Y** and **Z**) from three different sets of parents were born in a hospital. TWO of the babies were accidentally swopped. Blood groups of the parents were used to establish which baby belonged to which set of parents.

The blood groups of the parents and the babies are shown in the table below.

PARENTS	BABIES	BLOOD GROUPS OF PARENTS AND BABIES		
		Mother	Father	Baby
Mr and Mrs Pule	X	B	A	A
Mr and Mrs Chaka	Y	AB	B	O
Mr and Mrs Tau	Z	O	B	AB

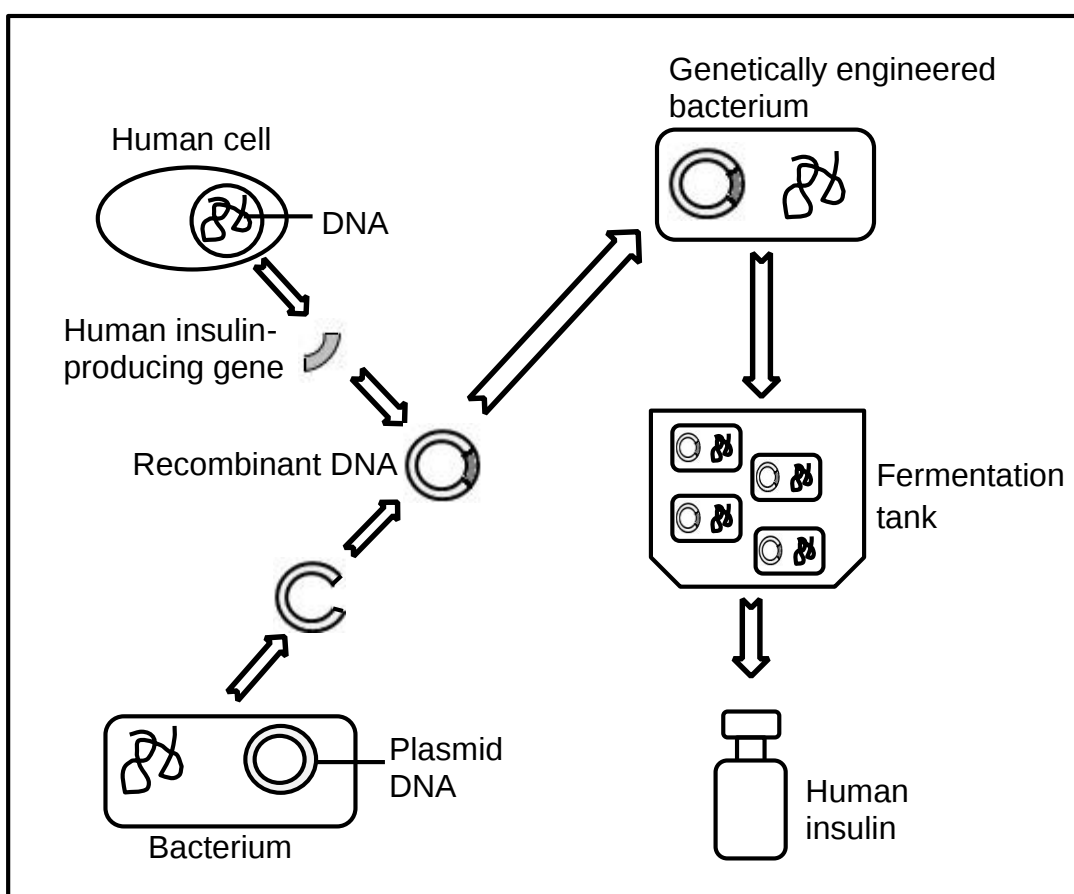
5.8.1 Which TWO babies (from X, Y and Z) were swapped? (2)

5.8.2 Give the surnames of the biological parents of the two babies that were swapped. Write the correct surnames of the parents next to the letter (X, Y or Z). (2)

5.8.3 Give the possible genotype(s) of Mr Pule that could have produced baby X. (2)
(6)

5.9 Synthetic insulin is used to treat diabetes and is produced by genetic engineering technology.

The diagram below represents the process.



5.9.1 Define *genetic engineering*. (2)

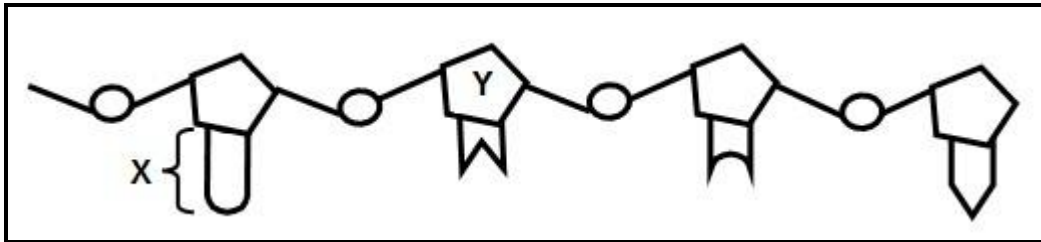
5.9.2 Describe the steps involved in producing the recombinant DNA. (4)

5.9.3 Explain why bacteria are most suitable for genetic engineering. (2)

5.9.4 Suggest THREE objections that some people might have to genetic engineering. (3)
(11)

6. CODE OF LIFE

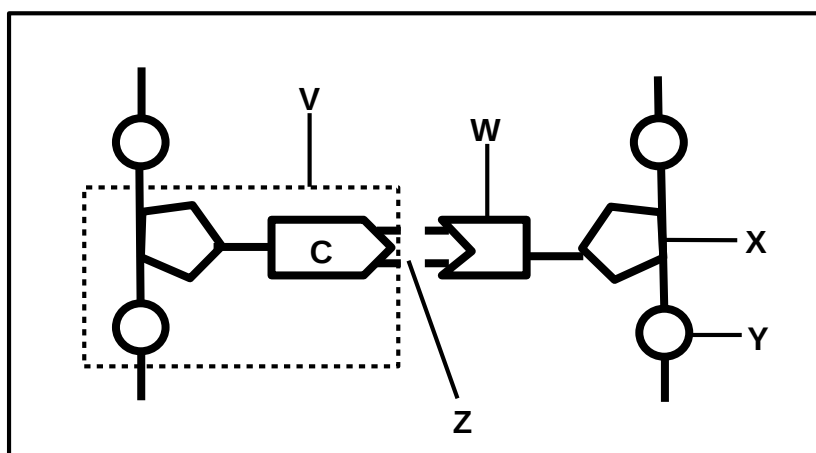
- 6.1 The diagram below represents a single-stranded nucleic acid found in the nucleus.



- 6.1.1 Identify the molecule represented in the diagram. (1)

- 6.1.2 Identify:
 (a) Part X (1)
 (b) Sugar Y (1)
(3)

- 6.2 The diagram represents a portion of a nucleic acid.



- 6.2.1 Name the nucleic acid. (1)

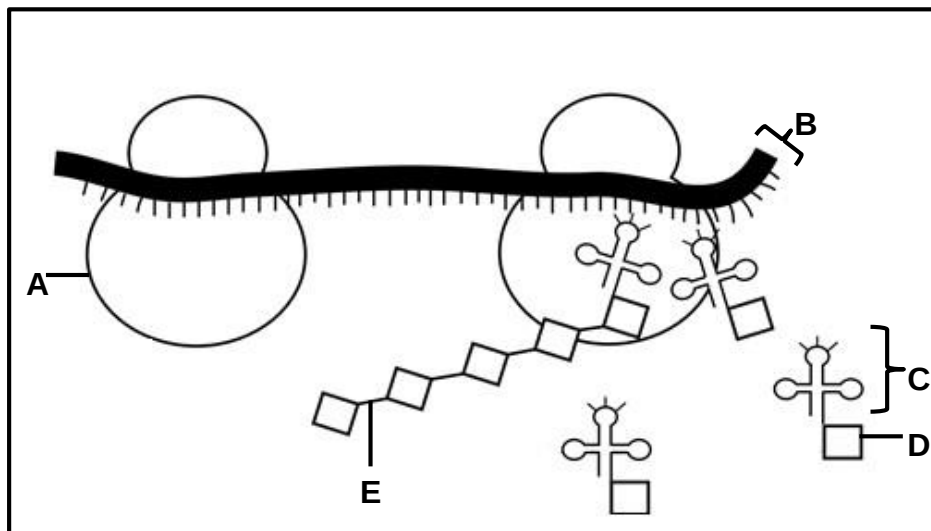
- 6.2.2 Name TWO places in animal cells where this nucleic acid may be found. (2)

- 6.2.3 Identify:
- (a) Portion V (1)
 - (b) Nitrogenous base W (1)
 - (c) Molecule Y (1)
 - (d) Bond Z (1)

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

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

6.3 The diagram represents a process during protein synthesis.



6.3.1 Identify the process above. (1)

6.3.2 Identify:

(a) Organelle **A** (1)

(b) Molecule **B** (1)

(c) The bond at **E** (1)

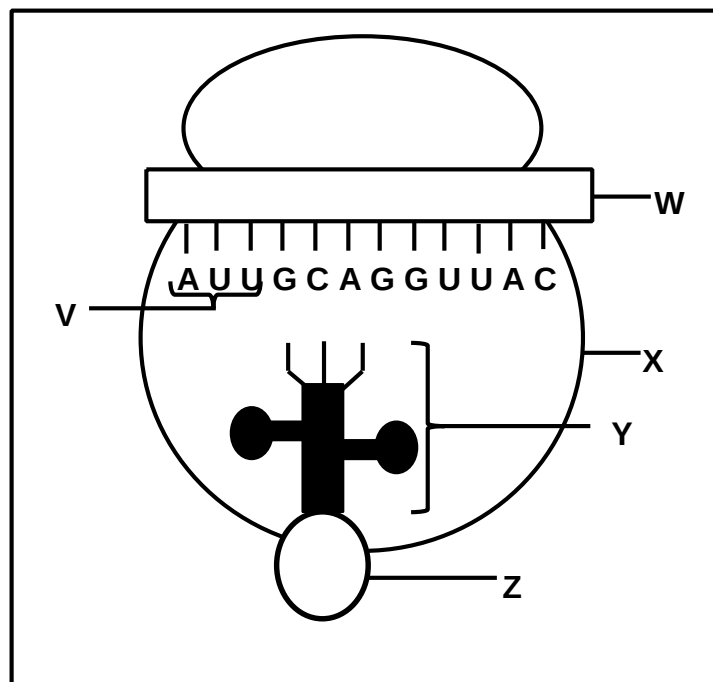
6.3.3 Give only the LETTER of the molecule that:

(a) Carries the amino acid (1)

(b) Is copied from DNA (1)

(c) Is the monomer/building block of proteins (1)
(7)

6.4 The diagram below represents the process of translation.



6.4.1 Name:

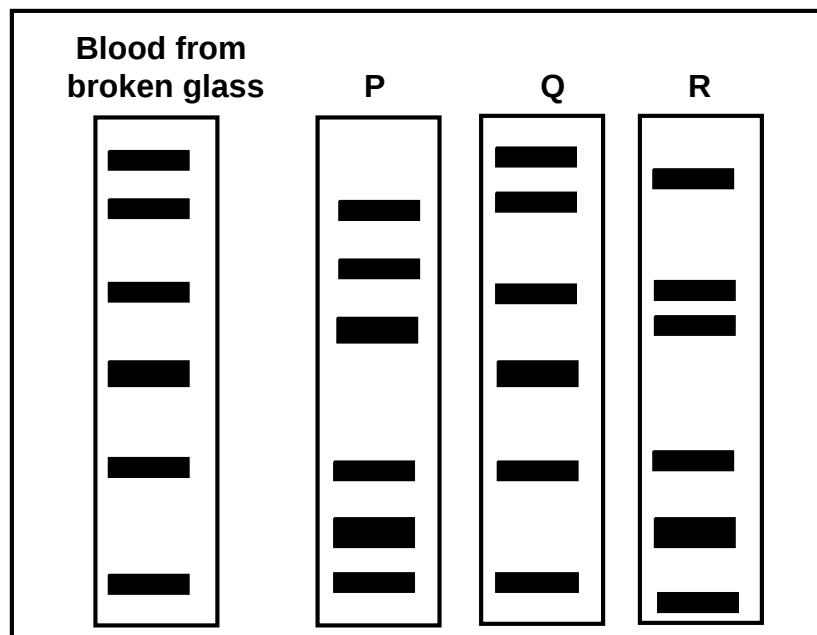
- (a) Organelle **X** (1)
- (b) Molecules **W** and **Y** (2)
- (c) The monomer of molecule **W** (1)

6.4.2 Where in the cell is:

- (a) Organelle **X** found (1)
 - (b) Molecule **W** formed (1)
- (6)**

6.5 When a thief broke into a car he cut his arm on the broken glass. Scientists extracted DNA from the blood found on the broken glass. They analysed this DNA sample and compared it to the DNA from three suspects, **P**, **Q** and **R**.

The table below shows the results of the analysis for the DNA from each source.



6.5.1 What do the diagrams above represent? (1)

6.5.2 Which suspect is most likely the thief? (1)

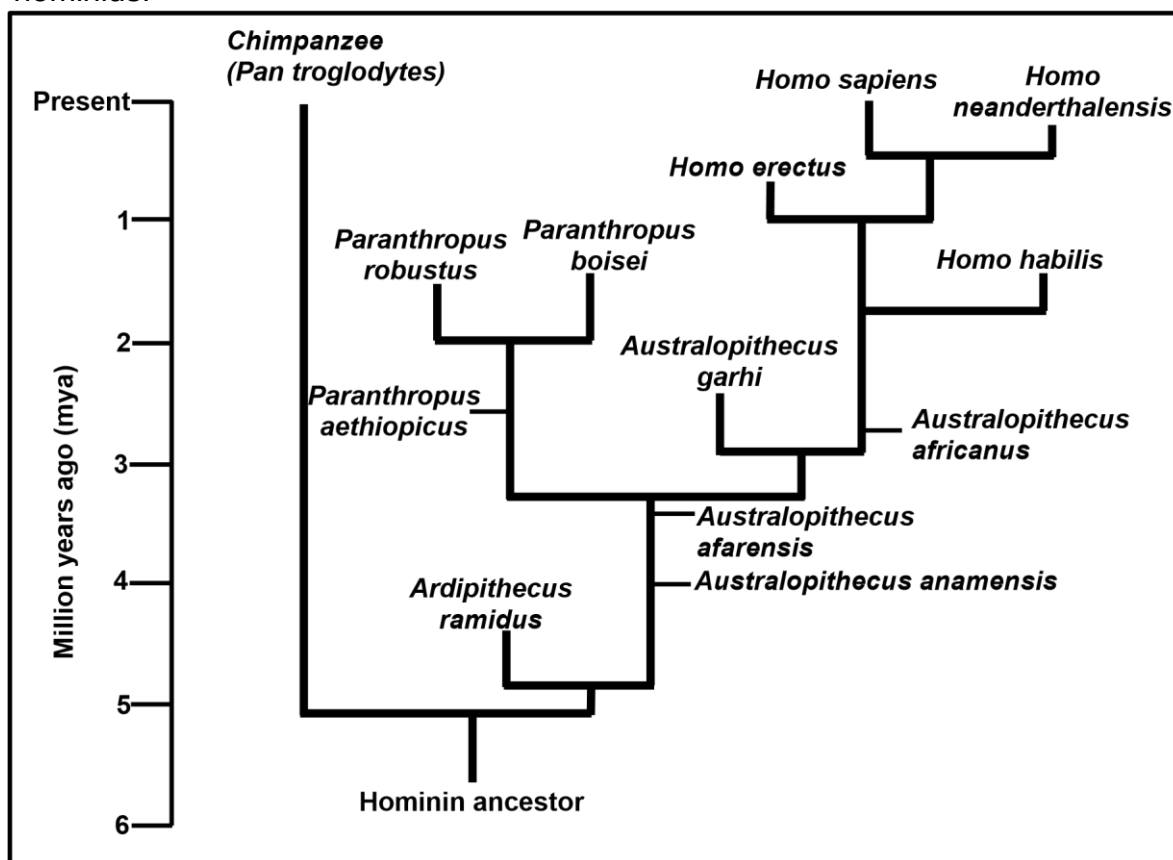
6.5.3 Give a reason for your answer to QUESTION 6.5.2. (1)

6.5.4 State TWO possible disadvantages of using this evidence in a court of law. (2)
(5)

6.6 Tabulate TWO structural differences between a monomer of RNA and a monomer of DNA. (5)

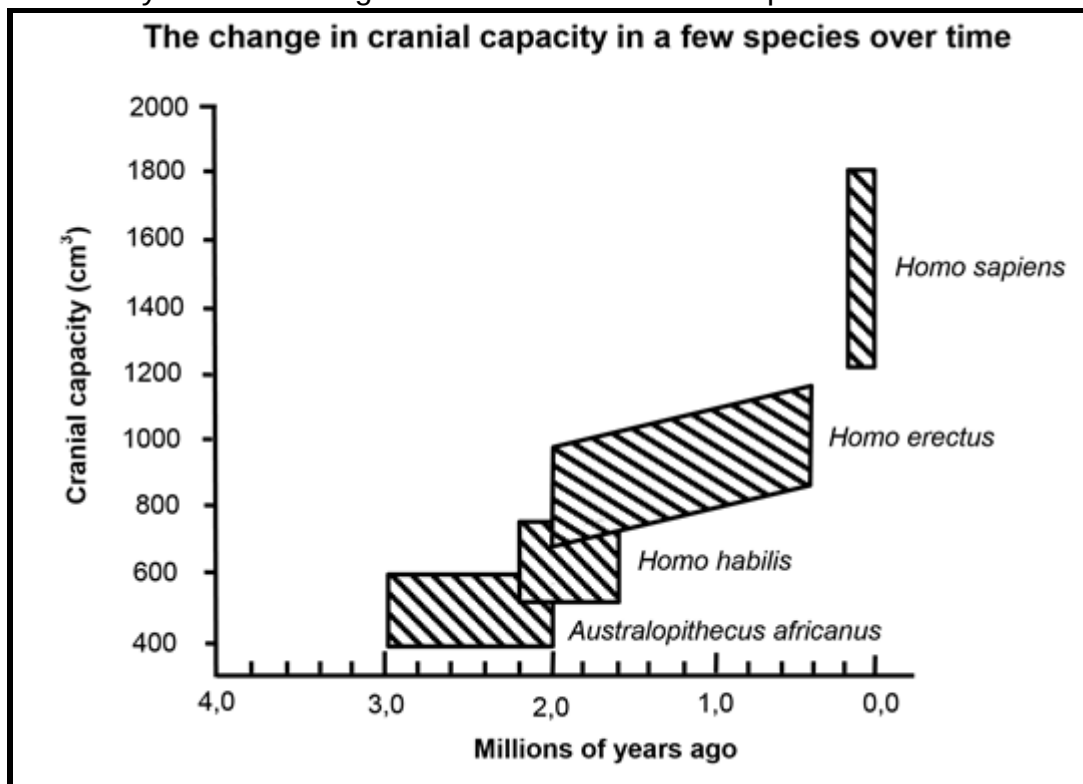
7. EVOLUTION

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



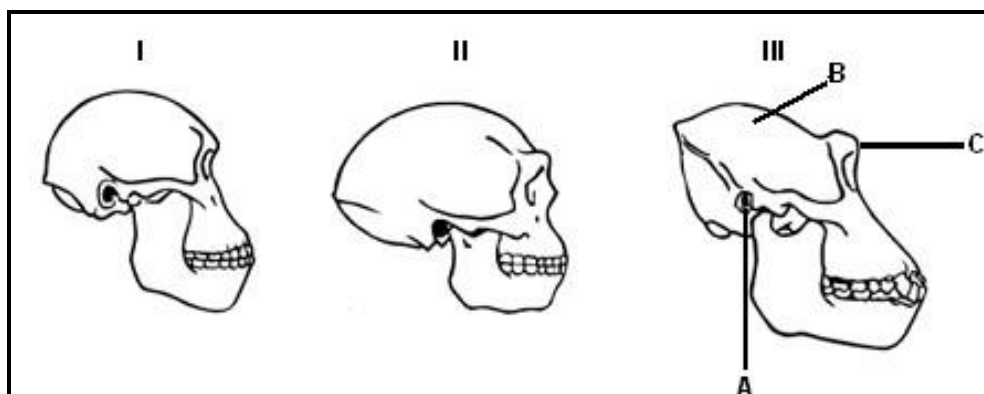
- 7.1.1 What is this type of diagram called? (1)
- 7.1.2 How many of EACH of the following are represented in the diagram: (1)
- (a) Genera (1)
- (b) *Homo* species (1)
- 7.1.3 Name the species that have *Paranthropus aethiopicus* as a common ancestor. (2)
- 7.1.4 When did: (1)
- (a) *Ardipithecus ramidus*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

7.2 Study the below diagram below and answer the questions based on it.



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

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



- 7.3.1 Name parts **B** and **C** respectively. (2)
- 7.3.2 Name the type of teeth that is larger in genus **III** compared to that of genera **I** and **II**. (1)
- 7.3.3 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)
- 7.3.4 Give only the LETTER of the structure that is more pronounced in organism **III** than in organisms **I** and **II**. (1)
- 7.3.5 Give the correct sequence of the organisms (**I**, **II** and **III**), from most primitive to most evolved. (2)
- (11)**

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

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

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

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

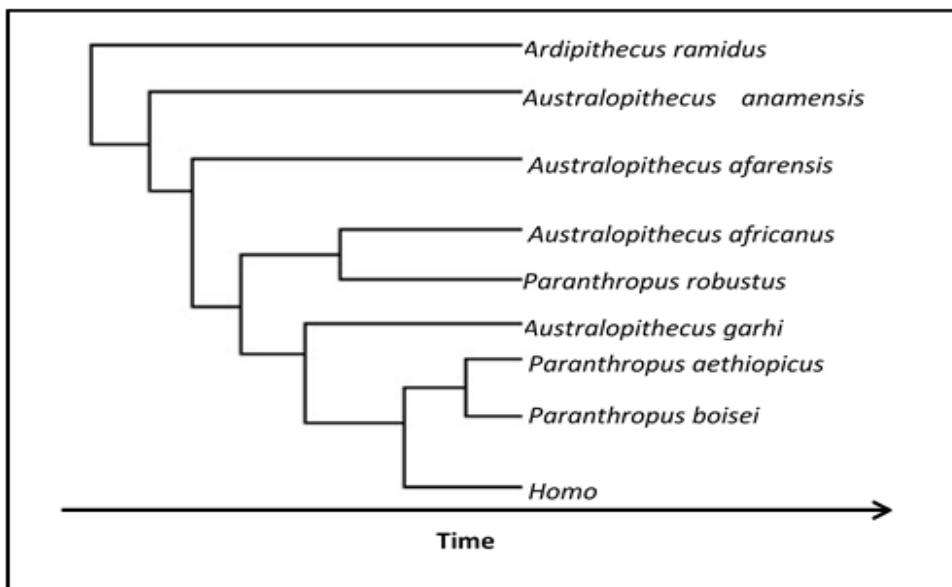
7.4.3 Give the smallest cranial capacity (in cm³) of a *Homo* species. (1)

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

7.4.5 Fossils are used as evidence of hominid evolution.

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

7.5 The diagram below shows possible evolutionary relationships between hominids.



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

7.5.1 What is this type of diagram called? (1)

7.5.2 How many genera are shown in the diagram above? (1)

7.5.3 According to this diagram, which:

(a) Genus is most recently evolved (1)

(b) Genus is oldest (1)

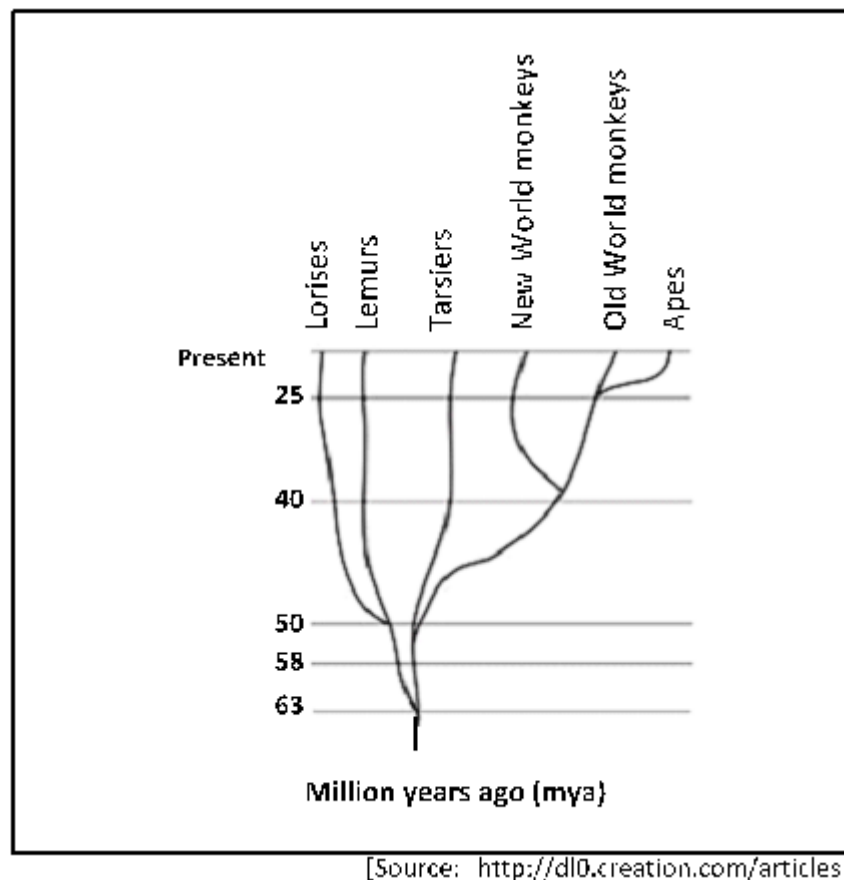
(c) Hominid share a common ancestor with *Australopithecus africanus*

7.5.4 Give ONE example of an *Australopithecus africanus* fossil found in South Africa. (1)

7.5.5 Name TWO *Homo* species, besides *Homo sapiens*, that were found in Africa. (2)

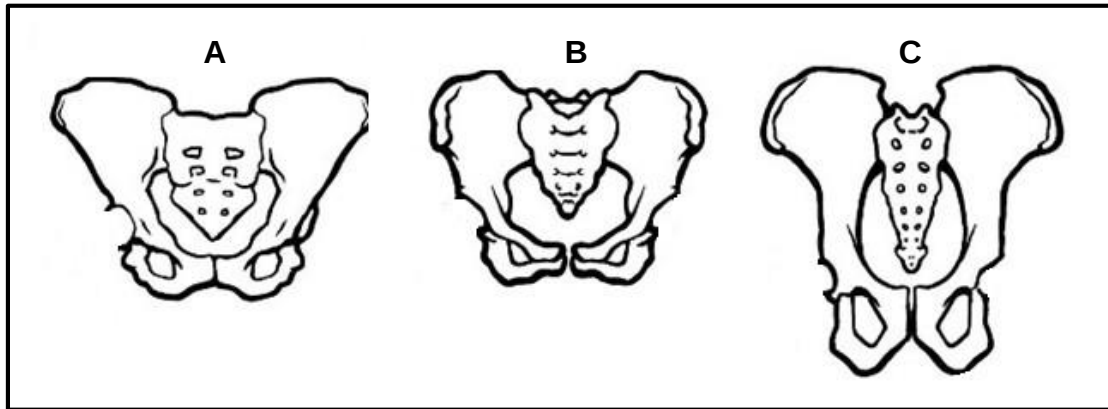
(8)

7.6 Study the diagram below



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

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



- 7.7.1 What term is used to describe organisms that are able to walk upright permanently? (1)
- 7.7.2 Which TWO diagrams above represent the pelvis of the organisms in QUESTION 7.7.1? (2)
- 7.7.3 Explain your answer to QUESTION 7.7.2. (2)
- 7.7.4 State ONE feature of the spine of the organism represented by **C**. (1)
- (6)**
- 7.8 Tabulate THREE differences between the skulls of humans and African apes. (7)