EXAMINATION	NATIONAL SENIOR CERTIFICATE
GRADE	12
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SUBJECT	LIFE SCIENCES
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MARK TOTAL	150
DURATION (HOURS)	2½
NUMBER OF PAGES	16

SOUTH AFRICAN COMPREHENSIVE ASSESSMENT INSTITUTE

SUID-AFRIKAANSE KOMPREHENSIEWE ASSESSERINGSINSTITUUT

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer **ALL** the questions.
2. Write **ALL** the answers in the **ANSWER BOOK.**
3. Start the answer to **EACH** question at the top of a **NEW** page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. **ALL** drawings should be done in pencil and labelled in blue ink.
7. Draw diagrams, tables or flow charts only when requested to do so.
8. The diagrams in the question paper are **NOT** necessarily drawn to scale.
9. A non-programmable calculator, protractor and a compass may be used, where necessary.
10. Write neatly and legibly, in **BLUE** ink only.

SECTION A

QUESTION 1

1.1 Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 Four different blood groups are possible in the offspring if the parents have blood groups …

A AB and O.

B B and AB.

C O and B.

D A and B.

1.1.2 Which of the following best supports the Out of Africa hypothesis?

A Cultural evidence such as tool-making.

B *Ardipithecus* and *Homo habilis* fossils have been found in Africa only.

C Oldest fossils have been found in other parts of the world and the youngest fossils in Africa.

D Genetic evidence shows the relationship between a European ancestor and Africans.

1.1.3 Rosalind Franklin greatly contributed towards understanding the structure of deoxyribonucleic acid because she ...

A discovered the double-helix shape with Watson & Crick.

B used crystallography to produce the first x-ray images of a DNA molecule.

C collaborated with Chargaff to define the rules of complementary base pairing.

D worked with Wilkins to determine that DNA is double-stranded.

1.1.4 Random arrangement of chromosomes during gametogenesis is important because …

A it leads to variation in the cells produced.

B it achieves the necessary chromosome number.

C it ensures that the genetic instruction is copied identically.

D it produces mutant chromosomes that differ from the parent cell.

1.1.5 A married couple has two biological children: a boy and a girl. Only the boy has been diagnosed with a recessive X-linked genetic disorder in this family.
Choose the correct statement regarding the scenario.

A The boy inherited the defective allele from his father.

B The boy's mother must be a carrier for the disorder.

C The girl inherited a defective allele from her father but a normal allele from her mother.

D The boy inherited the defective alleles from both his parents.

1.1.6 The following two frog species look very similar yet they are two separate species that live in the same habitat.

(a) (b)

[Source: https://bio.libretexts.org/Workbench/General_Ecology]

The *Rana aurora* (a) breeds during the early months of the year and the *Rana boylii* (b) breeds just before winter. Identify the type of reproductive isolation, from the options below, that will prevent interbreeding between the two species.

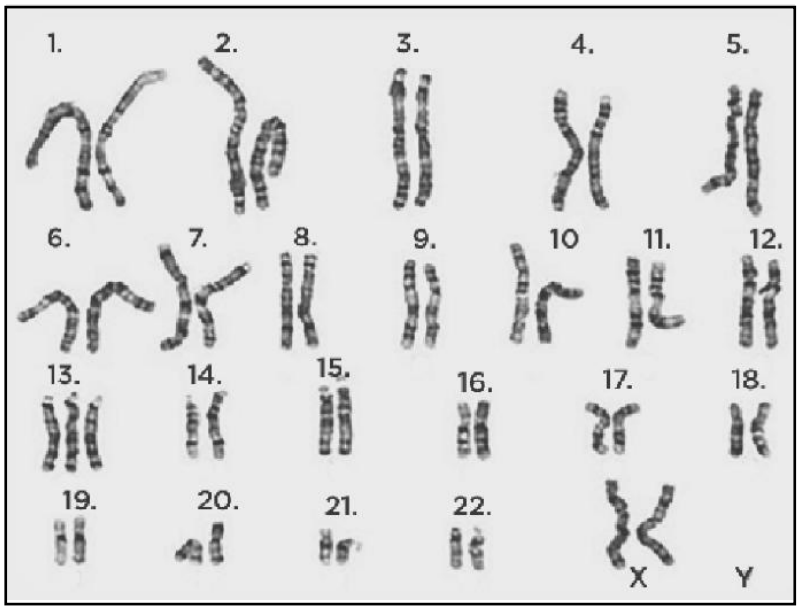
A Mechanical

B Behavioural

C Temporal

D Ecological

1.1.7 Consider the karyotype below to answer the question that follow.



i) The person is male.
ii) The person is female.
iii) The person has Down Syndrome.
iv) The person is genetically normal.
v) The person has Trisomy 13.

Which combination of statements is true regarding the karyotype illustrated above?

A i and ii only

B ii and iii only

C ii and v only

D i and iv only

1.1.8 If a blacksmith develops strong muscles due to the nature of his work, the characteristic for strong muscles will be carried on to his offspring.

The scenario above, is an example of …

A Lamarck's Law of Use and Disuse.

B Lamarck's Law on the inheritance of Acquired Characteristics.

C Darwin's theory of natural selection.

D Darwin's theory of gradualism.

1.1.9 The following statements refer to protein synthesis.

i) Takes place only in the cytoplasm of all cells.
ii) The anticodon is identical to the original DNA strand, except Thymine is replaced with Uracil.
iii) tRNA bring free amino acids to the ribosome where they bind to form a chain.
iv) mRNA leaves the nucleus and acts as a messenger of the information used to code the protein.

Which one of the following combinations is correct?

A i, ii and iii only
B ii, iii and iv only
C i, iii and iv only
D i, ii and iv only (9x2) **(18)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.9) in the ANSWER BOOK.

1.2.1 The barcode pattern formed by the base sequence of prepared, processed DNA.

1.2.2 Differences in DNA between individuals of the same population of a species.

1.2.3 Complete set of chromosomes containing all the genes of an organism.

1.2.4 A cell condition in which the nucleus contains a single set of chromosomes.

1.2.5 Variety of life forms found on Earth.

1.2.6 An explanation that can be supported, for something that has been observed.

1.2.7 The point at which chromatids of homologous chromosomes overlap.

1.2.8 Division of the nucleus.

1.2.9 Nitrogen triplet on the mRNA strand. (9x1) **(9)**

1.3 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 only **A only, B only, Both A and B** or **None,** next to the question numbers (1.3.1 to 1.3.3) in you ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Importance of meiosis	A. Produce haploid gametes B. Increase genetic variation
1.3.2 A pair of identical chromosomes	A. Heterozygous B. Homozygous
1.3.3 An example of continuous variation	A. Blood groups B. Arm span

(3x2) **(6)**

1.4 Consider the table of DNA base triplets below that code for different amino acids.

Nitrogen triplet in DNA template	Amino Acid
GAA	Leu
GTA	His
GGG	Pro
CGT	Ala
ACC	Trp
CCT	Gly

[Source adapted from: Mind the Gap]

An mRNA chain consists of the following nitrogen triplets:

CCC-CUU-GGA-UGG-UGG

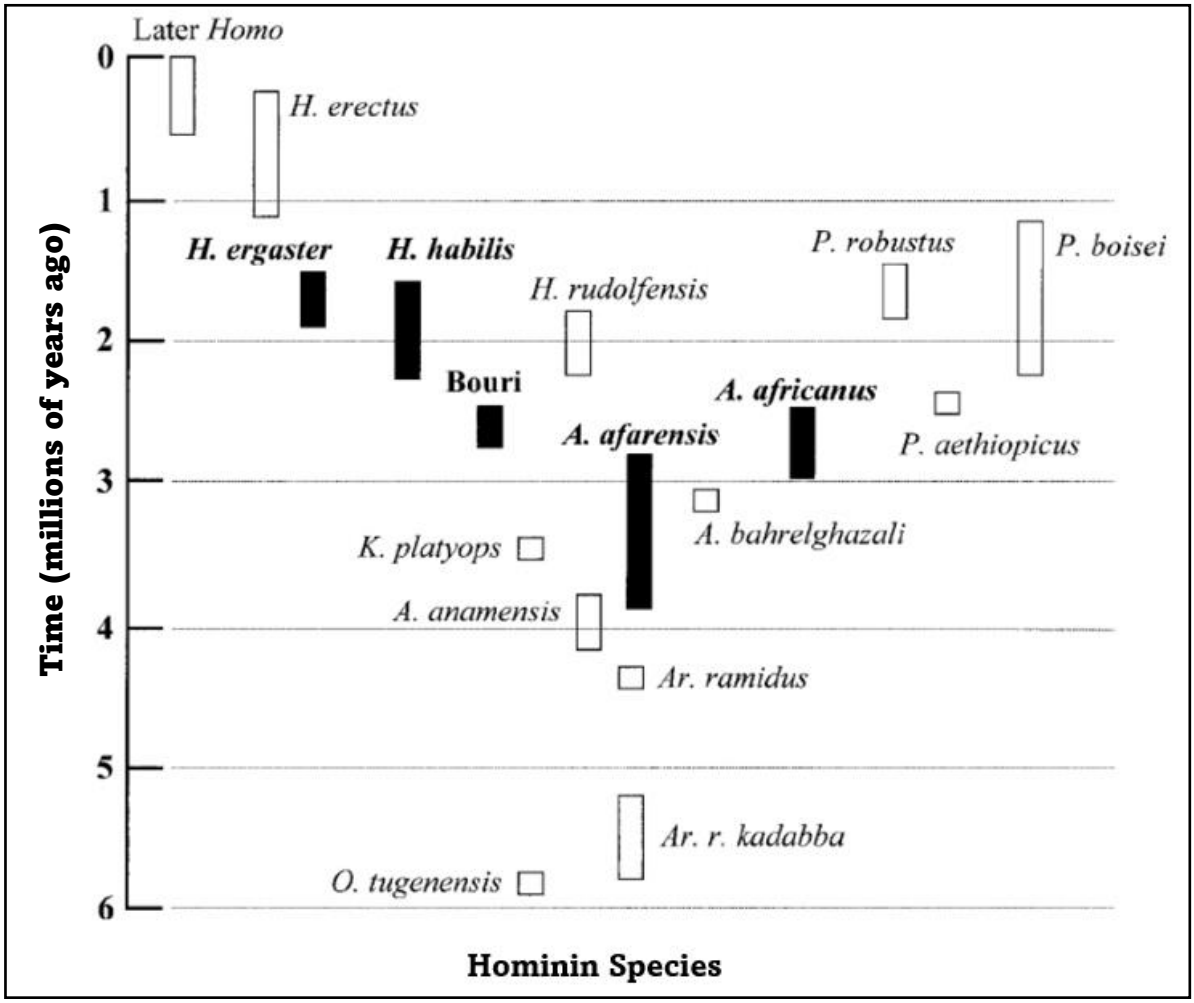
1.4.1 Name the process in which the mRNA chain is formed. (1)

1.4.2 Provide the amino acids coded for from left to right. (4)

1.4.3 What type of bond will form between consecutive amino acids in an amino acid chain? (1)

1.4.4 The GGA triplet is mutated to GCA. Discuss the resulting change of this mutation. (3)
(9)

1.5 Study the diagram of the evolutionary relationships of the modern human below to answer the questions that follow.



[Source: https://www.researchgate.net/figure/Hominin]

1.5.1 Give the name of the diagram illustrated above. (1)

1.5.2 According to the diagram, list TWO other species that lived at the same time as *A. africanus*. (2)

1.5.3 Determine the period of time between the extinction of *H. ergaster* and the appearance of Later *Homo*. (2)

1.5.4 Complete the following table regarding ONE *Australopithecus* species visible on the diagram of which fossils were found in South Africa. Write down the letter as well as the correct answer in the ANSWER BOOK.

Species	Name of fossil	Discovering scientist
a)	b)	c)

(3)

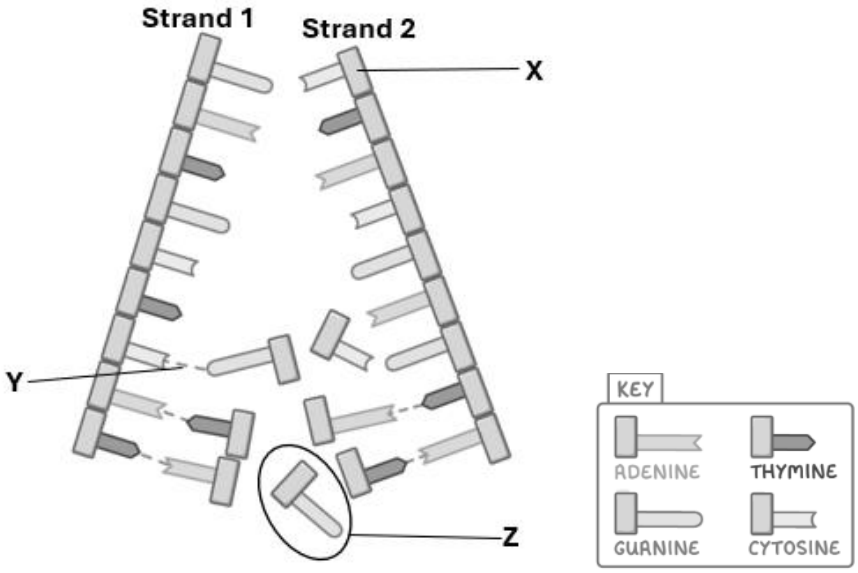
(8)

TOTAL SECTION A: [50]

SECTION B

QUESTION 2

2.1 The diagram below represents an important biological process that takes place in all cells at microscopic level. Study the diagram to answer the questions that follow.



[Source adapted from: https://puppeteer.cognitoedu.org/coursesubtopic/b3-alevel-ocr_TBCGHiYN

2.1.1 Identify the following:

a) Components of structure **X** (2)
b) Bond **Y** (1)
c) Structure **Z** (1)

2.1.2 Briefly explain the importance of the biological process illustrated above. (2)

2.1.3 Using the diagram and key provided above, draw a stick diagram, from top to bottom, of the newly formed DNA strand that formed from strand 1. (4)

2.1.4 Explain how structure **Z** would be different in an mRNA molecule and name the complimentary base to this nitrogen base. (2)

(12)

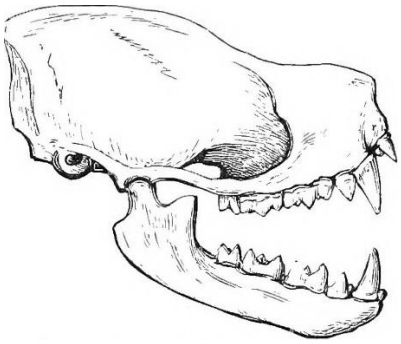
2.2 Read the following extract and consider the diagrams of two species of bats below.

Bats

Bats are the only flying mammals, and their story is unique. Unlike most other mammals, bats couldn't easily cross cold regions like the ancient land bridge that once connected Alaska and Siberia.

This means that bats on different sides of the globe remained isolated for a very long time. It's why we have unique species like vampire bats in the Americas and fish-eating bats in Southeast Asia.

Anatomy of a vampire bat



Anatomy of a fish-eating bat

[Source compiled from: alamy.com; earth.com; researchgate.net

2.2.1 Identify the method of speciation referred to in the text. (1)

2.2.2 Identify ONE visible difference in the diagrams of the vampire bat and the fish-eating bat and suggest a possible reason for the difference. (2)

2.2.3 Use your knowledge of speciation to discuss why and how the bats developed into different species in the Americas and Southeast Asia. (7)

(10)

2.3 Extensively drug-resistant TB (XDR-TB) is a rare type of MDR-TB caused by TB bacteria that are resistant to several antibiotics. A South African study was conducted in 2021 to study the reported cases of TB and laboratory-diagnosed cases of MDR-TB and XDR-TB *(Key challenges facing the TB programme in South Africa today)*. Their results are shown in the table below:

Years	Diagnosed cases of TB	Diagnosed cases of MDR-TB	Diagnosed cases of XDR-TB
2015	235900	3150	85
2016	302550	4120	300
2017	342310	5820	460
2018	388750	7430	465
2019	402000	8125	490
2020	398540	9120	580
2021	354680	7540	820

[Source adapted from:https://www.researchgate.net/figure]

2.3.1 Identify the following for the study:

a) Dependent variable (1)

b) Independent variable (1)

2.3.2 MDR-TB and XDR-TB are not the same as normal TB. Discuss this statement by referring to natural selection and evolution. (3)

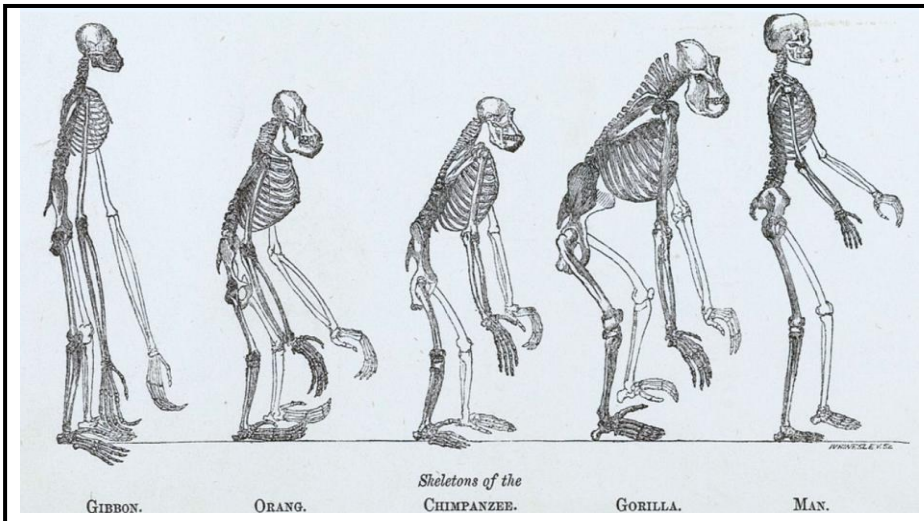
2.3.3 Present the data provided in the table for XDR-TB on a LINE GRAPH. (6)

2.3.4 Describe the relationship between the diagnosed cases of MDR-TB and XDR-TB from 2019 to 2021. (2)

2.3.5 Suggest TWO possible reasons for the decrease in TB cases in 2021. (2)

(15)

2.4 The diagram below illustrates the skeletons of a few hominids. Consider the diagram when answering the following questions



[Source: https://www.britannica.com/science/human-evolution]

2.4.1 Define the term *hominin*. (2)

2.4.2 What type of evidence could be used to draw the diagram shown above? (1)

2.4.3 Comment on the relevance of the small number of offspring produced by both African apes and humans. (2)

2.4.4 Tabulate TWO differences between African apes and humans by referring to:

a) Palate shape
b) Cranial ridges (5)

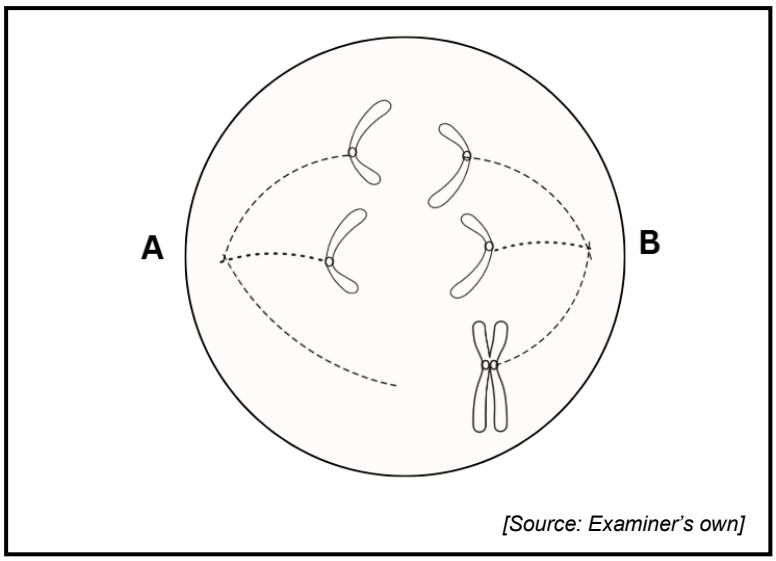
2.4.5 Gibbons, orangs and chimpanzees are quadrupedal. Discuss how modern humans are anatomically different to be bipedal. (3)

(13)

TOTAL QUESTION 2: [50]

QUESTION 3

3.1 The diagram below represents a cell during meiosis.



[Source: Examiner's own]

3.1.1 Identify the phase shown above. (1)

3.1.2 Identify the abnormality present in the diagram above. (1)

3.1.3 Describe the impact that this abnormality will have on the chromosome number of the resulting gametes. (2)

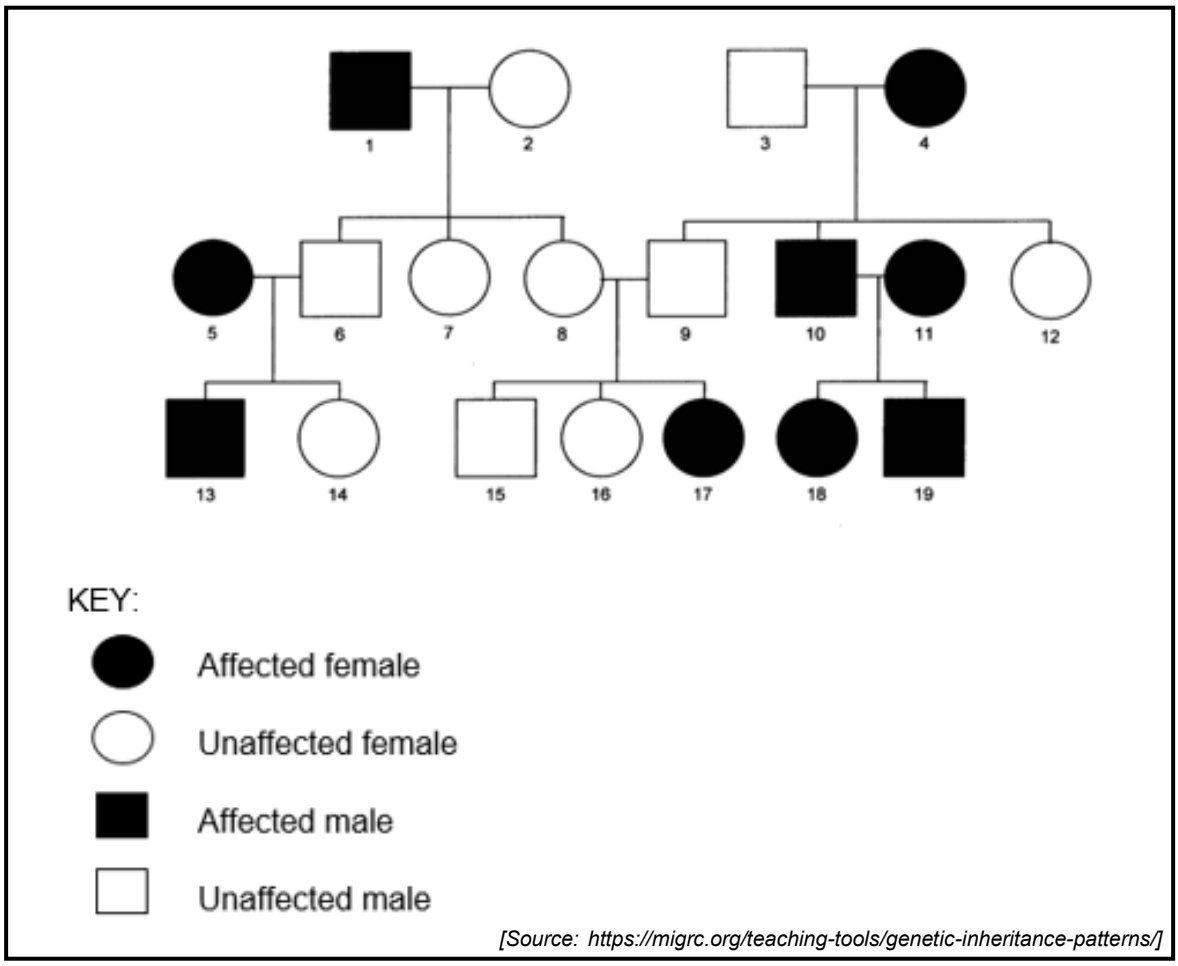
3.1.4 Briefly discuss the consequences of the fusion of a gamete, like the one illustrated on side **B**, with a normal gamete in humans. (3)

3.1.5 Describe the phase prior to the phase illustrated above. (3)

3.1.6 Suggest a reason why the diagram above is not an example of a human cell. (2)

(12)

3.2 Study the pedigree diagram of two families with Wilson's disease (excess build-up of copper in the body) to answer the questions that follow.



[Source: https://migrc.org/teaching-tools/genetic-inheritance-patterns/]

3.2.1 Identify the inheritance pattern illustrated above. (2)

3.2.2 Why are pedigree diagrams important for a family during family planning? (2)

3.2.3 Individual 14 is heterozygous for the disorder, determine the percentage chance of having a child that is a carrier, if she marries individual 19. (2)

3.2.4 Use the letters **B** and **b** to write down the genotype of individual 9. (2)

(8)

3.3 A heterozygous father with blood group B, and a homozygous mother with blood group A start a family.

3.3.1 How many alleles control blood groups? (1)

3.3.2 Give the genotypes for both the father and mother. (2)

3.3.3 What is the possibility (%) of their offspring to be:

a) Homozygous for blood group **B** (2)
b) Blood group **AB** (2)

3.3.4 The father is in an accident and requires a blood transfusion, from which blood groups will he be able to receive blood? (2)

3.3.5 Explain TWO reasons for your answer in QUESTION 3.3.4. (4)

(13)

3.4 A farmer's daughter saw a speckled chicken at a farmers' market and told him about it. However, when he got there, it was already sold. He has been struggling to find one for his daughter and decided to try and breed one at home. He bought 5 chickens with the allele for white **(W)** feathers and 5 with the allele for black **(B)** feathers.

3.4.1 Identify the type of dominance exhibited in the chickens. (1)

3.4.2 By using a genetic cross, determine the number of speckled chicks the farmer can expect from a white hen and black rooster with 10 chicks. (6)

3.4.3 If the offspring mate with each other, what is the percentage chance of having black chicks? (2)

3.4.4 The farmer wants to investigate the possibility of speckled chickens and speckled eggs. Identify the type of crossing involved in such a breeding experiment. (1)

(10)

3.5 Read the extract below and answer the questions that follow.

Marfan syndrome is an inherited disorder caused by a mutation that affects connective tissue — the fibres that support and anchor your organs and other structures in your body. Marfan syndrome most commonly affects the heart, eyes, blood vessels and skeleton.

People with Marfan syndrome are usually tall and thin with unusually long arms, legs, fingers and toes. The damage caused by Marfan syndrome can be mild or severe. If your aorta (the large blood vessel that carries blood from your heart to the rest of your body) is affected, the condition can become life-threatening.

[Source adapted from: https://www.mayoclinic.org/diseases-conditions/marfan-syndrome/]

3.5.1 Define the term *mutation*. (2)

3.5.2 Give ONE advantage of mutations. (1)

3.5.3 A man with Marfan syndrome and an unaffected woman is having a baby. Discuss the importance of genetic testing and genetic counselling for expecting parents with a family history of genetic disorders. (4)

(7)

TOTAL QUESTION 3: [50]

TOTAL SECTION B: [100]

GRAND TOTAL: [150]

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