Hillcrest High School

Grade 12

LIFE SCIENCES

JUNE 2024

MARKS: 150

TIME: 2 ½ Hours

EXAMINER: Mrs R. Harmse

MODERATORS: Mrs L. Prior

Miss E. Blom

Instructions:

1. Answer **ALL** the questions in the answer booklet provided.
2. This paper consists of **TWO** Sections and **THREE** Questions.
3. Number the questions exactly as the questions are numbered.
4. Write neatly and legibly.
5. All drawings should be done in pencil and labelled in ink.
6. Use **ONLY** blue or black ink.
7. Non-programmable calculators, protractors and compasses may be used.

SECTION A

QUESTION 1

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

1.1.1. If two dominant alleles are both expressed in the phenotype of the offspring it is an example of ...

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

1.1.2. The central nervous system is made up of the ...

A. autonomic and peripheral nervous systems.
B. cranial and spinal nerves.
C. sympathetic and parasympathetic nerves.
D. brain and spinal cord.

1.1.3. Which of the following statements about species that use external fertilisation are correct?

(i) Most young survive to maturity
(ii) Water is needed for fertilisation
(iii) Produce a small number of eggs
(iv) Produce a large number of eggs

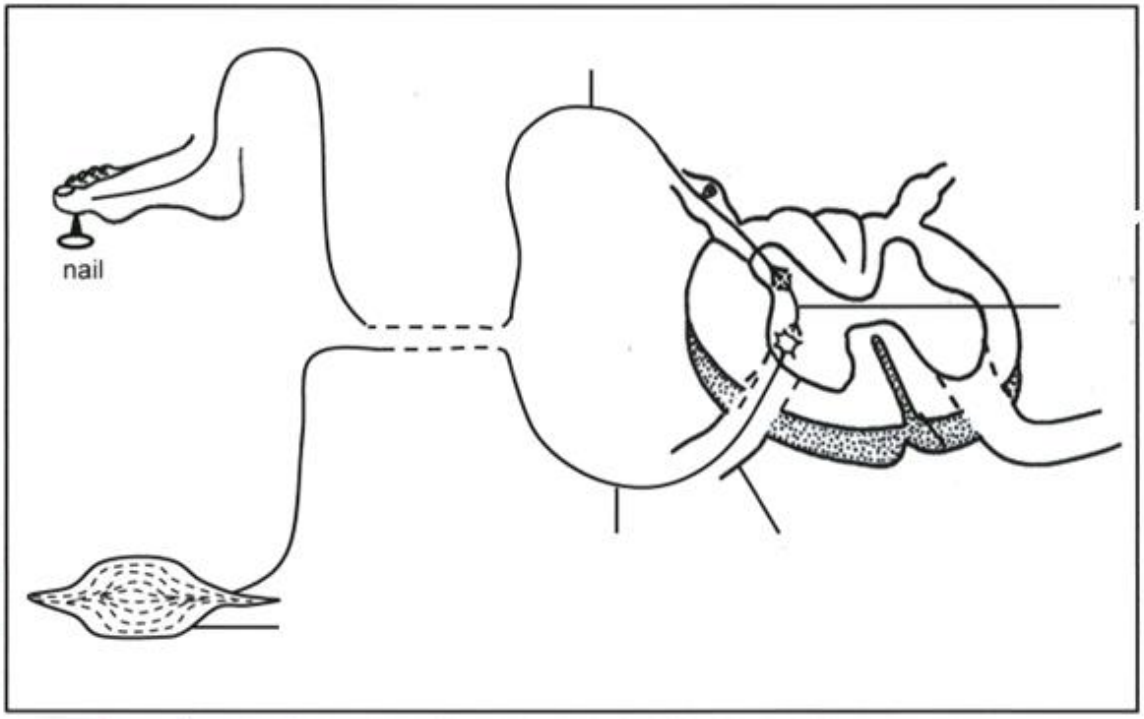
A. (i) and (ii) only
B. (i), (ii) and (iv) only
C. (ii) and (iii) only
D. (ii) and (iv) only

1.1.4. Which ONE of the following involves the development of the young outside within eggs until it hatches?

A. Ovipary
B. Vivipary
C. Ovovivipary
D. Amniotic egg

QUESTIONS 1.1.5 AND 1.1.6 ARE BASED ON THE DIAGRAM BELOW

A boy steps on a nail and pulls his leg away suddenly. The diagram below shows the pathway taken to create this reaction.



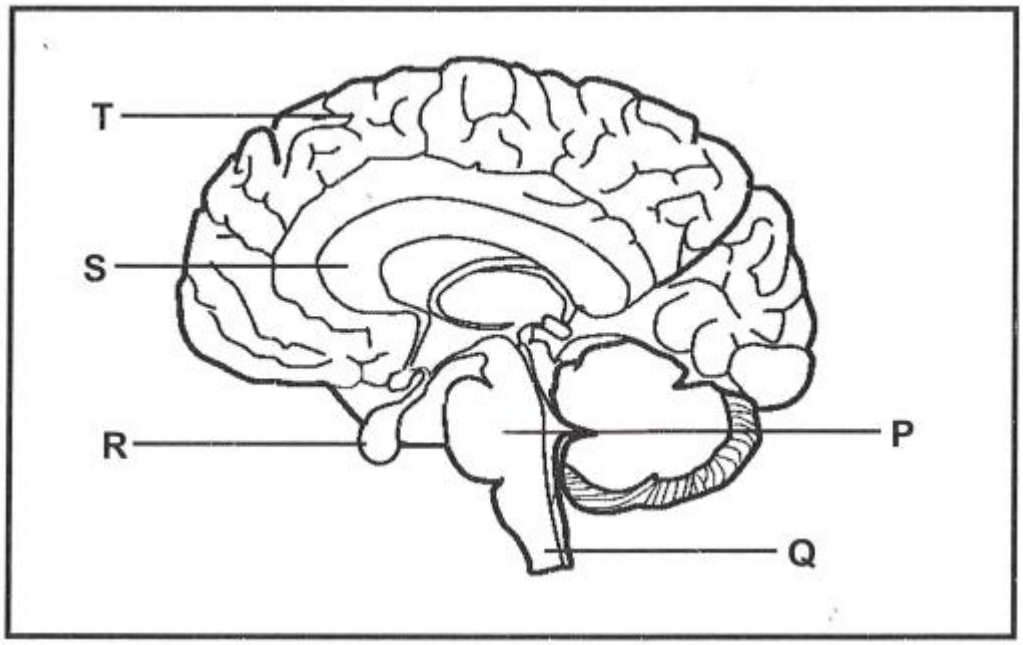
1.1.5. The effector in this diagram is represented by:

A. I
B. F
C. G
D. H

1.1.6. The impulse is carried towards the CNS by:

A. J
B. H
C. I
D. G

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



1.1.7. Which part of the brain is known to maintain vital functions such as heart rate and breathing?

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

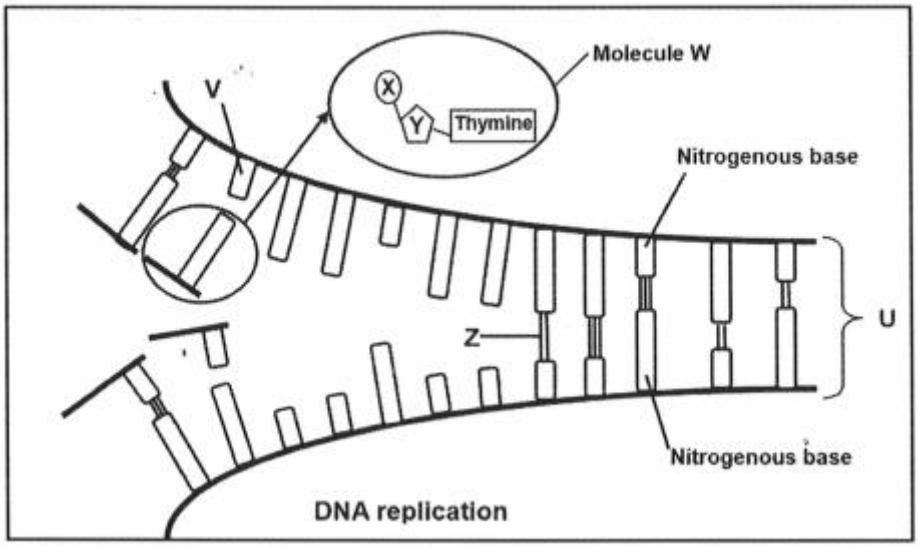
1.1.8. Give the letter that represents the hypophysis.

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

1.1.9. The allantois in the amniotic egg

A. grows out of the embryo and collects waste products.
B. is a cord of blood vessels.
C. contains yolk to nourish the embryo.
D. area for gaseous exchange.

1.1.10. The diagram below represents DNA replication.



Part W represents:

A. An enzyme
B. A codon
C. A DNA strand
D. A nucleotide (**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 1.2.9) in the ANSWER BOOK.

1.2.1. The part of the eye that maintains the shape of the eyeball.

1.2.2. The part of the amniotic egg that nourishes the embryo.

1.2.3. The tiny gap found between two neurons.

1.2.4. A handicap caused by severe damage to the spinal cord.

1.2.5. A hormone that controls blood sugar.

1.2.6. An endocrine gland that is found in the throat area.

1.2.7. A pair of chromosomes where both alleles on a locus are dominant for a trait.

1.2.8. The type of development in birds where the young are dependent on the mother to survive.

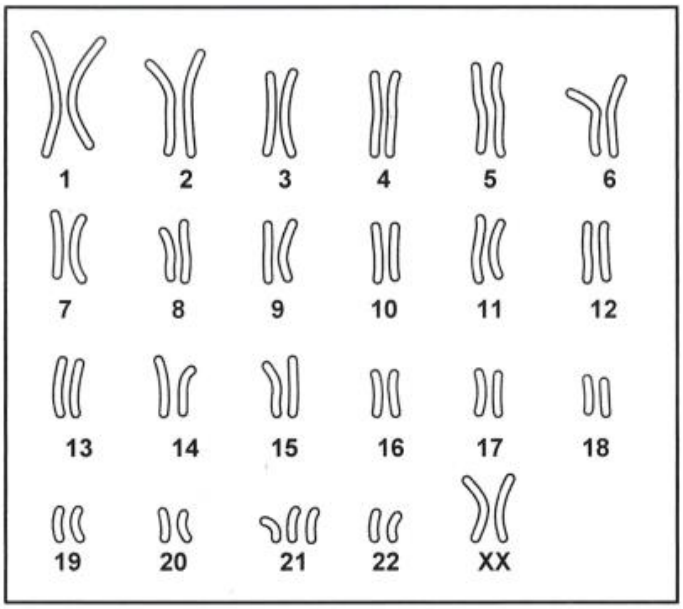
1.2.9. DNA that has been created artificially and contains DNA from two different sources. **(9)**

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 number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1. The structure in the head of the sperm containing digestive enzymes.	A. Albumen
	B. Acrosome
1.3.2. Sudden changes in the genetic make up of an organism.	A. Mutation
	B. Chromosomal aberration
1.3.3. Increase the heart rate.	A. Sympathetic nerves
	B. Parasympathetic nerves

(3 X 2) (6)

1.4. The diagram shows the chromosomes in one human cell.



1.4.1. Name the type of diagram shown above. (1)

1.4.2. Identify the chromosomes labelled 1-22. (1)

1.4.3. State whether the individual shown is a male or a female. (1)

1.4.4. Which chromosome number displays an error? (1)

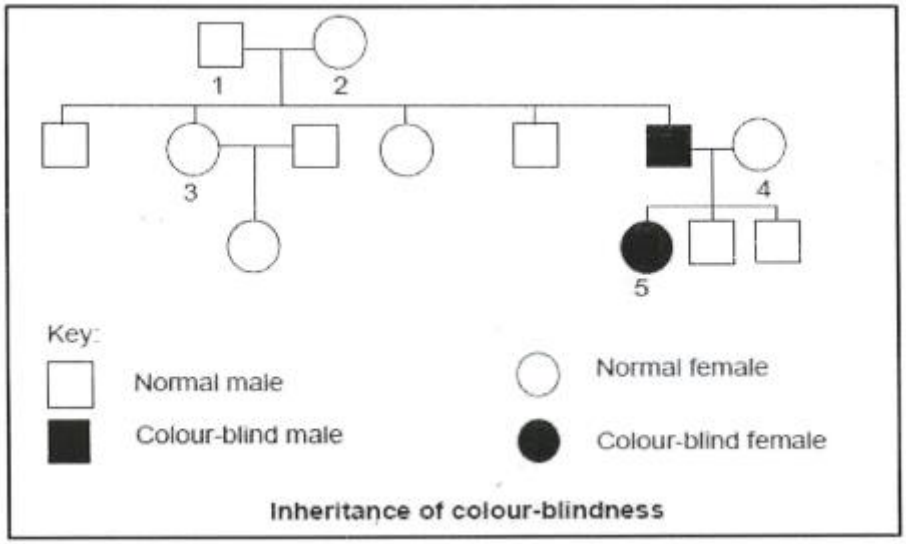
1.4.5. Name this error. (1)

1.4.6. Which genetic disorder is caused by this error. (1)

1.4.7. In which phase of meiosis would this error have occurred? (1)

(7)

1.5. The pedigree diagram below shows the inheritance of colour-blindness in a family. Colour-blindness is sex-linked and is caused by a recessive allele (**d**). The ability to see colour is caused by a dominant allele (**D**).



Inheritance of colour-blindness

1.5.1. How many of the male offspring of parents 1 and 2 were normal? (1)

1.5.2. State the genotype of:

(a) Individual 2 (2)

(b) Individual 5 (2)

1.5.3. If individual 5 marries a normal male, what percentage of their daughters will have an allele for colour-blindness, but will not be colour-blind? (1)

1.5.4. How many males are there in this diagram? (1)

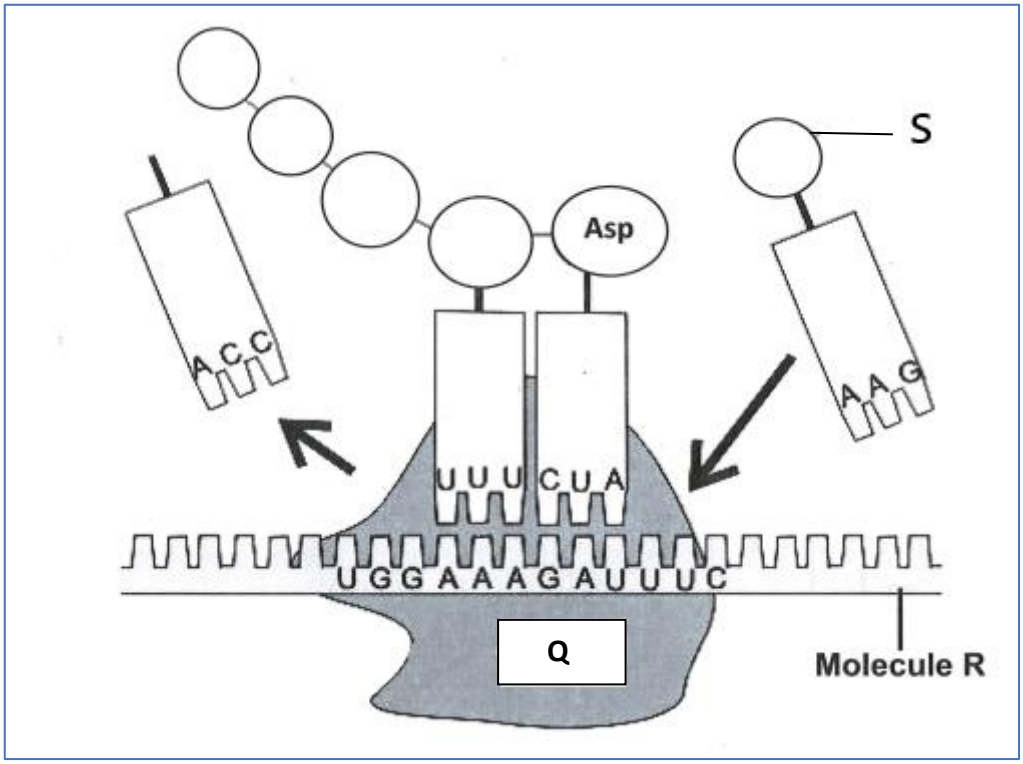
1.5.5. How many individuals are biologically related to parent 2? (1)

(8)

SECTION A: Q1: (50)

SECTION B
QUESTION TWO

2.1. The diagram below shows the part of a stage in protein synthesis.



2.1.1. Give the name and letter of a cell organelle in this diagram. (2)

2.1.2. How many codons are shown altogether in the molecule **R**? (1)

2.1.3. Give the DNA triplet for the amino acid **Asp.** (1)

2.1.4. Name and describe the stage of protein synthesis shown in the diagram above. (5)

2.1.5. What molecule is represented by **R**? (1)

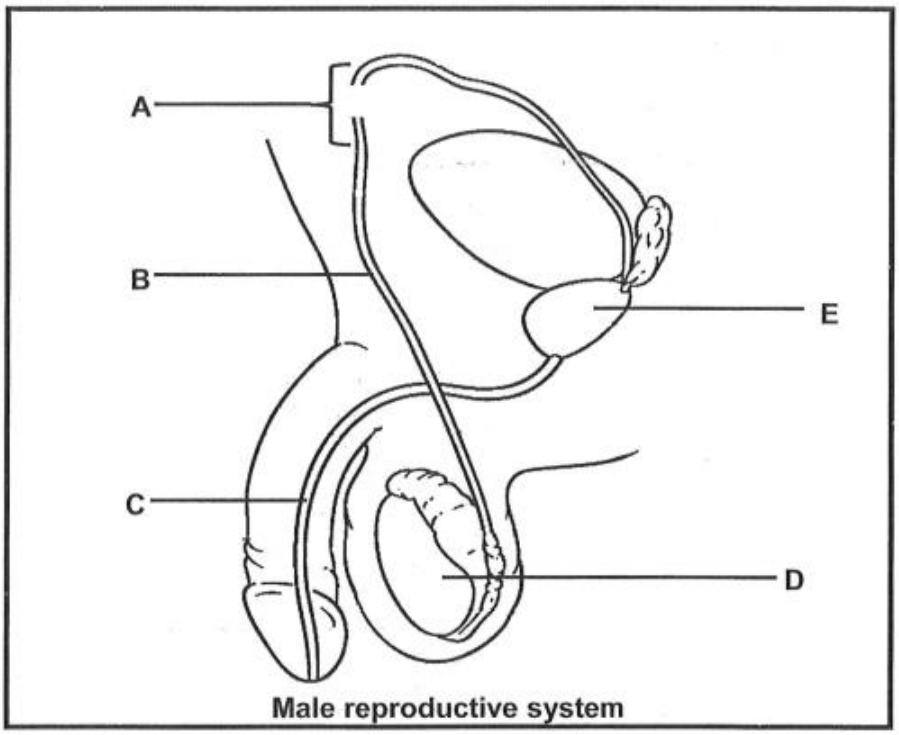
2.1.6. Which letter represents an amino acid in the diagram above? (1)

2.1.7. Write down the DNA triplet base for the SECOND codon of molecule R. (1)

2.1.8. Name the type of DNA mutation that will occur if one nitrogen base is left out and describe the effect of this on the protein. (3)

(15)

2.2. The diagram below shows the male reproductive system.



2.2.1. Identify part labelled **B.** (1)

2.2.2. Provide the LETTER and NAME for:

(a) The part that produces sperm. (2)

(b) The part that adds fluid to the sperm. (2)

2.2.3. Name and describe the type of gametogenesis that occurs in part **D**. (3)

2.2.4. Explain fully the role of part **C** in the male reproductive organ. (2)

2.2.5. A man had surgery and his part **A** was cut as shown in the diagram above.

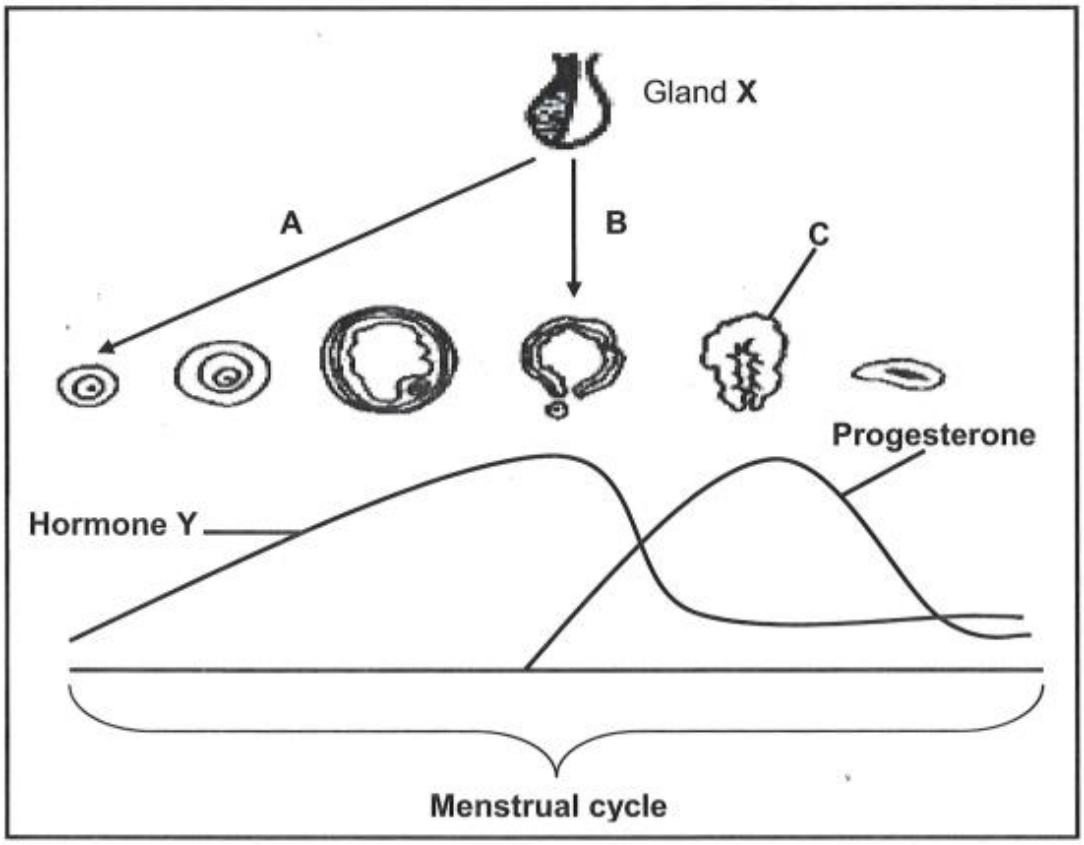
Explain ONE reason why this man will:

(a) Not be able to reproduce (2)

(b) Still be capable of releasing semen from the body. (2)

(14)

2.3. The diagram below represents the stages of the menstrual cycle.



2.3.1. Identify:

(a) Gland **X** (1)

(b) Process happening at **B** (1)

2.3.2. Give TWO visible reasons from the diagram indicating that fertilisation did not take place during the menstrual cycle. (2)

2.3.3. State the effect of hormone **Y** on the lining of the uterus. (1)

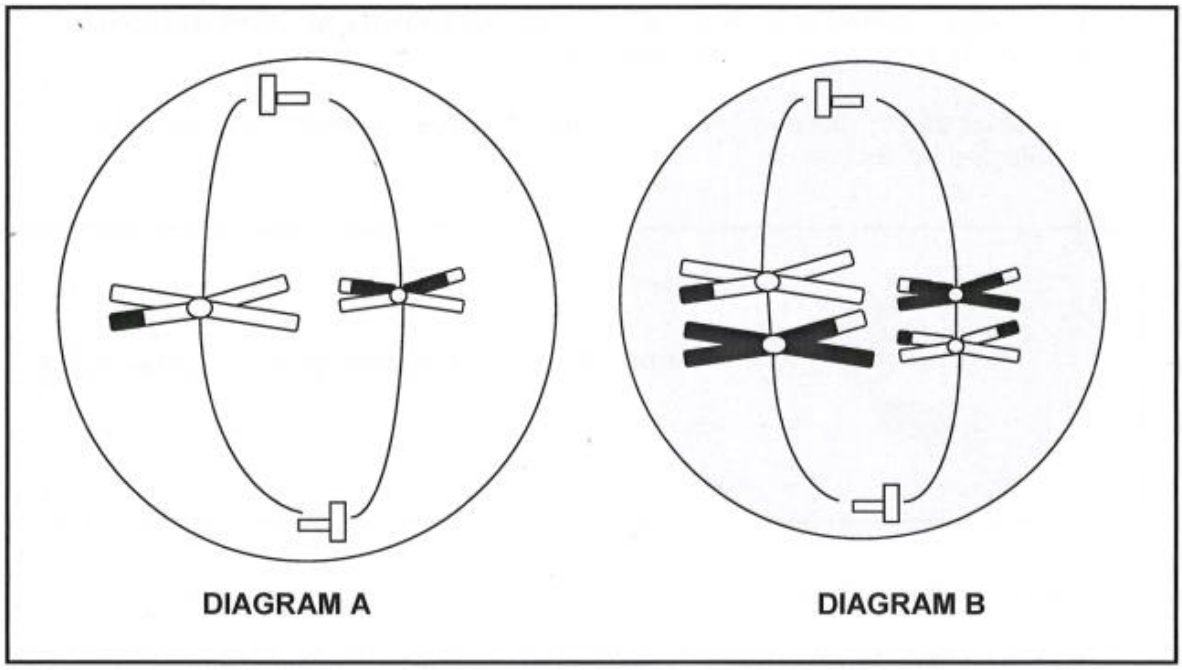
2.3.4. Explain the effect of the disintegrating corpus luteum on the menstrual cycle. (3)

2.3.5. On which day of the cycle will the process at B happen? (1)

2.3.6. How long is the average menstrual cycle in humans? (1)

(10)

2.4. The diagrams below show two phases of meiosis in an animal cell.



2.4.1. Identify the phase represented by **DIAGRAM B.** (1)

2.4.2. Study Diagram B. Name and describe fully the process which resulted in the appearance of the homologous chromosomes. (4)

2.4.3. Name the phase that will follow the one represented by **DIAGRAM A**. (2)

2.4.4. How many cells will result in the final phase in Diagram A? (1)

2.4.5. Name ONE place in a human female where meiosis takes place. (1)

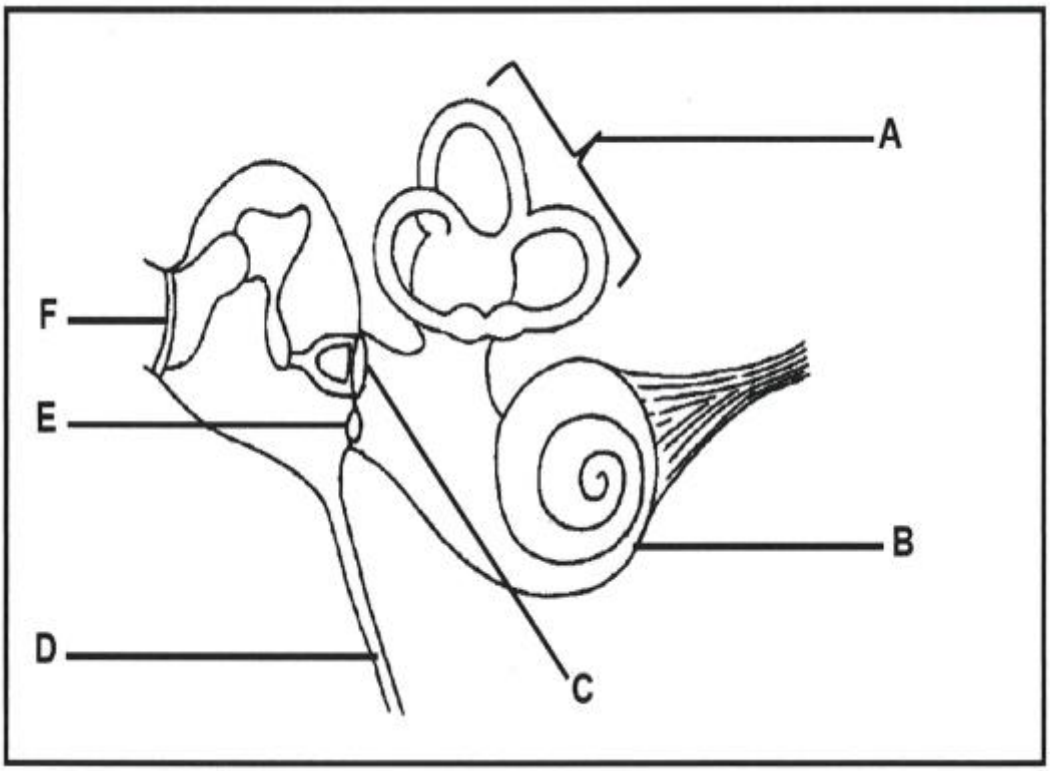
2.4.6. Give TWO reasons why the number of chromosomes differ in **A** and **B**. (2)

(11)

QUESTION 2: (50)

QUESTION THREE:

3.1. The diagram below shows part of the human ear.



3.1.1. a) Give the LETTER and NAME that equalises pressure between the outer and the middle ear. (2)

b) Give the 2 letters that are on either side of the middle ear. (2)

3.1.2. Name and give a function of the part labelled **F**. (2)

3.1.3. Explain the significance of the arrangement of the structures labelled **A**. (3)

3.1.4. Explain how the sound waves arrive at part **F**. (1)

3.1.5. State the main function of part **B.** (2)

(12)

3.2. In tomato plants the allele for red fruit **(R)** is dominant over the allele for yellow fruit **(r)**. The allele for tallness **(T)** is dominant over the allele for shortness **(t).**

Plant **A**, which is heterozygous for red fruit and homozygous tall, was crossed with Plant **B**, which has yellow fruit and is short.

3.2.1. Write down the genotype of:

(a) Plant **A** (1)

(b) Plant **B** (1)

3.2.2. Write down ALL the possible genotypes of the gametes of plant **A**. (4)

3.2.3. Name the phenotype of an offspring having the genotype:

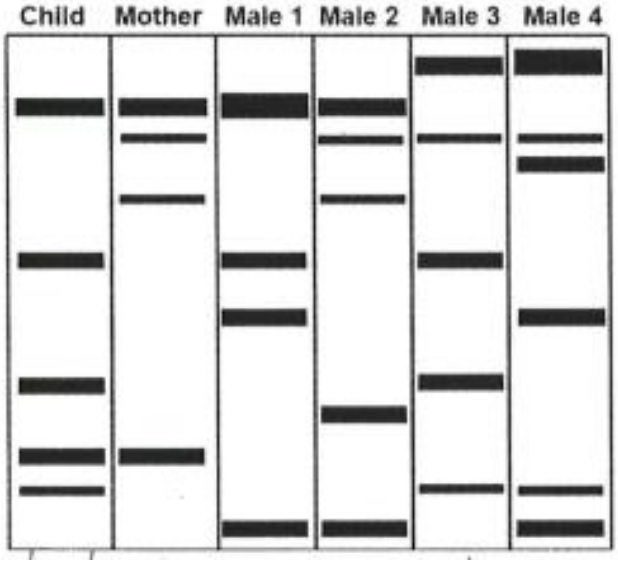
(a) Rrtt (1)

(b) RrTt (1)

3.2.4. Draw the punnet square showing a cross between two offspring both having the genotype Rrtt (2)

(10)

3.3. The diagram below shows the DNA profiles of a child, her mother and four males. There is uncertainty about who the biological father is. To establish paternity, DNA profiling was conducted.



GENOTYPES: X^hX^h X^HX^h X^HY X^HY X^hY X^HY

3.3.1. Identify the biological father of the child using DNA profiles. (1)

3.3.2. Explain your answer above. (3)

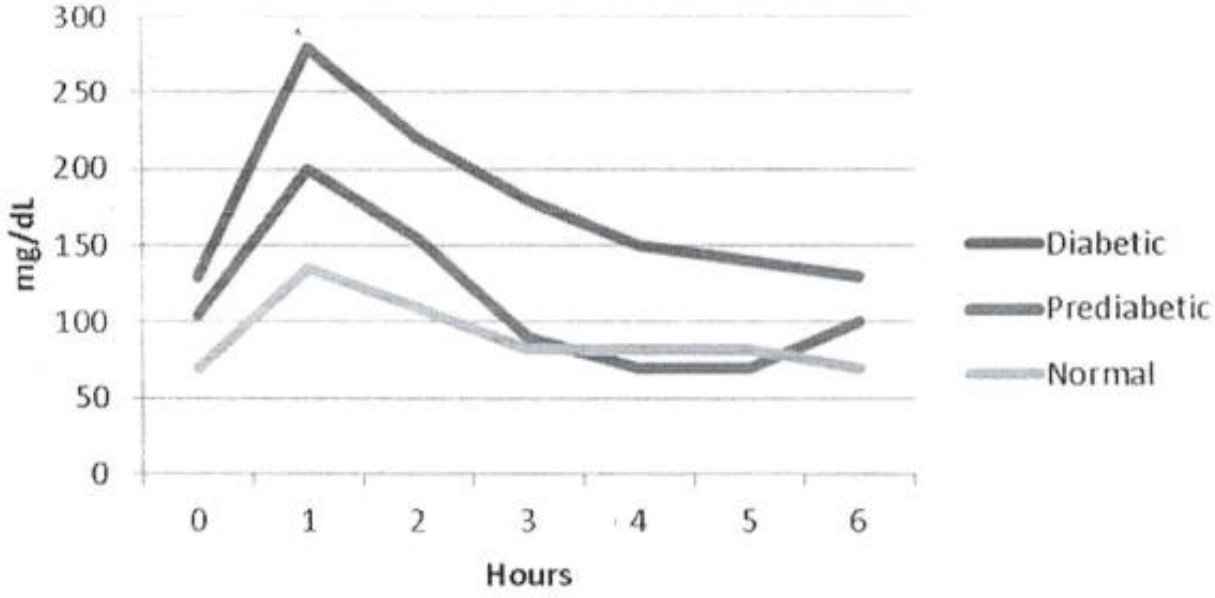
3.3.3. The child is a haemophiliac which is a sex-linked disease.

Use a genetic cross to further prove that the male you chose in 3.3.1 is the biological father. (6)

3.3.4. Fully explain why the other 3 males could not be the father based on the results from your genetic cross. (5)

(15)

3.4. The graph below shows the result of blood sugar changes after eating in a diabetic, prediabetic and normal person.



3.4.1. Name the human organ that produces insulin. (1)

3.4.2. State the dependent variable. (1)

3.4.3. What trend can you see in the graph for all 3 types? (2)

3.4.4. Explain how the human body is able to regulate the spike in glucose in a normal person. (5)

3.4.5. How could this investigation be made more valid by the investigator. Give only ONE way. (1)

3.4.6. Calculate the difference in the blood sugar level after 2 ½ hours, in the normal and diabetic person.
Show all working. (3)

(13)

QUESTION 3: 50

SECTION B: Q2 + Q3: (100)