KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES

JUNE EXAMINATION 2023

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MARKS: 150

TIME: $2^1/_2$ hours

N.B. This question paper consists of 17 pages including this page.

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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 answers 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. Make ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass, where necessary.
11. Write neatly and legibly.

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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 to D) next to the question number (1.1.1 to 1.1.10) in your ANSWER BOOK, for example 1.1.11 D.

1.1.1 Which ONE of the following involves the development of the young within eggs that are retained inside the mother's body until it hatches?

A Ovipary
B Vivipary
C Ovovivipary
D Amniotic egg

1.1.2 Below is a list of items related to reproductive strategies in invertebrates.

(i) The male deposits sperm into the body of a female.
(ii) The female then lays her eggs in batches of 20 or 50 on plants or on the ground.
(iii) Female butterflies are often dead by the time the caterpillar is formed

Which of the following combination/s increase/s the reproductive success in invertebrates?

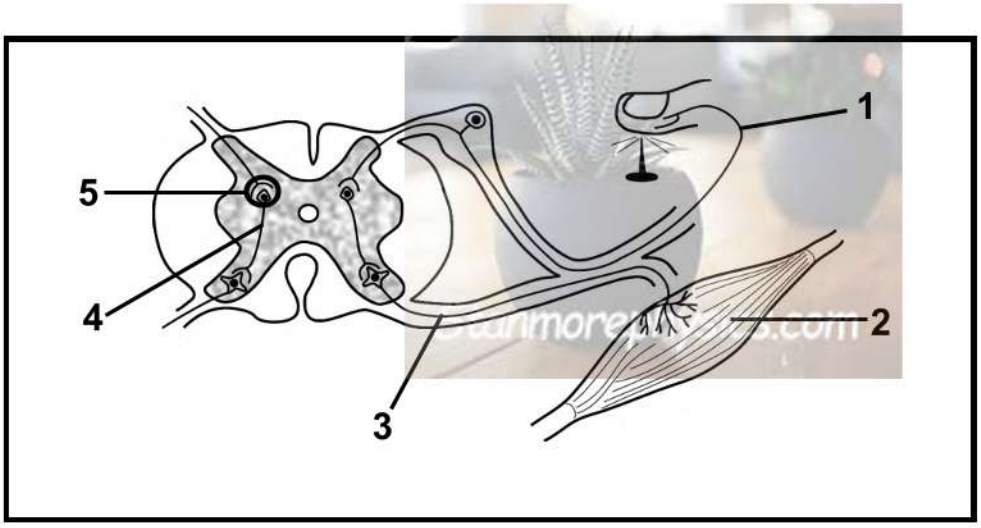
A (i), (ii) and (iii)
B (i) only
C (ii) only
D (i) and (ii)

1.1.3 If a recessive allele on the X-chromosome is passed on to the offspring it is an example of …

A sex-linked inheritance.
B incomplete dominance.
C multiple alleles.
D co-dominance.

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QUESTIONS 1.1.4 AND 1.1.5 ARE BASED ON THE DIAGRAM OF A REFLEX ARC BELOW.



1.1.4 Which part brings about a response to a stimulus received by the body?

A **1**
B **2**
C **3**
D **4**

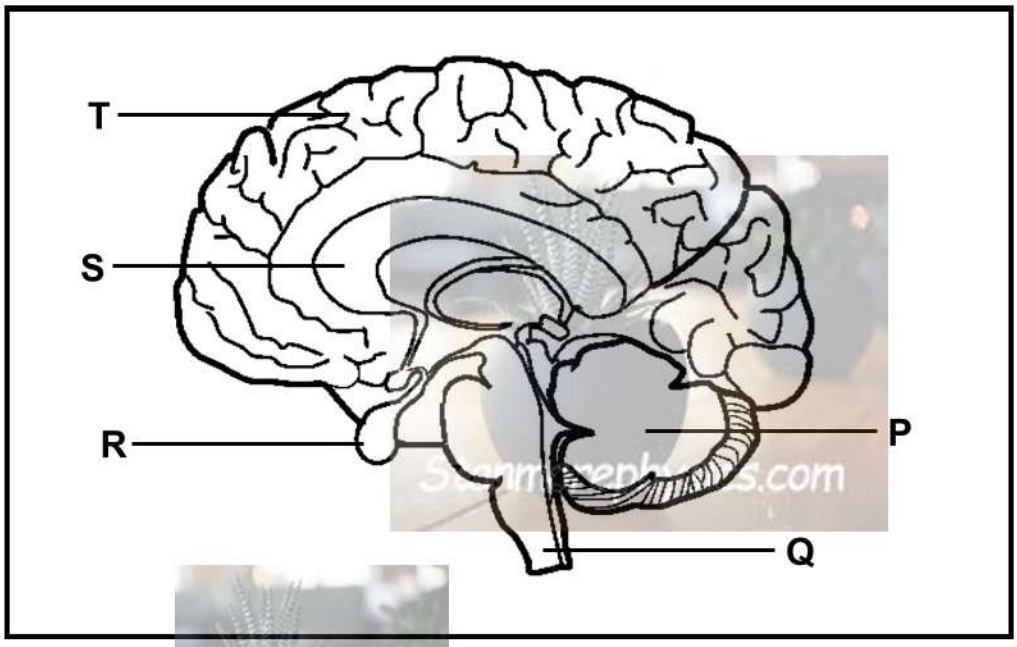
1.1.5 The function of part **5** is to …

A ensure one directional flow of an impulse.
B carry impulses from towards the central nervous system.
C carry impulses away from the central nervous system.
D insulates the axon.

1.1.6 External fertilisation is the fusion of haploid nuclei of a …

A male and female gametes in the body of the female.
B male and female gametes outside the body of the female.
C male gamete with a diploid female gamete inside the body of the female.
D male gamete with a female somatic/body cell inside the body of the female.

QUESTIONS 1.1.7 AND 1.1.8 ARE BASED ON THE DIAGRAM OF A HUMAN BRAIN BELOW



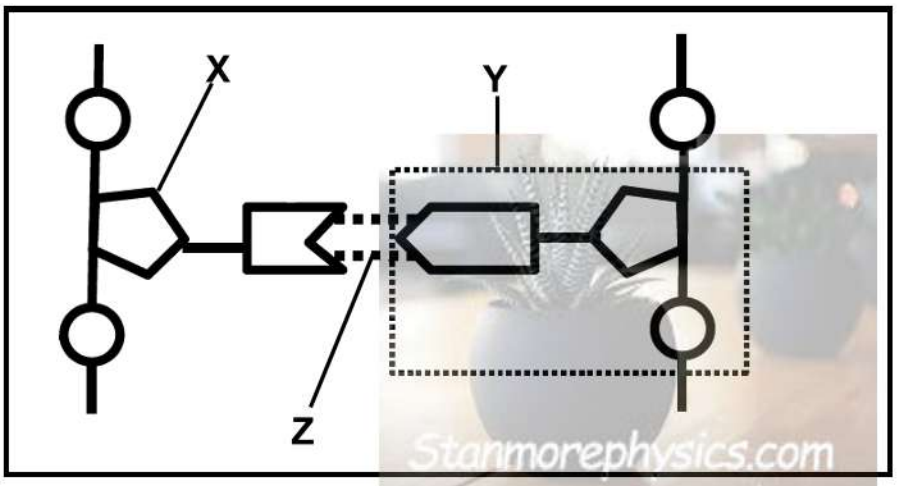
1.1.7 Which ONE of the following parts is most likely damaged if voluntary actions are not coordinated?

A **P**
B **Q**
C **S**
D **T**

1.1.8 Which ONE of the following is part of the endocrine system?

A **P**
B **Q**
C **R**
D **S**

1.1.9 The diagram represents a portion of a nucleic acid.



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Which ONE of the following combinations shows correct labels for the different parts?

	NUCLEIC ACID	MOLECULE X	PORTION Y	BOND Z
A	DNA	Ribose sugar	Amino acid	Peptide
B	RNA	Deoxyribose sugar	Nucleic acid	Nitrogen
C	DNA	Deoxyribose sugar	Nucleotide	Hydrogen
D	RNA	Ribose sugar	Nucleoplasm	Hydrogen

1.1.10 A small section of DNA template strand has the following sequence of bases that codes for different amino acids:

G C T C G T T A A

Which ONE of the following is the CORRECT representation of the codons and number of amino acids coded for by this section?

	CODONS	NUMBER OF AMINO ACIDS
A	GCU CGU UAA	1
B	CGA GCA AUU	3
C	CGT GCT TUU	9
D	GCA CGA AUU	3

(10 x 2) **(20)**

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 1.2.6) in the ANSWER BOOK.

1.2.1 The area of the retina that contains the highest concentration of cones

1.2.2 The structure within the amniotic egg which collects the embryo's nitrogenous waste

1.2.3 Part of the reflex arc that converts a stimulus into an impulse

1.2.4 The disease caused by damage to the myelin sheath of neurons

1.2.5 A hormone that controls salt concentration in the blood

1.2.6 An endocrine gland found on top of each kidney

1.2.7 The type of development in birds where the young are able to independently move and feed themselves after hatching

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

1.2.9 The position of a gene on a chromosome (9 x 1) **(9)**

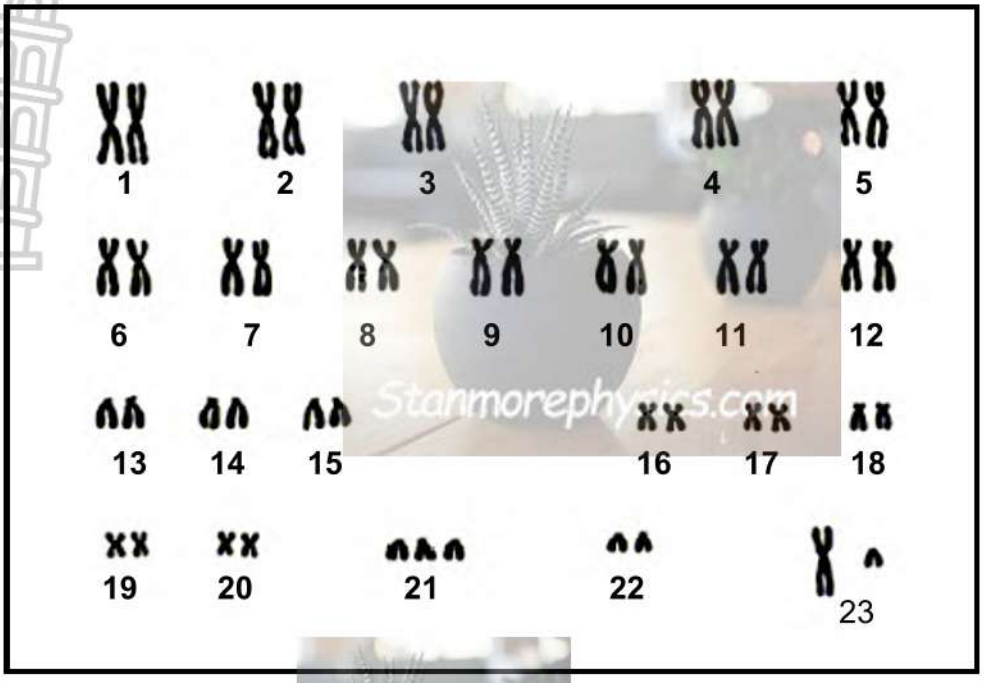
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1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	The functional connection between two consecutive neurons	A: Effector B: Dendrite
1.3.2	Hormones secreted by the pituitary gland	A: Growth hormone B: Thyroxin
1.3.3	Produces amniotic fluid	A: Chorion B: Amnion

(3 x 2) **(6)**

1.4 The diagram below shows a human karyotype.



1.4.1 State the:

(a) gender of the person whose karyotype is shown above (1)

(b) biological term for chromosome pair **23** (1)

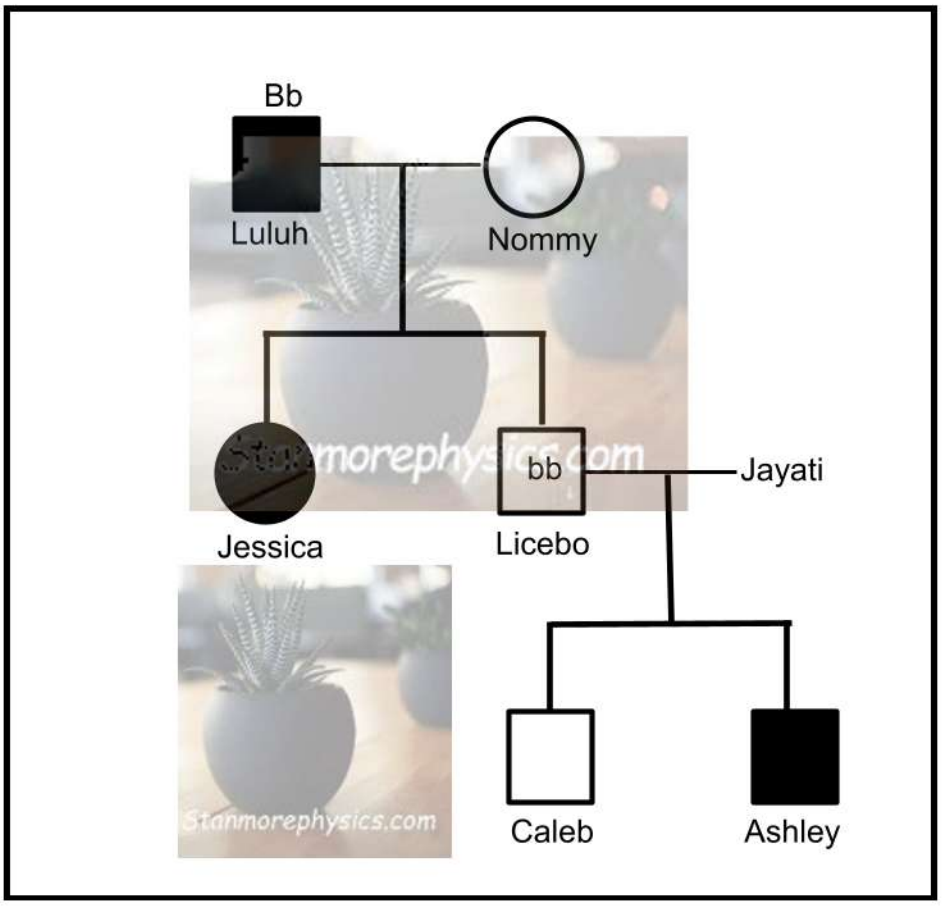
(c) genetic disorder in the person whose karyotype is shown above. (1)

(d) **error** during meiosis that led to the disorder mentioned in QUESTION 1.4.1 (c). (1)

(e) **phase** of meiosis where the error mentioned in QUESTION 1.4.1 (d) occurred. (1)

1.4.2 State TWO ways in which meiosis is biologically important. (2)
(7)

1.5 The diagram below shows the pattern of inheritance of hair colour in a family. The letter **B** represents the allele for black hair and **b** represents the allele for brown hair.



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

(a) Females (1)

(b) Individual(s) that are not biologically related to Luluh (1)

(c) Grandchildren of Nommy and Luluh (1)

(d) Individuals that are definitely heterozygous (1)

1.5.2 Give the genotype of Nommy. (1)

1.5.3 State the phenotype of Jayati. (1)

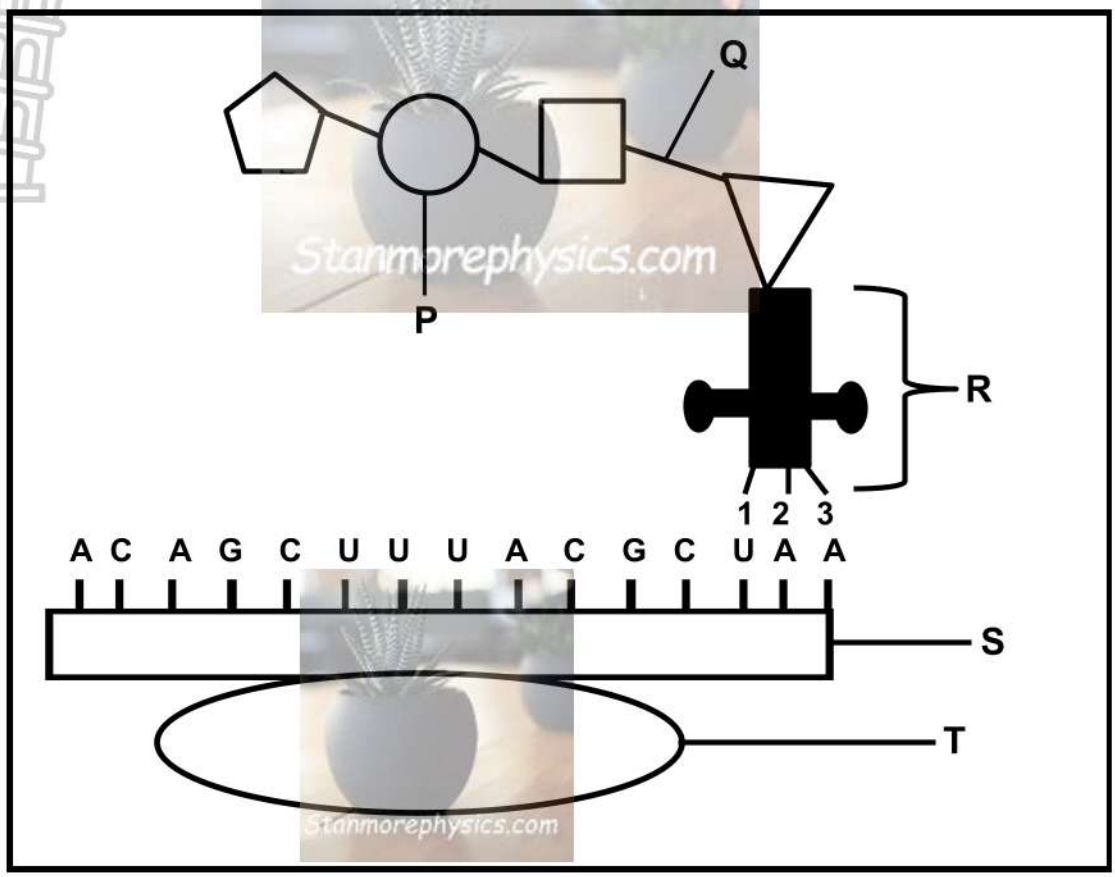
1.5.4 If Ashley marries a woman who has the same genotype as his, what is the percentage chance of them having a child with brown hair? (2)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below shows the process of protein synthesis.



2.1.1 Identify:

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

(b) Nitrogen bases **1**, **2** and **3** (in this order) in molecule **R**. (2)

2.1.2 Write down the LETTER only of the:

(a) Molecule that is a monomer of proteins (1)

(b) Organelle that is a site for protein synthesis (1)

2.1.3 Name the process that resulted in the formation of molecule **S**. (1)

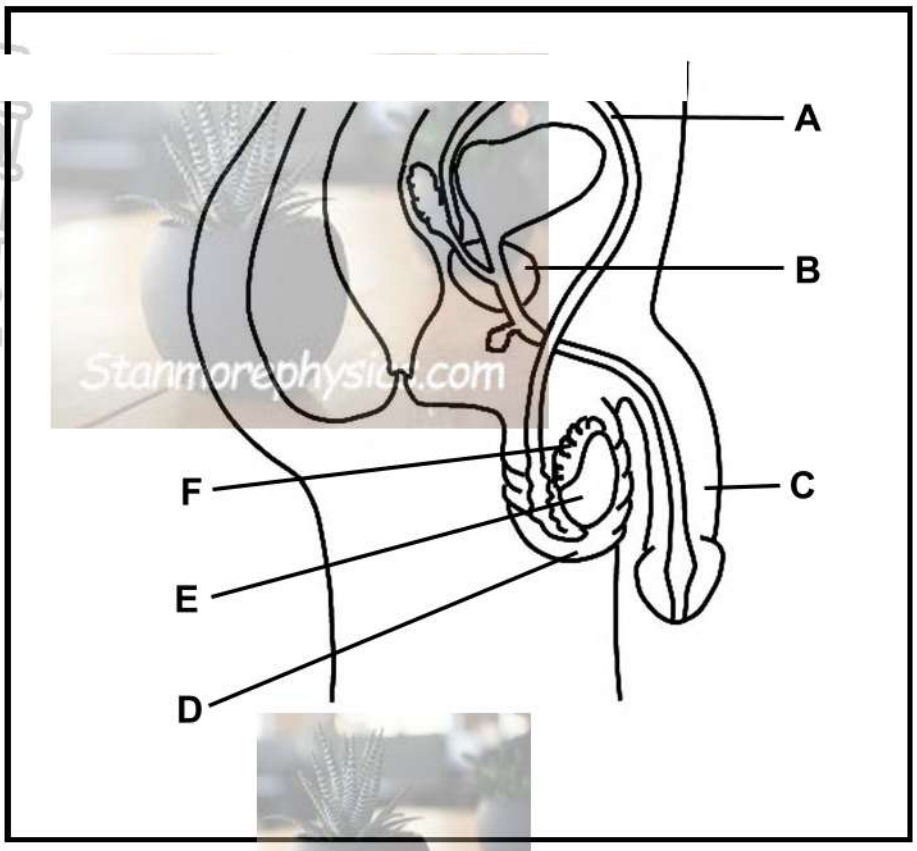
2.1.4 Name and describe the stage of protein synthesis that is taking place in the diagram above. (5)

2.1.5 Write down the DNA base triplets that codes for the first 3 nitrogen bases of molecule **S**. The molecule is read from left to right. (1)

2.1.6 Explain the effect of mutation in a DNA molecule on a protein to be manufactured. (3)

(15)

2.2 The following diagrams shows a human male reproductive system



2.2.1 Identify parts:

(a) **F** (1)

(b) **C** (1)

(c) **D** (1)

2.2.2 Explain:

(a) why a blockage in part **A** may lead to infertility in a male. (2)

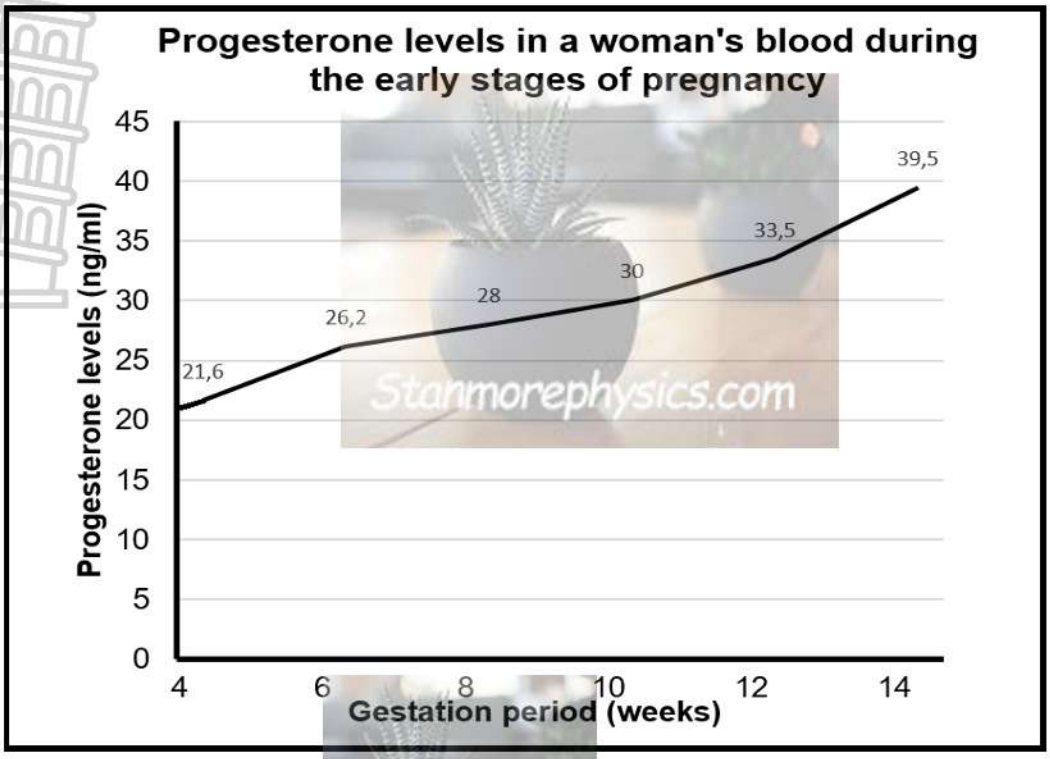
(b) the role of part **B** in reproduction (2)

(c) the advantage of part **E** hanging outside the body of a male (2)

(9)

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



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2.3.1 Name TWO structures responsible for the production of progesterone before and after a female becomes pregnant. (2)

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

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

2.3.4 State ONE importance of the negative feedback mechanism described in QUESTION 2.3.3 if a female becomes pregnant. (1)

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

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

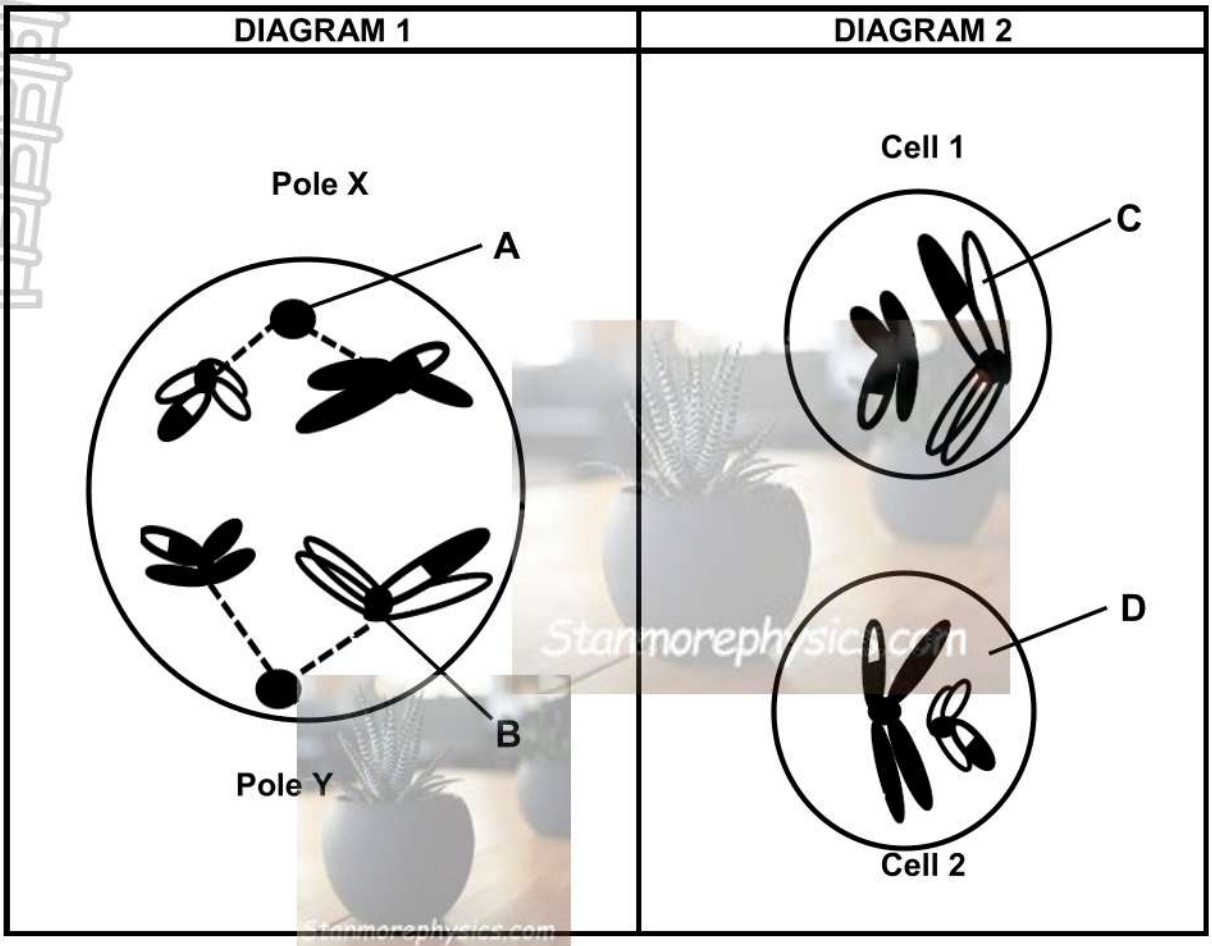
(a) Explain why this woman should be concerned about the decrease in progesterone levels. (2)

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

(12)

2.4 Describe the process of oogenesis. **(5)**

2.5 The diagrams below show phases of meiosis not in the correct order.



2.5.1 Identify parts:

(a) **C** (1)

(b) **D** (1)

2.5.2 Identify the phase of meiosis represented by cell in diagram 1. (1)

2.5.3 Explain your answer to QUESTION 2.5.2. (2)

2.5.4 Which cell (**1** or **2**) resulted from pole **Y**? (1)

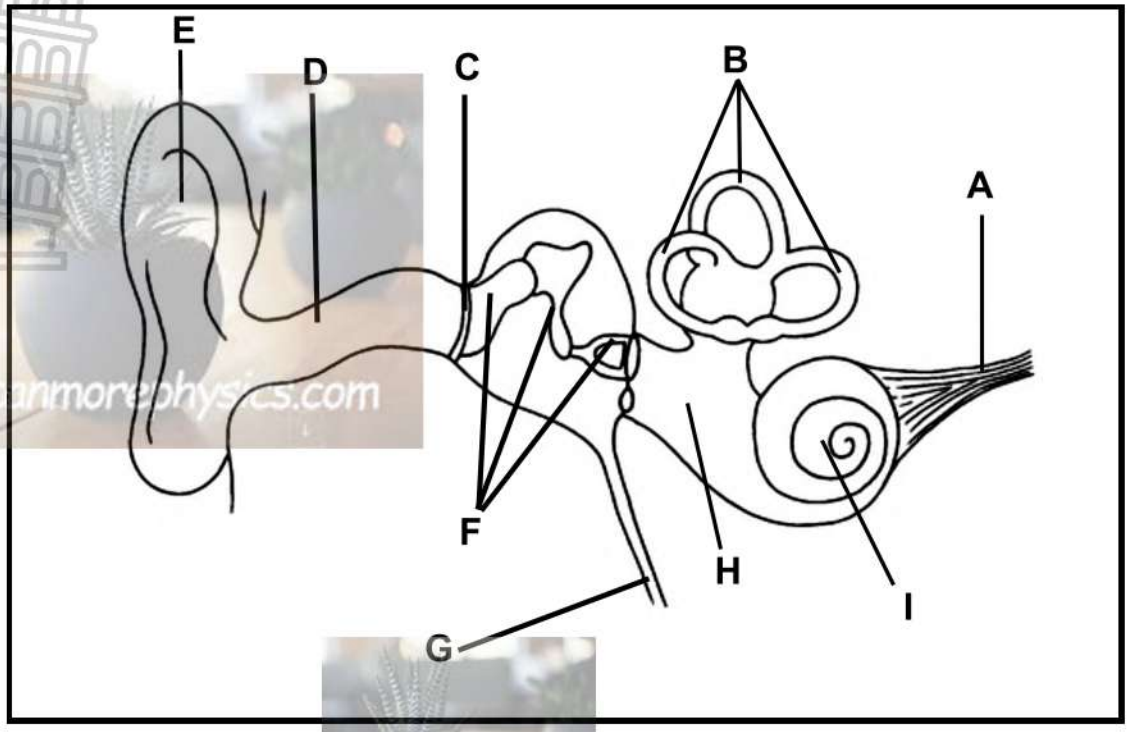
2.5.5 State ONE function of part **B**. (1)

2.5.6 Write down the LETTER and the NAME of the part that is only found in animal cells and not in plant cells. (2)

(9)
[50]

QUESTION 3

3.1 Study the following diagram.



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3.1.1 Identify:

(a) **A** (1)

(b) **F** (1)

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

3.1.3 Write down the FOUR LETTERS of the middle and outer ear, in their correct sequence of involvement during hearing. (2)

3.1.4 Describe the role of part **H** in maintaining balance. (4)

3.1.5 Explain the consequence in hearing if part **I** became damaged. (3)
(12)

3.2 In plant species *Strelitzia reginae*, two characteristics, flower colour and plant height were studied. Each of these characteristics has two variations: flowers may be orange or purple in colour and the plants may be tall or short.

Plants that are heterozygous for flower colour have reddish-brown (blend of orange and purple) flowers and plants that are homozygous recessive for plant height are short.

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

CHARACTERISTICS	DOMINANT ALLELE	RECESSIVE ALLELE
Plant Height	**T**	**t**
Flower colour	**P, O**	

3.2.1 State Mendel's Law of Segregation (3)

3.2.2 Give the term for a genetic cross involving two characteristics. (1)

3.2.3 Name the type of dominance shown by the *strelitzia reginae* flower colour. (1)

3.2.4 Give the:

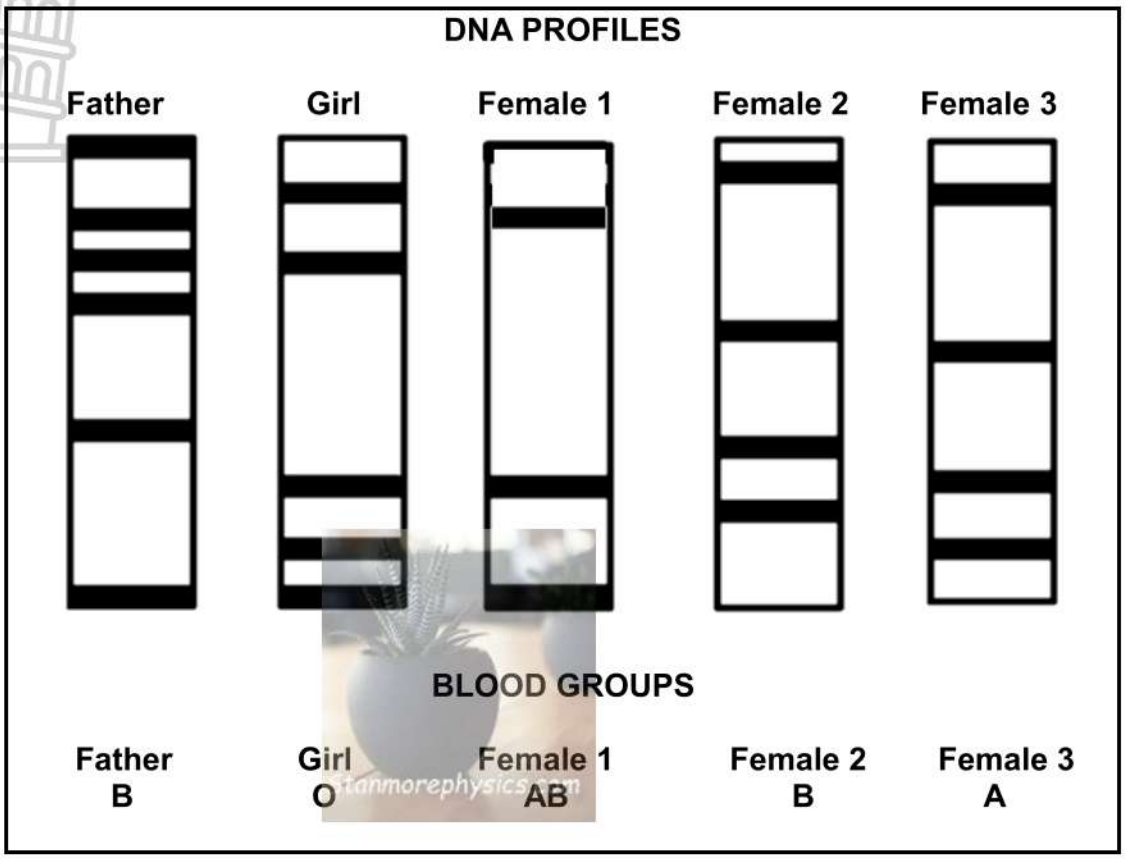
(a) Recessive phenotype for plant height (1)

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

(c) Genotype of a purple flowering tall plant (2)
(10)

3.3 A family wanted to identify the biological mother of a girl. The father of the girl is known. Blood groups and DNA profiles of the father, the girl and three females were used to determine maternity (biological mother).

The data below shows the results of the two procedures.



3.3.1 Identify the biological mother of the girl using DNA profiles. (1)

3.3.2 Explain your answer to QUESTION 3.3.1. (3)

3.3.3 Female **1** claims that the girl is her biological child.

State TWO reasons why she may reasonably argue against the use of DNA profiling to determine maternity. (2)

3.3.4 The father is heterozygous for blood type. Use a genetic cross to prove that female 1 is not a biological mother. (6)

3.3.5 Explain why the maternity of the girl could not be established using blood groups only. (5)
(17)

3.4 A scientific investigation was conducted with 30 athletes to determine the effect of nicotine on energy levels (stamina).

The procedure was as follows:

- The group of athletes was given the first cup of tea, containing no nicotine, to drink. (Cup **A**)
- The group then had to run for as long as possible at the same speed.
- They ran around a 600 m track on level ground.
- The group was given a second cup of tea, containing nicotine, to drink before running for the second time. (Cup **B**)

The table below shows the average time the group of athletes was able to run after drinking Cup **A** and drinking Cup **B**.

TYPE OF TEA	AVERAGE TIME DURATION OF RUNNING (Minutes)
Cup A (220ml without nicotine)	79
Cup B (220ml with nicotine)	135

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3.4.1 State:

(a) the dependent variable (1)

(b) how the dependent variable was measured (1)

3.4.2 State the relationship between nicotine consumption and the stamina of the athletes. (2)

3.4.3 The procedure does not indicate how much time passed between each running exercise.

Explain why this is an important factor to know. (2)

3.4.4 Explain the purpose of giving the athletes Cup **A** tea to drink during the investigation. (2)

3.4.5 Describe the changes that will occur in the blood vessels of the skin and the blood flow in the athletes during this investigation. (2)

3.4.6 State ONE way in which the investigator could have improved the validity of this investigation. (1)

(11)

TOTAL SECTION B: 100
GRAND TOTAL: 150