



**PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF EDUCATION**

GRADE 12

LIFE SCIENCES

STEP AHEAD PROGRAM

Teachers Guide

January 2021

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Nucleic Acids

Question 1

- | | | |
|-----|---|--------------------------|
| 1.1 | DNA✓/Deoxyribonucleic acid | (1) |
| 1.2 | Nucleus✓/chromosome
Mitochondria✓
(Mark first TWO only) | (2) |
| 1.3 | (a) Nucleotide✓
(b) Guanine✓/G
(c) Phosphate✓/P
(d) Hydrogen✓ bond | (1)
(1)
(1)
(1) |
| 1.4 | Double helix✓ | (1) |
| 1.5 | DNA replication✓ | (1) |
| | | (9) |

Question 2

- | | | |
|-----|--|------------|
| 2.1 | DNA✓ | (1) |
| 2.2 | 1 Phosphate✓
2 Deoxyribose✓sugar
3 Thymine ✓/T | (3) |
| 2.3 | Nucleotide✓ | (1) |
| | | (5) |

Question 3

- 3.1 (a) W – Nucleotide✓
U – DNA✓ (2)
- (b) X – Phosphate✓/phosphate ion
Y – Deoxyribose✓sugar (2)
- (c) Z – Hydrogen✓ bond (1)
- (d) V – Adenine✓ (1)
- 3.2 Nucleus ✓ (1)
- 3.3 Interphase ✓ (1)
- (8)

Question 4

- 4.1
- The DNA molecule unwinds✓
 - Hydrogen bonds between the two strands break✓/ the molecule unzips
 - Each strand serves as a template✓
 - Free nucleotides✓ attach to the individual strands
 - with complementary nitrogen bases✓ pairing
 - Two identical DNA molecules✓ are formed
 - Process is controlled by enzymes✓ Any 5 (5)
- 4.2
- If the incorrect nitrogen base✓ attaches to the original strand/if a nitrogen base is added or deleted
 - the sequence✓/order of the bases changes on the new DNA molecule
 - resulting in a change in the gene structure✓ Any 2 (2)
- (7)

Question 5

Location, structure and function

- The DNA is located in the nucleus✓/chromosomal/genes
- and mitochondria ✓
- DNA is a nucleic acid✓
- It has a double stranded✓
- helix✓ configuration
- consisting of building blocks called nucleotides✓
- The three components of a nucleotide are as follows:
- Nitrogenous bases✓
- Phosphate portion✓
- Deoxyribose sugar portion✓(in DNA)
- 4 nitrogenous bases✓ of DNA:
- adenine (A) bonds with thymine (T) ✓
- cytosine (C) bonds with guanine (G) ✓
- by hydrogen bonds✓
- Sections of DNA carry hereditary✓ information
- DNA contains coded information for protein synthesis✓

(Any 10) (10)

Replication✓

- The double helix unwinds✓
- Double stranded DNA unzips✓
- as the weak hydrogen bonds break✓
- Each original DNA strand serves as a template✓
- Free nucleotides✓ build
- a new DNA strand✓ onto each of the original DNA strands
- by attaching to their complementary✓ nitrogenous bases/(A to T, and C to G)
- this results in two identical✓ DNA molecule

(Any 7) (7)
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic.	Ideas are arranged in a logical/cause-effect sequence.	All aspects required by the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to the location, structure, and functions of the DNA molecule and the replication process is discussed.	Only information relevant to the location, structure and functions of the DNA molecule and the replication process is discussed in a logical and sequential manner.	At least 8 correct points for the location, structure and functions of the DNA molecule and 5 correct points for the explanation of the replication process are given.
Mark	1	1	1

TOTAL SECTION C: 20

Question 6

- 6.1 Process by which the DNA of a person/organism is mapped✓/
DNA sequence of an individual is determined/barcode pattern of
DNA (1)
- 6.2 - Suspect was framed✓ by leaving DNA evidence at the
scene✓/swopping specimens at the lab
- Human error✓ during DNA profiling process✓
- Suspect had an identical twin✓ who has the same DNA profile✓
- The DNA evidence of the accused was at the scene✓ before✓
the crime was committed
(Mark first TWO only) Any 2 x 2 (4)
(5)

Question 7

- 7.1 3✓ (1)
- 7.2 The DNA profile of the semen✓ found on the female victim matches
the DNA profile of the blood of suspect 3✓ (2)
- 7.3 Everybody, except for identical siblings, has a unique DNA profile✓
(Mark first ONE only) (1)
- 7.4 Require a large length of DNA to get accurate profile✓
Deliberate swopping of specimens in the laboratory✓
Human error in laboratory✓ any (2)
(Mark first TWO only)
- 7.5 Determine genetic disorders✓
Paternity tests✓
Determine identity of dead persons✓
Research into variation in populations✓
Tracking individuals in population e.g. cycads in South Africa✓ (2)
(Mark first TWO only) (8)

Question 8

8.1 Using/not using DNA evidence increases/decreases the number of people found guilty of crimes✓✓

OR

8.2 Using/not using DNA evidence has no effect in finding people guilty of crimes✓✓ (2)

8.3 Number of people✓ found guilty/convicted (1)

$$44 - 25✓ = 19✓ \quad (2)$$

- 8.4
- More criminals are found guilty when DNA evidence is included✓in the investigation
 - DNA found at a crime scene✓
 - can be compared to the DNA database✓
 - making it easier✓/faster
 - to identify suspects in the crime✓
- any 4 (4)
(9)

Question 9

Structure (S)

- RNA is single stranded✓
- and is made up of nucleotides✓ which comprise:
- ribose✓ sugar
- phosphate✓ group
- nitrogenous bases✓ which are
- adenine, uracil, guanine and cytosine✓ / (A, U, G and C)
- The phosphate group is attached to the ribose sugar✓
- and the nitrogenous base is attached to the ribose sugar✓
- Bases on RNA are arranged in triplets✓
- as codons on mRNA✓
- and anticodons on tRNA✓
- tRNA has a clover-leaf✓ /hairpin structure
- tRNA has a place of attachment for an amino acid✓

Any (9)

Involvement in protein synthesis (P)

- mRNA✓ forms
- during transcription✓ /by copying the coded message from DNA
- and moves out of the nucleus✓
- and attaches to the ribosome✓
- During translation✓
- the anticodon matches the codon✓
- tRNA✓
- brings the required amino acid✓ to the ribosome
- Amino acids become attached by peptide bonds✓
- to form the required protein✓

Any (8)

Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the: - structure of RNA and - involvement of the different types of RNA in protein synthesis is given There is no irrelevant information	All the information regarding the - structure of RNA and - the involvement of the different types of RNA in protein synthesis is given in a logical manner	At least: - 6/9 correct points for the structure of RNA (S) - 5/8 for the involvement in protein synthesis (P)
Mark	1	1	1

Question:10

- | | | | |
|------|---|-----|-----|
| 10.1 | 3✓ | | (1) |
| 10.2 | ATG✓ | | (1) |
| 10.3 | It determines the codes✓ for the sequence of amino acids ✓
which determines the type of protein ✓ | max | (2) |
| 10.4 | (a) AUG✓ | | (1) |
| | (b) - tRNA picks up specific amino acids✓
- its anticodon✓ matches up with the codon of mRNA
- therefore the amino acids are arranged in a
particular sequence✓
- to form particular polypeptides✓/proteins | | |
| | | any | (3) |
| | | | (8) |

Question 11

- | | | |
|------|---|---------|
| 11.1 | (a) A - Transcription✓ | (1) |
| | (b) B - Translation✓ | (1) |
| 11.2 | C - Ribosome✓ | (1) |
| 11.3 | <ul style="list-style-type: none"> - Process is called transcription✓ - Free (RNA) nucleotides✓ - from the nucleoplasm✓ - arrange according to the base sequence✓ of the DNA template - in a complementary✓ way - A - U✓ - C - G✓ - Sugar-phosphate bonds form✓ between nucleotides to form required mRNA - Process controlled by enzymes✓ | max (5) |
- (8)

Question 12

12.1 (a) DNA✓ (1)

(b) Ribosome✓ (1)

12.2 (a) 2✓ (1)

(b) 5✓ (1)

(c) 7✓ (1)

12.3

- The mRNA attaches to the ribosome✓
- When each codon✓ of the mRNA
- matches with the anticodon ✓ on the tRNA
- the tRNA brings the required amino acid to the ribosome✓
- When the different amino acids are brought in sequence✓
- adjacent amino acids are linked by peptide bonds✓
- to form the required protein✓/polypeptide

Any 4 (4)

12.4 (a) CCT✓✓ (2)

(b) CCU✓✓ (2)

12.5

DNA	RNA
Has deoxyribose✓ sugar	Has ribose✓ sugar
Has nitrogen base thymine (T)✓/ A, C, G and T	Has nitrogen base uracil(U)✓/ A, C, G and U

(Mark first TWO only) (2 x 2) (4)

TABLE NOT REQUIRED

(17)

Question 13

- 13.1 2✓ (1)
- 13.2 CUC✓ (1)
- 13.3 (a) TGG✓ (1)
(b) Aspartate✓ (1)
- 13.4 (a) - C was replaced by U✓ on the 4th codon✓/AGC
OR
- AGC✓/the 4th codon changed to AGU✓ (2)
- (b) - It codes for the same amino acid✓/serine
- Therefore there will be no effect✓/same protein formed (2)
- 13.5 - The process is **transcription**✓* **Compulsory mark**
- The double helix DNA molecule unwinds✓
- When the hydrogen bonds break✓
- the DNA molecule unzips✓/2 DNA strands separate
- One strand is used as the template ✓to form mRNA
- using free RNA nucleotides✓from the nucleoplasm
- The mRNA is complementary to DNA✓/A-U, C-G
- This process is controlled by enzymes✓ 1* + Any 5 (6)
(14)

Question 14

- 14.1 (a) DNA✓ molecule (1)
(b) Amino acid✓ (1)
- 14.2 Transcription✓ (1)
- 14.3 - The sequence of nitrogen bases on molecule W/DNA will change✓
- This would cause a corresponding change on the molecule X✓/mRNA
- The amino acid brought in by tRNA will be different✓
- A different protein will form✓ (4)
- 14.4 (a) UCU✓ (1)
(b) Arginine✓ ; Methionine✓ ; Glycine✓
(Must be in the correct order) (3)
(11)

Question 15

- 15.1 Transcription✓ (1)
- 15.2 Nucleus✓ (1)
- 15.3 (a) GTC✓ (1)
- (b) UAC✓ (1)
- 15.4 Valine✓✓ (2)
- 15.5
- A mutation affects the nucleotide/nitrogen base sequence✓
 - Resulting in a changed mRNA✓/codon
 - A different amino acid✓ may be coded for
 - by tRNA✓
- Any 3 (3)
- (9)**

Question 16

- 16.1
- (a) GGT✓ (1)
- (b) AAA✓ (1)
- (c) UCA✓ (1)
- 16.2
- (a) 1✓ (1)
- (b) 198✓ (1)
- (c) 66✓ (1)
- 16.3
- One of the base triplets on the DNA has changed✓
 - from ACG to ACC✓
 - The triplet ACG codes for the amino acid cysteine✓
 - while the triplet ACC codes for the amino acid tryptophan✓
 - resulting in a change in the sequence of amino acids✓
- Any 4 (4)
- (10)**

Question 17

PROTEIN SYNTHESIS

Transcription✓ (T)

- Double stranded DNA unwinds ✓
- and unzips when✓
- the hydrogen bonds break✓
- and this is controlled by enzymes✓
- One strand is used as a template✓
- to form mRNA✓
- using free RNA nucleotides from the nucleoplasm✓
- The mRNA is complementary to the DNA✓
- mRNA now has the coded message for protein synthesis✓

Translation✓ (S)

- mRNA moves from the nucleus✓/to the ribosome
- Each tRNA carries an amino acid✓
- tRNA carries the amino acid to the ribosome✓
- When the anticodon on the tRNA✓
- matches the codon on the mRNA✓
- Amino acids become attached✓ in the sequence determined by the mRNA
- by peptide bonds✓
- to form the required protein✓

Max 13

EFFECTS OF A MUTATION (M)

- A gene mutation affects arrangement/type of the nitrogen bases✓/nucleotides
- This changes the code on the DNA ✓
- which changes the code on the RNA✓
- A different amino acid✓ may be coded for
- which causes a change in the amino acid sequence✓ in the protein
- leading to the formation of a different/alternate/no protein

Max 4 (17)
Content: (3)
Synthesis: (20)

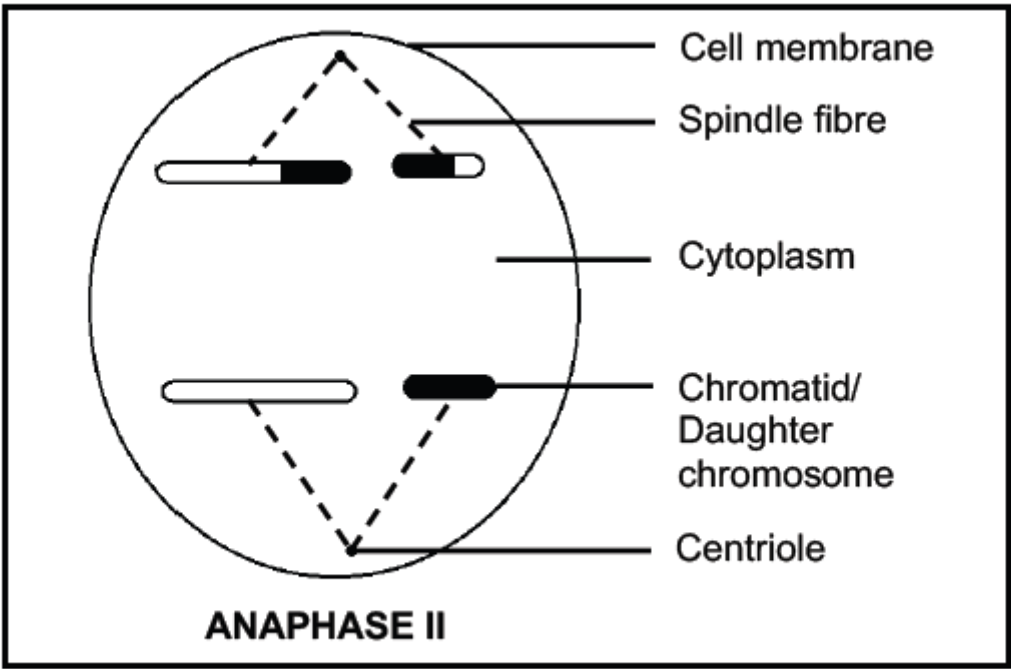
ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the description of protein synthesis and the effects of mutation on the process is given	The description of protein synthesis and the effects of mutation on the process given are logical and sequential	At least 5 correct points in the description of transcription and 5 correct points in the description of translation and 2 correct points on the effects of mutation
Mark	1	1	1

TOTAL SECTION C: 20

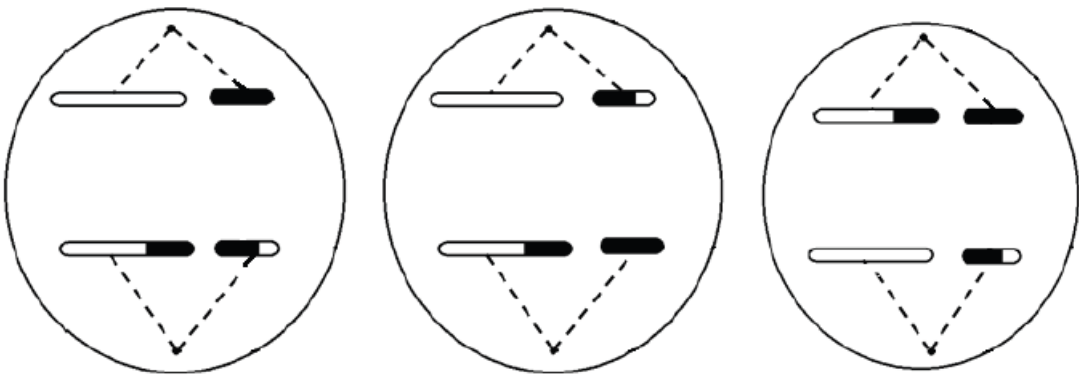
MEIOSIS

Question 1



OR

ANY ONE OF THE FOLLOWING ARRANGEMENTS INCLUDING CORRECT LABELS



MARK ALLOCATION FOR DIAGRAM

Correct phase drawn/chromatids separating (P)	1
Correct shading of chromatids (S)	1
Correct number and size of individual chromatids/daughter chromosomes (2 short and 2 long) (N)	1
Any TWO correct labels	2
TOTAL	5

Question 2

- 2.1
- A pair of chromosomes that are similar in length✓
 - Carry genes for the same characteristics✓
 - Have alleles at the same loci✓
 - Have the same centromere position✓
 - One is obtained from each parent✓

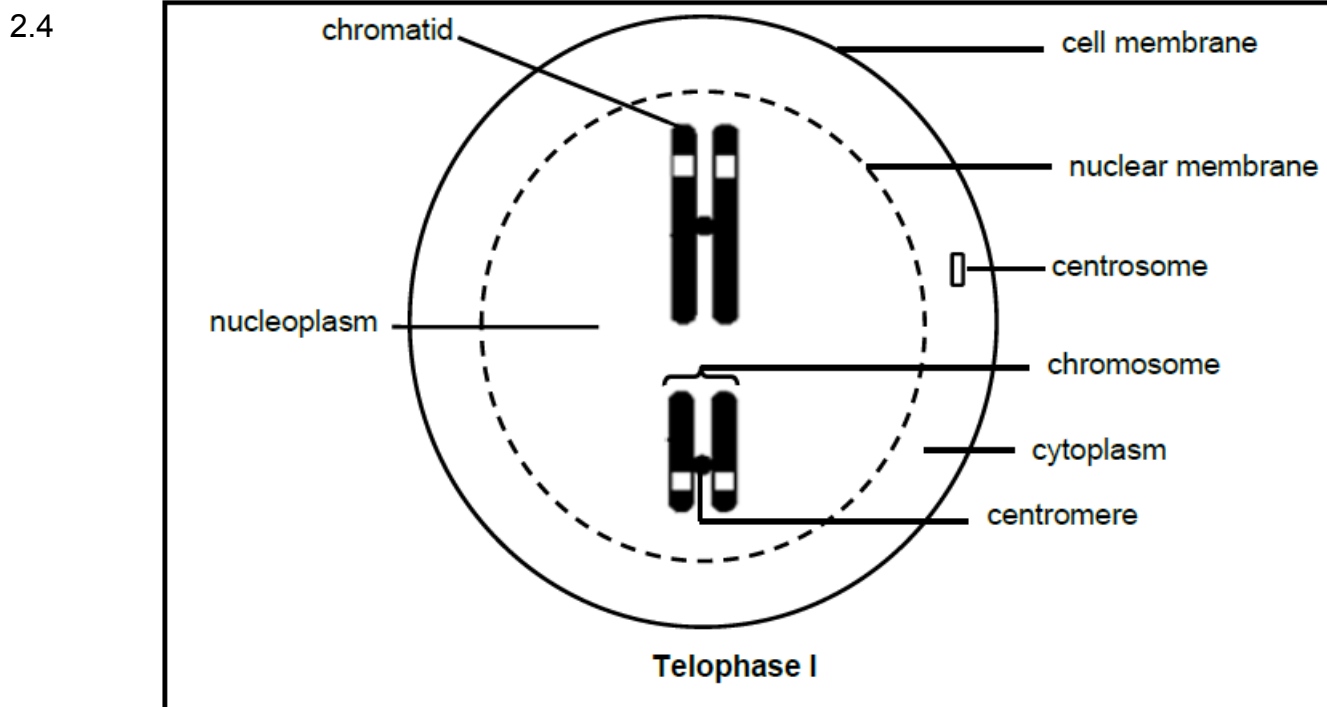
Any 2 (2)

(Mark first TWO only)

2.2 Spindle fibre✓ (1)

2.3 (a) 8✓ (1)

(b) 4✓ (1)



Criteria to mark diagram

Single cell is drawn	(S)	1
Only 2 replicated chromosomes in drawing	(T)	1
One replicated chromosome longer than the other	(L)	1
Caption		1
Any TWO correct labels		2

(6)

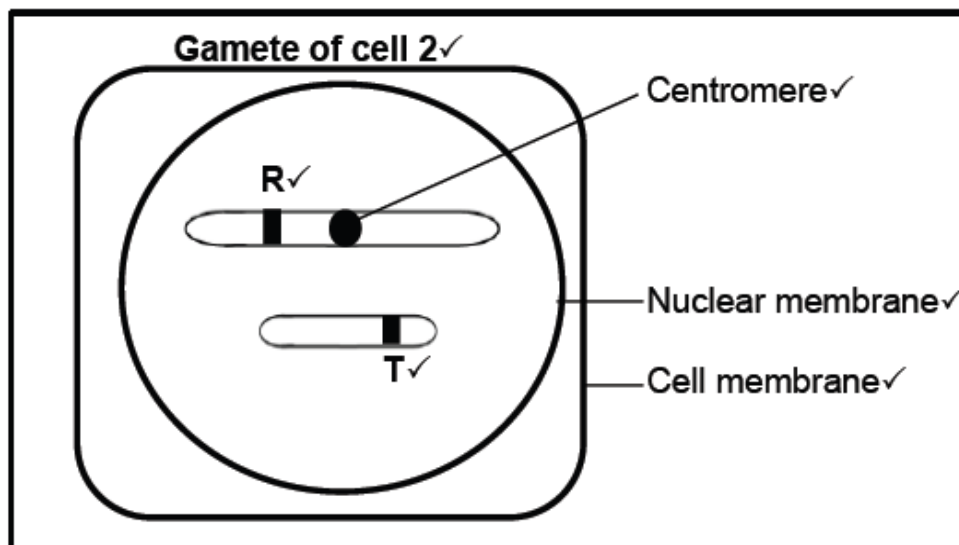
Question 3

3.1 Human somatic cells have 46✓ chromosomes and this cell only has 4✓ chromosomes (2)

3.2 (a) 2✓ (1)

(b) 2✓ (1)

3.3.



Criteria to mark diagram

Heading	1
Only 2 daughter chromosomes in drawing	1
Daughter chromosome indicating T	1
Daughter chromosome indicating R	1
Any ONE label	1

(5)

(9)

Question 4

4.1 (a) Centromere✓ (1)

(b) Centriole✓ (1)

(c) Chromatid✓/daughter chromosome (1)

4.2 $4 \rightarrow 2 \rightarrow 1 \rightarrow 3$ ✓✓ (2)

4.3 4✓ (1)

Question 5

- 5.1 (a) Metaphase I✓ (1)
(b) Telophase I✓ (1)
- 5.2 (a) B✓ (1)
(b) C✓ (1)
(c) D✓ (1)
- 5.3 Testis✓ (1)
(6)

Question 6

- 6.1 Telophase II✓ (1)
- 6.2 - There are 4 cells✓
- Each cell contains only a single set of un-replicated✓/single stranded chromosomes (2)
(MARK FIRST TWO ONLY)
- 6.3 (a) Two/2✓ (1)
(b) Four✓/4/2 pairs (1)
- 6.4 (a) - Crossing over✓
- Random arrangement✓ of chromosomes on the equator (2)
(MARK FIRST TWO ONLY)
- (b) - The gametes that form will be genetically different✓
- leading to variation in the offspring✓/increasing the gene pool
- This increases a species chances of survival✓ (3)
(10)

Question 7

7.1	23✓	(1)
7.2	(a) Centromere✓	(1)
7.3	(b) Chiasma✓/chiasmata	(1)
7.4	Ovary✓	(1)
	(a) Crossing over✓	(1)
	(b) Prophase I✓	(1)
	(c) ova✓/gametes/sex cells	(1)
	C → B → A✓(correct sequence)	(1)
		(8)

Question 8

8.1	Homologous chromosomes✓	(1)
8.2	45✓	(1)
8.3	Gonosomes✓	(1)
8.4	The presence of a Y chromosome✓/XY chromosome	(1)
8.5	Chromosome✓mutation	(1)

- 8.6
- Non-disjunction occurred✓/A homologous pair of chromosomes failed to separate
 - at position 21✓
 - during Anaphase✓
 - resulting in one gamete with 24 chromosomes✓/an extra chromosome/2 chromosomes at position 21
 - The fertilisation of this gamete with a normal gamete✓/gamete with 23 chromosomes/1 chromosome at position 21
 - results in a zygote with 47 chromosomes✓
 - There are 3 chromosomes✓/an extra chromosome at position 21/ this is Trisomy 21
- Any 6 (6)
(11)

Question 9

- 9.1 X - chiasma✓
Z - centromere✓ (2)
- 9.2 The chromosomes are of the same structure ✓/ size/ shape/ length
Crossing-over is taking place✓ any (1)
(Mark first ONE only)
- 9.3 It increases genetic variation✓/produces recombinant gametes (1)
(Mark first ONE only)
- 9.4 Random arrangement of chromosomes✓ /independent assortment (1)
(Mark first ONE only)
- 9.5 40✓/20 pairs (1)
(6)

Question 10

10.1 Prophase I✓ (1)

10.2

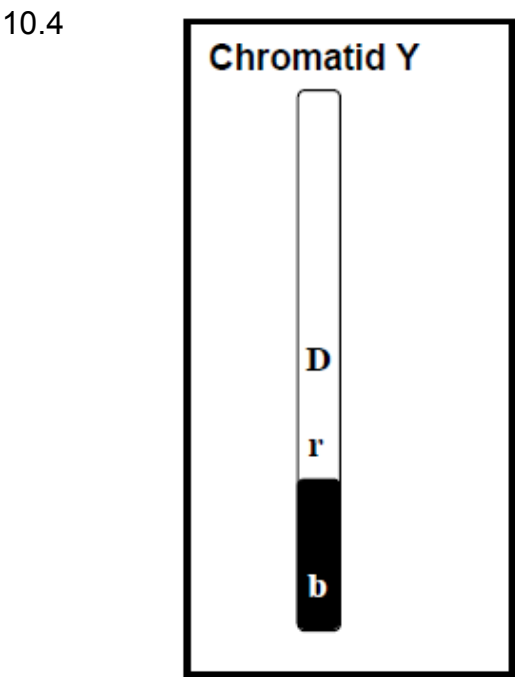
- Homologous chromosomes lie next to each other✓
- Chromatids overlap✓/touch
- at points called chiasmata✓
- and genetic information is exchanged✓/swapped

Any 3 (3)

10.3

- Crossing over introduces genetic variation✓ in gametes
- It may lead to new characteristics which are favourable✓
- or new characteristics which are unfavourable✓
- therefore affecting the chances of survival of the organism✓/ natural selection.

Any 2 (2)



ASSESSING THE DIAGRAM	
CRITERIA	MARKS
Chromatid Y represented (must be labelled if a whole chromosome is represented)	1
Alleles indicated correctly	1

(2)
(8)

Question 11

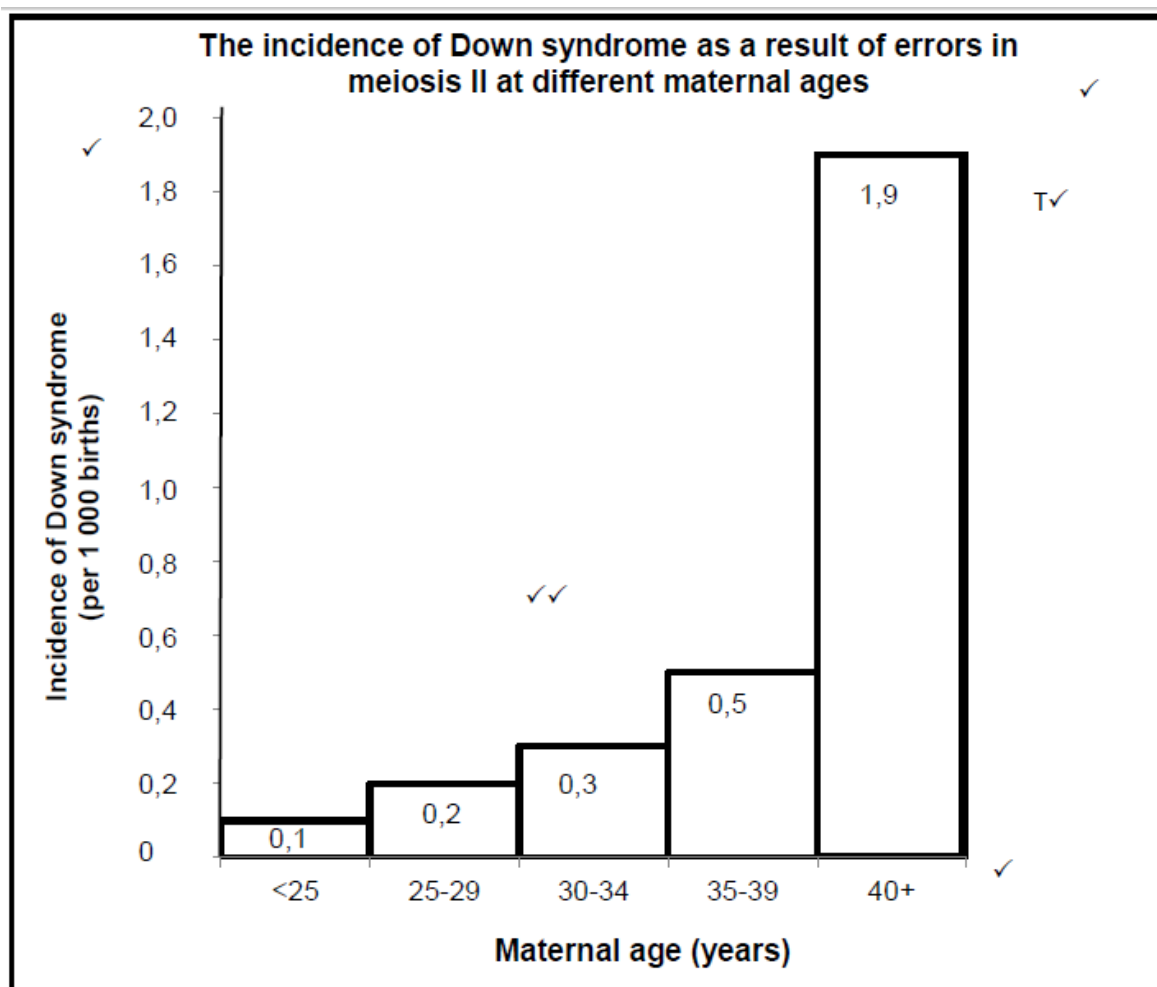
- 11.1 – Due to non-disjunction✓ / Non-separation of a chromosome pair
– during Anaphase I✓
– Two chromosomes moved to the one pole✓ and
– none moved to the other pole✓ Any (3)
- 11.2 – Gamete **A** will have 24 chromosomes✓ / an extra chromosome
– and when it fertilises a normal ovum✓ / gamete with 23 chromosomes
– the zygote will have 3 chromosomes at position 21✓ / 47 chromosomes (3)
- 11.3 (a) Prophase I✓ (1)
- (b) – Adjacent chromatids of homologous chromosomes cross✓
– at a point called the chiasma✓
– There is an exchange of DNA segments✓ / genetic material (3)
- (c) – Crossing over introduces genetic variation✓ in gametes
– Genetic variation may result in favourable characteristics✓
– that ensure a better chance of survival✓
– when environmental conditions change✓

OR

- Crossing over introduces genetic variation✓ in gametes
– Genetic variation may result in unfavourable characteristics✓
– that reduce the chance of survival✓
– when environmental conditions change✓ Any (3)
(13)

Question 12

12.1



Criterion	Elaboration	Mark
Type of graph	Histogram is drawn of Meiosis II	1
Caption	Including both variables: 'Incidence of Down syndrome and Maternal age'	1
X-axis	Correct label and units for X-axis: Maternal Age (years); Equal width of bars	1
Y-axis	Correct label, unit and scale for Y-axis: Incidence of Down syndrome (per 1 000 births)	1
Plotting of the bars	1 – 4 bars plotted correctly – 1 mark 5 bars correctly plotted – 2 marks	2

(6)

NOTE:

If axes are transposed:

- Marks will be lost for labelling of 'X-axis' and 'Y-axis'.

12.2 Non-disjunction✓

(1)

12.3 Meiosis I✓

(1)

12.4 Number of Down syndrome babies = $\frac{1,9}{7,8} \times 44$
= 10,71/11 babies

(3)
(11)

Question 13

STRUCTURE AND ARRANGEMENT OF CHROMOSOMES

- Each chromosome comprises two chromatids✓
- held together by a centromere✓
- There are 23 pairs✓/46 chromosomes in
- human somatic cells✓/body cells
- which are arranged into homologous pairs✓
 - that are similar in length✓
 - carry genes for the same characteristics✓
 - have alleles of a particular gene at the same loci✓ and
 - have the same centromere position✓
- Each somatic cell has 22 pairs/44 autosomes✓ and
- a pair/2 gonosomes✓/sex chromosomes/X and Y chromosomes
- Autosomes are arranged in pairs from largest to smallest✓ in a karyotype
- Males have XY chromosomes✓
- Females have XX chromosomes✓
- The X chromosome is larger than the Y chromosome✓

Max 8 (8)

BEHAVIOUR OF CHROMOSOMES IN MEIOSIS I

- During prophase✓ I
- chromosomes pair✓ up/homologous pairs/bivalents form
- Crossing over✓/exchange of genetic material occurs
- between chromatids✓/adjacent chromosome pairs
- During metaphase✓ I of meiosis
- homologous chromosomes✓/chromosome pairs are arranged
- at the equator✓ of the cell
- in a random✓ way
- with the chromosome attached to the spindle fibre✓
- During anaphase✓ I
- chromosome pairs separate✓/chromosomes move to opposite poles
- During telophase✓ I
- the chromosomes reach the poles of the cell✓

Max 9 (9)
Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question.	Ideas are arranged in a logical sequence.	All aspects of the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to structure and arrangement of human chromosomes and their behaviour in the different phases of meiosis I is given. No irrelevant information included.	The description of structure and arrangement of human chromosomes and their behaviour in the different phases of meiosis I is given in a logical and sequential manner.	At least the following marks should be obtained - 5/8 for the structure and arrangement of human chromosome - 6/9 for behaviour during meiosis I
Mark	1	1	1

DIVERSITY IN REPRODUCTIVE STRATEGIES IN VERTEBRATES

Question 1

- 1.1 External fertilisation ✓
- 1.2 Precocial ✓
- 1.3 Amniotic ✓
- 1.4 Altricial ✓
- 1.5 Ovovivipary ✓

5X1=5

Question 2

- 2.1 A Only ✓✓
- 2.2 B Only ✓✓
- 2.3 B Only ✓✓
- 2.4 A only ✓✓
- 2.5 B Only ✓✓
- 2.6 Both A and B ✓✓
- 2.7 A Only ✓✓

7X2= 14

Question 3

- 3.1 (a) Fertilisation of egg by a specific male is enhanced.or more efficient. (1)
- (b) Fertilised egg is protected from dehydration✓.OR
Protected from predation ✓as it develops inside the father's pouch✓ (1)
- 3.2 External✓ (1)
- 3.3 Fertilisation occurs inside the pouch that is outside the sea horse's body✓. (1)
(4)

Question 4

- 4.1
- The hatchling's eyes are closed✓
 - The hatchling can't move✓
 - The hatchling can't feed on its own✓
 - The hatchling has no feathers✓/wings are not developed
- (Any 2) (2)
- (MARK FIRST TWO ONLY)**
- 4.2
- Foetus develops inside the uterus✓ for greater protection✓
 - Food is supplied by the mother✓ and is therefore supplied for a longer period✓
- (Any 1 x 2) (2)
- (MARK FIRST ONE ONLY)**
- 4.3
- More yolk allows for greater development✓ of the chick
 - so that it can be more independent✓ after hatching
- (2)
(6)

Question 5

- 5.1 (a) Diagram 1✓ (1)
- (b) Diagram 2✓ and Diagram 3✓ (2)
- (c) Diagram 1✓ and Diagram 2✓ (2)
- 5.2 Amniotic✓ egg (1)
- (6)

Question 6

- 6.1 E- Shell (1)
- 6.2 Protect the egg from dehydration and physical damage (1)
- 6.3 (a) Amnion ✓ (1)
- (b) Chorion ✓ (1)
- (c) Allantois ✓ (1)
- (5)

Question 7

- 7.1 Gaseous exchange in amniotic eggs
- Gases move by diffusion✓
 - into and out of the egg✓
 - through the porous shell✓/allantois/chorion
- Nourishment of the embryo in amniotic eggs
- The egg contains yolk✓/albumin
- which provide nutrients✓ to the embryo
- Max (4)

HUMAN REPRODUCTION

Question 1

- 1.1 A - prostate gland✓
B - vas deferens / sperm duct✓
E - urethra✓
G - nucleus✓ (4)
- 1.2 C - Stores sperms temporarily✓/sperms mature here
(Mark first ONE only)
- F - Contain enzymes to break down the cell membrane of the egg cell✓
(Mark first ONE only) (2)
- 1.3 D✓ testis ✓/seminiferous tubules (2)
- 1.4 To keep the testes at a temperature that is (about 3 °C) lower than body temperature✓
A lower temperature is necessary for the production of healthy sperm✓/so that healthy sperms can survive (2)
- 1.5 (a) Interstitial cells✓/Cells of Leydig (1)
(b) Testosterone✓ (1)
- 1.6 (a) Severing of the vas deferens✓
Will not allow sperms to pass to urethra and into the female✓
and hence no fertilisation results✓ any (2)
- (b) Yes✓ (1)
- (c) HI virus is carried in body fluids✓/ seminal fluids/saliva/blood
Can infect a person through open wounds✓/blood transfusion/
sexual intercourse
Therefore vasectomy does not stop the transmission of HIV (2)
(17)

Question 2

- 2.1 (a) F✓ testis✓/seminiferous tubules (2)
(b) C✓ urethra✓ (2)
(c) D✓ epididymis✓ (2)
- 2.2 testosterone✓ (1)
- 2.3 (a) F✓ (1)
(b) B✓ (1)
(9)

Question 3

- 3.1 (a) Epididymis✓ (1)
(b) Testis✓ (1)
(c) Vas deferens✓/sperm duct (1)
- 3.2 Stores sperm cells✓ (1)
(Mark first ONE only)
- 3.3 Sperm cells will not pass to urethra✓
to fertilise the egg✓
and hence he will not be able to have children✓ (3)
- 3.4 The HI virus may still be passed on✓during sexual intercourse
through the secretions of the accessory glands✓ (2)
(9)

Question 4

- 4.1 Spermatogenesis✓ (1)
- 4.2 Testis✓ (1)
- 4.3 (a) 23✓ (1)
(b) 23✓ (1)
- 4.4 - Crossing over✓
- Random assortment of chromosomes✓ (any order)
(Mark first TWO only) (2)
- 4.5 2✓ (1)
- 4.6 Sperm cells✓/spermatozoa/male gametes (1)
(8)

Question 5

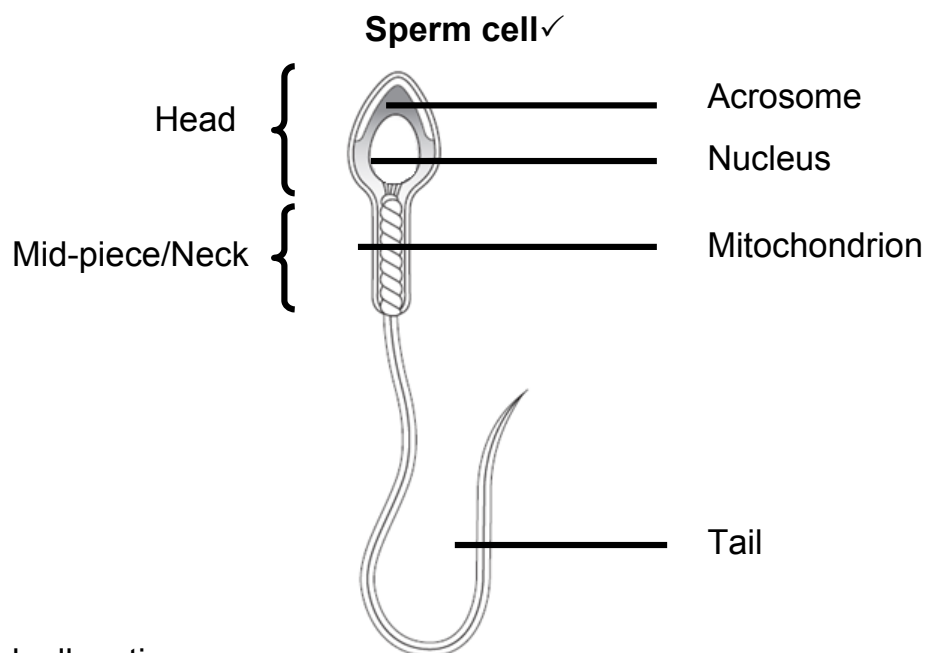
- 5.1 Oogenesis✓ (1)
- 5.2 - At the end of the process in DIAGRAM I/oogenesis, one✓
gamete/ovum forms/three cells degenerate
- At the end of the process in Diagram II/spermatogenesis four✓
gametes/sperm form/none of the cells degenerate (2)
- 5.3 Testes✓/seminiferous tubules (1)

- 5.4 (a) 23✓ (1)
- (b) 23✓ (1)
- 5.5 - Crossing over✓
- Random arrangement✓ of chromosomes (2)
(MARK FIRST TWO ANSWERS ONLY)
- 5.6 - This will result in multiple births✓/There will be increased chances of fertilisation
- which will lead to an increase in human population✓ (2)
(10)

Question 6

- 6.1 Spermatogenesis✓ (1)
- 6.2 - Higher temperature will denature the enzymes✓
- and damage cell membranes✓ (2)
- 6.3 - An increase in exercise✓
increases sperm count✓ (2)
- 6.4 - Increase the number of participants✓/sample size
- Repeat the investigation✓ (Any 1) (1)
(MARK FIRST ONE ONLY)

6.5



Mark allocation:

Heading✓

Any 2 correct labels ✓✓

Correct drawing✓ (Must have head, mid-piece and a tail in appropriate proportions)

(4)
(10)

Question 7

- 7.1 (a) Nucleus✓ (1)
- (b) Tail✓ (1)
- 7.2 - C/ middle piece contains mitochondria✓
that provides energy for movement✓
- 7.3 - Has a tail✓
for swimming✓ Any (1 x 2) (2)
- (Mark first ONE only)**
- No acrosome✓ will be present in the sperm cell
- therefore no enzymes present✓
- Sperm cell will be unable to penetrate the ovum✓
- therefore no fertilisation will occur✓ Any (3)
- (7)**

Question 8

- 8.1 C✓ – Endometrium✓ (2)
- 8.2 D✓ – Vagina✓ (2)
- 8.3 A✓ – Fallopian tube✓ (2)
- 8.4 B✓ – Ovary✓ (2)
- (8)**

Question 9

- 9.1 A – Fallopian tube✓
B – Ovary✓
C – Vagina✓ (3)
- 9.2 - Encloses✓ and protects✓ the developing embryo/foetus
- Forms part of the placenta✓
- Which provides for the nutrition✓/ gaseous exchange/
excretion of the embryo
- Allows for implantation✓/attachment of the embryo
- Contracts during labour for child birth✓ (3)
- (Mark first THREE only)**
- 9.3 (a) The sperms will be prevented from reaching the ovum✓/
prevents the ovum from travelling along the Fallopian
tube (1)
- (b) The egg produced in the other ovary✓ can still be fertilised✓
in the other Fallopian tube (2)
- (9)**

Question 10

- | | | |
|------|------------------------------|------------|
| 10.1 | B✓ Urethra✓ | (2) |
| 10.2 | E ✓ Fallopian tube ✓/oviduct | (2) |
| 10.3 | C✓ Testis✓ | (2) |
| 10.4 | F✓ Ovary ✓ | (2) |
| | | (8) |

Question 11

- | | | |
|------|--|--------------------|
| 11.1 | A - Urethra✓
B - Vas deferens✓/sperm duct
F - Fallopian tube✓/oviduct | (3) |
| 11.2 | (a) - Protects the sperm cell against the acidic environment of the vagina✓
- Increases the motility of the sperm✓
- Provides nutrients✓
(Mark first ONE only) | Any (1) |
| | (b) - Place for foetus to develop ✓
- Maintain pregnancy✓
- Assist in childbirth✓
- Implantation✓ of blastula
- Protects the foetus✓/prevents infections(mucus plug forms by cervix)
- Passage for sperm cells✓between vagina and fallopian tubes
(Mark first ONE only) | Any (1) |
| 11.3 | (a) D✓
(b) G✓ | (1)
(1) |
| 11.4 | (a) Spermatogenesis✓
(b) Oogenesis✓ | (1)
(1) |
| 11.5 | - Serves as a birth canal✓
- Allows for passage of blood/ endometrial lining/amniotic fluid/placenta
- Facilitates sexual intercourse ✓/receives semen
- Secretes acid which prevents infections✓
(Mark first TWO only) | Any (2) |
| 11.6 | - To keep the testes at a temperature that is lower than body temperature✓/optimum temperature for sperm production
- which is necessary for the production of healthy sperm✓/so that healthy sperms can survive | (2)
(13) |

Question 12

- 12.1 (a) FSH✓/Follicle stimulating hormone (1)
- (b) Ovulation✓ (1)
- 12.2 - It causes the endometrium✓
- To become thicker✓/more glandular/more vascular (2)
- 12.3 (a)
- The levels of progesterone drop✓
- therefore FSH secretion is no longer inhibited✓/FSH secretion is resumed
- and a new follicle starts to develop✓ (3)
- (b)
- The levels of progesterone drop✓
- therefore the endometrium is no longer maintained ✓
- and menstruation takes place✓ (3)
- (10)**

Question 13

- 13.1 Accept day 14 or day 15✓ (1)
- 13.2 Days 0 - 7✓ (1)
- 13.3 - Causes the follicle to burst open✓/stimulates ovulation
- Stimulates the formation of the corpus luteum✓
(Mark first ONE only) (1)
- 13.4 - LH levels remain low up to day 12/13 ✓
- Then it increases sharply up to day 14✓
- After which it decreases and remains low✓ (3)
- 13.5 As the oestrogen level increases ✓
the thickness of the endometrium also increases✓ (2)
- 13.6 Maintain the increase in the thickness of the endometrium✓
for greater chance of implantation✓ (2)
- 13.7 No✓ (1)
- 13.8 The progesterone level✓has dropped✓/not maintained/corpus luteum has started to degenerate (2)
- (13)**

Question 14

- 14.1 Day 14✓/15 (1)
- 14.2 Day 0–6✓/day 0–7 (1)
- 14.3 Stimulates follicle✓/ovum development in the ovary/secretion of oestrogen (1)
- 14.4 An increase in progesterone level✓ inhibits the release of FSH✓
OR
 FSH stimulates the development of the ovum✓ and progesterone prepares for implantation ✓when this ovum is fertilised (2)
- 14.5 - Corpus luteum ✓
 - starts to secrete progesterone✓
 - which thickens✓ the lining of the uterus wall/endometrium
 14.6. Any (2)
- 14.6 No✓ (1)
- 14.7 - Corpus luteum has degenerated✓
 - Progesterone level has decreased✓
 - FSH level starts to rise✓
 - LH level decreases✓
(Mark first TWO only) Any (2)
(10)

Question 15

- 15.1 37✓ °C ✓ (accept 36,9 to 37,1) (2)
- 15.2 (37,1 – 36,2) ✓ = 0,9 ✓°C (2)
- 15.3 The temperature rose✓
 The oestrogen level decreased✓
 The progesterone levels starts to increase✓
(Mark first THREE only) (3)
- 15.4 Starts secreting progesterone to maintain the thickness✓
 of the endometrium/uterus lining✓/prepare the uterus lining for the embryo (2)
(9)

Question 16

- 16.1 (a) Corpus luteum✓
(b) Placenta✓ (2)
- 16.2 (a) Hypophysis✓/Pituitary gland
(b) Stimulates mammary glands to produce milk✓ (2)
- 16.3 There is no need to maintain endometrium any longer✓ – allows the placenta removal as afterbirth✓ (2)
- 16.4 Uterine wall will disintegrate✓ – miscarriage occurs✓/implantation would not occur (2)
- 16.5 Brings about contractions✓ of the uterus during labour/stimulates milk production (1)
(9)

Question 17

- 17.1 (a) Oestrogen✓ (1)
(b) Progesterone✓ (1)
- 17.2 - It increases✓
- the thickness✓ of the endometrium/the blood vessels in the endometrium/the amount of glandular tissue in the endometrium (2)
- 17.3 (a) Release of an ovum✓ from the ovary✓/Graafian follicle (2)
(b) Day 14✓ (1)
(c) LH✓/Luteinizing hormone (1)
- 17.4 - High levels of hormone B/progesterone will inhibit✓
- the secretion of FSH✓
OR
- No new ova/mature follicles✓
- are required during pregnancy✓ (2)
- 17.5 - The progesterone✓
- levels decreased✓
- because the corpus luteum degenerated✓ (3)
(13)

Question 18

- 18.1 FSH✓
OR
Oestrogen✓
(Mark first ONE only) Any (1)
- 18.2 -The follicle✓ develops✓ during this period stimulated by increased levels of FSH
-The lining of the endometrium✓ thickens✓ during this period stimulated by increased levels of oestrogen
(Mark first ONE only) Any(1 x 2) (2)
- 18.3 - Corpus luteum has not disintegrated✓
- it continues to secrete progesterone✓
- so the endometrial lining remains thickened✓ (3)
- 18.4 - The zygote✓
- undergoes mitosis✓
- until a ball of cells is formed✓
- called a morula✓
- The morula continues to divide and forms a mass of cells with a hollow cavity✓
- called a blastocyst✓
- the outer membrane of the blastocyst forms chorionic villi✓/
attachment villi
- which attaches it to the endometrium✓ Any (5)
- 18.5 (a) For family planning✓/ to know when they can get pregnant (1)
- (b) LH✓/FSH/oestrogen
- There is a rise in levels✓ of LH/FSH/oestrogen
- around the time of ovulation✓ (3)
- (15)**

Question 19

- 19.1 - Corpus luteum✓
- Placenta✓ (2)
(Mark first TWO only)
- 19.2 Progesterone levels are increasing✓ (1)
- 19.3 - High levels of progesterone✓
- inhibits/causes a decrease in the secretion of FSH✓ (2)
- 19.4 To prevent the growth of a new follicle✓/ovulation during the pregnancy (1)

$$19.5 \quad 39,5 - 21,6 \checkmark = 17,9$$

$$\frac{17,9}{21,6} \times 100\% = 82,87\% / 82,9\% / 83\% \quad (3)$$

- 19.6 (a) - The endometrium/uterine lining/placenta will not be maintained✓
- Menstruation will begin✓/the placenta will detach/ she will have a miscarriage (2)
- (b) Give the woman progesterone supplements✓ (1)
- (12)

Question 20

- The menstrual cycle is a series of events that occur in the female body to prepare it for possible pregnancy✓
- Which involves ovarian cycle✓
- and the uterine cycle✓
- It takes an average of 28 days✓
- The pituitary gland✓/hypophysis
- secretes FSH✓
which stimulates the development of a primary follicle✓ in the ovary
- The developing follicle✓/Graafian follicle
- secretes oestrogen✓
which stimulates the thickening of the lining of the uterus✓/endometrium
- Around day 13 pituitary gland✓/hypophysis
- secretes LH✓
- which cause ovulation to occur✓
- The remains of the Graafian follicle develops into the corpus luteum✓
which secretes the progesterone✓
which continues to stimulate the thickening of the uterus✓
- High levels of progesterone✓
- inhibits the production of FSH✓
so that the ovaries are no longer stimulated to produce another follicle✓
- If fertilisation does not occur, the corpus luteum degenerates✓
and stops producing progesterone✓
- The pituitary gland/hypophysis is no longer inhibited in its production of FSH✓ and a new follicle develops
- The thick endometrium is no longer maintained✓/ it degenerates
and is shed together with blood/menstruation takes place

Any (17)

Content: (17)

Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance	Logical sequence	Comprehensive
Elaboration	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been addressed
Mark	1	1	1
Paper 2	Only information relevant to the <i>menstrual cycle</i> or the <i>role of hormones of the menstrual cycle</i> is given. (There is no irrelevant information)	The events of the menstrual cycle are presented in the correct sequence and the hormones linked to the appropriate events	The role of all 4 hormones in the menstrual cycle are mentioned
	R✓	L✓	C✓

Question 21

- High levels of progesterone✓
 - Inhibits secretion of FSH✓
 - There is no development of an ovum✓/primary follicle
 - Therefore no ovum released/ovulation✓
 - Thus there will be no fertilisation✓
- Any **(4)**

Question 22

- 22.1 (a) Jelly layer✓ (1)
- (b) Cell membrane✓/plasmalemma/plasma membrane (1)
- (c) Cytoplasm✓ (1)
- (d) Nucleus✓ (1)
- 22.2 (a) G✓ - Middle piece✓/neck (2)
- (b) E✓ - Acrosome✓ (2)
- (c) D✓ - Nucleus✓ (2)
- (10)**

Question 23

- 23.1 - As a result of the blocked Fallopian tube✓
- the sperm cannot reach the ovum✓
- therefore fertilisation cannot take place✓ (Any 2) (2)
- 23.2 (a) FSH✓/follicle stimulating hormone (1)
- (Mark first ONE only)**
- (b) Oestrogen✓ (1)
- (Mark first ONE only)**

- 23.3
- A zygote✓ is formed
 - which divides by mitosis✓
 - forming a ball of cells✓
 - called the morula✓
 - which further divides to form a hollow ball of cells✓ (Any 4) (4)
- 23.4
- Progesterone levels would fall✓
 - The endometrium would no longer be maintained✓
 - A miscarriage would occur✓ (3)
- (11)

Question 24

- 24.1 Pituitary✓ gland/hypophysis (1)
- 24.2 LH rises✓ immediately before ovulation✓ (2)
- 24.3 To monitor their fertile periods✓ to prevent pregnancy✓/to increase chances of falling pregnant (2)
- 24.4
- Oestrogen levels rise✓
 - because the developing follicle secretes oestrogen✓ (2)
- 24.5 Between 16 and 18✓✓ (2)
- 24.6
- Progesterone only rises after ovulation✓
 - When the corpus luteum is formed✓
 - This shows that the fertility period has already passed✓ (3)
- (12)

Question 25

Structural suitability of the sperm cell for internal fertilisation

- The front of the head of the sperm cell contains an acrosome✓/vesicle which carries enzymes to dissolve a path into the ovum✓
- Nucleus of the sperm✓ carries genetic material of the male✓/ haploid number of chromosomes
- The middle piece contains mitochondria✓ which release energy✓ so that sperms could swim
- The presence of a long tail✓ enables sperm cells to swim✓ towards the ovum
- The contents of the sperm cell such as the cytoplasm is reduced✓/condensed making the sperm light for efficient movement✓ (Any 3 x 2) (6)

Fertilisation

- In the Fallopian tubes✓
- one sperm cell makes contact with the ovum's membrane✓
- The nucleus of the sperm enters the ovum✓
- Then the ovum membrane becomes impenetrable✓ to other sperms
- The nucleus of the sperm fuses✓
- with the nucleus of the ovum✓ } OR sperm fuses with an ovum✓
- to form a diploid✓ zygote
- This is called fertilisation✓

(Any 5) (5)

Events after fertilisation until implantation

- The zygote divides by mitosis✓ many times
- to form an embryo✓
- It first consists of a ball of cells✓
- called the morula✓
- which then develops into a hollow ball of cells✓
- called the blastula✓/blastocyst
- It embeds itself into the uterus lining✓/endometrium
- using chorionic villi✓

(Any 6) (6)
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logical sequence	Comprehensive
All information provided is relevant to the question	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay in sufficient detail
Only information regarding: - The structural suitability of the sperm cell - Events during fertilisation - Events after fertilisation until implantation No irrelevant information.	All structures are related to the respective functions of the sperm cell. The sequence of events in fertilisation and post fertilisation until implantation is in the correct order.	At least the following points should be included: - The structural suitability of the sperm cell (4/6) - Events during fertilisation (3/5) - Events after fertilisation until implantation (4/6)
1 mark	1 mark	1 mark

Question 26

Spermatogenesis✓ (S)

- Takes place under the influence of testosterone✓
- in the seminiferous tubules✓/testis
- Diploid cells✓/germinal epithelium
- undergo meiosis✓
- to form haploid sperm cells✓

(Any 4) (4)

Formation and transport of semen (T)

- Sperm mature✓/are temporarily stored
- in the epididymis✓
- During ejaculation✓
- sperm move into the vas deferens✓
- As it passes the seminal vesicles✓,
- prostate gland✓ and
- Cowper's glands✓
- fluids are added that provide nutrition,✓
- promote the movement✓ of the sperm
- and neutralise the acids ✓ produced in the vagina
- The semen passes through the urethra✓
- of the penis✓
- into the vagina✓
- during copulation✓
- and swims up the Fallopian tube✓ where it meets the ovum

(Any 7) (7)

Structural suitability of the sperm cell for fertilisation (A)

- The acrosome✓
- contains enzymes to dissolve a path into the ovum✓
- Nucleus of the sperm✓
- carries genetic material of the male✓/haploid number of chromosomes
- Many mitochondria✓in the middle piece
- release energy✓ so that sperms could swim
- The presence of a tail✓
- enables sperm cells to swim✓ towards the ovum
- The contents of the sperm cell such as the cytoplasm is reduced✓/condensed
- making the sperm light for efficient movement✓
- Sperm is streamlined✓
- to allow for easier movement✓

(MARK FIRST THREE ONLY)

(Any 3 x 2) (6)

Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance (R)	Logical sequence (L)	Comprehensive (C)
All information provided is relevant to the question	Ideas arranged in a logical/cause-effect sequence	Answered all aspects required by the essay in sufficient detail
All information relevant to - Spermatogenesis - Formation and transport of semen - Structural suitability of sperm. There is no irrelevant information	The information on - Spermatogenesis - Formation and transport of semen and - Structural suitability of sperm is in a logical sequence	The following must be included: - Spermatogenesis (2/4) - Formation and transport semen (5/7) - Structural suitability of sperm (4/6)
1 mark	1 mark	1 mark

Question 27

- 27.1 Fertilisation✓ (1)
- 27.2 Mitosis✓ (1)
- 27.3 - Chorion✓
- Amnion✓
(Mark first TWO only) (2)
- 27.4 (a) Zygote✓ (1)
(b) Morula✓ (1)
(c) Blastocyst✓/blastula (1)
- 27.5 Fallopian tube✓/oviduct (1)
- 27.6 47✓ (1)
(9)

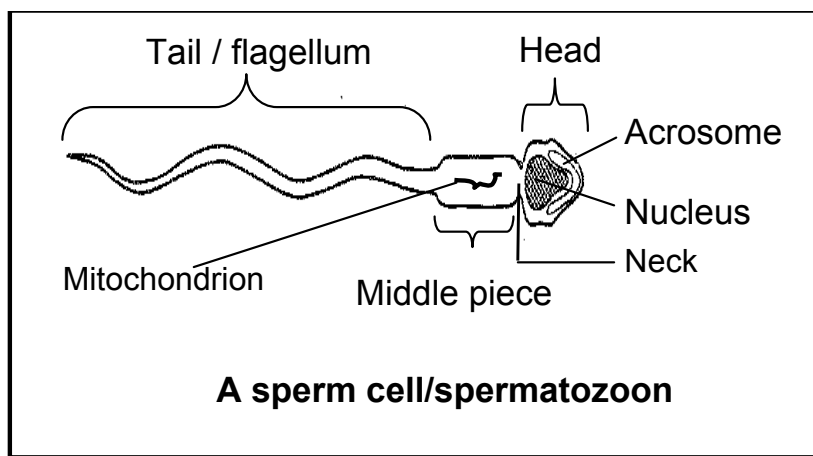
Question 28

- 28.1 (a) Zygote✓ (1)
(b) Morula✓ (1)
(c) Placenta✓ (1)
- 28.2 (a) Fertilisation✓ (1)
(b) Implantation✓ (1)
- 28.3 (a) 46✓/23 pairs (1)
(b) 23✓ (1)
(7)

Question 29

- 29.1 C - Endometrium✓/placenta /uterus/uterine wall/myometrium
D - Ovary✓ (2)
- 29.2 1 - Ovulation✓
2 - Fertilisation✓
3 - Mitosis✓/ cell division/growth/cleavage (3)
- 29.3 (a) 23✓ (1)
(b) 46✓/23 pairs (1)

29.4



Caption: 1 mark

Label: any 4 correct labels: 4 marks

(5)

29.5

Shock absorber✓/prevents physical or mechanical damage

Protects the foetus from drying out✓

Insulates the foetus against temperature fluctuations✓

Allows foetal movement for growth and development✓

(Mark first TWO only)

any

(2)

29.6

(a) Oxygen✓

(Dissolved) food✓ (examples e.g. glucose, amino acids, water)

Antibodies✓

(Mark first ONE only)

any

(1)

(b) Metabolic waste✓

Carbon dioxide✓

Nitrogenous waste/(examples e.g. urea, ammonia, uric acid)

Water ✓

any

(1)

(Mark first ONE only)

(16)

Question 30

30.1

Ovary ✓

30.2

Ovum ✓/egg

30.3

Zygote✓

30.4

Sperm cell✓/tail of sperm cell

30.5

Umbilical cord✓

30.6

Amniotic✓

(6)

Question 31

- 31.1 (a) Umbilical cord✓ (1)
- (b) Cervix✓/endometrium/uterus wall (1)
- 31.2 It provides the fluid medium for free movement of foetus✓
It acts as a shock absorber✓
It protects the foetus against dehydration✓
It protects the foetus against temperature changes✓
Promotes lung development✓
Holds waste✓ any (1)
- (Mark first ONE only)**
- 31.3 Uterine walls are made up of (strong) muscles✓ – which contract and relax to push the foetus✓/ afterbirth forward
- Cervix has (elastic) muscles✓ – allowing dilation of the opening to let the foetus out✓ any (1 x 2) (2)
- 31.4 Respiratory✓/Gaseous exchange system
Digestive ✓ system
Excretory✓ system
(Mark first TWO only) any (2)
- 31.5 High levels of progesterone✓ inhibits the secretion of FSH✓ (2)
- (9)**

Question 32

- 32.1 A✓ (1)
- 32.2 A✓ /B (1)
- 32.3 E✓ (1)
- 32.4 B✓ (1)
- 32.5 D✓ (1)
- (5)**

Question 33

- 33.1 (a) Chorion✓/Amnion (1)
- (b) Umbilical cord✓ (1)
- 33.2 - Protects the foetus from shock✓/Acts as a shock absorber
- Protects the foetus from drying out✓
- Protects the foetus from temperature changes✓
- Allows free movement of the foetus✓ (Any 2) (2)
- (MARK FIRST TWO ONLY)**

- 33.3
- Gaseous exchange system✓
 - Excretory system✓
 - Digestive system✓
- (Any 1) (1)
- 33.4 **(MARK FIRST ONE ONLY)**
- The foetus will receive less nutrients✓
and therefore have a lower birth mass✓/physical under-development/mental under-development
 - The foetus will receive less oxygen✓
and therefore have a lower birth mass✓/physical under-development/mental under-development
 - Waste will accumulate✓
and it will affect the functioning of the foetus✓
- (Any 1 x 2) (2)
- (MARK FIRST ONE ONLY)** (7)

Question 34

- 34.1
- It act as a micro-filter✓/prevents harmful substances from reaching the foetus
 - It secretes progesterone✓/oestrogen during pregnancy
 - Immunity is transferred from the mother to the foetus✓
- (Any 2) (2)
- (MARK FIRST TWO ONLY)**

34.2

BLOOD VESSEL C	BLOOD VESSEL D
High concentration of nutrients✓/example of nutrient	Low concentration of nutrients✓/example of nutrient
Low concentration of waste products✓/example of waste product	High concentration of waste products✓/example of waste product
High concentration of oxygen✓	Low concentration of oxygen✓
Low concentration of carbon dioxide✓	High concentration of carbon dioxide✓

(MARK FIRST TWO ONLY)

Table: (1) and (Any 2 x 2) (5)

- 34.3
- Waste products/nitrogenous waste/CO₂ will accumulate✓ in the foetus' body
causing the death of the foetus✓
- (2)
- (MARK FIRST ONE ONLY)**

- 34.4
- Harmful substances✓/bacteria
 - may pass from the mother's blood to the blood of the foetus✓
- OR**
- The blood types✓/other proteins of the mother and baby
 - may not be compatible✓
- (2)
- (11)**

Question 35

- The zygote divides by mitosis✓
- to form a ball of cells✓
- called the morula✓
- More mitotic divisions of the morula occurs to form a hollow ball of cells✓
- called a blastocyst✓
- The blastocyst attaches to the endometrial lining✓
- The outer wall of the blastocyst, called the chorion✓,
- develops projections called villi✓ which
- embeds/implants✓ into the uterine wall
- The cells of the embryo continues to divide✓
- and differentiate✓
- to form the different organs and limbs✓
- and is now called a foetus✓
- The foetus is enclosed in a sac called the amnion✓
- filled with amniotic fluid✓
- which protects the foetus against temperature fluctuations✓
- protects the foetus against dehydration✓
- and protects the foetus against mechanical injury✓/acts as a shock absorber
- The chorionic villi and the endometrium form the placenta✓
- where the blood of both the foetus and the mother✓
- run close to each other✓
- allowing for nutrients to diffuse✓ into the blood of the foetus
- The umbilical vein✓
- carries the absorbed nutrients from the mother to the foetus✓

Any (17)

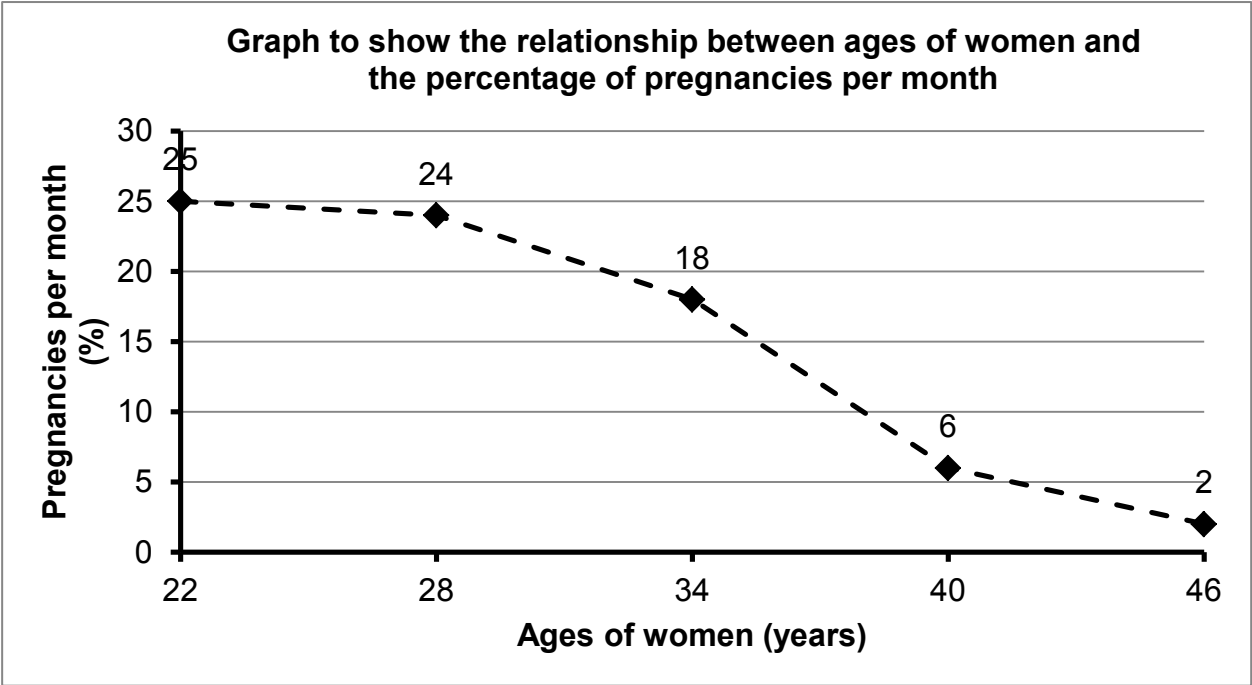
Content: (17)
Synthesis: (3)

ASSESSING THE PRESENTATION OF THE ESSAY

RELEVANCE	LOGICAL SEQUENCE	COMPREHENSIVE
All information provided is relevant to the topic	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay
Only information relating to the development of the zygote to the foetus and its nutrition and protection is included (there is no irrelevant information)	Events that lead to the change from a zygote to a foetus are stated in the order in which they occur	ALL three aspects are included: 1. Development of zygote to foetus 2. Nutrition of the foetus 3. Protection of the foetus
1 mark	1 mark	1 mark

Question 36

36.1



Mark allocation of the graph

Criteria	Mark Allocation
Correct type of graph drawn for the pregnancies per month only	1
Title of graph including the two variables (Age of women and pregnancies per month)	1
Correct label and unit for X-axis and Y-axis	1
Correct scale for X-axis and Y-axis	1
Drawing of the graph	0: No points plotted correctly 1: 1 to 4 points plotted correctly 2: All 5 points plotted correctly

36.2 The older the women, the higher the chances of having miscarriages✓✓

OR

The younger the women, the lower the chances of having miscarriages✓✓ (2)

36.3 $50\% \times 12\checkmark = 6\checkmark$

OR

$\frac{50}{100} \times 12\checkmark = 6\checkmark$ (2)
(10)

Question 37

Gaseous exchange in amniotic eggs (A)

- Gases move by diffusion✓
- into and out of the egg✓
- through the porous shell✓/allantois/chorion

Nourishment of the embryo in amniotic eggs

- The egg contains yolk✓/albumin
- which provide nutrients✓ to the embryo

Max (4)

Gaseous exchange and nourishment of the foetus in humans (F)

- In the placenta✓
- the mothers blood comes into close contact with the foetal blood✓
- Oxygen✓
- and nutrients✓
- diffuse from the mothers blood into the foetal blood✓
- in the umbilical veins✓
- This nutrient rich blood is carried to the foetus through the umbilical cord✓
- Carbon dioxide diffuses from the foetal blood✓
- in the umbilical artery✓
- into the maternal blood✓

Max (7)

Protection of the foetus in humans (P)

- The foetus develops inside the uterus✓
- and is protected by the mothers body✓
- Antibodies from the mothers blood✓
- pass into the foetus' blood and provide immunity✓
- The placenta acts as a microfilter✓
- preventing toxins from the mother entering the foetal blood✓
- The foetus is enclosed in the amnion✓
- which contains amniotic fluid✓
- The amniotic fluid provides protection against dehydration✓
- and acts as a shock absorber✓
- It provides a suitable temperature✓ for the developing embryo

Max (6)

Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logical sequence	Comprehensive
All information provided is relevant to the question	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay in sufficient detail
All the information provided is relevant to: - Gaseous exchange and nourishment in amniotic eggs - Gaseous exchange, nourishment and protection in the human foetus There is no irrelevant information	All the information regarding the: - Gaseous exchange and nourishment in amniotic eggs - Gaseous exchange, nourishment and protection in the human foetus is arranged in a logical manner.	At least the following points should be included: - Gaseous exchange and nourishment in amniotic eggs (2/4) - Gaseous exchange and nourishment in the human foetus (5/7) - Protection in the human foetus (4/6)
1 mark	1 mark	1 mark

GENETICS

Question 1

- 1.1.1 Dihybrid✓
- 1.1.2 Crossing Over✓
- 1.1.3 Genome✓
- 1.1.4 Recessive✓
- 1.1.5 Dominant ✓
- 1.1.6 Locus✓
- 1.1.7 Cloning✓
- 1.1.8 Gene✓
- 1.1.9 Incomplete dominance✓
- 1.1.10 Heterozygous✓
- 1.1.11 Alleles✓
- 1.1.12 Genetic engineering✓/genetic modification/Biotechnology
- 1.1.13 Codominance✓
- 1.1.14 Homozygous✓
- 1.1.15 Monohybrid ✓

(15)

Question 2

- 2.1 **P₁/parent phenotype** No white forelock x White forelock ✓
genotype hh x Hh ✓
- Meiosis*
- G/gametes** h, h x H, h ✓
- Fertilisation*
- F₁ genotype** Hh, hh, Hh, hh ✓
Phenotype 2 x without 'white forelock' & 2 x 'with 'white forelock' ✓
- Parents and offspring✓/P₁ and F₁
 Meiosis and fertilisation✓

Gametes	H	h
h	Hh	hh
h	Hh	hh

1 mark for correct gametes
 1 mark for correct genotypes

Max (6)

Question 3

3.1

P₂	Phenotype	Grey male	x	Albino female✓
	Genotype	Gg	x	gg✓
<i>Meiosis</i>				
	G/gametes	G, g	x	g, g✓
<i>Fertilisation</i>				
F₂	Genotype	Gg;	Gg;	gg; gg ✓
	Phenotype	2 grey rabbits : 2 albino rabbits ✓		

Phenotypic ratio of offspring is *1 : 1✓

P₂ and F₂✓

Meiosis and fertilisation✓

***1 compulsory + any 6**

OR

P₂	Phenotype	Grey male	x	Albino female✓
	Genotype	Gg	x	gg✓
<i>Meiosis</i>				
<i>Fertilisation</i>				

Gametes	G	g
g	Gg	gg
g	Gg	gg

1 mark for correct gametes
1 mark for correct genotypes

F₂	Phenotype	2 grey rabbits : 2 albino rabbits ✓
----------------------	-----------	-------------------------------------

Phenotypic ratio of offspring is *1 : 1✓

P₂ and F₂✓

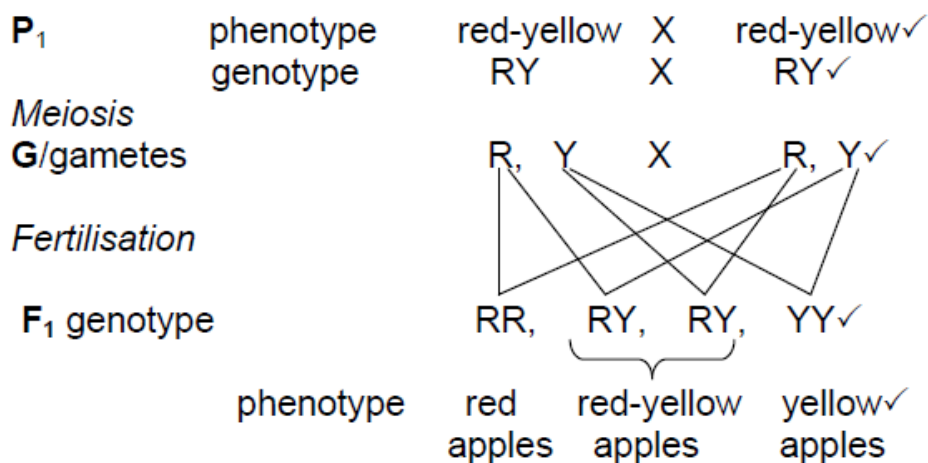
Meiosis and fertilisation✓

***1 compulsory + any 6**

(7)

Question 4

4.1



P₁ and F₁✓
 Meiosis and fertilisation✓

(Any 6)

OR

P₁ phenotype red-yellow X red-yellow✓
 genotype RY X RY✓

Meiosis

Fertilisation

Gametes	R	Y
R	RR	RY
Y	RY	YY

1 mark for correct gametes
 1 mark for correct genotypes

F₁ genotype RR, RY, RY, YY✓
 phenotype red red-yellow yellow✓
 apples apples apples

P₁ and F₁✓
 Meiosis and fertilisation✓

(Any 6) (6)

4.2

50%✓/half

(1)

4.3

A tree with red apples✓ should be crossed with a tree that produces yellow apples✓

(2)
 (9)

Question 5

- 5.1 (a) Genes✓/alleles (1)
(b) Monohybrid✓ (1)
- 5.2 Ovary✓ (1)
- 5.3 (a) 2✓/Two (1)
(b) 4✓/Four (1)
- 5.4 (a) Violet✓ (1)
(b) Short✓ (1)
- 5.5 2✓/Two (1)
(8)

Question 6

- 6.1 (a) 3✓ (1)
(b) 3✓ (1)
- 6.2 (a) Hearing✓/Normal (1)
(b) Hh✓ (1)
- 6.3 - Lyall inherited one recessive allele✓
- from each parent✓ (2)

6.4

P₁	Phenotype	Hearing	x	Deaf✓
	Genotype	HH	x	hh✓
<i>Meiosis</i>				
	G/gametes	H	H	x
				h
<i>Fertilisation</i>				h✓
F₁	Genotype	Hh	Hh	Hh
				Hh✓
	Phenotype	All hearing✓ 0% deaf✓*		

P₁ and F₁✓
Meiosis and fertilisation✓

***1 Compulsory mark + Any 6**

		OR		
P₁	Phenotype	Hearing	x	Deaf ✓
	Genotype	HH	x	hh ✓

Fertilisation

Gametes	H	h
H	HH	Hh
h	Hh	hh

1 mark for correct gametes
1 mark for correct genotypes

P₁ and F₁✓
Meiosis and fertilisation✓

(7)
(13)

Question 7

7.1

P₁ Phenotype Male x Female✓
 Genotype XY x XX✓

Meiosis

Fertilisation

Gametes	X	Y
X	XX	XY
X	XX	XY

1 mark for correct gametes
 1 mark for correct genotypes

F₁ Phenotype ***50% males✓ / 50% females**

P₁ and F₁✓
 Meiosis and fertilisation✓

***Compulsory 1 + Any 5**

OR

P₁ Phenotype Male x Female✓
 Genotype XY x XX✓

Meiosis

G/gametes

Fertilisation

F₁ Genotype

X, Y x X, X✓
 XX; XX; XY XY✓

Phenotype

***50% males✓ / 50% females**

P₁ and F₁✓
 Meiosis and fertilisation✓

***Compulsory 1 + Any 5 (6)**

Question 8

- 8.1 (a) Autosomes✓ (1)
(b) Gonosomes✓ /sex chromosomes (1)
- 8.2 Male✓ (1)
- 8.3 - There is a Y-chromosome✓/XY chromosomes
- at chromosome pair 23✓ (2)
- 8.4 One comes from the male parent✓ and the other comes from the female parent✓
- OR**
- One comes from the sperm✓ and the other comes from the ovum✓ (2)
(7)

Question 9

- 9.1 4✓ (1)
- 9.2 The allele for the trait is carried on the X-chromosome✓/
Y chromosome does not carry the allele for the trait.
Male only has one X chromosome✓
A male needs only one recessive allele✓ to be haemophiliac
Whereas for a female to be haemophiliac **both alleles must be**
recessive✓ any (3)
- 9.3 (a) $X^H X^h$ ✓✓ (2)
(b) $X^h Y$ ✓✓ (2)
- 9.4 25%✓✓ / $\frac{1}{4}$ **OR** 50% ✓✓ / $\frac{1}{2}$ (2)
- 9.5 To determine if the wife is a carrier✓
To determine the chances of having a child with haemophilia✓
Help them evaluate whether they would cope with such a child✓
Help them make an informed decision about whether to have children ✓ any (2)
(Mark first TWO only) (12)

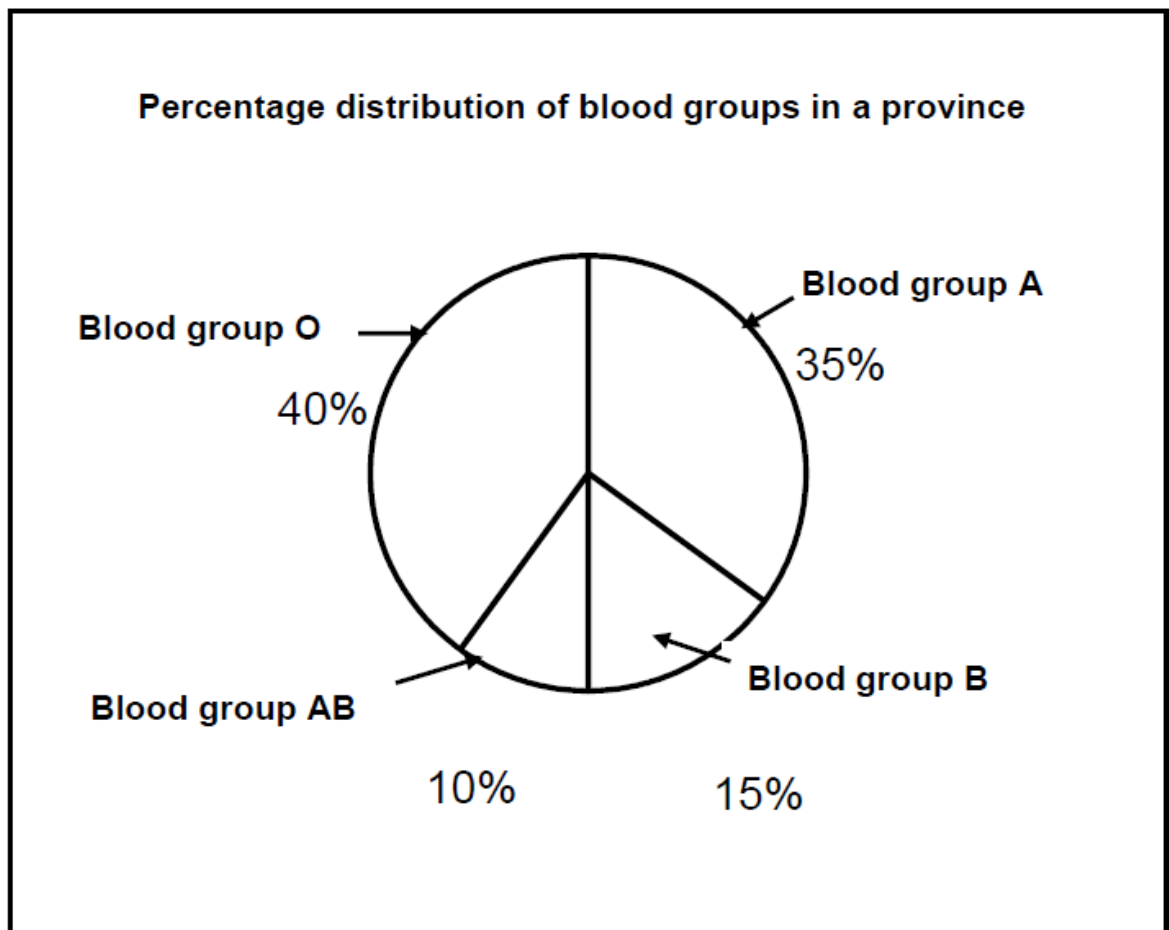
Question 10

- 10.1 (a) Female without SCID✓ (1)
(b) Male with SCID✓ (1)
(c) $X^D X^d$ ✓✓ (2)
- 10.2 – He inherited the recessive allele✓ / X^d (2)
– from the mother✓ / individual 4 (6)

Question 11

- 11.1 One✓ (1)
- 11.2 Blood groups are controlled by three alleles✓ / I^A , I^B , I which when in combination provide four phenotypes✓ / A, AB, B, O. (2)

11.3



$$\begin{aligned}\text{Blood group A: } & \frac{35}{100} \times \frac{360}{1} \\ & = 126^\circ\end{aligned}$$

$$\begin{aligned}\text{Blood group B: } & \frac{15}{100} \times \frac{360}{1} \\ & = 54^\circ\end{aligned}$$

$$\begin{aligned}\text{Blood group AB: } & \frac{10}{100} \times \frac{360}{1} \\ & = 36^\circ\end{aligned}$$

$$\begin{aligned}\text{Blood group O: } & \frac{40}{100} \times \frac{360}{1} \\ & = 144^\circ\end{aligned}$$

Rubric for the mark allocation of the calculations

Marks	Calculations
1	1–3 correct
2	4 correct

Rubric for the mark allocation of the pie chart

Caption	1
Correct proportion of slices	1: 1–2 correct 2: 3–4 correct
Label / key for each slice	1: 1 correct label 2: 2 correct label 3: 3–4 correct labels

(8)

NOTE: If the wrong type of illustration is drawn: marks will be lost for drawing the slices in correct proportions

(11)

Question 12

- 12.1 (a) O✓ (1)
- (b) AB✓ (1)

Question 13

- 13.1 (Blood group) A✓ (1)
- 13.2 $\frac{40}{100} \times \frac{5\,000\,000}{1}$ ✓
= 2 000 000✓/2 million (3)
- 13.3 - The alleles I^A and I^B ✓
- are equally dominant✓ (2)
- 13.4 - When phenotypes fit into separate or distinct categories✓
- with no intermediate phenotypes✓ (2)
- 13.5 (a) i✓ (1)
(b) Blood group O✓ (1)
(10)

Question 14

- 14.1 One✓/ 1 (1)
- 14.2 Mrs Thomas✓ (1)
- 14.3 - The child has the genotype ii✓/ is homozygous recessive and
- if both parents are heterozygous✓/ have the genotypes $I^A i$ or $I^B i$
- she inherits one recessive allele from each parent✓ (3)
(5)

Question 15

- 15.1 (a) $I^B I^B$ ✓ of $I^B i$ ✓ (2)
(b) ii✓ (1)
- 15.2 - The baby inherited one allele for type O blood/i from each parent✓ since
- her genotype is ii✓
- Mr Phonela does not have an allele for O blood/i✓ (3)
- 15.3 Blood type can be used to exclude a particular man✓ as the parent
but it cannot confirm that a particular man is the father✓
Since a large portion of the population have the same blood type✓
(Any 2) (2)

15.4

- Normal females have two X✓ chromosomes
- Normal males have one X and one Y✓
- The female always provides X in the egg✓
- If an egg cell is fertilized by an X bearing sperm✓ a female/girl✓ is formed
- If an egg is fertilized by a Y bearing sperm✓ a male/boy✓ is formed

(Any 5)

OR

Gametes		male gamete✓	
		X	Y
female gamete✓	X	XX✓	XY✓

2 XX : 2 XY

Female ✓ Male✓

(Any 5)

(5)

(13)**Question 16**

16.1 Dihybrid✓ cross

(1)

16.2 (a) Red✓

(1)

(b) Short✓

(1)

(c) Red✓ and Tall✓

(2)

(d) ffhh✓✓

(2)

16.3

- When two organisms with pure breeding✓
- contrasting traits✓ are crossed
- all the individuals of the F₁ generation will display the dominant trait✓

OR

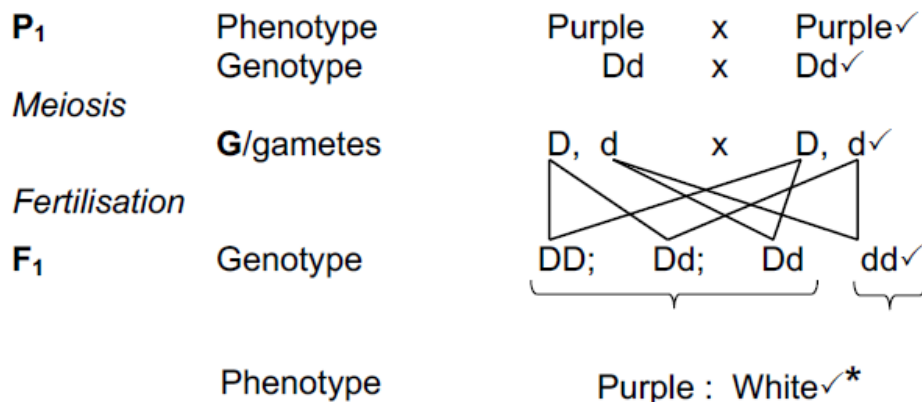
- If an organism is heterozygous✓
- the dominant allele✓
- will determine the phenotype✓

(3)

(10)

Question 17

- 17.1 Purple✓ (1)
- 17.2 – When purple-flowering plants and white-flowering plants are crossed ✓
 – all the offspring have purple flowers✓ /have no white flowers (2)
- 17.3 – The two alleles for a characteristic✓
 – separate during meiosis✓ so that
 – each gamete contains only one allele✓ for that characteristic (3)



P₁ and F₁✓
 Meiosis and fertilisation✓

*Compulsory 1 + Any 5

OR

- 17.4 **P₁** Phenotype Purple x Purple✓
 Genotype Dd x Dd✓

Meiosis

Fertilisation

Gametes	D	d
D	DD	Dd
d	Dd	dd

1 mark for correct gametes
 1 mark for correct genotypes

F₁ Phenotype Purple: White✓*
 P₁ and F₁✓
 Meiosis and fertilisation✓

*Compulsory 1 + Any 5

(6)
 (12)

Question 18

- 18.1 Dihybrid✓ cross (1)
- 18.2 (a) Black✓ (1)
(b) Black without white patches✓ (1)
(c) Grey with white patches✓ (1)
- 18.3 - They can be homozygous dominant for coat colour✓/have the genotype BBtt
- or heterozygous for coat colour✓/have the genotype Bbtt (2)
- 18.4 - Alleles of a gene for one characteristic segregate independently✓
- of the alleles of a gene for another characteristic✓
- The alleles for each gene will therefore come together randomly✓ during gamete formation (3)
(9)

Question 19

- 19.1 White✓ (1)
- 19.2 Genetic cross 2✓ (1)
(Mark first ONE only)
- 19.3 **Greater proportion of plants had white✓✓ corn/**
3 white : 1 yellow
- OR**
- Yellow appeared in offspring yet not in parents✓ showing that yellow is recessive✓/white is dominant (2)

19.4

P₁/parent phenotype white maize x white maize✓
 genotype Gg x Gg✓

Meiosis

G/gametes G, g x G, g✓

Fertilisation

F₁/offspring genotype GG, Gg, Gg & gg✓
 phenotype 3 white and 1 yellow maize✓

Generations: Parents/P₁ and offspring /F₁✓

Processes: Meiosis and fertilisation✓

any (6)

OR

P₁/parent phenotype white maize x white maize✓
 genotype Gg x Gg ✓

*Meiosis**Fertilisation*

gametes	G	g
G	GG	Gg
g	Gg	gg

1 mark for correct gametes✓
 1 mark for correct genotypes✓

F₁/offspring
 phenotype 3 white and 1 yellow maize✓

Generations: Parents/P₁ and offspring /F₁✓

Processes: Meiosis and fertilisation✓

any (6)
 (10)

Question 20

- 20.1
- Stem cells are undifferentiated✓
 - and have the potential to develop into any type of cell✓
 - to replace the nerve cells that are damaged✓
- (3)

- 20.2
- An embryo is a potential life✓/could develop into a baby
 - It poses moral or ethical issues✓

OR

- Umbilical cords are discarded✓
 - Do not pose a moral or ethical issue✓
- (2)
(5)

Question 21

- 21.1 (a) It allows for the production of organisms with desired characteristics✓ / high average milk yield (1)
(Mark first ONE only)
- 21.2 (b) – It reduces genetic variation✓ in offspring
– It results in no further genetic improvement✓
– It is expensive✓
– It may not be economical for commercial agriculture✓
(Mark first ONE only) Any (1)
- 21.3 LMJC 865 had a high average milk-production yield✓ / produced 78 litres per day/ had the desired characteristic (1)
- 21.4 – A diploid cell✓ / a cell with all the genetic information is needed
– An ovum is a haploid cell✓ / only contains half of the genetic information (2)
- The nucleus of an ovum is removed✓ and replaced with
– the nucleus of a somatic donor cell✓ / diploid donor cell
– The zygote is stimulated✓
– for mitosis✓ to occur
– The embryo is then placed into the uterus of an adult female✓

OR

- Plants may be cloned by vegetative reproduction✓ / asexual reproduction / tissue culture / grafting
– A plant with the desired characteristics is selected✓
– A vegetative part of the “parent” plant structure is removed✓ / (examples) and
– placed inside a growth medium✓ / (examples)
– and allowed to grow✓ Any 4 (4)
(9)

Question 22

- 22.1 (a) New equipment✓/research is expensive
Labour intensive✓
Many clinical trials✓ must be done/long time to produce a safe product any (2)
(Mark first TWO only)
- (b) May easily pollinate/mate with non-GM crops/animals✓
They might out-compete✓/destroy the naturally occurring organisms
Reduces gene pool✓/variation
May not be a suitable food source anymore✓ for other organisms
GMO may be poorly adapted to environment✓ any (2)
(Mark first TWO only)
- 22.2 Interfering with nature✓
Immoral/ we cannot play God✓
Violation of natural organism's intrinsic value✓
Unsure of long term effects✓
Potential health risk✓
Domination of world food production by only a few companies✓
(Mark first THREE only) any (3)
(7)

Question 23

- 23.1 (a) Cloning✓ (1)
- (b) Oogenesis✓/gametogenesis/ meiosis (1)
- 23.2
- The donor horse has the desired characteristics✓
 - that need to be copied✓
 - and be present in the offspring✓/next generation Any 2 (2)
- 23.3
- The nucleus contains all the genetic information✓✓/
hereditary characteristics/chromosomes of the champion horse (2)
- 23.4 (a) 64✓ (1)
- (b) 32✓ (1)
- (c) 64✓ (1)
- 23.5
- A gamete is generally haploid✓
 - This ovum is diploid✓ since
 - it has the nucleus of a somatic cell ✓ Any 2 (2)
- (11)**
[40]

Question 24

- 24.1
- The meat/egg chickens will grow faster/slower than the egg/meat chickens✓✓
- OR**
- There will be no difference in the rate of growth of the two types of chicken✓✓ (2)
- 24.2 The type✓/age of chicken. (1)
- 24.3 $\left[\frac{2500 - 500}{500} \times 100 \right] \checkmark = 400 \checkmark \%$ (2)
- 24.4 Increase✓ the reliability✓ (2)

- 24.5
- The same person must weigh the chicks✓ to get accurate results
 - The same scale✓ must be used to weigh the chicks
 - The chicks must be weighed at the same time of day✓
 - Same environmental conditions✓/example
 - Same type of food✓
 - The same amount of food✓
 - The same feeding time✓
 - Cages must be the same size✓
 - Chickens must be female✓
 - Age of the chickens✓
 - Same number of chickens in each sample group✓
 - **(Mark first THREE only)**
- Any 3 (3)
- 24.6
- The chickens that underwent selective breeding for meat production grow faster than chickens bred for egg laying✓✓
- OR**
- The chickens that underwent selective breeding for egg laying grow slower than chickens bred for meat production✓✓
- OR**
- The weight of the chickens increases with age✓✓/time
- (2)
- 24.7
- Products produced more quickly✓
 - Increased resistance to diseases✓
 - Improved quality of (chicken) products✓
 - Improved yield of (chicken) products✓
- Any 2 (2)
- 24.8
- The chickens are larger✓/heavier so they cannot run away from predators✓
 - The chickens are larger✓ and is more visible to predators✓
 - Decreased variation✓ therefore more susceptible to diseases✓
 - **(Mark first ONE only)**
- Any 1 x 2 (2)
(16)

Question 25

25.1 (a) Colour blind male✓/male with Daltonism (1)

(b) $X^D X^d$ ✓ (1)

25.2 - Linda inherited one recessive allele/ X^d from her father✓
 - and one recessive allele/ X^d from her mother✓ (2)

25.3 - Males only have one X-chromosome✓
 - If this chromosome carries the recessive allele✓/ X^d
 - the male will be colour blind✓
 - Females have 2 X-chromosomes✓
 - They need to have two recessive alleles✓/ $X^d X^d$ to be affected
 - A dominant allele on the other X-chromosome will mask the effect✓
 Any 4 (4)

25.4

P₁	Phenotype	Normal female	x	Normal male ✓
	Genotype	$X^D X^d$	x	$X^D Y$ ✓
<i>Meiosis</i>				
	G/gametes	X^D, X^d	x	X^D, Y ✓
<i>Fertilisation</i>				
F₁	Genotype			
	Phenotype	Normal females, } Normal male, } ✓ * Colour blind male }		
P ₁ and F ₁ ✓				
Meiosis and fertilisation✓				

P₁	Phenotype	Normal female	X	Normal male ✓
	Genotype	X ^D X ^d	X	X ^D Y ✓

Gametes	X^D	Y
X^D	$X^D X^D$	$X^D Y$
X^d	$X^D X^d$	$X^d Y$

1 mark for correct gametes✓

1 mark for correct genotypes✓ *

P₁ and F₁✓
Meiosis and fertilisation✓

***Compulsory 2 + Any 4 (6)**
(14)
[40]

26.1

any (7)

OR

P₁/parent phenotype tortoise-shell female x orange male ✓
genotype X^BX^O x X^OY ✓

✓ { Meiosis
Fertilisation

gametes	X ^B	X ^O
X ^O	X ^B X ^O	X ^O X ^O
Y	X ^B Y	X ^O Y

1 mark for correct gametes ✓
1 mark for correct genotypes ✓

F₁/offspring
phenotype: 1 tortoise-shell female, 1 black male,
1 orange female and 1 orange male ✓✓
(1 mark for gender and 1 mark for fur colour with
correct proportion)

any (7)

26.2 The allele for the trait is carried on the X-chromosome✓ only/
Y-chromosome does not carry the allele for the trait
The trait only shows when it is in the heterozygous✓ condition

(2)

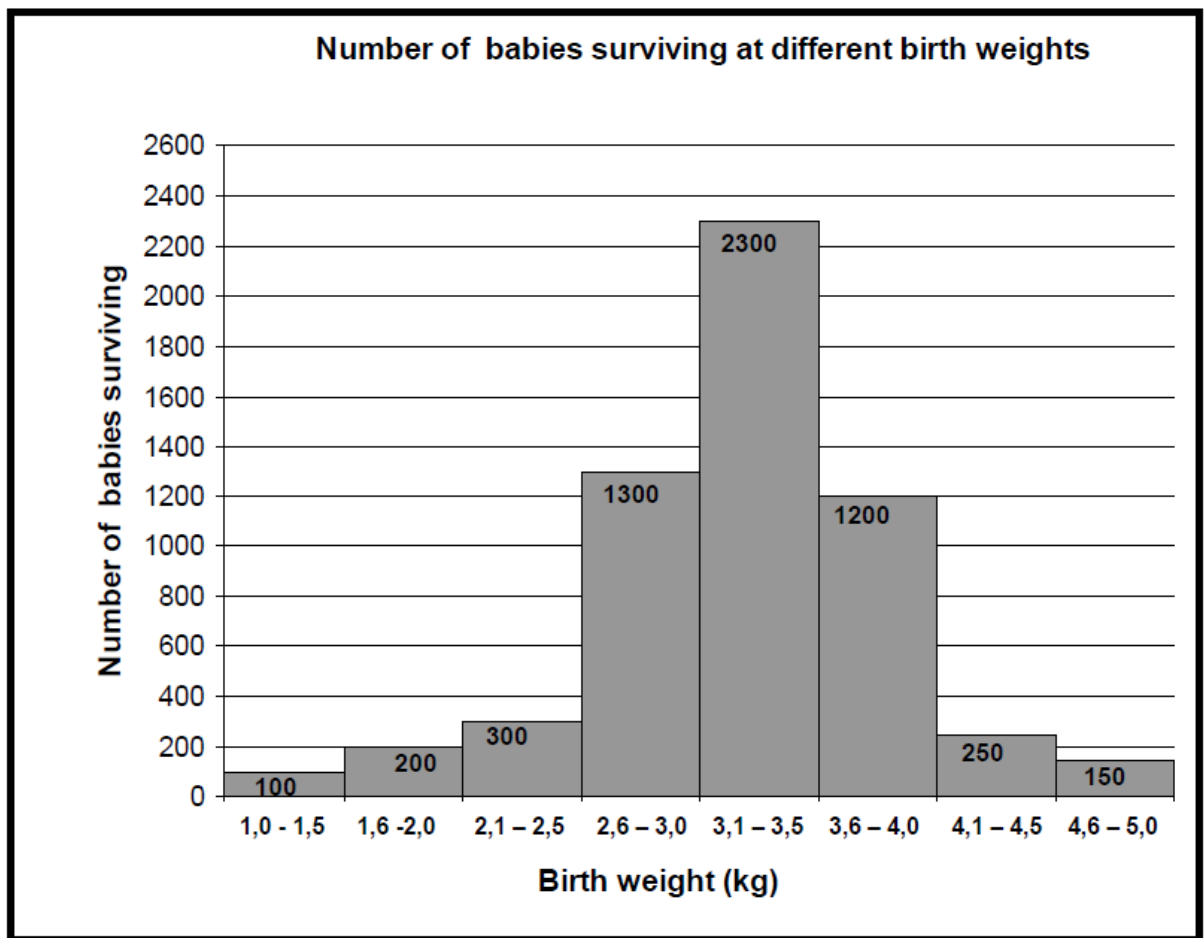
26.3 - Both alleles are dominant✓/co-dominant
- Both colours are equally expressed✓ in the phenotype

(2)

(11)

Question 27

27.1



Checklist for the mark allocation of the graph

Correct type of graph (histogram)	1
Title of graph	1
Correct label for X-axis (including unit) and Y-axis	1
Appropriate scale for X-axis and width of the bars	1
Appropriate scale for Y-axis	1
Plotting of bars	1 – 1 to 7 bars plotted correctly 2 – all 8 bars plotted correctly

27.2 Polygenic ✓ inheritance (1)

27.3 Polygenic inheritance: Genes are found at different/multiple loci ✓
One gene inheritance: Gene found at one locus ✓

OR

Polygenic inheritance: Has a range of intermediate phenotypes ✓
for the trait/continuous variation

One gene inheritance: Has distinct phenotypes ✓ for a trait/
discontinuous variation

(2)
(10)

NERVOUS CO-ORDINATION

Question 1

- 1.1 (a) Medulla oblongata✓
 (b) Corpus callosum✓
 (c) Cerebellum✓
- 1.2 - Controls all voluntary activities✓/example
 - It contains centres that receives and interprets all the sensations✓/example
 - It is the seat of higher mental functions✓/example
 - Influences emotional behaviour✓/ example (Any 3)

(MARK FIRST THREE)

Question 2

- 2.1 B✓ - Cerebrum✓ (2)
- 2.2 D✓ - Cerebellum✓ (2)
- 2.3 A✓ - Pituitary gland✓/Hypophysis (2)
- 2.4 C✓ - Corpus callosum✓ (2)
- 2.5 E✓ - Spinal cord✓ (2)
- (10)**

Question 3

- 3.1 Motor✓ neuron (1)
- 3.2 - Transmits impulse away from the cell body✓
 - Carries impulse to effector✓
(Mark first ONE only) Any (1)
- 3.3 - Insulates the neuron✓
 - causing it to conduct impulse faster✓/prevent a short circuit (2)
- 3.4 - Nerve impulse will not be carried to the effector✓/muscle/gland
 - therefore there will not be a response to the particular stimulus✓ (2)
- (6)**

Question 4

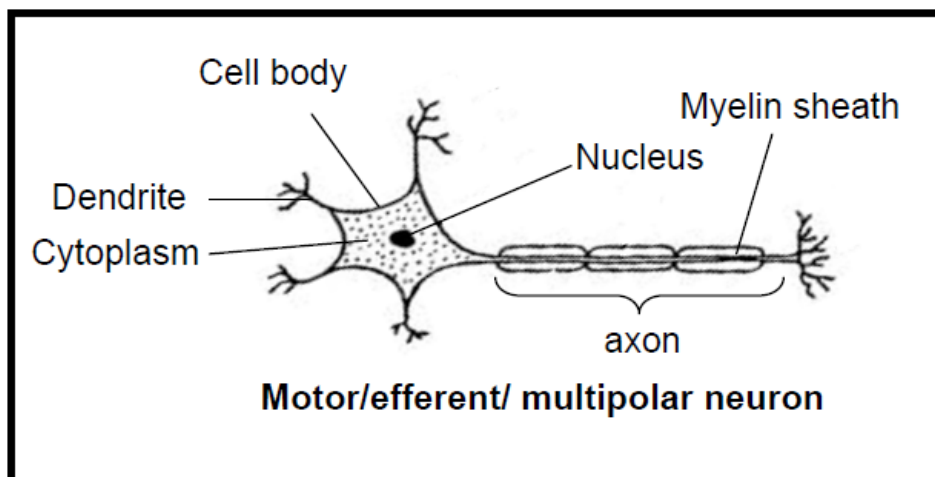
- | | | |
|-------|-------------------------------|-----|
| 4.1.1 | Motor✓ neuron | (1) |
| 4.1.2 | (a) Nucleus✓/nuclear membrane | (1) |
| | (b) Cytoplasm✓ | (1) |
| | (c) Dendrite✓ | (1) |
| 4.1.3 | (a) C✓ - Axon✓ | (2) |
| | (b) D✓ - Myelin sheath✓ | (2) |
| 4.1.4 | Multiple sclerosis✓ | (1) |

Question 5

- | | | |
|-----|---|-------------|
| 5.1 | Reflex arc✓ | (1) |
| 5.2 | (a) B - Motor✓ neuron/multipolar neuron/efferent neuron | (1) |
| | (b) C - Interneuron✓/connector neuron | (1) |
| | (c) E - Sensory✓ neuron/unipolar neuron/afferent neuron | (1) |
| 5.3 | (a) F✓ | (1) |
| | (b) A✓ | (1) |
| 5.4 | (a) D✓ - Synapse✓ | (2) |
| | (b) G✓ - Myelin sheath✓ | (2) |
| | | (10) |

Question 6

- 6.1 (a) C - Effector✓/muscle
 (b) D - Synapse✓
 (c) E - Spinal cord✓
 (d) F - Connector neuron✓/interneuron
 (e) G - Dorsal root✓/spinal nerve (5)
- 6.2 Impulse will not reach the CNS✓/the body will be unaware of the stimulus
 and no reflex action✓
 will occur, causing harm to the body✓
 Any (2)
- 6.3 Pulling your hand away from a hot object✓/blinking/coughing/sneezing//knee-jerk/ any appropriate stimulus and response/
 (swallowing/peristalsis/breathing/heartbeat/dilation and constriction of blood vessel/pupillary mechanism/ yawning/salivation)
 (Mark first TWO only) Any (2)



Mark allocation for diagram:

- Correct caption✓
 Correct type of neuron drawn✓
 Any 3 correct labels✓✓✓

(5)
(14)

Question 7

- | | | |
|-----|--------------------|------------|
| 7.1 | (a) E✓ | (1) |
| | (b) A✓ | (1) |
| | (c) C✓ | (1) |
| 7.2 | F✓ - motor neuron✓ | (2) |
| 7.3 | D to E✓ | (1) |
| | | (6) |

Question 8

- | | | |
|-----|--------------------------------------|------------|
| 8.1 | (a) D✓ Synapse✓ | (2) |
| | (b) C✓ Interneuron✓/Connector neuron | (2) |
| | (c) A✓ Dendrite✓ | (2) |
| | (a) E✓ | (1) |
| | (b) F✓ | (1) |
| | | (8) |

Question 9

- 9.1 A✓ (1)
- 9.2 The impulse does not travel to the brain✓/goes directly from receptor to effector via the spinal cord (1)
- 9.3
- Allows the person to respond rapidly✓
 - and without thinking✓/involuntarily
 - to a stimulus✓
 - to prevent damage to the body✓*
- 1* compulsory + any other 2 (3)
- 9.4 Nerve✓/spinal cord (1)
- 9.5
- It acts as an insulator✓
 - and therefore, speeds up the nerve impulse✓/prevents a short circuit
- (2)
- 9.6
- The person would be able to feel the stimulus✓
 - but would be unable to react✓
 - because the impulse would not be transmitted to the effector✓
- Any (2)
- 9.7
- The receptor receives the stimulus✓
 - and converts it into an impulse✓
 - which is transported by a sensory neuron✓ via the spinal cord
 - to the brain✓*/cerebrum
 - The brain/cerebrum interprets the impulse✓*
 - The brain/cerebrum sends an impulse to a motor neuron✓
 - which conducts the impulse to the effector✓
 - to bring about a response✓
- 2* compulsory + any other 4 (6)
(16)

Question 10

10.1	A✓ - Iris✓	(2)
10.2	C✓ - Choroid✓	(2)
10.3	E✓ - Optic nerve✓	(2)
10.4	D✓ - Fovea✓/yellow spot	(2)
10.5	B✓ - Cornea✓	(2)
		(10)

Question 11

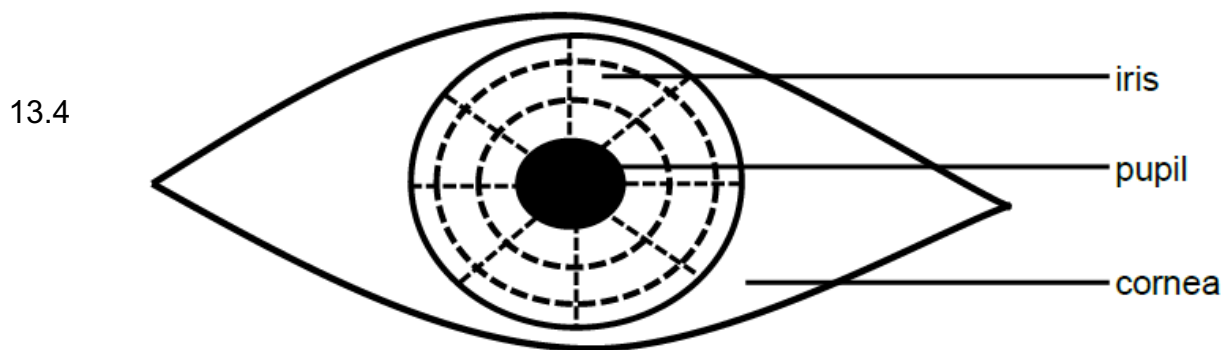
11.1	A – Ciliary✓muscle/(body) B – Iris✓ E – Choroid✓	(3)
11.2	(a) F✓ (b) D✓ (c) C✓ (d) A✓	(1) (1) (1) (1) (7)

Question 12

12.1	(a) A✓ - ciliary muscle✓ (b) C✓ - iris✓ (c) D✓ - cornea✓	(2) (2) (2)
12.2	Accommodation✓	(1)
12.3	Diagram 2✓	(1) (8)

Question 13

- 13.1 Iris✓/radial and circular muscles (1)
- 13.2 (20 – 30)✓s (1)
- 13.3
- Radial muscles contract✓
 - Circular muscles relax✓
 - Pupil increases in diameter✓
- (3)



Correct drawing of the front view of an eye✓
Pupil = 6 mm✓
Any 2 correct labels✓✓

(4)
(9)

Question 14

- 14.1 (a) 7✓ (1)
- (b) Diameter of the pupil is the largest✓, indicating dim light conditions✓/ allowing more light to enter (2)
- 14.2
- Since less light enters the eye
- the radial✓ muscles of the iris [contract]✓
 - the circular✓ muscles of the iris [relax]✓
 - causing the pupil to dilate✓/become wider/become bigger thus allowing more light to enter any (4)
- [] = only allocate mark if linked to correct muscle (7)

Question 15

- 15.1 (a) **A** - Refraction of light✓
- Focus light rays on the retina✓ (Any 1) (1)
(MARK FIRST ANSWER ONLY)
- (b) **C** - Converts light stimuli to impulses✓
- Forms images✓ (Any 1) (1)
(MARK FIRST ANSWER ONLY)
- 15.2 (a) - The pupil/part B can dilate more✓
- to allow more light to enter the eye✓ (2)
- 15.3 (b) - The retina/part C has more rods✓
- enabling them to see in dim light✓ (2)
- 15.4 - The radial muscles of the iris relax✓
- Circular muscle of the iris contract✓
- The pupil constricts✓
- and less light enters the eye✓ (4)
(10)

Question 16

- 16.1 2 – cornea✓
 3 – lens ✓
 4 – suspensory ligaments ✓
 5 – ciliary muscles✓/body (4)
- 16.2 Pupillary mechanism ✓/Pupil reflex (1)
- The radial muscles ✓ of the iris contracts ✓ and the circular
 muscles ✓ relax✓
 The pupil ✓ dilates and more light enters the eye✓ (Any 5) (5)
- 16.3 (a) Wear spectacles with convex ✓ lenses/use contact convex
 lenses/using lasers during surgery to reshape the cornea
- (b) Wear spectacles with lenses which are unevenly ground✓ to
 compensate for the uneven cornea/lens/surgery
- (c) Cataracts surgically✓ removed/lens replacement
- (d) Wear spectacles with concave ✓ lenses/use contact concave
 lenses/using lasers during surgery to reshape the cornea (4)
- (14)**

Question 17

- 17.1 (a) Curvature✓ of the lens of the eye (1)
(b) Distance✓ of the pencil from the eye (1)
- 17.2 Amount of light✓
Time✓ to focus on the pencil
Use the same pencil✓
Same eye✓
Mark first TWO only (Any TWO) (2)
- 17.3 -To increase the validity✓ of the procedure✓
-To get valid results✓ for the factor being tested✓
-To get results for the factor that is being tested✓ so the above factors
do not interfere with the factor being tested✓ (Any 1 x 2) (2)
- 17.4 The curvature of the lens of the eye decreases✓ as
the pencil moves further away✓ from the eye
Further than 150 cm no changes in the thickness✓ (3)
- 17.5 Ciliary muscles✓
Suspensory ligaments✓
Mark first TWO only (2)
(11)

Question 18

- 18.1 Have photoreceptors✓/rods and cones to convert light stimuli into impulses✓ (2)
- 18.2 The iris contains 2 sets of muscles✓
The radial muscles contract✓
and the circular muscles relax ✓
causing the pupil to dilate✓
allowing more light to enter the eye✓
to form a clear image✓ Any (5)
- 18.3 Number 3✓ (1)
- 18.4 The relative clarity of the image is the best ✓/has greatest number of cones for colour vision. (1)
- 18.5 Blind spot ✓ (1)
- (10)**

Question 19

- 19.1 (a) Transmits sound waves to the tympanic membrane✓/Secretes ear wax (1)
(Mark first ONE only)
- (b) Equalises pressure on either side of the tympanic membrane✓ (1)
(Mark first ONE only)
- (c) Releases pressure from the inner ear✓ (1)
(Mark first ONE only)
- 19.2 (a) C✓ (1)
- (b) D✓ (1)
- 19.3 - The receptors cannot convert the stimuli into impulses✓
- No impulses/fewer impulses are transmitted to the cerebrum✓
- and the person does not hear anything✓/hearing is impaired (3)
- 19.4 - The sound vibrations are transmitted from the large tympanic membrane✓
- to the smaller oval window✓
- through the ossicles✓
- which are arranged from largest to smallest✓
- This concentrates the vibrations✓, amplifying them Any (3)
- 19.5 - A change in speed/direction of movement✓
- stimulates the cristae✓
- The stimulus is converted to an impulse✓
- The impulse is transmitted to the cerebellum✓
- via the auditory nerve✓
- The cerebellum sends impulses to the muscles✓ to restore balance Any (4)
(15)

Question 20

- 20.1 (a) Round window✓ (1)
- (b) Cochlea✓ (1)
- Cristae✓ (1)
- 20.2 (a)
- Impulses from the cochlea cannot be transmitted to the brain✓
 - and therefore hearing will not occur✓ (2)
- 20.3 (b)
- Part A will not be able to vibrate✓
 - The round window will not absorb the sound waves✓ from the cochlea
 - and hearing will be affected✓ (Any 2) (2)
- (7)

Question 21

- 21.1 (a) Auditory nerve✓ (1)
- (b) Round window✓/Fenestra rotunda (1)
- 21.2 Cerebrum✓ (1)
- 21.3
- The cristae✓in the semi-circular canals
 - are stimulated by changes in speed and direction✓
 - when the endolymph moves✓
 - The cristae convert the stimuli to nerve impulses✓
 - The nerve impulses are transported along the auditory nerve✓
 - to the cerebellum✓to be interpreted
 - Impulses sent to muscles✓ to restore balance (Any 5) (5)
- 21.4
- The mucus will block the opening of the Eustachian tube✓
 - Air cannot enter or leave✓the middle ear
 - to equalise pressure✓/causing imbalance in pressure
- OR**
- Mucus may move through the Eustachian tube✓
 - causing pressure in the middle ear✓
 - pushing on the tympanic membrane✓/part E (3)
- 21.5
- The ossicles/structures at A will not be able to vibrate✓
 - and hence no vibrations will be passed to the inner ear✓/cochlea will not be stimulated/no amplification (2)
- (13)**

Question 22

As the ball moved towards the goalkeeper:

- Accommodation✓ took place
- Ciliary muscles contracted✓
- Suspensory ligaments became slack✓
- This reduced the tension on lens✓
- Lens became more convex✓/round
- Refractive power of the lens increased✓
- Image of the ball fell on the retina✓

Any (5)

Hearing

The shout of his team-mate was heard by the goal keeper as follows:

- The sound waves were directed by the pinna✓
- through the auditory canal✓
- to the tympanic membrane✓/eardrum
- causing it to vibrate✓
- The vibrations of the tympanic membrane were transferred to the ossicles✓ in the middle ear
- which eventually caused the oval window to vibrate✓
- This set up pressure waves in the cochlea✓
- This stimulated the Organ of Corti✓ in the cochlea
- to convert this stimulus into a nerve impulse✓
- which was then transmitted along the auditory nerve✓
- and interpreted in the cerebrum✓

Any (7)

Balance and equilibrium

As he dived:

- A change in the direction and speed✓ of the body
- causes the movement of fluid in the semicircular canals✓
- which stimulates the cristae✓
- A change in the position of the head✓
- stimulated the maculae✓ in the utricle and saccule
- The stimuli were converted into impulses✓
- which were transported along the auditory nerve✓
- and interpreted in the cerebellum✓
- which then sent impulses to the muscles✓
- to restore balance and equilibrium✓

Any (5)
Content (17)
Synthesis (3)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logical sequence	Comprehensive
All information provided is relevant to the topic	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay
Only information relating to accommodation, hearing and balance & equilibrium is included. (There is no irrelevant information)	Logical sequence of events in accommodation, hearing and balance & equilibrium.	Includes sufficient information on all 3 processes, i.e. accommodation(min 3/5), hearing(min 4/7) and balance & equilibrium(min 3/5)
1 mark	1 mark	1 mark

TOTAL SECTION C: 20

ENDOCRINE SYSTEM

Question 1

- 1.1 1 – pituitary ✓ gland
4 – adrenal ✓ gland (2)
- 1.2 (a) 3✓
(b) 1✓
(c) 2✓
(d) 4✓ (4)
- 1.3 They respond to internal and/or external stimuli✓
They protect organisms✓ (2)
(Mark first TWO only)
- 1.4 Hormones: Responses are slow processes✓/may affect multiple sites
Nerves: Responses are quick reactions✓/affect localised sites (2)
(10)

Question 2

- 2.1 Adrenalin✓ (1)
- 2.2 - Increases the heart rate✓
- Increases blood pressure✓
- Stimulates the conversion of glycogen into glucose✓
- Increases the blood supply to the heart✓/skeletal muscles
- Decreases blood flow to the digestive system✓
- Decreases blood flow to the skin✓
- Increases muscle tone✓
- Increases the rate/depth of breathing✓
- Increases the rate of respiration✓/metabolism
- Dilates/increases the diameter of the pupils✓
(Mark first THREE only) Any (3)
(4)

Question 3

- 3.1 (a) Pituitary✓/hypophysis (1)
(b) Thyroxin✓ (1)
- 3.2 Negative feedback✓ mechanism (1)
- 3.3 - Less hormone B✓ will be secreted
- More hormone A✓ will be secreted
(Mark first TWO only) (2)
(5)

Question 4

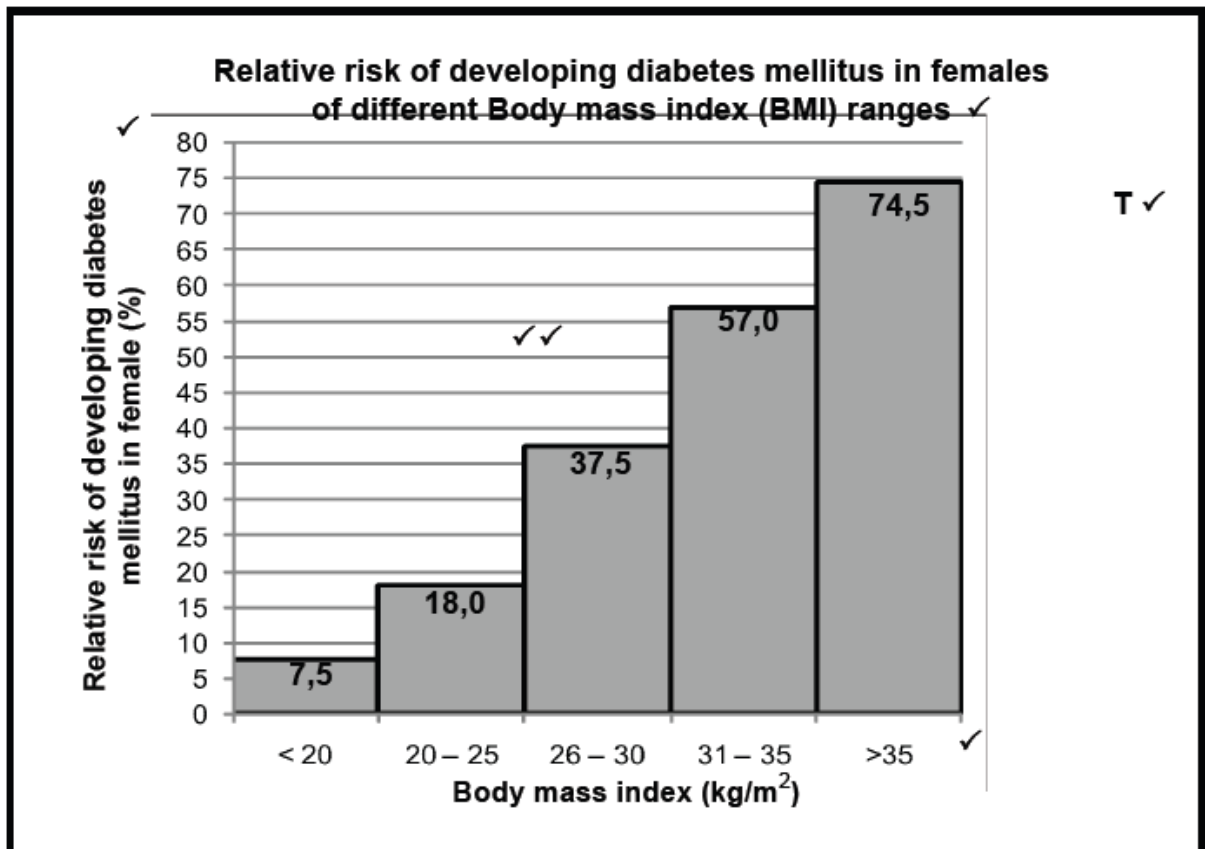
- 4.1 - Gland that secretes hormones✓
- directly into the blood✓/(rather than through ducts) (2)
- 4.2 (a) Insulin✓ (1)
(b) Glucagon✓ (1)
- 4.3 Pancreas✓/Islets of Langerhans (1)
- 4.4 - There will be NO conversion of glucose into glycogen✓
- in liver✓/muscles
- No absorption of glucose by cells✓
- The blood glucose levels will stay high✓
- and may lead to diabetes✓/any example of symptoms (Any 4) (4)
(9)

Question 5

- 5.1 - The blood glucagon levels increase✓/from 100 to 210 (picograms/ml)
 - from 0 to 20 min✓
 - and become constant✓thereafter (3)
- 5.2 - during exercise more energy is needed✓
 - therefore the rate of cellular respiration increased✓
 - Increased cellular respiration requires more glucose✓
 - hence more glucagon is secreted✓
 - to stimulate the conversion of glycogen to glucose✓ Any (3)
- 5.3 Decrease✓ (1)
- 5.4 - The lack of insulin✓/defective insulin
 - decreases the conversion✓
 - of glucose to glycogen✓ (3)
 (10)

Question 6

6.1



Check list for the mark allocation of the graph

Correct type of graph (T)	1
Title of graph	1
Correct label , appropriate scale for X-axis and width of the bars for X-axis (including unit)	1
Correct label and appropriate scale for Y-axis (including unit)	1
Plotting of bars	1–1 to 4 bars plotted correctly 2–all 5 bars plotted correctly

NOTE:

If the wrong type of graph is drawn:

- Marks will be lost for 'correct type of graph'

If axes are transposed:

- Marks will be lost for labelling of X-axis and Y-axis
- Marks will be lost for plotting of bars

6.2

(6)

6.3

Insulin✓

(1)

6.4

Pancreas✓

(1)

Glucagon✓

Adrenalin ✓

Thyroxin✓

(Mark first TWO only)

(in any order)

Any

(2)

(10)

Question 7

Hormones secreted by the pituitary gland

Growth Hormone✓/(GH)

- Stimulates the growth of the long bones✓/skeletal muscles.

Follicle Stimulating Hormone✓/FSH

- Stimulates follicle development ✓in the ovaries of females.

Luteinising Hormone✓(LH)

- Stimulates ovulation✓/formation of the corpus luteum in the ovaries

Thyroid Stimulating Hormone✓/TSH

- Regulates the growth of the thyroid gland✓/secretion of thyroxin

Prolactin✓

- Stimulates the production of milk✓ by the mammary glands

ADH✓

- Regulates the water content✓ in the blood

Any 4x2 (8)

Pituitary Control of Thyroid Function

- The pituitary is sensitive to the concentration of the hormone thyroxin✓ in the blood
- When the thyroxin concentration in the blood decreases✓ below a certain level
- the pituitary gland is stimulated to secrete more TSH✓
- TSH stimulates the thyroid gland✓
- to secrete more thyroxin✓
- thus increasing the level of thyroxin in the blood✓
- back to the normal level✓
- When the thyroxin concentration in the blood increases✓ above a certain level
- the pituitary gland secretes less TSH✓
- The lower TSH level means that the thyroid gland secrete less thyroxin✓
- This decreases the level of thyroxin in the blood✓
- back to the normal level✓

Max (9)

Content (17)
Synthesis (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Description	Marks
All information given is relevant to the hormones of the pituitary gland and negative feedback involving the thyroid gland	1
The different events in negative feedback are presented in the correct sequence	1
Provided sufficient information on the hormones and negative feedback	1

HOMEOSTASIS

Question 1

- | | | |
|-----|--------------------------------|------------|
| 1.1 | Pancreas✓ | (1) |
| 1.2 | Insulin✓ | (1) |
| 1.3 | Glucagon✓ | (1) |
| 1.4 | Diabetes✓ mellitus | (1) |
| 1.5 | Negative feedback✓/homeostasis | (1) |
| | | (5) |

Question 2

- Blood glucose levels rise above normal✓
 - The pancreas✓/islets of Langerhans
 - secrete insulin✓ into the blood
 - which travels to the liver✓/muscle cells
 - and stimulates the conversion of excess glucose into glycogen✓
 - which decreases the blood glucose levels✓ to normal
- Any **(5)**

Question 3

3.1

- | | | |
|-----|---|----------------|
| (a) | Volume of urine✓ | (1) |
| (b) | <ul style="list-style-type: none"> - Decide on a time✓/date/place to conduct the investigation - Decide on the apparatus✓/materials that need to be used - Decide how to record the data✓ - Advertise for volunteers to participate✓ - Decide on the number of participants to include✓ - Decide what factors to keep constant✓/example of factor to be kept constant | |
| | (Mark first TWO only) | Any (2) |
| (c) | <ul style="list-style-type: none"> - The same room✓/environment/ temperature - The same apparatus✓ - The same investigator✓ - No other liquid intake by both groups✓ - The same level of activity✓ | |
| | (Mark first TWO only) | Any (2) |
| (d) | <ul style="list-style-type: none"> - They used a large sample✓/12 men/6 men in each group - The average volume of urine produced was calculated✓ | |
| | (Mark first TWO only) | (2) |

- 3.2
- Alcohol inhibits/reduces the secretion of ADH✓
 - Less ADH in the blood causes the renal tubules✓/distal convoluted tubules and collecting ducts
 - to become less permeable to water✓
 - Less water is reabsorbed✓ back into the blood
 - A larger volume of urine is produced✓
- Any (4)
(11)

Question 4

4.1 0,50 ✓mol/ml (1)

- 4.2
- To establish a baseline✓/minimum CO₂ in the blood
 - To allow a comparison with results✓
- OR**
- Acts as a control✓
 - To determine if the results obtained are caused by the exercise✓/independent variable
- Any (1 x 2) (2)

- 4.3
- Body's metabolic rate increases✓
 - this means that the rate of cellular respiration increases✓
 - to produce more energy✓/ ATP
 - and therefore releases more CO₂
- Any (2)

- 4.4
- CO₂ levels in the blood increase above normal levels:
- Receptor cells in the carotid artery in the neck are stimulated✓
 - To send impulses to the medulla oblongata✓ in the brain
 - Medulla oblongata stimulates breathing muscles✓/(intercostal muscles and diaphragm)
 - and heart✓
 - Breathing muscles contract more actively✓
 - increasing the rate of breathing✓
 - and depth of breathing✓
 - The heart beats faster✓
 - More CO₂ is taken to and exhaled from the lungs✓
- Any (6)
(11)

Question 5

- 5.1 Constricted✓ (1)
- 5.2
- Less blood flows✓ to the skin
 - so less heat is lost to the environment✓ by radiation
 - Less sweat is formed✓ because less blood flows to the sweat glands
 - therefore less evaporation✓ of sweat
 - and hence less cooling✓ of the skin
 - Body heat is conserved✓
- Any (4)
- 5.3
- Hypothalamus is stimulated✓
 - sends message to the blood vessels of the skin to dilate✓ / vasodilation occurs
 - More blood flows✓ to the surface of the skin
 - More heat is lost by radiation✓ from the skin surface
 - More sweat is formed✓ because more blood flows to the sweat glands
 - and therefore more heat is lost by increased evaporation✓ of sweat
- Any (4)
(9)

Question 6

Increasing the metabolic rate

- To increase the metabolic rate the level of thyroxine must increase✓
- The pituitary gland is stimulated✓
- to secrete more TSH✓
- which stimulates the thyroid gland✓
- to secrete more thyroxine✓

(Any 4) (4)

Increasing the level of glucose

- As a result of the decrease in glucose level the pancreas is stimulated✓
- to secrete glucagon✓
- which stimulates the conversion of stored glycogen to glucose✓
- in the liver✓/muscles
- The glucose is then released into the bloodstream✓
- The glucose level in the blood increases✓ and returns to normal

(Any 5) (5)

Decreasing the level of CO₂

- High CO₂ levels stimulate the receptor cells in the carotid artery✓
- The stimulus is converted to an impulse✓
- and sent to the medulla oblongata✓
- which stimulates the heart✓
- to beat faster✓
- bringing blood with CO₂ quickly to the lungs ✓
- It also stimulates the breathing muscles✓
- to increase the depth and rate of breathing✓
- CO₂ is exhaled quickly from the lungs✓
- The CO₂ level in the blood decreases✓ and returns to normal

(Any 8) (8)

Content: (17)

Synthesis: (3)

(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Relevance	Logical sequence	Comprehensive
All information provided is relevant to the question	Ideas arranged in a logical/ cause-effect sequence	Answered all aspects required by the essay in sufficient detail
All the information provided is relevant to the: - Mechanism to increase metabolic rate - Mechanism to increase glucose level - Mechanism to decrease CO₂ level	All the information regarding the: - Mechanism to increase metabolic rate - Mechanism to increase glucose level - Mechanism to decrease CO₂ level is arranged in a logical manner.	At least the following points should be included: - Mechanism to increase metabolic rate (3/4) - Mechanism to increase glucose level (3/5) - Mechanism to decrease CO₂ level (5/8)
There is no irrelevant information.		
1 mark	1 mark	1 mark

PLANT HORMONES

Question 1

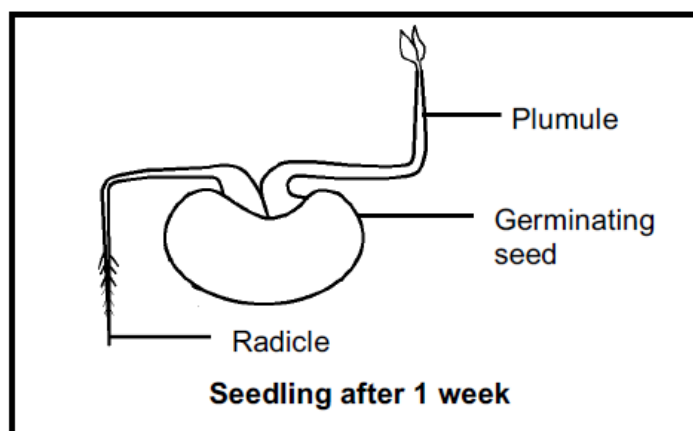
- 1.1 Auxins✓ (1)
- 1.2 (a) Light✓ (1)
- 1.3 (b) Gravity✓ (1)
- 1.4 Plant structure **B** has bent towards the light✓/towards **A**/positively phototropic (1)
- Auxins accumulated on the lower side✓ of the root
 - The high concentration of auxins on the lower side of the root inhibits growth✓
 - The lower concentration of auxins on the upper side stimulates growth✓
 - causing uneven growth✓/the root to bend downwards/positive geotropism
- Any (3)
(7)

Question 2

The diagram below represents a germinating seed. Assume that the radicle and plumule were exposed to uniform light from all directions.

- 2.1 - The growth of a plant✓/part of a plant
- in response to a stimulus✓ (2)

2.2



Checklist for marking the diagram:

Caption	(1)
Correct drawing:	
Radicle growing downwards	(1)
Plumule growing upwards	(1)
ONE correct label: Plumule/radicle/germinating seed	(1)
Total	(4)

(4)
(6)

2.3	2.3.1	Tip of the stem✓/tip of root/apical meristem/terminal bud/apical bud	(1)
	2.3.2	- The stem grows✓✓/bends - towards the light✓✓	(4) (5)

Question 3

3.1	Phototropism✓	(1)
3.2	Light✓/Sunlight/Radiant energy	(1)
3.3	Auxins✓/ IAA/ Indole acetic acid	(1)
3.4	Inhibit ✓	(1)
3.5	Apical dominance✓	(1) (5)

Question 4

- 4.1 Geotropism✓/gravitropism (1)
- 4.2
- Auxins✓
 - accumulate at the lower✓ part of the stem
 - because of gravity✓
 - The higher concentration of auxins at the lower part of the stem stimulates cell elongation✓/growth on the lower side of the stem
 - The lower concentration of auxins at the upper part of the stem inhibits cell elongation✓/growth on the upper side of the stem
- (Any 4) (4)
- 4.3
- The leaves and stem will be carried in such a way that they receive maximum sunlight✓
 - for photosynthesis✓
- OR**
- 4.4
- Exposes the flowers more favourably✓
 - for pollination✓/seed dispersal
- (2)
- The roots will grow downwards✓/towards gravity (1)
- (8)**

Question 5

- 5.1 To ensure unilateral light✓/the plant receives light from one direction only (1)
- 5.2 Auxins✓/IAA/indole acetic acid (1)
- 5.3 Differences between plants A and B after two weeks
- T✓
- | Plant A | Plant B |
|--|---|
| The stem of the plant will bend towards the light✓ | The stem of the plant will remain straight✓/will not bend towards the light |
| Does not have lateral branches✓/only lower lateral branches will start to grow | All the lateral branches will grow✓along the whole stem |
| The plant will be taller✓ | The plant will be shorter✓ |
- (Mark first TWO only) 1 table (T) + (2 x 2) (5)
- 5.4
- The gibberellins cause the stem/plant to grow longer✓/taller
 - because gibberellins stimulate the elongation/growth of the internodes✓
- (2)
- (9)**

Question 6

- 6.1 (a) A and B✓ (1)
- (b) A and C✓ (1)
- 6.2 - To ensure that the results are attributed to gravity✓
- and not light✓/ to eliminate the effect of light (2)
- 6.3 B – No growth will be observed✓
C – Roots will grow **horizontally**✓/not change direction (2)
- 6.4 - Auxins will move to the lower side of the root✓/attracted by gravity
- and a high concentration will inhibit growth on the lower side of the roots✓
- while growth will occur faster on the upper side of the root✓
- causing the root to bend downwards✓ Any (3)
- 6.5 - Used same type of plant✓/pea only
- Seedlings were the same age✓/germination period was 7 days
- All groups were exposed to the same environment✓/light intensity/ placed in dark cupboard
- Same number of seedlings for each group✓
- Root tips were cut at the same length✓
- All seedlings placed in same position✓/horizontally
- Allowed same amount of time for the 3 groups✓
- Appropriate controls were set up✓ Any (3)
- (Mark first THREE only)** (12)

Question 7

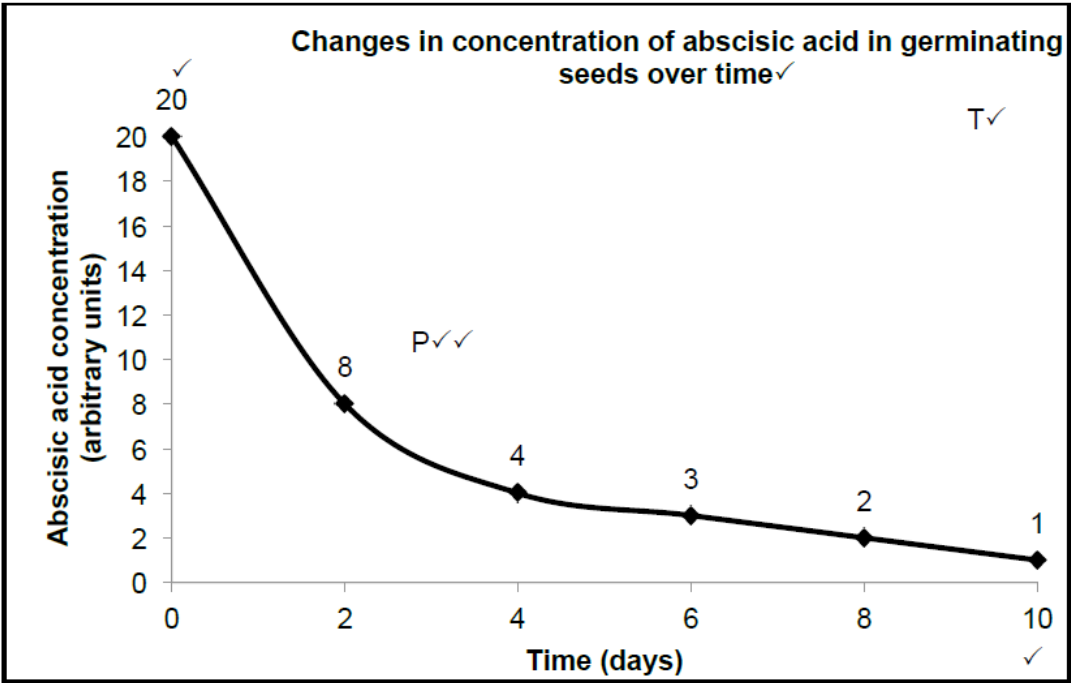
- 7.1 Treatment✓ of plant shoot (1)
- 7.2
- Same type of plant✓
 - Placed in the same environment✓
 - Same amount of time✓
 - Tip removed at the same length✓
 - Same concentration of auxins✓
 - Same type of agar✓
- (Mark first TWO only) Any (2)
- 7.3
- (a) - Shoot B would show upward growth✓
- Auxins in the agar gel diffused downwards✓ into the shoot
 - leading to cell elongation✓ (3)
- (b) - No growth in shoot C✓
- Shoot tip contains NO auxins✓ (2)
- 7.4
- Repeat the investigation✓
 - Use more than 1 plant per investigation✓/increase sample size
- (Mark first TWO only) Any (2)
(10)

Question 8

- 8.1
- To allow time for the auxins from the tip✓
 - to diffuse into the agar jelly✓ (2)
- 8.2
- Auxins from the agar jelly✓
 - diffused into the shoot/coleoptile on one side/the left side only✓
 - The cells on this side were stimulated to grow✓/elongate
 - The cells on the other side/right side did not receive auxins✓
 - and grew more slowly✓
 - This uneven growth✓ caused the stem to bend to the right
- Any (4)
- 8.3
- Remove the agar jelly completely✓/use agar jelly/substance that does not contain auxins
 - and place a black box✓ around the tip of the coleoptile (2)
- (8)

Question 9

9.1



Mark allocation of the graph

Criteria	Mark Allocation
Correct type of graph including the joining of points	1
Title of graph	1
Correct scale, label and unit for X-axis	1
Correct scale, label and unit for Y-axis	1
Drawing of the graph	0: No points plotted correctly 1: 1 to 5 points plotted correctly 2: All 6 points plotted correctly

NOTE:
If the wrong type of graph is drawn: Marks will be lost for "correct type of graph".
If axes are transposed: Marks will be lost only for labelling of X-axis and Y-axis. (6)

- 9.2
- (a) Decreased✓

(b) Increased✓
- (1)

(1)

(8)

- 9.3
- Auxins✓

- are sensitive to light✓

- Light stimulus from one side causes auxins to move to the shaded side✓/destroyed on the illuminated side

- Auxin concentration is higher on the shaded side✓

- This promotes cell elongation✓ on shaded side of plant

- resulting in more growth✓ on this side

- Stem grows towards the light stimulus ✓

- This is called phototropism✓
- (Any 4)

(4)

Question 10

- 10.1 To act as a control✓
allowing us to reason that any difference in starch content✓
was due to the action of the hormones ✓ Any (2)
- 10.2 (a) Stimulates✓ the accumulation of starch in cells✓ (2)
(b) Does not promote✓ the accumulation of starch in cells✓ (2)
(6)

Question 11

- 11.1 (a) Auxin concentration✓ (1)
(b) Plumule growth✓ (1)
- 11.2 For measurement of the plumule length✓ (1)
- 11.3 - To simulate the same conditions✓ under which germination
takes place for the normal growth✓ of the seedlings
- To expose the seedlings to uniform light✓
so that no other variable is introduced/to ensure validity/ to
allow upward growth of the plumule for easy measuring✓/
(MARK FIRST ONE ONLY) (Any 1 x 2) (2)
- 11.4 - They used seven seedlings in each group✓/35 seeds in total/a
large sample
- They calculated the average✓ increase in plumule length
(MARK FIRST ONE ONLY) (Any 1) (1)
- 11.5 - Same species of beans✓
- Seedlings of the same age✓
- Seedlings of the same size✓
- Same temperature✓
- The same investigator✓
- Identical apparatus (beakers/petri-dishes/graph
paper/grid/volume of solution) ✓ (Any 3) (3)
(MARK FIRST THREE ONLY)
- 11.6 An increase in auxin concentration up to an optimum stimulates
the growth rate of the plumule/stem. With further increase in auxin
concentration there is an inhibition of plumule/stem growth ✓✓ (2)
(11)

Question 12

- | | | | |
|------|---|-------------|-----|
| 12.1 | Apical tips✓/stem tips/root tips
(Mark first ONE only) | | (1) |
| 12.2 | Promotes cell elongation✓
(Mark first ONE only) | | (1) |
| 12.3 | - Only kills part of a plant✓
leaving the chance of the roots to grow again✓ | | |
| 12.4 | - Poisonous✓
can be harmful to other organisms✓
(Mark first TWO only) | Any (2 x 2) | (4) |
| | - It could kill the beans as well✓
thus reducing the yield of the crop✓ | | (2) |
| | | | (8) |

Question 13

Plant stems response to unilateral light

- Plant stems response to light is positively phototropic✓
- Auxins✓
- produced in the tip of the stem✓
- move away from unilateral light✓
- so that there is a high concentration of auxins on the darker side✓
- which stimulates growth✓/cell division/cell elongation
- The low concentration of auxins on the side exposed to light✓
- inhibits growth✓
- This uneven growth✓
- causes the stem to bend towards the light✓

Max 7

How humans receive and interpret light stimuli

- Light enters the eye ✓
- through the cornea✓
- which refracts the light✓
- It then passes through the aqueous humour✓
- and the pupil✓
- The size of the pupil is adjusted by the iris✓
- to regulate the amount of light that enters the eye✓
- The light then passes through the lens✓
- which also refracts the light✓
- It then passes through the vitreous humour✓
- and reaches the retina✓
- which has the photoreceptors✓/rods and cones which convert the light stimulus into a nerve impulse

Max 10 (10)

Content: (17)

Synthesis: (3)
(20)

EVOLUTION

Question 1

1.1

Lamarckism	Darwinism
1 Variation of the offspring occurs when individuals in the population change. ✓	1 Variation in the offspring is inherited. ✓
2 Change occurs because of adaptation to the environment/ Law of use and disuse. ✓	2 Natural selection – individuals best suited to the environment survive. ✓
3 Individuals in the population change. ✓	3 The population as a whole changes. ✓
4 Acquired characteristics are inherited by offspring. ✓	4 Characteristic are passed on from generation to generation to enable individuals to survive in the environment. ✓

(Mark first THREE only)

(Any (3 x 2) + 1 for table)

(7)

Question 2

2.1

- There was variation ✓ with regard to the feet within the ancestral duck populations
- Some ancestral ducks had skin ✓ attached between the toes
- As food became scarce ✓ / environment changed
- Competition for food increased ✓
- Those ducks which had skin attached between their toes ✓ / desired characteristic could swim better
- To secure food and survived ✓
- Those ducks that did not have skin attached between their toes were unable to swim well ✓
- Did not secure food and died ✓
- Through natural selection entire populations ✓ of ducks with webbed feet evolved

any (7)

Question 3

- 3.1
- The population will split up into two groups✓
 - and each group adapts to the new environmental factors✓/ develops separately/each group undergoes natural selection independently
 - each group may become genotypically✓
 - and phenotypically different✓
 - which might prevent them from interbreeding✓/become reproductively isolated leading to the formation of a new species
- (5)

Question 4

- 4.1 Long roots✓ (1)
- 4.2 Natural selection✓/survival of the fittest (1)
- 4.3
- There is variation✓ in the length of roots among the cacti plants
 - The cacti with the long roots have the desirable characteristic✓/are better adapted/ long roots absorb water from deep underground
 - for surviving under dry/unfavourable conditions✓
 - more of the cacti with long roots survive✓
 - most of the cacti with the short roots die✓
 - most of the offspring produced have long roots ✓
- any (5)

Question 5

- 5.1 Natural selection✓ (1)
- 5.2
- (In A)
- There is variation✓ in the appearance of the mice
- There were equal numbers✓ of white and black mice
- (In B)
- The predator/bird catches the black mice✓
- The white mice are camouflaged✓/black mice are more visible
- Reducing the number✓ of black mice
- (In C)
- The population of the white mice remains the same✓but the number of black mice has been **further** reduced✓/ more white mice survived
- The above statements do not have to be categorized into A, B and C***
- any (5)
- 5.3 White ✓ (1)
- (7)

Question 6

- 6.1 Speciation✓ (1)
- 6.2
- In diagram 1 the rabbits were able to interbreed✓/genes can flow freely in the population
 - In diagram 2 the two populations were separated by the river✓/geographic barrier
 - The two populations cannot interbreed✓/no gene flow
 - Within each of the two separated populations there was variation✓
 - Each group underwent natural selection✓independently✓ as a result of varying environmental conditions✓
 - Each group becomes genotypically✓ and phenotypically✓ different
 - In diagram 3 the geographic separation no longer exist✓
 - but the two populations do not interbreed✓/no gene flow even though they can mix
 - because of the presence of reproductive isolating mechanism✓
 - They are now 2 different species✓ any (5)
- (6)

Question 7

- 7.1 $1,6 \text{ m} / 0,4 \text{ m} \checkmark$ OR $0,4 \text{ m} \times 4 = 1,6 \text{ m} \checkmark$
 $= 4 \checkmark \checkmark$: 4 times✓✓
- OR
- $35 \text{ mm} / 25 \text{ mm} \checkmark = 1,4 \text{ times} \checkmark \checkmark$ (due to translation error) (3)
- 7.2
- Over time the number of toes appeared to decrease in number✓/ digits are now fused
 - but increased in size✓/elongated (2)
- 7.3
- The taller body✓/legs of the modern horse enables it to look over grasses and have a wider view✓
 - The single/fused toe✓of the modern horse enables it to run faster✓ over open ground
- (Mark FIRST answer only in learner's script) (any 1 x 2) (2)
- (7)

Question 8

- 8.1 - It is characterised by long periods of little or no change✓
- alternating with short periods of rapid change✓
- during which new species may form✓ (3)
- 8.2 They contain toxins✓ which kill the snakes
OR
Too large✓ to be swallowed Any 1 (1)
- 8.3 - Having a smaller jaw✓
- means cane toads cannot be consumed✓
- thereby protecting the snakes from ingesting the toxins✓ (3)
- 8.4 - Since the snakes' jaws were used less ✓/not used
- the snakes developed smaller jaws✓
- This characteristic (of a smaller jaw) was inherited by the offspring✓
- Over many generations the jaw of the snake became smaller✓ (4)
(11)

Question 9

Lamarckism

- The ancestral elephant stretched its proboscis✓
 - to get leaves✓ in trees/further from the body
 - The more it used the proboscis✓,
 - the longer it became✓
 - The offspring then inherited the acquired longer proboscis ✓
 - Over many generations the length of the proboscis increased✓
 - until it became a trunk✓ as in the modern elephant
- Any 5 (5)

Darwinism

- There was a great deal of genetic variation✓ amongst the offspring
 - Some had long proboscis✓
 - and some had short proboscis✓
 - There was a change in environmental conditions✓/competition amongst the animals for food
 - They had to reach higher in the trees to get leaves✓
 - The animals with shorter proboscis died✓
 - Those individuals with the longer proboscis survived✓
 - They then reproduced✓
 - and passed on this characteristic to their offspring✓
 - The next generation of animals had a greater proportion✓ of animals with longer proboscis
- Any 9 (9)

Artificial selection

- Humans✓ select the elephants with
 - desirable characteristics✓/long trunk
 - and mate them to produce offspring with longer trunks✓
 - Those that are pure breeding✓ for long trunks
 - are further selected to mate to produce offspring with further longer trunks✓
- Any 3 (3)
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the explanations in terms of Lamarckism, Darwinism and artificial selection are provided	Explanations in terms of Lamarckism, Darwinism and artificial selection are provided in a logical and sequential manner.	At least 3 correct points for the explanation using Lamarckism, 6 correct points for the explanation using Darwinism and 2 correct points using artificial selection
Mark	1	1	1

Question 10

Evolution according to Lamarck

Lamarck explained evolution using the following two 'laws':

The law of use and disuse: ✓

- As an organism uses a structure or organ more regularly✓, it becomes better developed or enlarged in that organism✓.
- If an organism does not use a structure or organ frequently✓, it becomes less developed or reduced in size and may disappear altogether in that organism✓

The inheritance of acquired characteristics: ✓

- Characteristics developed during the life of an individual✓
- (Acquired characteristics) can be passed on to their offspring. ✓ (Max 5) (5)

Evolution according to Darwin

- Organisms produce a large number of offspring✓
- There is a great deal of variation✓ amongst the offspring
- Some have favourable characteristics✓
- and some do not✓
- When there is a change in the environmental conditions✓/or
- there is competition
- Then organisms with characteristics which are more favourable survive✓
- Whilst organisms with less favourable characteristics die✓
- This is called natural selection✓
- The organisms that survive reproduce✓
- And thus pass on the favourable characteristics to their offspring✓
- The next generation will therefore have a higher proportion of individuals with the favourable characteristics✓ (Max 8) (8)

Darwin's ideas about gradualism compared to Punctuated Equilibrium

- Darwin believed that evolution takes place through an
- accumulation of small✓
- gradual changes that occur over a long period of time✓
- supported by transitional forms in fossil record✓
- Punctuated equilibrium suggested that evolution sometimes involves long periods of time where species do not change✓/very little change occurs
- This alternates with short periods of time where rapid changes occur✓
- New species are formed in a short period of time✓/relative to the long period of no/little change
- supported by the absence of transitional forms✓ (Max 4) (4)

Content: (17)
Synthesis: (3)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay	There is no irrelevant information. Only information relating to the theories of Lamarck and/or Darwin and/or Punctuated Equilibrium is/are given.	The information provided for each of the theories of Lamarck and/or Darwin and/or Punctuated Equilibrium is/are arranged logically.	At least three points included on each of the 3 theories: Lamarck, Darwin and Punctuated Equilibrium
Mark	1 R	1 L	1 C

Question 11

- 11.1 - Ponds 1 and 2 should be identical✓in physical and biological conditions✓
 - Equal numbers✓ of predatory fish✓/non-predatory fish to be introduced
(Mark first ONE only) (Any 2 x 1) (2)
- 11.2 (a) The presence of a predator✓ (1)
 (b) The number of spots✓ (1)
- 11.3 - As a control✓/to compare the results between the ponds.
 - To ensure that any changes that occurred✓ were due to the
 - presence of the predator✓/independent variable (3)
- 11.4 - There is variation✓ amongst the male guppies
 - Some have more spots✓ while others have fewer spots
 - The ones that have more spots attract predators✓
 - and are eaten✓/killed by predators
 - The ones with fewer spots✓ survived✓ and reproduced
 - to pass the gene for fewer spots on to the next generation✓
 - Over a period of time, the pond with predators
 - had guppies with fewer spots (Any 5) (5)
(12)

Question 12

- 12.1 (a) Temperature✓ (1)
- 12.2 (b) Number of clover plants that survived✓/percentage survival (1)
- Repeat the investigation✓
 - Set up more greenhouses✓ at each temperature
 - Use a larger sample of clover plants✓
 - Increase the period of the investigation✓
- Any 2 (2)
- (Mark first TWO only)**
- 12.3 They counted the number of clover plants that survived and divided it by the original number✓/200 then multiplied it by 100✓ (2)
- 12.4
- The hypothesis will be accepted✓
 - because there are more✓ clover plants/higher percentage survival
 - at the higher temperature✓
- OR**
- The hypothesis will be accepted✓
 - because there are fewer✓ clover plants/ lower percentage survival
 - at the lower temperature✓
- (3)
- 12.5
- The bitter taste✓ of the cyanide in the clover plants
 - prevents herbivores/predators✓ from feeding on them
- (2)
- 12.6
- The mutation caused variation✓ amongst the clover plants
 - Some produce cyanide✓ and
 - others do not produce cyanide✓
 - The cyanide-producing plants are killed at lower temperatures✓
 - The non-cyanide-producing plants survive at the lower temperatures✓ and reproduce
 - The allele for cyanide production is not passed on to the next generation✓
 - decreasing the number of cyanide producing clover plants✓ in the next generation
- Any 6 (6)
- (17)**

Question 13

- 13.1 (a) Exposure to insecticide✓ (1)
(b) Number of insects that survived✓/survival rate of insects (1)
- 13.2 - Sample size✓/300 insects
- Size of containers✓
- Conditions✓
- Concentration of insecticide✓
- Volume of insecticide✓
- Time period✓/24 hours Any 3 (3)
(Mark first THREE only)
- 13.3 - They only conducted the investigation once✓/did not repeat
- They used a small sample/only 300 insects✓
- They used only two storage bins✓ Any 2 (2)
(Mark first TWO only)
- 13.4 Insects that were previously exposed to the insecticide had a higher survival rate✓✓
OR
Insects that were not previously exposed to the insecticide had a lower survival rate✓✓ (2)
(9)

Question 14

14.1 (a) colour of lizard✓ (1)

(b) % survival of the lizards✓ (1)

14.2 It is harmful✓/lethal to the red lizards as they will be seen✓ on the black rock by the predators

OR

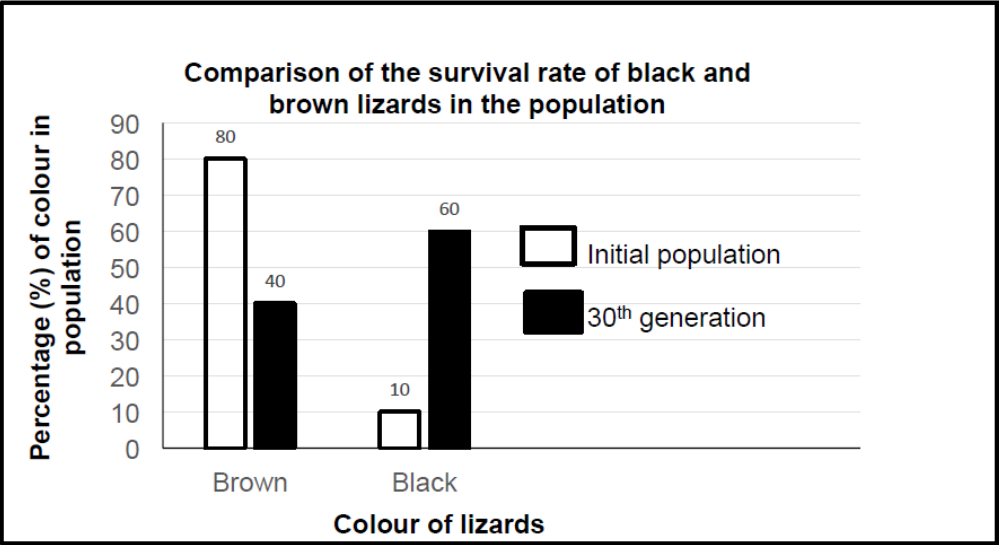
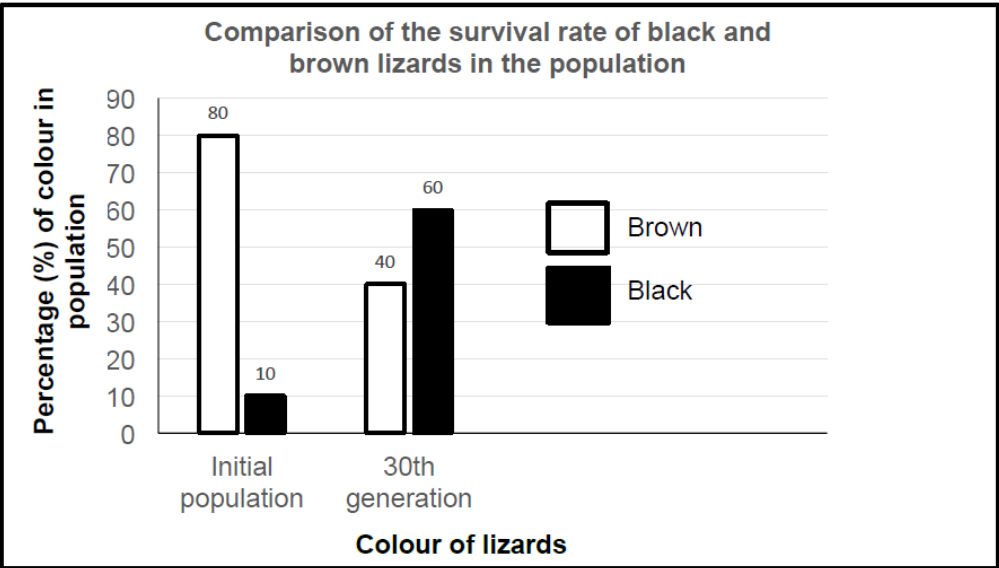
Red lizards did not warm up fast on cold days✓ and they could not escape predators✓/catch prey (2)

14.3 - To ensure reliability✓ of results
- To allow enough time for reproduction✓ and survival to be able calculate the percentage
- A change in population proportions will not be seen over a shorter time period✓ Any 2 (2)

14.4 - Conduct the investigation under the same environmental conditions✓/examples of conditions
- used the same sampling technique✓
- used the same number✓ of lizards in each sample collected
- used equal number of males and females for each category✓
- ensured that the lizards were fertile✓
(Mark first TWO only) Any 2 (2)

14.5 - There is variation✓ in colour amongst the lizards
- Some are red, black or brown✓
- Red and brown lizards✓
- are not camouflaged well against the dark rocks✓/ or cannot warm up effectively and
- are killed✓ by predators
- the black lizards are better camouflaged✓/warm up faster to avoid predators
- and survive✓ and reproduce
- to produce more black lizards✓ in the next generation Any 6 (6)

14.6



Guideline for the assessing the graph

Bar graph	1
Title of graph	1
Correct label and scale for X-axis	1
Correct scale and label for Y-axis	1
Drawing of bars	1: 1 to 3 bars plotted correctly 2: All 4 bars plotted correctly

(6)

NOTE:

If the wrong type of graph is drawn, marks will be lost for:

- 'Bar graph'
- 'Drawing of bars'

(20)

Question 15

Mutations (Mu)

- A mutation is a change in the DNA✓/ gene/nucleotide sequence or
- a change in the number✓/size of a chromosome
- Mutations introduce new alleles✓ which results in
- new genotypes✓ and hence
- new phenotypes✓ from one generation to another

Any 4 (4)

Meiosis (M)

- In prophase I✓ of meiosis
- crossing over✓ occurs
- between homologous chromosomes✓
- resulting in the exchange of genetic material✓
- leading to chromosomes with a mixture of maternal and paternal genetic material✓
- In metaphase✓ of meiosis
- random arrangement of chromosomes occur✓
- leading to chromosomes moving into gametes in different combinations✓

Any 5 (5)

Role of variation in speciation (S)

- Speciation occurred through geographical isolation✓
- The original population was separated by the sea✓/a body of water
- and there was no gene flow✓ between the two populations
- **There was variation in neck length within each population✓ ***
- Each population was exposed to different environmental conditions✓ and
- underwent natural selection independently✓
- Over a long period of time the two populations became different✓
- genotypically and phenotypically✓
- When the two populations were mixed again✓
- they were unable to interbreed to produce fertile offspring✓
- thus indicating the formation of a new species✓

***Compulsory 1 + Any 7** (8)
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the description of mutations and meiosis as sources of variation and the role of variation in speciation is given. There is no irrelevant information.	All the information regarding description of mutations and meiosis as sources of variation and the role of variation in speciation is given in a logical manner	Correct points as follows: - 2/4 for mutations, - 3/5 for meiosis and - 6/8 for the role of variation in speciation
Mark	1	1	1

Question 16

- 16.1 - A population is a group of organisms of the same species✓/that can interbreed to produce fertile offspring and
- occupy a given area at a certain time✓ (2)
- 16.2 - Crossing over✓
- Random arrangement✓ of chromosomes
- Random fertilisation✓
- Random mating✓ Any 3 (3)
(Mark first THREE only)
- 16.3 - The squirrels with favourable characteristics✓ caused by the mutation
- survive✓/natural selection occurs
- since they are better suited✓ to the environmental conditions
- These characteristics are passed on to future generations✓ Any 3 (3)
- 16.4 - Since there are now two✓ species/a new species of squirrels
- the biodiversity has increased✓ (2)
- 16.5. - Allow them to interbreed✓/reproduce/mate
- They will not produce fertile offspring✓/check if they produce fertile offspring
- OR**
- Conduct DNA tests✓ of both species
- and compare them✓ (2)
(12)

Question 17

- 17.1 - Taste✓/sweetness
- Size✓/largest fruits (2)
- 17.2 - Humans✓/villagers
- select the fruits with desirable characteristics✓/sweetest and largest fruits
- and scatter✓/grow them/use them to form the next generation of offspring (3)
- 17.3 - Climate✓
- Temperature✓
- 17.4 - Water✓
- Soil✓
- Light✓
- Humidity✓
- Gases✓ Any 1 (1)
- (Mark first ONE only)**
- 17.5 - If trees are produced through marcotting there would be no variation within the plantation✓/trees would be genetically identical
- Any change in the environment/diseases/insects affecting one tree will probably destroy the whole plantation✓ /no other characteristics will be introduced
(Mark first ONE only) (2)
- 17.6 - No✓/ the fruits cannot be labelled as genetically modified (GM)
- because no gene transfer✓/introduction in the marcotting process took place (2)
- Production of medication/resources cheaply✓
- Control pests with specific genes inserted into a crop✓
- Using specific genes to increase crop yields✓/food security
- Introduction of genes to improve human health✓
- Selecting genes to increase shelf-life of plant products✓
- Improving the quality of the crop✓
- Allows a faster production time✓
- Developing resistance to drought✓
- Developing resistance to pests✓
- Developing resistance to herbicides✓
- Developing resistance to diseases✓ Any 2 (2)
- (Mark first TWO only)**
- (12)

Question 18

Differences

- A species is a group of organisms with similar characteristics ✓^D
- that are able to interbreed ✓^D
- to produce fertile offspring ✓^D
- A population is a group of organisms of the same species ✓^D
- found in the same habitat ✓^D
- at the same time ✓^D

Speciation by geographic isolation

- A population of organisms becomes split ✓^S
- by a geographical barrier ✓^S/example of a geographical barrier.
- The two populations cannot interbreed ✓^S/there is no gene flow between the two.
- Natural selection occurs independently ✓^S in each population.
- Due to different environmental conditions ✓^S on either side of the barrier,
- the two populations become genotypically and phenotypically ✓^S
- different ✓^S from each other.
- Even if the geographical barrier is removed, the individuals will not be able to interbreed ✓^S
- We say that the original population has now become two separate species ✓^S

Effect of speciation and extinction on biodiversity

- Since there is an increase in the number of species ✓^B
- speciation increases ✓^B biodiversity
- Extinction results in the loss of the number of species ✓^B
- therefore results in a decrease ✓^B in biodiversity

Any 17
Content: (17)
Synthesis: (3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay in Q4	Only information relevant to the differences between population and species; the description of speciation and effect of speciation and extinction on biodiversity is given	All the information regarding the differences between population and species, the description of speciation and the effect of speciation and extinction on biodiversity is given in a logical manner	At least: - 4 correct points for the differences, - 5 for the description of speciation and - 2 for effects of speciation and extinction on biodiversity
Mark	1	1	1

Question 19

- 19.1 X - Foramen magnum✓ (1)
Y - Canine✓ (1)
- 19.2
- The foramen magnum is located in a more forward position✓/below the skull
 - showing that organism C is bipedal✓
 - This allows for the vertebral column/spine to extend vertically✓/from the base of the skull
 - to balance the body weight in upright walking✓
- Any 3 (3)
- 19.3 (a) B✓ (1)
(b) A✓ (1)
- 19.4
- There is an increase✓
 - in the cranium size✓ from organism B to organism C
 - This will allow it to house a larger brain✓/cerebrum which suggests greater intelligence
- (3)
- 19.5
- | Skull B | Skull C |
|-----------------------------------|-------------------------------------|
| Brow ridges pronounced✓ | Brow ridges are not as pronounced✓ |
| More protruding jaws✓/larger jaws | Less protruding jaws✓/ smaller jaws |
- (Mark first TWO only) Table1 + (2 x 2) (5)
(15)

Question 20

- 20.1 B- Cranium ✓
C- Brow ridge✓ (2)
- 20.2 Canine✓ (1)
- 20.3 (a) I✓ ; II✓ (Mark first TWO only) (2)
(b) II✓ (Mark first ONE only) (1)
(c) III✓ (Mark first ONE only) (1)
(d) III✓ (Mark first ONE only) (1)
- 20.4 C✓ (1)
- 20.5 III → I → II✓✓ (2)
(11)

Question 21

- 21.1 Bipedal✓ (1)
- 21.2 A✓ and B✓ (2)
(Mark first TWO only)
- 21.3 Both have a short✓ and wide✓ pelvis (2)
- 21.4 Less curved spine✓/C-shaped spine (1)
(Mark first ONE only) (6)

Question 22

- 22.1
 - Eyes in front/binocular vision✓
 - Freely rotating arms✓
 - Long upper arms✓
 - Bare fingertips or nails✓
 - Opposable thumb✓
 - Upright posture ✓**(Mark first FIVE only)** (Any 5) (5)
- 22.2 (a) More curved spine✓/S-shape in humans but less curved✓/
C-shaped in apes (2)
- (b) Short and wide✓ pelvis in humans but long and narrow✓
pelvis in apes ✓ (2)
- 22.3
 - Canines have changed from large✓
 - to small✓.
 - This is due to a change from eating raw✓ food
 - to eating cooked✓ food(4)
(13)

Question 23

23.1	Phylogenetic tree ✓		(1)
23.2	4✓		(1)
23.3	(a) <i>Paranthropus</i> ✓		(1)
	(b) <i>Ardipithecus ramidus</i> ✓		(1)
	(c) <i>P. robustus</i> ✓		(1)
23.4	Mrs Ples✓ Taung Child✓ Little Foot✓ (Mark first ONE only)	(Any 1)	(1)
23.5	<i>H. habilis</i> ✓ <i>H. erectus</i> ✓ (Mark first TWO only)	(Any 2)	(2) (8)

Question 24

24.1	Phylogenetic✓/evolutionary tree		(1)
24.2	(a) 5✓		(1)
	(b) 4✓		(1)
24.3	<i>(Paranthropus) robustus</i> ✓ and <i>(Paranthropus) boisei</i> ✓		(2)
24.4	(a) Accept any value in the range 4,3 to 4,5 million years ago✓/mya		(1)
	(b) 1 mya✓		(1)
24.5	(a) <i>Homo neanderthalensis</i> ✓		(1)
	(b) <i>(Homo) habilis</i> ✓		(1)
			(9)

Question 25

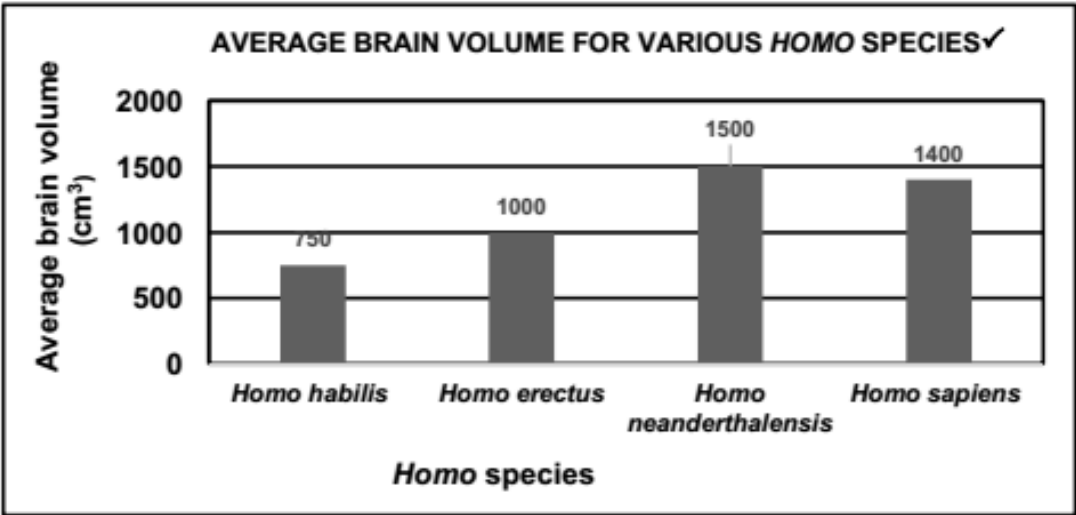
- 25.1 *A. anamensis*✓ and *A. afarensis*✓
(Mark first TWO only) (2)
- 25.2 (4,5mya – 3mya)✓ = 1,5✓mya✓ (3)
- 25.3 The cranium increased in size✓ so it could accommodate a larger brain✓ (2)
- 25.4 Smaller teeth✓/canines in *Homo* species, can chew food that was cooked✓/made soft using fire

OR

Larger teeth/canines are not necessary ✓ because the food is softer ✓ because of cooking with fire. (2)
(9)

Question 26

- 26.1 - Genetic✓/mitochondrial DNA /Y chromosome
- Cultural✓ (2)
(Mark first TWO only)
- 26.2 *Ardipithecus ramidus*✓ (1)
(Mark first ONE only)
- 26.3 - They would measure the volume✓
- of the cranium✓of the fossil (2)
- 26.4 (1400 - 500)✓
= 900✓cm³ (2)
- 26.5 (a) There is an overlap in their period of existence✓/they both existed between 2 and 1,6 mya (1)
- (b) - It has the smallest brain volume✓
- It appeared first✓/is the oldest Any 1 (1)



Guideline for assessing the graph:

Bar graph drawn	1
Title of graph includes both variables	1
Correct label for X-axis	1
Correct label and unit for Y-axis (cm³) (L)	
Equal width and interval of bars	1
Correct scale for Y axis (S)	
Required bars drawn (B)	1 Only REQUIRED bars drawn
Drawing of bars (B)	1 All 4 REQUIRED bars drawn correctly

(6)
(15)

Question 27

27.1 A transitional fossil shows characteristics✓ of two✓/between genera/species (2)

27.2 Bipedalism✓/stood upright (1)

27.3

- Structure of the pelvis✓
- Cranial volume✓

(MARK FIRST ONE ONLY) Any 1 (1)

27.4

- The foramen magnum is located more forward beneath the skull✓, so that
- the vertebral column extends beneath✓ the skull.
- The spine is S-shaped ✓to
- support an upright posture✓
- The pelvis is shorter and wider✓
- to support the body above✓the pelvis

(MARK FIRST TWO ONLY) Any (2 x 2) (4)

27.5

- There was a change in diet✓
- from tough✓/raw to
- softer✓/cooked food

(3)
(11)

Question 28

- 28.1 Hominidae✓ (1)
- 28.2 600✓ cm³ (1)
- 28.3 1,6 million years ago✓/mya (1)
- 28.4 Taung child✓/ } *A.africanus*
 Mrs Ples✓/ }
 Karabo✓/ *A.sediba*
 Little foot✓/ *A.prometheus* Any 2 (2)
(Mark first TWO only)
- 28.5 *Homo sapiens*✓ (1)
(6)

Question 29

- 29.1 Projecting nose✓
 Smaller canines ✓
 Bipedal✓
(Mark first THREE only) (3)
- 29.2 They had a wider view✓ to spot danger
 They could carry offspring✓/food/tools
 Large surface area for thermoregulation✓
(Mark first TWO only) (2)
- 29.3 Have characteristics of both *Homo*✓ species and *Australopithecus*✓ species (2)
(7)

Question 30

- 30.1 'Out of Africa' hypothesis✓ (1)
- 30.2 Mitochondrial DNA✓/mtDNA (1)
- 30.3 - The mitochondrial DNA is only inherited from the mother✓
 - Any mutation✓ on this DNA
 - can be traced✓ along the maternal line only (3)
- 30.4 Fossil evidence✓
 Archaeological evidence✓ Any 1 (1)
(Mark first ONE only) **(6)**

Question 31

HYPOTHESIS

- All modern✓* humans
 - originated in Africa✓*
 - and migrated to other parts✓ of the world
- 2(*compulsory) +1 (3)

FOSSIL EVIDENCE✓

- The fossils of human ancestors ✓/(*Australopithecus* and *Ardipithecus*)
 - were only found in locations✓ in Africa/Rift Valley, Ethiopia and South Africa
 - The fossils of *Homo habilis* ✓ were only found in Africa and
 - the oldest fossils of *Homo erectus* ✓ were found in Africa
 - The oldest *Homo sapiens* fossils✓ were also found in Africa
- Any 3 (3)

GENETIC EVIDENCE✓

- Analysis of mutations ✓ on the
 - mitochondrial DNA✓ shows that the
 - oldest female ancestors ✓ were located in Africa
 - and that all humans descended from her✓/mitochondrial Eve
- Any 3 (3)

CULTURAL EVIDENCE✓

- The oldest most primitive artefacts✓/examples of artefacts (tools, cutlery, art etc.) were found in Africa
- (2)

BIPEDALISM

The fossils of all three genera indicate that:

- The foramen magnum is located in a more forward position✓ indicating that the vertebral column was attached below the skull✓
 - The pelvis are wider ✓ /shorter to support the body of the organism above it ✓
 - The curvature of the spine✓ is S-shaped which allows for an upright body posture ✓
- Any (3 x 2)
Content (6)
Synthesis (17)
(3)
(20)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic.	Ideas are arranged in a logical/cause-effect sequence.	All aspects of the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to the 'Out of Africa' hypothesis and bipedal fossils of the three genera are described.	The description of the evidence for the 'Out of Africa' hypothesis and the evidence of bipedalism is presented in a logical and sequential manner.	At least 9 correct on 'Out of Africa' hypothesis and 4 correct on evidence for bipedalism.
Mark	1	1	1

TOTAL SECTION C: 20

Question 32

Foramen magnum

- The foramen magnum was in a backward position in the ape-like beings✓^F
- but in a forward/ central/ ventral position in modern humans✓^F

Significance

- This represents a change from quadrupedalism in ape-like beings✓^S
- To bipedalism/(walking upright) in modern humans✓^S, leading to the following in modern humans:
 - o Increased awareness of the environment✓^S in sensing danger/food
 - o Freeing of the hands to use implements✓^S/ carry objects/ weapons/ offspring
 - o Exposure of a large surface area for thermoregulation✓^S/losing body heat to surroundings in hot conditions/reducing overheating
 - o Display of sex organs /breasts as part of courtship behaviour✓^S

Cranium

- Modern humans have a larger cranium✓^F *than the ape-like beings*✓^F
- Modern humans have a less sloping forehead✓^F *than the ape-like beings*✓^F
- Modern humans have a cranium that is more rounded✓^F *than the ape-like beings*✓^F

Significance

- This allowed space for a larger brain✓^S in humans *than in ape-like beings*✓^S, making the following possible:
 - o Better co-ordination of movement✓^S
 - o Processing of a large amount of information✓^S
 - o Processing information faster✓^S
 - o Development of spoken and written languages to communicate✓^S

Jaws

- Humans have smaller jaws✓^F *than the ape-like beings*✓^F
- Humans have jaws that are non-prognathous✓^F/ flat face compared to the jaws of ape-like beings which are prognathous✓^F/sloping face
- Humans have C-shaped jaws✓^F /jaws that are gently curved compared to the U shaped jaws✓^F in the ape-like beings

Significance

- This corresponds with a change in diet from hard, raw food✓^S in the ape-like beings
- To softer, cooked food✓^S in humans

Dentition/Teeth

- In ape-like beings there are gaps✓^F/diastema between incisors and canines
- but no gaps✓^F between the teeth in humans
- Humans have smaller teeth✓^F/incisors and canines *than the ape-like beings*✓^F
- Humans have flatter molars and pre-molars✓^F *than the ape-like beings*✓^F

Significance

- This corresponds with the decreased need to bite and tear✓^S
- and an increased need to grind and chew✓^S in humans
- in view of the change in diet to soft, cooked food✓^S

Eyebrow ridges

- Humans have eyebrow ridges that are smaller^{✓^F} *than those of the ape-like beings*^{✓^F}

Significance

- There is a decreased need to strengthen the skull^{✓^S} of humans
- due to the smaller size of the jaws^{✓^S}

Cranial ridge

- In humans the cranial ridge is absent ^{✓^F} compared to its presence in the ape-like beings^{✓^F}

Significance

- Cranial ridge not necessary in humans to provide strong point of attachment since jaw muscles are not very strong as in ape-like beings.^{✓^S}

Brow ridge

- In humans the brow ridge is less developed^{✓^F} *than in the ape-like beings*^{✓^F}

Significance

- This corresponds with the decreased need for skull reinforcement ^{✓^S}
- due to due to weaker jaw muscles^{✓^S} in humans as opposed to *ape-like beings*

Description of features that changed any (10)

Significance of the changes (must be linked to the features described) any (17)

Content: (17)

Synthesis: (3)

Assessing the presentation of the essay

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay	Only information relevant to the <i>structural changes</i> or <i>significance</i> is given (there is no irrelevant information)	Generally each significance is appropriately linked to the relevant structural change to the skull	At least 3 structural changes described together with the significance of each
Mark	1	1	1

R[✓]

L[✓]

C[✓]