LIMPOPO

PROVINCIAL GOVERNMENT

REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF

EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES

JUNE EXAMINATION 2025

MARKS: 150

Time: 2½hours

This question paper consists of 17 pages including the cover page

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. ALL drawings should be done in pencil and labelled 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.

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

1.1.1 Which ONE of the following CORRECTLY identifies the two nucleic acids?

A RNA is a double-stranded and DNA is single –stranded.

B DNA contains the sugar deoxyribose while RNA contains the sugar ribose.

C RNA has the nitrogenous base thymine, and DNA has the nitrogenous base uracil.

D DNA has a short chain while RNA has a long chain.

1.1.2 Which ONE of the following correctly matches a reproductive structure and its function?

A Vagina – fertilisation.

B Fallopian tube – maturation of sperm cells.

C Uterus – development of the embryo.

D Seminal vesicle – development of an ovum.

1.1.3 Below is a list of events that occur during cell division.

(i) Homologous chromosomes line up in pairs at the equator of the cell.

(ii) Chromatids are pulled to opposite poles of the cell.

(iii) Chromosome pairs arrange themselves randomly at the equator of the cell.

(iv) Chromosomes line up in a single row at the equator of the cell

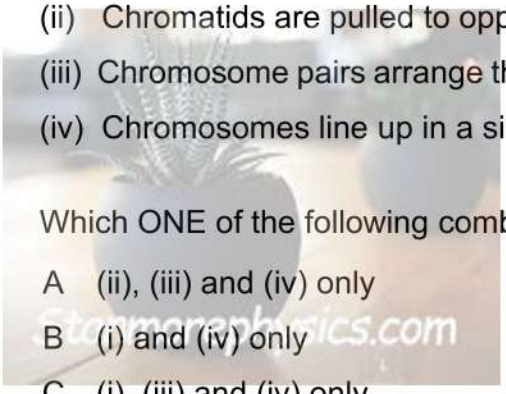
Which ONE of the following combinations occurs in both meiosis and mitosis?

A (ii), (iii) and (iv) only

B (i) and (iv) only

C (i), (iii) and (iv) only

D (ii) and (iv) only



1.1.4 Which ONE of the following is a characteristic of hatchlings of birds that show altricial development?

A Eyes are open when they hatch.
B Able to move around after hatching.
C Able to feed themselves.
D Eyes are closed when they hatch.

1.1.5 The process by which DNA is copied before cell division is called…

A transcription
B translation
C mutation
D replication

1.1.6 Which ONE of the following processes is responsible for the production of male gametes?

A Oogenesis
B Ovulation
C Spermatogenesis
D Ejaculation

1.1.7 More males than females are colour-blind because…

A The allele for colour-blindness is recessive and located on the X-chromosome.
B Colour-blind males have two copies of the allele for colour-blindness.
C The allele for colour-blindness is recessive and located on the Y-chromosome.
D Fathers pass the allele of colour blindness to their sons only.

1.1.8 Which of the following CORRECTLY represents the events involved in the secretion and action of ADH?

	Water level in blood relative to normal	**Amount of ADH produced relative to normal**	**Amount of water reabsorbed by the renal tubules**
A	Decrease	Decrease	Decrease
B	Decrease	Increase	Increase
C	Increase	Decrease	Increase
D	Increase	Increase	Decrease

1.1.9 Which ONE of the following scientists won the Nobel Prize for the discovery of the DNA structure?

A Watson and Franklin.
B Wilkins and Franklin.
C Watson and Crick.
D Crick and Franklin.

1.1.10 Which of the following statements is associated with the hormone TSH?

(i) Regulates the metabolic rate in the body cells

(ii) Is secreted by the pituitary gland

(iii) Stimulates the secretion of thyroxin

(iv) Decreases the glucose level in the blood

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

(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 1.2.10) in the ANSWER BOOK.

1.2.1 The structure that joins two chromatids together

1.2.2 The disease caused by the lack of insulin production in the body

1.2.3 An analysis of DNA samples to identify individuals that may be related

1.2.4 The structure at the tip of a sperm cell containing enzymes that help in breaking the wall of an ovum during fertilization

1.2.5 The manipulation of biological processes to satisfy human needs

1.2.6 The structure where the production of egg cells takes place in females

1.2.7 A change in the DNA sequence that can lead to alterations in gene function

1.2.8 The hormone that regulates the salt concentration in the blood

1.2.9 A fluid – filled structure in vertebrates that surrounds the embryo

1.2.10 A branch of the autonomic nervous system that increases heartbeat

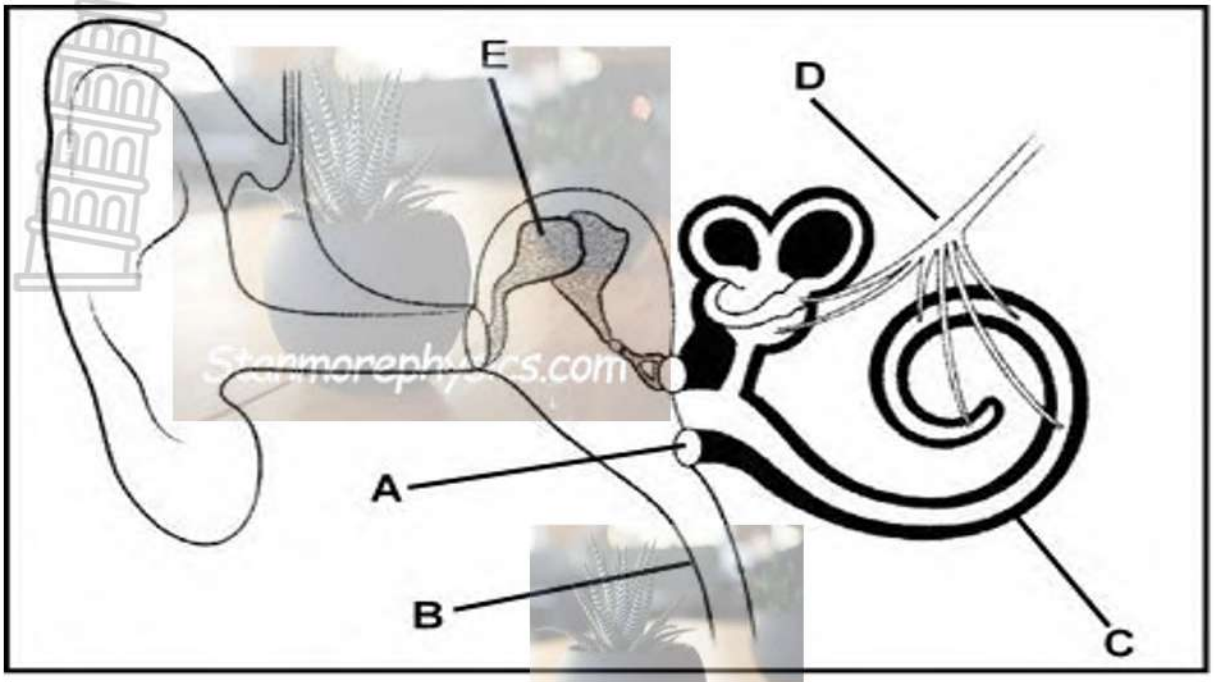
(10 x 1) (10)

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 **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 process that produces gametes with half the number of chromosomes of the parent cell.	A: Mitosis B: Meiosis
1.3.2	The embryo obtains food from the yolk found in the egg.	A: Vivipary B: Ovovivipary
1.3.3	The hormone secreted by the pituitary gland.	A: Oestrogen B: Growth hormone

(3x2) (6)

1.4 The diagram below represents the human ear.



1.4.1 Identify part:

(a) **A** (1)

(b) **E** (1)

1.4.2 Give the LETTER and NAME of the part that:

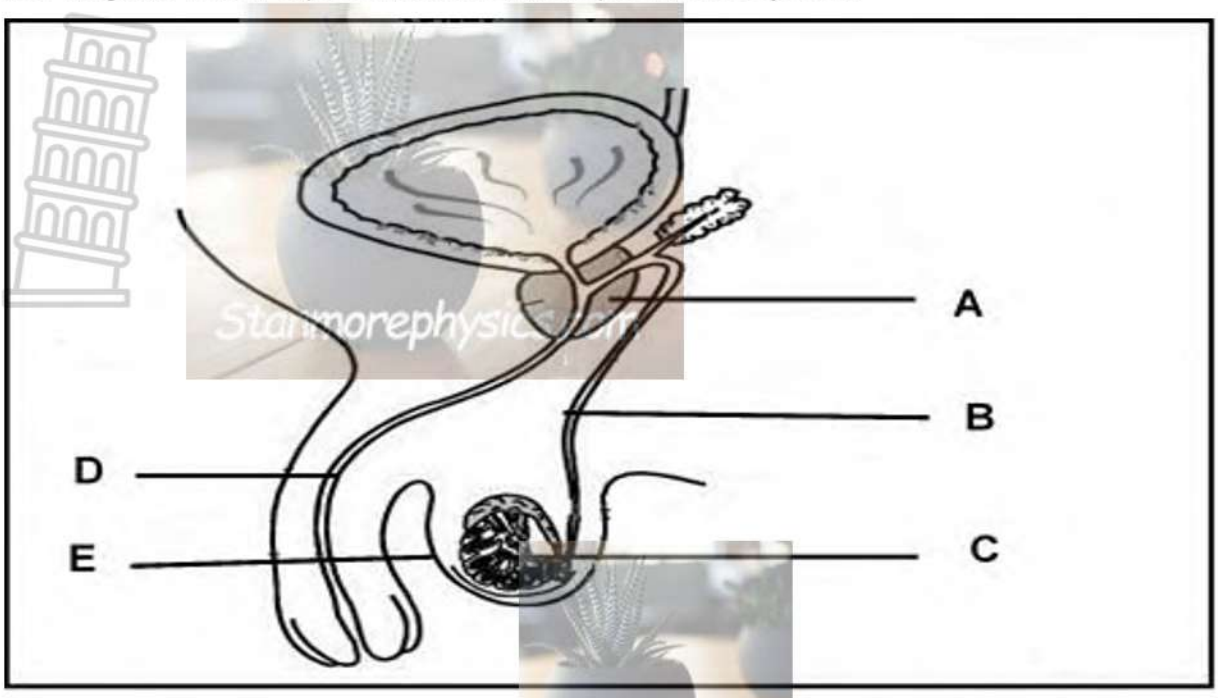
(a) Equalizes pressure on both sides of the tympanic membrane. (2)

(b) Has receptors for hearing. (2)

1.4.3 Give the LETTER of the part that will fail to send nerve impulses to the brain when damaged. (1)

(7)

1.5 The diagram below represents the male reproductive system.



1.5.1 Identify part:

(a) **B** (1)

(b) **D** (1)

1.5.2 Give the LETTER and NAME of the part that:

(a) Produces sperm cells. (2)

(b) Secretes an alkaline fluid to neutralize the acidity of the vagina. (2)

1.5.3 Name the hormone that is responsible for the onset of puberty in males. (1)

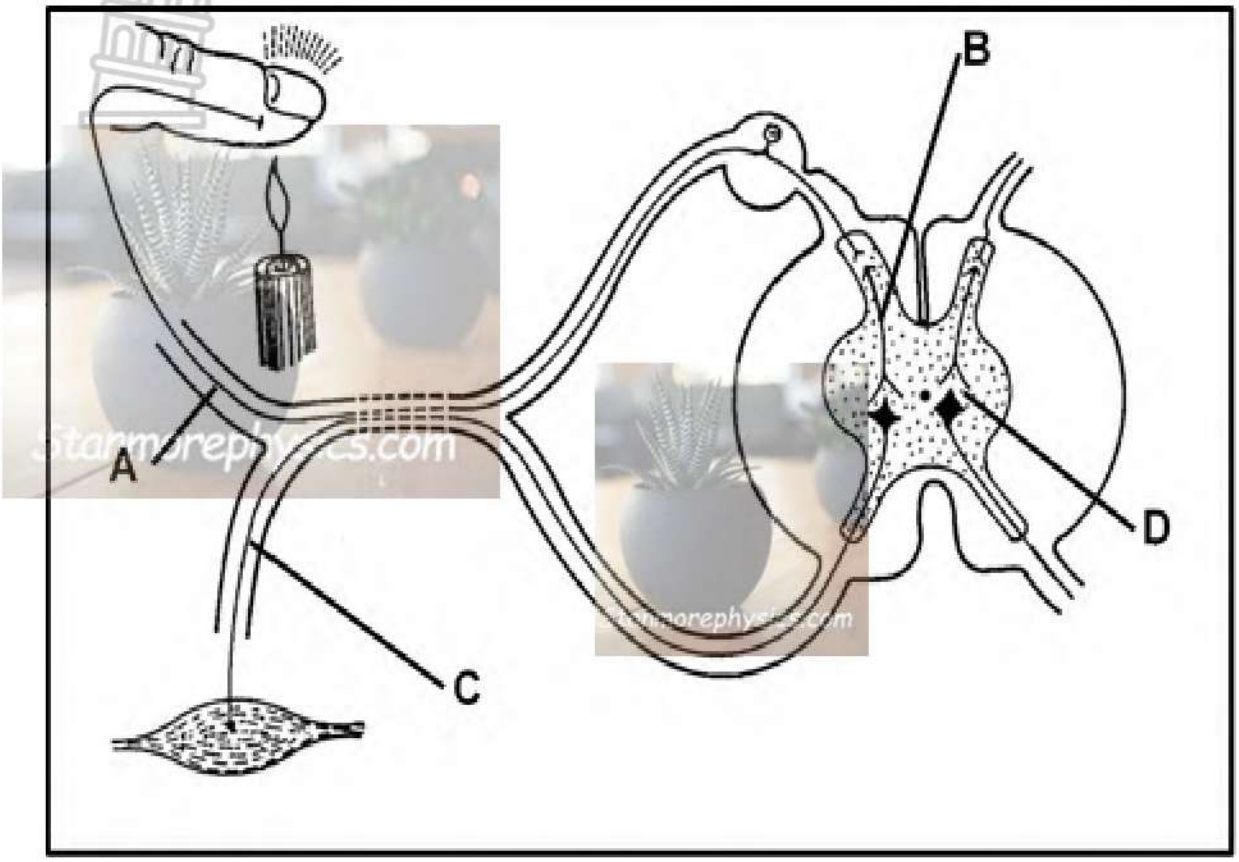
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents a part of the central nervous system.



2.1.1 Identify part:

(a) **A** (1)

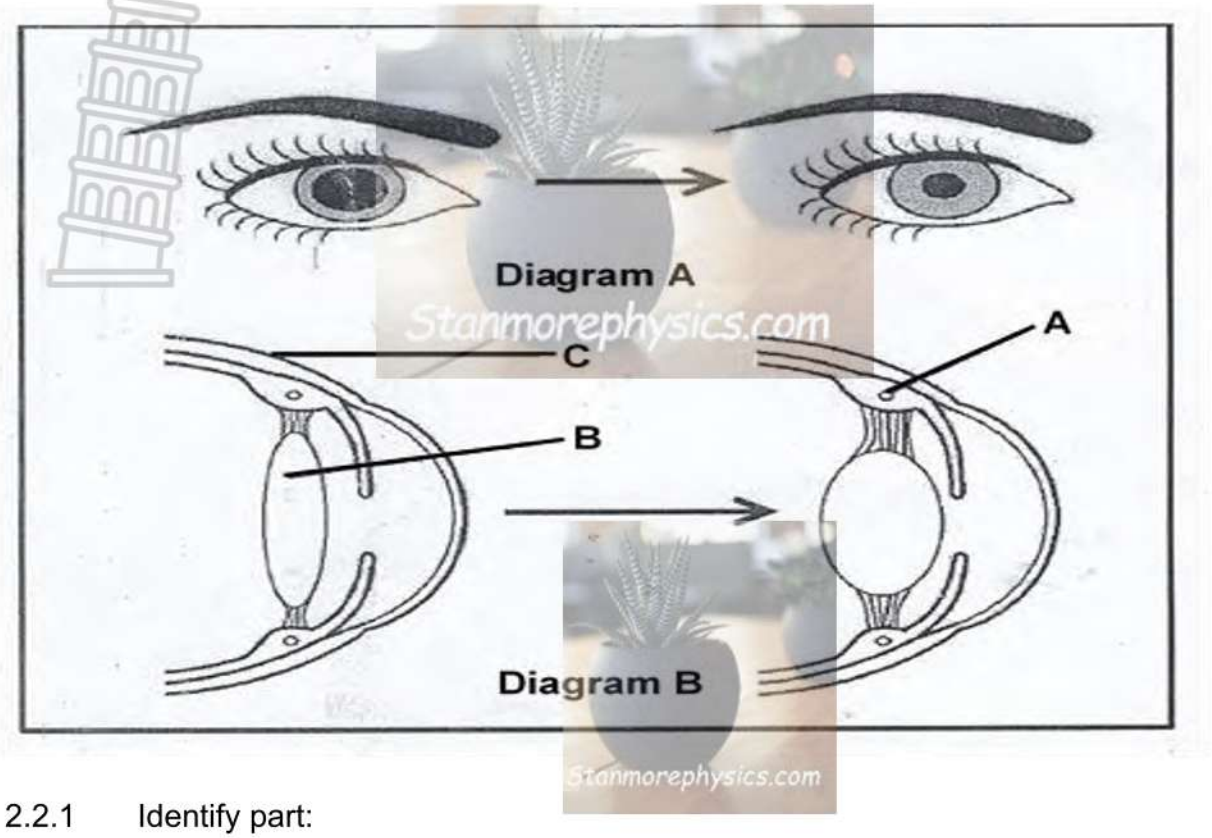
(b) **B** (1)

2.1.2 Explain ONE consequence for the body if part **C** is damaged. (2)

2.1.3 Explain what the effect will be on the reflex arc and reflexes of a person who suffers from multiple sclerosis. (2)

(6)

2.2 The diagram below shows the response of the human eye to two different conditions.



2.2.1 Identify part:

(a) **A** (1)

(b) **C** (1)

2.2.2 State the process that is taking place in diagram **A**. (1)

2.2.3 Give the conditions responsible for the change in the process mentioned in QUESTION 2.2.2. (1)

2.2.4 Name the process and describe the change that takes place in diagram **B**. (6)

(10)

2.3 The table below shows the average rate of blood flow to the skin at different environmental temperatures.

Environmental temperature (°C)	Average of blood flow to the skin (ml/100ml tissue/min)
0	3,5
10	5
25	5,5
40	12
50	19
55	20

2.3.1 At what environmental temperature was the average rate of blood flow to the skin the highest? (1)

2.3.2 Calculate the percentage increase in the blood flow to the skin between 10°C and 40°C. Show ALL your working. (3)

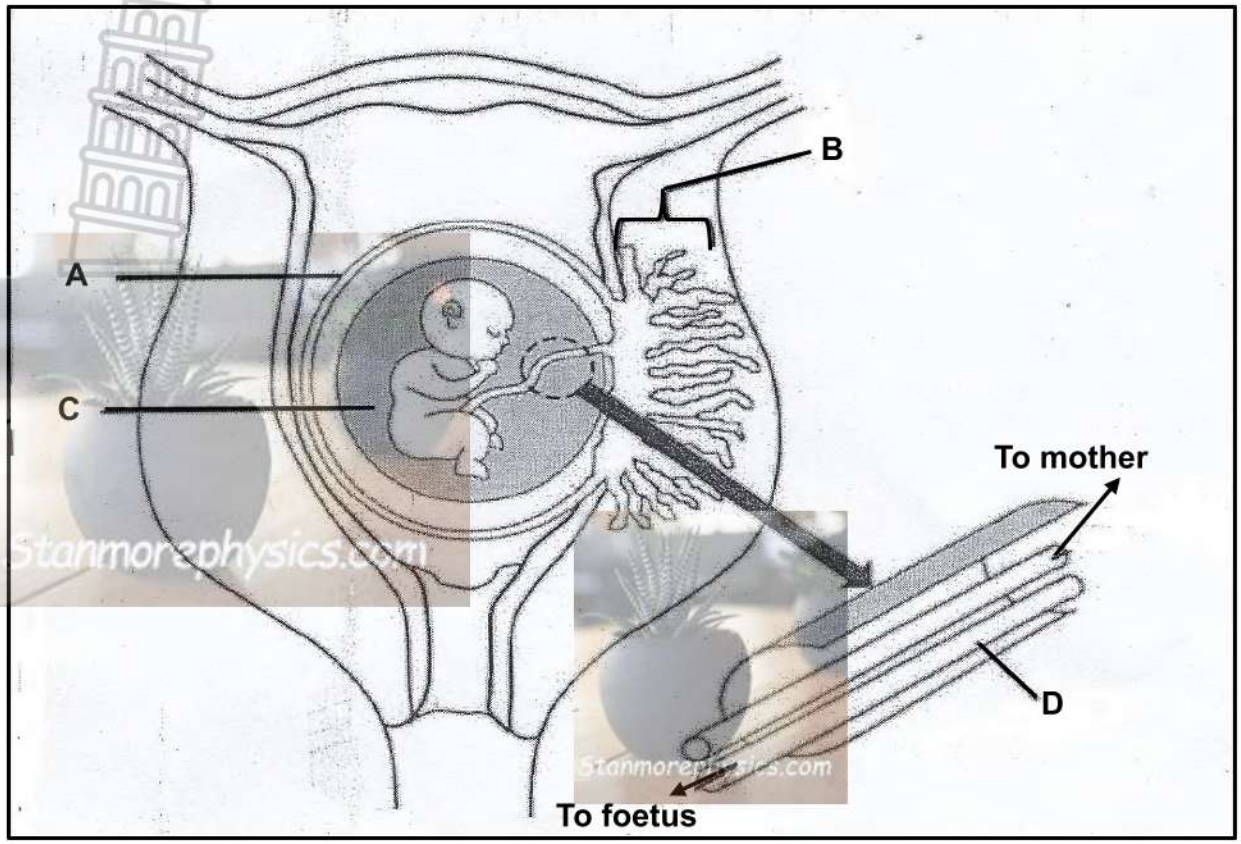
2.3.3 Describe the relationship between the environmental temperature and the average rate of blood flow to the skin. (2)

2.3.4 Frostbite is a condition where long term exposure to extreme cold conditions lead to death of tissue in areas like the nose and fingers.
Use the data in the table to explain why tissue may die. (3)

2.3.5 Explain the average rate of blood flow to the skin between 25°C and 50°C. (4)

(13)

2.4 The diagram below shows a developing human foetus.



2.4.1 Identify the following:

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

(b) Blood vessel **D** going to the foetus. (1)

2.4.2 State TWO ways in which part **B** functions in protecting the developing foetus. (2)

2.4.3 Name TWO systems in the body that will take over the functions of part **B** after birth. (2)

2.4.4 Describe the developmental changes in the fertilized ovum until implantation occurs in the uterus. (4)

(10)

2.5 In an investigation, a learner was asked to put a cotton thread through the eye of a needle 10 times with both eyes open, then with only the right eye open. This was done under the same light intensity and a distance of 40cm from the eyes.
The results are recorded in the table below.

Attempts	Time taken to thread the needle in seconds(s)	
	Both eyes open	Only right eye open
1	12	38
2	12	35
3	10	37
4	11	36
5	9	34
6	9	33
7	10	30
8	8	31
9	7	29
10	7	28

2.5.1 Apart from the two factors mentioned, state TWO other factors that had to be kept constant during the investigation. (2)

2.5.2 State a general conclusion that can be drawn from the results above. (2)

2.5.3 Give a reason why more than one attempt was made in this investigation. (1)

(5)

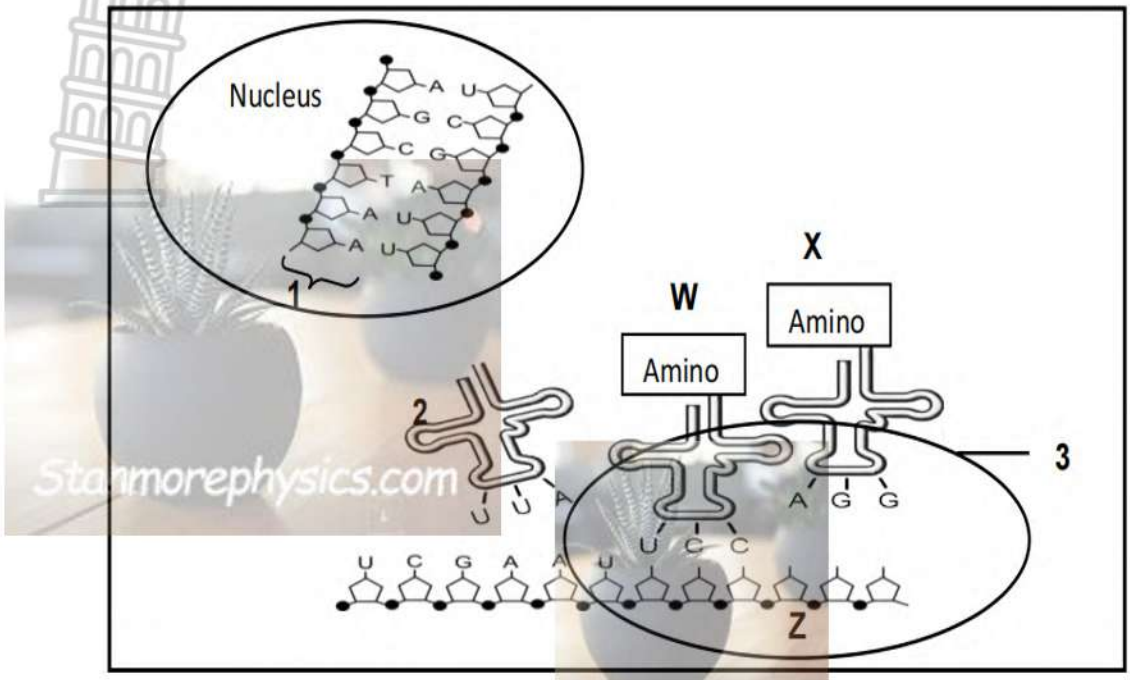
2.6 Describe how the sacculus and utriculus maintain balance in the human body. (6)

(6)

TOTAL QUESTION 2: 50

QUESTION 3

3.1 The diagram below illustrate a certain stage of protein synthesis.



3.1.1 Identify and describe the stage of protein synthesis occurring at point **Z**. (6)

3.1.2 The table below shows some amino acids coded for by codons on mRNA

CODON	**AMINO ACID**
GAG	Glutamate
CAG	Histidine
AGG	Arginine
CUG	Leucine
UCC	Proline
GUG	Valine

Use the table above to identify amino acid **W** and **X**.

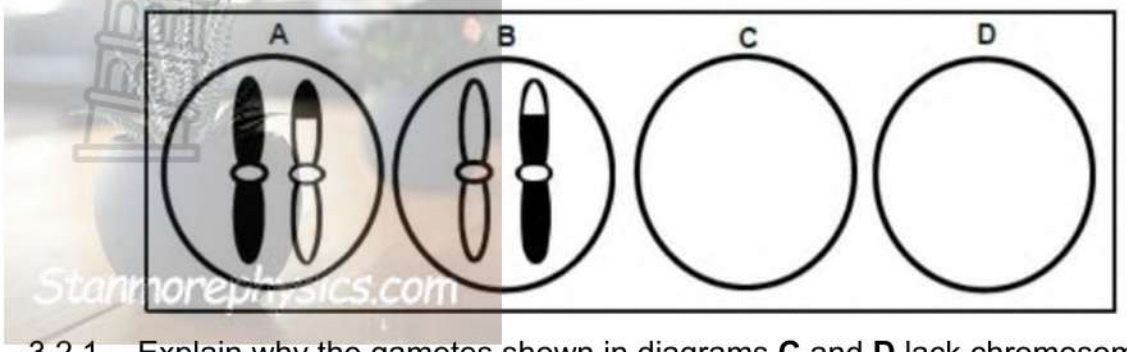
(2)

3.1.3 In a DNA molecule where 25% of the bases are Thymine, what is the ratio of Guanine to Adenine? Show and explain all your calculations.

(3)

(11)

3.2 The diagrams below show the distribution of chromosome pair 21 in gametes at the conclusion of meiosis II in a human.



3.2.1 Explain why the gametes shown in diagrams **C** and **D** lack chromosomes. (3)

3.2.2 Should gamete **A** participate in fertilization, explain how this could lead to the development of Down syndrome. (3)

3.2.3 As a result of the process of crossing-over chromosomes in diagrams **A** and **B** are different from one another.

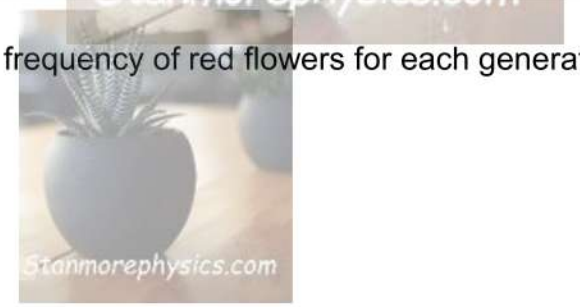
Name the phase of meiosis during which crossing over occurs and describe the process. (3)

(9)

3.3 A population of plants shows two phenotypes for flower colour: red (dominant, **R**) and white (recessive, **r**). Over several generations, the frequency of the red and white phenotypes was recorded in a controlled environment.

The data collected is shown below.

Generation	Red flower frequency (%)	White flower frequency (%
1	70	30
2	65	35
3	60	40
4	55	42
5	50	50



3.3.1 Draw a bar graph showing the frequency of red flowers for each generation (6)

3.3.2 Identify the:

(a) Independent variable (1)

(b) dependent variable (1)

(c) Name the type of dominance if a red flowered plant is crossed with a white flowered plant. (1)

(9)

3.4 In a species of flowering plants, the allele for tall stems (**T**) is dominant to the allele for short stems (**t**), and the allele for purple flowers (**D**) is dominant to the allele for white flowers (**d**). A cross is performed between two plants that are heterozygous for both traits.

3.4.1 Use a genetic cross to determine the possible genotypes and phenotypes of the offspring. (6)

3.4.2 Calculate the probability of obtaining an offspring with tall stems and white flowers. (3)

(9)

3.5 A couple, where the mother has blood type **A** and the father has blood type **B**, are expecting a child.

3.5.1 List all possible genotypes of the father. (2)

3.5.2 State the possible phenotypes of their child. (2)

3.5.3 If the child has blood type **O**, explain how this is genetically possible, considering the parents' blood types. (5)

3.5.4 How many alleles control blood groups? (1)

3.5.5 Which two alleles are co-dominant? (1)

3.5.6 Name ONE use of DNA profiling apart from paternity testing (1)

(12)

TOTAL SECTION B: 50

GRAND TOTAL: 150

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GRADE 12

LIFE SCIENCES

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MARKING GUIDELINES

This marking guideline consists of 14 pages including the cover pages

NSC

PRINCIPLES RELATED TO MARKING LIFE SCIENCES

1. **If more information than marks allocated is given**

   Stop marking when maximum marks is reached and put a wavy line and 'max' in the right-hand Margin.

2. **If, for example, three reasons are required and five are given**

   Mark the first three irrespective of whether all or some are correct/incorrect.

3. **If whole process is given when only a part of it is required**

   Read all and credit the relevant part.

4. **If comparisons are asked for, but descriptions are given**

   Accept if the differences/similarities are clear.

5. **If tabulation is required, but paragraphs are given**

   Candidates will lose marks for not tabulating.

6. **If diagrams are given with annotations when descriptions are required**

   Candidates will lose marks.

7. **If flow charts are given instead of descriptions**

   Candidates will lose marks.

8. **If sequence is muddled and links do not make sense**

   Where sequence and links are correct, credit. Where sequence and links are incorrect, do not credit. If sequence and links become correct again, resume credit.

9. **Non-recognised abbreviations**

   Accept if first defined in answer. If not defined, do not credit the unrecognised abbreviation, but credit the rest of the answer if correct.

10. **Wrong numbering**

If answer fits into the correct sequence of questions, but the wrong number is given, it is acceptable.

11. **If language used changes the intended meaning**

Do not accept.

12. **Spelling errors**

If recognisable, accept the answer, provided it does not mean something else in Life Sciences or if it is out of context.

13. **If common names are given in terminology**

Accept, provided it was accepted at the national memo discussion meeting.

14. **If only the letter is asked for, but only the name is given (and vice versa)**

Do not credit.

15. **If units are not given in measurements**

Candidates will lose marks. Memorandum will allocate marks for units separately.

16. **Be sensitive to the sense of an answer, which may be stated in a different way.**

17. **Caption**

All illustrations (diagrams, graphs, tables, etc.) must have a caption.

18. **Code-switching of official languages (terms and concepts)**

A single word or two that appear(s) in any official language other than the learner's assessment language used to the greatest extent in his/her answers should be credited, if it is correct. A marker that is proficient in the relevant official language should be consulted. This is applicable to all official languages.

SECTION A

QUESTION 1

1.1

1.1.1 B✓✓

1.1.2 C✓✓

1.1.3 D✓✓

1.1.4 D✓✓

1.1.5 D✓✓

1.1.6 C✓✓

1.1.7 A✓✓

1.1.8 B✓✓

1.1.9 C✓✓

1.1.10 C✓✓

(10 x 2) (20)

1.2

1.2.1 Centromere✓

1.2.2 Diabetes mellitus✓

1.2.3 DNA Profiling✓

1.2.4 Acrosome✓

1.2.5 Biotechnology✓

1.2.6 Ovary✓

1.2.7 Mutation✓

1.2.8 Aldosterone✓

1.2.9 Amnion✓

1.2.10 Sympathetic✓nervous system

(10 x 1) (20)

1.3

1.3.1 B only✓✓

1.3.2 B only✓✓

1.3.3 B only✓✓

(2x3) (6)

1.4

1.4.1 (a) Round window✓ (1)

(b) Hammer✓/malleus (1)

1.4.2 (a) B✓ – Eustachian tube✓ (2)

(b) C✓ - Cochlea✓ (2)

1.4.3 D✓ (1)

(7)

1.5

1.5.1 (a) Vas deferens✓/sperm duct (1)

(b) Urethra✓ (1)

1.5.2 (a) C✓ - testis✓ (2)

(b) A✓ – prostate gland✓ (2)

1.5.3 Testosterone✓ (1)

(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1

2.1.1 (a) Sensory neuron✓ (1)

(b) Interneuron/ Connector neuron✓ (1)

2.1.2 - The person will be able to receive the stimulus✓

- but will not be able to respond to it✓

- because the impulse will not be transmitted to the effector✓ Any two (2)

2.1.3 - The myelin sheaths are damaged✓

- This will cause a slow transmission of impulses✓

- and a slow reaction time✓ Any two (2)

(6)

2.2

2.2.1 (a) Ciliary muscle✓/ciliary body (1)

(b) sclera✓ (1)

2.2.2 Pupillary mechanism✓ (1)

2.2.3 - Good light conditions such as bright light✓ (1)

2.2.4 - Accommodation*✓for near vision

- Ciliary muscles contract✓

- Suspensory ligaments slacken✓

- Tension on the lens decreases✓

- The lens becomes more convex✓

- The refractive power of the lens increases✓

- A clear image is formed on the retina✓. Any (5 + 1 ***compulsory mark**) (6)

(10)

2.3

2.3.1 55°C✓ (1)

2.3.2 $\frac{12 - 5}{5}$ ✓ x 100✓ OR $\frac{7}{5}$ ✓ x 100%✓

= 140%✓ = 140% (3)

2.3.3 - As the temperature increases the average rate of blood flow to the skin increases✓✓ (2)

2.3.4 - At 0°C/ 10°C✓, less blood flows to the skin✓

- Less oxygen✓/nutrients reach the cells and the cells may die

OR

- At 0°C/ 10°C✓, less blood flows to the skin✓
- More carbon dioxide✓/waste products accumulate in the cells and the cells may die (3)

2.3.5 - As the temperature increases✓ from 25°C to 50°C

- Vasodilation occurs✓
- more blood flows to the skin ✓/5,5 to 19 ml/100ml tissue/min of blood flows to the skin.
- so that more heat✓/sweat is lost (4)

(13)

2.4

2.4.1 (a) Chorion ✓ (1)

(b) Umbilical vein✓ (1)

2.4.2 - Acts as a micro-filter✓/protect against pathogens

- Removes harmful wastes✓
- Produces antibodies✓
- Maintains the endometrium✓/secretes progesterone

(Mark first TWO only) (2)

2.4.3 - Respiratory system✓
- Digestive system✓
- Excretory system✓ Any two (2)

2.4.4 - The zygote divides by mitosis✓
- to form a (solid) ball of cells✓
- called the morula✓
- which develops into a hollow ball of cells✓
- called the blastula✓/blastocyst
- blastula develops chorionic villi✓ Any four (4)

(10)

2.5

2.5.1 - Size of the needle✓
- Thickness of the thread✓/type of the thread
- Colour of the thread✓
- Time period between attempts✓
- Starting distance between the needle and thread✓
- Light conditions✓

Any two (2)

2.5.2 - It takes less time to thread the needle with both eyes open compared to having one eye✓✓

OR

-It takes more time to thread the needle with only one eye open compared to both eyes open✓✓

OR

-The more attempts undertaken to thread the needle, the less time it takes✓✓ (2)

2.5.3 To increase the reliability✓ of the results (1)

(5)

2.6 When the position of the head changes✓

the maculae are stimulated✓

and converts the stimulus into a nerve impulse✓

which is transmitted via the auditory nerve✓

to the cerebellum to be interpreted✓

from which impulses are sent to the✓

skeletal muscles✓/to restore balance (6)

(6)

TOTAL QUESTION 2: 50

QUESTION 3

3.1

3.1.1 **Translation** *✓

Each tRNA carries a specific amino acid ✓

When the anticodon on the tRNA ✓

matches the codon on the mRNA ✓

then tRNA brings the required amino acid to the ribosome ✓

Amino acids become attached to each other by peptide bonds✓

to form the required protein ✓

(**any 5 + 1 compulsory***✓) (6)

3.1.2 W = Proline ✓ (1)

X = Arginine ✓ (1)

3.1.3 Percentage of Thymine (T): 25%

Percentage of Adenine (A): Since adenine pairs with thymine, there will be an equal percentage of adenine. So, adenine (A) is also 25%✓

Combined Percentage of Adenine (A) and Thymine (T): 25%(T)+25%(A)=50%

Remaining Percentage for Guanine (G) and Cytosine (C): The rest of the DNA molecule must be made up of guanine and cytosine, which together account for 100%−50% = 50% ✓

Percentage of Guanine (G): Since guanine pairs with cytosine, there will be an equal percentage of guanine and cytosine. Therefore, guanine (G) is 50% / 2 = 25%

Cytosine (C) is also 25% ✓

Ratio of Guanine to Adenine: Since both guanine (G) and adenine (A) are present in equal amounts (25%), the ratio of guanine to adenine is:

Ratio of G to A =25% / 25% = 1✓

Therefore, **the ratio of guanine to adenine is 1:1 (*✓any 2 plus compulsory**) (3)

(11)

3.2.

3.2.1 Due to non-disjunction✓/non - separation of chromosome pair during Anaphase I, two chromosomes moved to one pole✓ and none moved to the other pole ✓ (3)

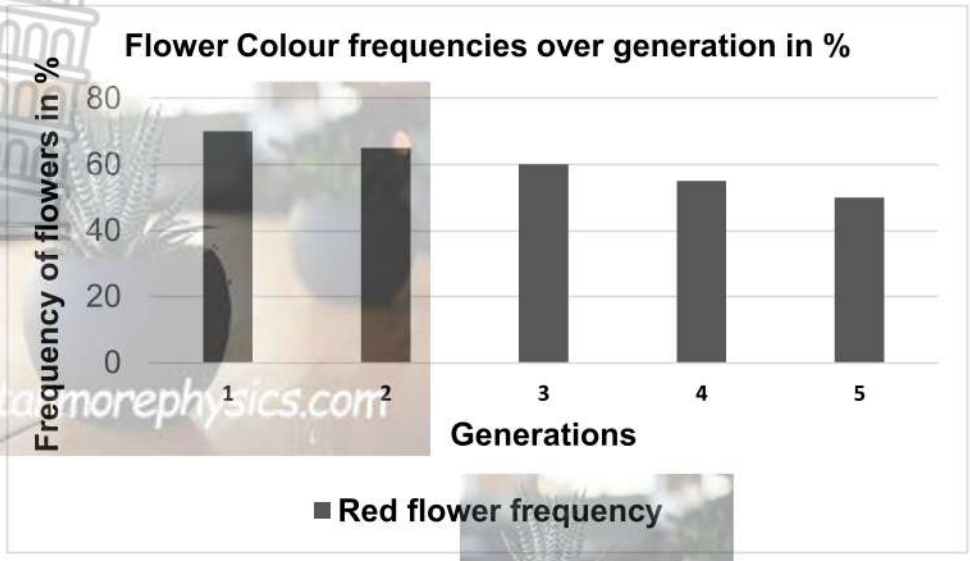
3.2.2 -Gamete A will have 24 chromosomes ✓/ an extra chromosome
- and when it fertilises a normal ovum ✓/ gamete with 23 chromosomes
- The zygote will have 3 chromosomes at position 21 ✓/ 47 chromosomes (3)

3.2.3 Prophase I ✓ Homologous chromosomes from each parent pair up and non-sister chromatids overlap ✓at the chiasma/chiasmata✓ and exchange the genetic materials (3)

(9)

3.3

3.3.1



Guideline for marking the graph/Rubric

Correct type of a graph	**(T)**	Bar graph drawn	1
Caption	**(C)**	Both variables included	1
Scale	**(S)**	Correct scale used for Y-axis Equal space and width of bars for X- axis	1
Axes labels	**(L)**	Both X and Y axis labelled correctly with units	1
Plotting of co-ordinates	**(P)**	1 to 3 plotted correctly All 5 co-ordinates plotted correctly	1 2

(6)

3.3.2 a) Generations✓ (1)

b) Frequency of flowers✓ (1)

c) Complete dominance✓ (1)

(9)

3.4

3.4.1 P1 Phenotype: Tall stem and Purple Flower X Tall Stem and Purple flower ✓

Genotypes TtDd x TtDd ✓

Meiosis

Fertilization

	TD	Td	tD	td	✓
TD	TTDD	TTDd	TtDD	TtDd	
Td	TTDd	TTdd	TtDd	Ttdd	✓
Td	TtDD	TtDd	ttDD	ttDd	
Td	TtDd	Ttdd	ttDd	Ttdd	

Genotypes:

1 TTDD: 2 TTDd: 2 TtPP: 4 TtDd: 1 TTdd: 2 Ttdd: 1 ttDD: 2 ttDd: 1 ttdd (**compulsory**) *✓

9 Tall stems, purple flowers:

3 Tall stems, white flowers

3 Short stems, purple flowers

1 Short stem, white flowers

P1 and F1 ✓

Meiosis and fertilization ✓

Any 5 plus (**compulsory**) *✓ (6)

3.4.2 Probability Calculation:

Stem Height: Tall (T-), Short (tt).

Flower Color: Purple (D-), White (dd).

Probability of tall stems (T-) and white flowers (dd):

Tall stems: 75% (TT, Tt) ✓

White flowers: 25% (dd) ✓

Combined probability: 75% X 25% = 18.75% ✓

OR

3/16✓ X 100✓ = 18.75✓% (3)

(9)

3.5 .

3.5.1 The father's genotypes could be either I^BI^B ✓or I^Bi. ✓ (2)

3.5.2 Blood type B, Blood type O, Blood type A, Blood type AB ✓✓ (All blood types to be correct for 2 marks) (2)

3.5.3 For the child to have blood type O, the father's genotype must be I^Bi, ✓which allows for the possibility of passing on an i allele✓. The mother, having the I^Ai✓ genotype, pass on an i✓ allele. Thus, when both i alleles come together in the child (ii), they result in blood type O .✓ (5)

3.5.4 Three / 3 ✓ (1)

3.5.5 I^A and I^B ✓ (1)

3.5.6 - Diagnosis of inherited disorders✓

- Developing cures✓

- Tracing criminals✓

- Identifying lost relatives✓

Any one (1)

(12)

TOTAL: 50

GRAND TOTAL: 150