

OXFORD



Life Sciences

CRITICAL CONCEPTS MADE EASY

MEMORANDA FOR ACTIVITIES

CONCEPTS INCLUDE:

- + Genetics
- + DNA
- + RNA
- + Meiosis
- + Human eye & ear

12

Topic 1

Answers

Worksheet 1.

- 1.1 A part of DNA ✓ that codes for one protein ✓ or characteristic ✓ (3)
- 1.2 Nucleus ✓ (1)
- 1.3 It is protected there, ✓ it cannot be damaged (influenced) ✓ by chemicals or activities in the cell (cytoplasm) itself ✓ (any 2)
- 1.4 The DNA contains the information of the cell. ✓ This must be constant to ensure that the cell's structure and functioning remains correct and the same. ✓ mRNA is made only in transcription ✓ during protein synthesis and ✓ and it is only for one gene. ✓ Once it has transferred the information to translation (the ribosome) ✓ its function has been completed ✓ and it breaks up ✓ (any 5)
- 1.5 There should be a phosphate group. ✓ (1) Make sure there is no circle in the pic at 8 – only a straight line
- 1.6 Nucleotide ✓ (1)
- 1.7 Structure 1 (nucleotide) is the monomer ✓ for the polymer (1)
- 1.8 The sugar will be ribose. ✓ The nitrogen base will be uracil (U instead of T). ✓ (2)
- 1.9 2. Phosphate group ✓
3. Guanine (G) ✓
4. Hydrogen bond ✓
5. Adenine (A) ✓
6. Deoxyribose ✓
7. Phosphodiester bond ✓ (6)
- 1.10 The purine bases are Guanine (G) and Adenine (A)
- 1.11 Total: 440
- 72 thymine
- 72 adenine ✓
- $72 + 72 = 144$ ✓
- $440 - 144 = 296$ ✓
- $296 \div 2 = 148$ ✓ cytosine (4)

.....

[28]

Worksheet 2.

- 1.1 DNA replication ✓ (1)
- 1.2 So that the two new cells (daughter cells) ✓ each have an exact copy of DNA. ✓ OR So that there are two DNA molecules ✓ when cell division begins. ✓ (2)
- 1.3 Each strand acts as a template ✓ to provide the instructions ✓ for how the new strand must be built. ✓ (3)
- 1.4 The DNA contains information for the structure and functioning of the cell. ✓ The same information ✓ must be transferred to the new cells, so that they are genetically identical to the parent cell ✓ and each other. ✓ (any 2)
- 1.5 Double-stranded ✓ Helix ✓ (2)
- 1.6 James Watson ✓ Francis Crick ✓ Maurice Wilkins ✓ Also accept surnames only. (3)
- 1.7 Rosalind Franklin ✓ Accept surname only (1)
- 1.8 Hydrogen ✓ (1)
- 1.9) A – old strand ✓ B – new strand Old strand ✓ ✓ (2)
- 1.10 Each DNA molecule ✓ that is formed consists of one old ✓ and one new strand. ✓ (3)

.....

[20]

Worksheet 3.

- 1.1 Transcription ✓ (1)
- 1.2 Nucleus ✓ (1)

- 1.3 1. Uracil ✓ 2. Guanine ✓ 3. Adenine ✓ (3)
 1.4 4. Deoxyribose Nucleic Acid ✓ 7. messenger ribonucleic acid (ribose nucleic acid) ✓ (2)
 1.5 Codon ✓ (1)
 1.6 321 ✓ (1)
 1.7 6. coding strand ✓ 8. non-coding strand ✓ (2)
 1.8 It provides the code (information or instructions) ✓ (1)
 1.9 It will leave the nucleus ✓ at the nuclear pore ✓ and move to the ribosome ✓ in the cytoplasm. ✓ (any 3)

..... [15]

Worksheet 4.

- 1.1 translation ✓ (1)
 1.2 second ✓ (1)
 1.3 The mRNA must first collect the code (information) from the DNA ✓ before the amino acids (protein) can be assembled ✓ (2)
 1.4 cytoplasm at the ribosome ✓ (1)
 1.5 1. Adenine ✓ 2. Uracil ✓ 3. Guanine ✓ (3)
 1.6 4. Peptide bond ✓ 5. Ribosome ✓ 6. Amino acid (chain, peptide chain, protein) ✓ 8. mRNA ✓ (4)
 1.7 7. Anticodon ✓ (1)
 1.8 tRNA ✓ (1)
 1.9 transports amino acids ✓ (1)

..... [15]

Worksheet 5.

- 1.1 7 ✓ (1)
 1.2 A permanent change ✓ in the genetic material. ✓ (2)
 1.3

| | | | | | | | |
|------------------------|---------|---------|---------|---------|---------|---------|---------|
| Normal mRNA | G A C ✓ | U G G ✓ | G G A ✓ | C U C ✓ | C U C ✓ | U U C ✓ | A G A ✓ |
| Normal amino acids | asp ✓ | trp ✓ | gly ✓ | leu ✓ | leu ✓ | phe ✓ | arg ✓ |
| Mutation 1 mRNA | G A C ✓ | U G G ✓ | G G A ✓ | C A C ✓ | C U C ✓ | U U C ✓ | A G A ✓ |
| Mutation 1 amino acids | asp ✓ | trp ✓ | gly ✓ | his ✓ | leu ✓ | phe ✓ | arg ✓ |
| Mutation 2 mRNA | G A C ✓ | U G G ✓ | G G A ✓ | C U C ✓ | C U C ✓ | U C A ✓ | G A A ✓ |
| Mutation 2 amino acids | asp ✓ | trp ✓ | gly ✓ | leu ✓ | leu ✓ | ser ✓ | glu ✓ |
| Mutation 3 mRNA | G A C ✓ | U A G ✓ | G G G ✓ | A C U ✓ | C C U ✓ | C U U ✓ | C A G ✓ |
| Mutation 3 amino acids | asp ✓ | stop ✓ | gly | thr | pro | leu | gln |

..... (51)

- 1.4 Mutation 1: substitution ✓ Mutation 2: deletion ✓ Mutation 3: insertion ✓ (3)
 1.5 The reading frame of the codons move forwards or backwards. ✓ The amino acid sequence changes ✓ from the point of the mutation onwards. ✓ Therefore a different protein is formed. ✓ (any 3)
 1.6 A stop codon has been generated, ✓ therefore the correct protein is not being synthesised. ✓ The cell might not be able to function without the protein ✓ or may be damaged. ✓ (any 3)

..... [63]

Worksheet 6.

- 1.1 A. chromosome ✓ B. spindle fibre ✓ C. daughter chromosome ✓ (3)
 1.2 Equator ✓ (1)
 1.3 Homologous ✓ pair of chromosomes ✓ (2)
 1.4 Anaphase ✓ (1)
 1.5 Chromosomes have crossed over parts ✓ and there are chromosome pairs at the equator. ✓ (2)
 1.6 Gametes ✓ (1)

..... [10]

Worksheet 7.

1.1 1, 4, 2, 3 ✓ (1)

1.2 1. Anaphase I ✓ 2. Metaphase II ✓ 3. Telophase II ✓ 4. Prophase II ✓ (4)

1.3 A. centrosome (centrioles) ✓ B. chromosome ✓ C. chromatid ✓ D. spindle fibre ✓ (4)

1.4 4 ✓ (1)

1.5. 1 Metaphase I ✓ 1.5.2 Telophase I ✓ 1.5.3 Anaphase II ✓ (3)

1.6 Animal cells ✓ (1)

1.7 Centrosome (centriole) ✓ or shape of cell (an invagination is starting to form) ✓ (any1)

1.8 Diagram 1 ✓ (1)

1.9 Daughter cells are gametes. ✓ At fertilisation ✓ a male (sperm cell) and a female gamete (egg cell) fuse. ✓
The resulting zygote is then diploid. ✓ (any 3)

1.10 Diagram 2 ✓ (1)

1.11 The chromosomes assort (align or arrange) independently ✓ from one another (1)

1.12 Genetic variation is required for natural selection to take place, ✓ which ensures that organisms adapt to their environment,
✓ this is especially important in a changing environment. ✓ (any 2)

.....

[23]

Worksheet 8

1.1 anaphase ✓ (1)

1.2 Two egg cells with 23 chromosomes ✓ One egg cell with 22 chromosomes ✓ One egg cell with 24 chromosomes ✓ (3)

1.3 21 ✓ (1)

1.4 Diagram: Cell in anaphase I

[Both chromosomes of the chromosome pair moving to the same pole, i.e. not one chromosome moving to one pole and the other chromosome to the other.]

Mark allocation:

Two chromosomes moving in the same direction ✓

Chromosomes attached to spindle fibres ✓

No other chromosomes included ✓

Labels: any 3: chromosome ✓ centromere ✓ chromatid ✓ centrosome (centriole) ✓ (6)

.....

[11]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

1.1 B

1.2 D

1.3 C

1.4 D

[2 X 4 = 8]

Question 2

2.1 Translation ✓ (1)

2.2 Ribosome ✓ (1)

2.3 1. cytosine ✓ 2. guanine ✓ 3. uracil ✓ 4. cytosine ✓ 5. adenine ✓ 6. adenine ✓ 11. messenger RNA ✓ (7)

2.4 7. Ser ✓ 8. Ala ✓ 9. Val ✓ (3)

2.5 anticodon ✓ (1)

2.6 Collect another amino acid (Ser) ✓ (1)

2.7 DNA helix unwinds ✓ hydrogen bonds between the strands break ✓ 1 DNA strand (coding strand); template ✓ mRNA is made complimentary to coding strand ✓ G to C on DNA ✓ C to G on DNA ✓ A to T on DNA ✓ U to A on DNA ✓ Hydrogen bonds between the DNA and mRNA break ✓ Hydrogen bonds between the two DNA strands reform ✓ DNA spirals up into a helix ✓ (any 7)

[21]

Question 3

3.1 So that the fish cakes could be compared to it. ✓ (1)

3.2 No ✓ (1)

3.3 Shark ✓ (1)

3.4 The pattern of the DNA profile of the fish cakes is not the same as the salmon, ✓ but the same as the shark. ✓ (2)

..... [5]

Question 4

4.1 proteins ✓ that package DNA ✓ (2)

4.2 acetyl ✓ and methyl ✓ (2)

4.3 diet (food) ✓ (1)

4.4 bees use it to create queens, ✓ which are healthy, ✓ whereas in humans it leads to diseases (health problems) ✓ (3)

4.5 Broccoli ✓ (1)

4.6 Yes. There are many advantages to epigenetics. ✓ Diseases could be cured or prevented ✓ by something that is quite simple, diet. ✓ No medical facilities (medication, medical staff) are needed. ✓ Some people are reluctant to use Western medicine, but will accept a change in diet more readily. ✓ Many people do not have access to medical facilities. ✓ OR

No. Humans ✓ should not be used for genetic studies. There might be unexpected effects ✓ that have a long-term influence ✓ on the people taking part in the study. There are too many aspects that are unknown ✓ about epigenetics. It is expensive research, requiring laboratory facilities (with qualified staff). There are alternative methods ✓ for dealing with these diseases.

Mark allocation:

2 marks per discussed reason

Accept any relevant, scientific answer, no emotions or religion. (4)

[13]

..... [Total: 47]

Topic 2 Answers

Worksheet 1

1.

1.1 seminiferous tubules

1.2 outside

1.3 temperature

1.4 body temperature 37°C

1.5 infertile

1.6 testosterone

1.7 testes

1.8 diploid

1.9 meiosis

1.10 n

[10]

2.

2.1 A. nucleus

B. head

C. mitochondrion (mitochondria)

D. tail (4)

2.2 acrosome: contains enzymes ✓ that digest the outer layer of the secondary oocyte, ✓ so that head of sperm cell can enter ✓ during fertilisation. ✓ (4)

2.3 C (mitochondria): provide energy ✓ for swimming (movement) ✓ of D (tail) ✓ (3)

2.4 23 chromosomes ✓ (1)

2.5 X – Y: Diagram = 20 mm* ✓

Magnification = 4 000 X

Actual diameter = 20 mm ÷ 4 000 ✓

= 0,005 x 1 000 ✓ mm** ✓

= 5 ✓ μm *** ✓ (6)

.....

[18]

Worksheet 2.

1.1 A. fallopian tube

B. ovary

C. vagina

D. myometrium

E. endometrium

F. cervix (6)

1.2

1.2.1 B

1.2.2 C

1.2.3 A (3)

1.3 Oogenesis (production of egg cells) ✓ starts in the foetal ovary. ✓

All primary oocytes develop ✓ in the foetal ovary (during pregnancy).

No development from germ cells to primary oocytes takes place after birth. ✓

A girl is born with all the primary oocytes she is going to have for the rest of her life. ✓ (any 3)

1.4 Table of structures and hormones produced

| Structure | Hormone |
|-----------------|----------------|
| Follicle ✓ | Oestrogen ✓ |
| Corpus luteum ✓ | Progesterone ✓ |

Mark allocation:

Information: 4

Table structure: frame and vertical line in the middle: 1 (5)

1.5 Menopause (1)

.....

[18]

Worksheet 3.

1.1 A. Follicle stimulating hormone

B. oestrogen

C. endometrium

D. blood vessels

E. ovulation

F. progesterone

G. inhibit (7)

1.2 brain ✓ (1)

1.3 Process by which the ruptured Graafian follicle ✓ develops into a corpus luteum. ✓ (2)

1.4 Stimulate production of testosterone. ✓ (1)

1.5 Placenta produces enough progesterone ✓ to maintain the pregnancy. (1)

1.6 During pregnancy: high progesterone concentrations: ✓ inhibit contractions of myometrium. ✓

End of pregnancy: low concentrations of progesterone: ✓ stimulate myometrium to contract. ✓ (4)

.....

[16]

Worksheet 4

1.1 endometrium (1)

1.2 lining (endometrium) released ✓ during menstruation, ✓ because of low progesterone concentration. ✓ (3)

1.3 FSH: Follicle stimulating hormone ✓ LH: luteinising hormone ✓ (2)

1.4 A. Graafian follicle ✓

C. corpus luteum ✓ (2)

1.5 ovulation (1)

1.6 Secondary oocyte is released from the ovary, ✓ into the Fallopian tube, ✓ so that it can be fertilised. ✓ (3)

1.7 Graafian follicle develops into a corpus luteum after ovulation (day 14). ✓ The corpus luteum produces progesterone, ✓ causing the concentration to increase, ✓ up to day 21. ✓ There has not been fertilisation, ✓ therefore the corpus luteum degenerates ✓ and decreases progesterone production, ✓ from day 24 to day 28 ✓ (8)

.....

[20]

Worksheet 5.

1.1 amnion (1)

1.2 Protects embryo and foetus against mechanical (physical) shock. ✓

Controls temperature. ✓

Allows movement of foetus. ✓

Prevents desiccation. ✓ (any 3)

1.3 amniocentesis (1)

1.4 Week 32 (1)

1.5 Week 36: 2 000 ml

Week 40: 1 500 ml

Difference = 2 000 – 1 500

= 500 ml

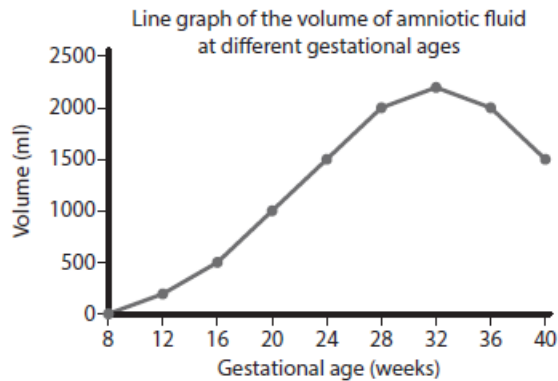
% decrease = difference/2000 x 100 ✓

= 500/2000 x 100 ✓

= 0.25 x 100 ✓

..... = 25 % ✓ (4)

1.6



Graph: Mark allocation:

Type of graph: line graph: 1

X-axis: Title (gestation age) and unit (weeks): 1

Y-axis: Title (Volume) and unit (ml): 1

Scale on X-axis and Y-axis: 1

Plotting: 7–9 points plotted correctly: 2; OR

1–6 points plotted correctly: 1; OR

0 points plotted correctly: 0

..... (6)

1.7 26 ✓ weeks ✓ 38 ✓ weeks ✓ (4)

1.8 Week 18: 750 ✓ ml

Week 22: 1 250 ✓ ml

Difference:

1 250 – 750 ✓

500 ✓ ml ✓ (5)

.....

[25]

Worksheet 6.

1.1 A. Follicle stimulating hormone

B. Oestrogen

C. Progesterone (3)

1.2 FSH: stimulates development (maturation) of follicles ✓ in ovary ✓ (2)

1.3 Oestrogen (hormone B) causes the primary (first) response ✓ in the uterus. ✓ Oestrogen starts the preparation ✓ of the uterus for pregnancy. ✓ Oestrogen starts the process of the endometrium ✓ becoming thicker ✓ and developing more blood

vessels ✓ and glands. ✓ Progesterone cannot start the process. ✓

Mark allocation:

At least 1 for oestrogen: first / start, then any 4. (5)

1.4 Structure (anatomy) and / or functioning of uterus not normal. (1)

1.5 There will be more zygotes if some of the zygotes do not develop into embryos, ✓ if some embryos do not develop ✓ or if the embryo does not implant the first time. ✓ (any 1)

1.6 Men produce (many) millions of sperm cells, ✓ so there will be enough. ✓ (2)

1.7

1.7.1 They cannot use a woman who have had problem pregnancies, because this one might be the same, ✓ want to be sure that the pregnancy will be successful ✓ (any 1)

1.7.2 She must not use it to make money, ✓ she might ask for financial compensation, ✓ she might want to sell the baby. ✓ (any 1)

1.7.3 There must not be a chance that she wants to keep the baby ✓ so that she can have a child. ✓ (any 1)

.....

[17]

Worksheet 7.

1.1 **Note:** Table not required, included for ease of marking.

| Aspect | Frogs | Ducks | |
|--------------------------------------|--|--|------------------------|
| Where fertilisation takes place | External fertilisation: ✓ Outside the bodies, ✓ in the water. | Internal fertilisation: ✓ In the body of the female ✓ | (2) |
| Where the eggs develop | Eggs develop in the water, ✓ so they are exposed to conditions in the water and predators. ✓ | Eggs develop in nests, ✓ where they are protected by the parent(s). ✓ | (2) |
| The structure of the eggs | Eggs contained in a jelly-like substance, ✓ which does not provide a lot of protection. ✓ | Eggs have a hard shell, ✓ which provides more protection ✓ | (2) |
| Number of gametes and eggs produced. | Many ✓ must be produced, because many are lost, ✓ at least some will survive. ✓ | Not so many produced, reproductive process is safer (more secure, less risky), ✓ egg cells, sperm cells and eggs protected, ✓ many will survive. ✓ | (any 2) (8) |

1.2 fish (1)

1.3 reptiles ✓ birds ✓ (2)

1.4 Provides nutrients. ✓ Removes waste products. ✓ Allows gaseous exchange. ✓ (3)

1.5 Protect ✓ and keep warm ✓ (2)

1.6 Precocial (1)

1.7 Nest is on the ground, ✓ it can walk (move) ✓ and has feathers. ✓ (any 2)

.....

[19]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION 1

Question 1

1.1 C, ✓ D ✓ (2)

- 1.2 A. ✓ bladder ✓ F. ✓ epididymis ✓ (4)
 1.3 B. vas deferens ✓
 E. urethra ✓
 F. epididymis ✓
 G. testis ✓ (any 2)
 1.4 spermatogenesis ✓ (1)
 1.5 nutrition of sperm cells ✓ (1)
 1.6 testosterone (1)
 1.7 Cowper's (bulbo-urethral) gland (1)
 1.8 mucous (1)
 1.9 vasectomy (1)
 1.10 It is a type of contraceptive method, ✓ used for family planning. ✓ Sperm cells are not released, ✓ therefore no fertilisation can take place. ✓ (any 3)

..... [18]

SECTION 2

Question 2

- 2.1 Progesterone: concentrations remain low, ✓ and constant. ✓
 There is no corpus luteum ✓ to produce progesterone. ✓
 Oestrogen: follicles develop ✓ and produce more oestrogen as they develop (mature). ✓ (any 4)
 2.2 Ovulation ✓ (1)
 2.3 The Graafian follicle, ✓ which is at the edge of the ovary, ✓ ruptures and releases the secondary oocyte ✓ from the ovary. ✓ (any 3)
 2.4 Progesterone concentration increases after Day 20. ✓ (1)
 2.5 High progesterone concentrations inhibit production of follicle stimulating hormone (FSH) ✓ by the pituitary gland. (1)
 2.6 During pregnancy no follicles should develop. ✓ There is already a pregnancy, ✓ therefore there is no need for oocytes to develop. ✓ (any 2)
 2.7 Progesterone concentration would have been lower ✓ or it would have decreased. ✓ (any 1)
 2.8 If fertilisation does not take place, the corpus luteum starts to degenerate ✓ on about Day 20. As it degenerates, it produces less progesterone. ✓ OR As there is not a functioning corpus luteum ✓ in the ovary, there cannot be a high concentration of progesterone. ✓ (2)

..... [15]

Question 3

- 3.1
 3.1.1 A. ovary
 3.1.2 B. mitosis
 3.1.3 C. $2n$ /diploid/46
 3.1.4 D. meiosis
 3.1.5 E. Ovum (egg cell) (5)
 3.2 oestrogen (1)
 3.3 fallopian tube (1)
 3.4 23 (1)
 3.5 Accept anything between 13 and 16 (1)
 3.6 Ovulation ✓ takes place on day 14. (1)

..... [10]

Question 4

- 4.1 endometrium (1)
 4.2 chorion (1)
 4.3 Table of comparison of blood vessels in umbilical cord

| | | | |
|-----------------------------|--------------------|------------------|------|
| Name | Umbilical artery | Umbilical vein | |
| Number | 2 | 1 | |
| Oxygen content | Deoxygenated blood | Oxygenated blood | |
| Nutrients or waste products | Waste products | Nutrients | |
| Direction of flow | Foetus to mother | Mother to foetus | (10) |

4.4 alcohol, medication, nicotine, other (recreational) drugs, heroin, cocaine, marihuana, viruses (rubella, HIV) (any 3)

4.5 If the blood vessels in the placenta are constricted less blood \checkmark will flow in them. Consequently, less nutrients and oxygen will reach the foetus. \checkmark This lack of nutrients might decrease the growth rate \checkmark of the foetus so that its birth weight is low. \checkmark (any 3)

..... [18]

..... **[Total: 61]**

Topic 3 Answers

Worksheet 1

1.

1.1 phenotype ✓ (1)

1.2 wrinkled seeds: rr ✓ round seeds: Rr ✓ (2)

1.3 filial ✓ (1)

1.4 P 1 wrinkled x round

rr x Rr

Meiosis



Fertilisation

| | |
|---|------------|
| | R.....r |
| r | Rrrr |
| r | Rrrr |

F 1 Rr : rr ✓

Round : wrinkled ✓

Punnett square included ✓

P 1 and F 1 ✓

Meiosis and fertilisation ✓ (6)

1.5 50 ✓ % ✓ (2)

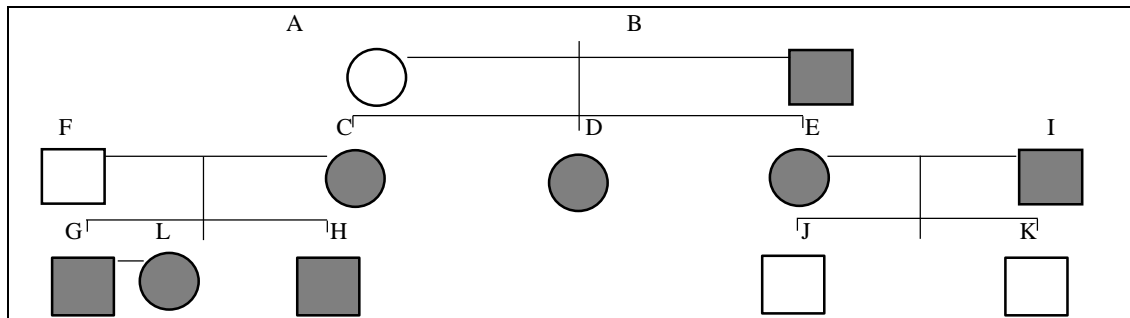
1.6 50 ✓ % ✓ (2)

.....

[14]

2.

2.1 Pedigree diagram



Mark allocation:

Rabbit A–L: correctly drawn: 12

Correct matings: 1

Correct offspring: 1 (14)

2.2 A. II

B. LI

C. LI

D. LI

- E. Ll
- F. ll
- G. Ll
- H. Ll
- I. Ll
- J. ll
- K. ll
- L. LL .. (12)
- 2.3 Yes ✓ (1)
- 2.4 L ✓ and l ✓ (2)
- 2.5 LL ✓ : 2Ll ✓ : ll ✓ (3)
- 2.6 75% (1)

.....

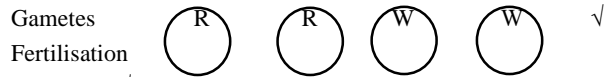
[33]

Worksheet 2.

- 1.1 co-dominance ✓ (1)
- 1.2 P 1 solid red cow x solid white bull

RR x WW ✓

Meiosis



F 1 RW ✓

Roan

P 1 and F 1 ✓

Meiosis and fertilisation ✓ (5)

1.3 These parents will always produce a roan calf (100%), ✓ therefore the chances of producing a red calf is 0 ✓ % ✓ (2)

.....

[8]

Worksheet 3.

- 1.1 Dihybrid ✓ (1)
- 1.2 A. pointy nose and curly tail ✓
- B. pointy nose and curly tail ✓
- C. Gametes ✓
- D. Fertilisation ✓
- E. Tr ✓
- F. tR ✓
- G. TR ✓
- H. tR ✓
- I. TtRr ✓
- J. TtRR ✓
- K. ttRr ✓

L. pointy nose and curly tail ✓

M. 2 ✓ (13)

1.3 The genes for nose shape and those for tail shape sort independently, ✓ therefore all possible combinations of R's and T's must be included ✓ in the list of gametes. (2)

.....

[16]

Worksheet 4.

1.1 The use of organisms, biological systems or processes ✓ for the manufacturing of products ✓ that are required to improve the quality of life or provide food. ✓ (3)

1.2 bacteria, ✓ fungi, ✓ plants, ✓ insects, ✓ mammals ✓ (any 3)

1.3 Safer ✓

Causes fewer side effects. ✓

Better than therapies currently in use. ✓

Provides treatment for which conventional therapies were ineffective. ✓

Can be produced on a large scale. ✓ (any 3)

1.4 Table of groups of biopharmaceuticals and disease or condition that they prevent or treat.

| Biopharmaceutical | Disease or condition |
|--------------------------|---|
| Blood clotting factors ✓ | Haemophilia ✓ |
| Hormones ✓ | Diabetes ✓ |
| Growth factors ✓ | Anaemia ✓ |
| Cytokines ✓ | Renal cell cancer, hepatitis B, hepatitis C and sclerosis (any 1) ✓ |
| Enzymes ✓ | Cystic fibrosis ✓ |
| Vaccines ✓ | Allergies, cancer, Alzheimer's disease, influenza, hepatitis A, hepatitis B, diphtheria, tetanus, pertussis and polio (any 1) ✓ |
| Antibiotics | Bacterial infections |

Mark allocation:

Content: 12

Table structure: frame, column headings, neat and organised: 1

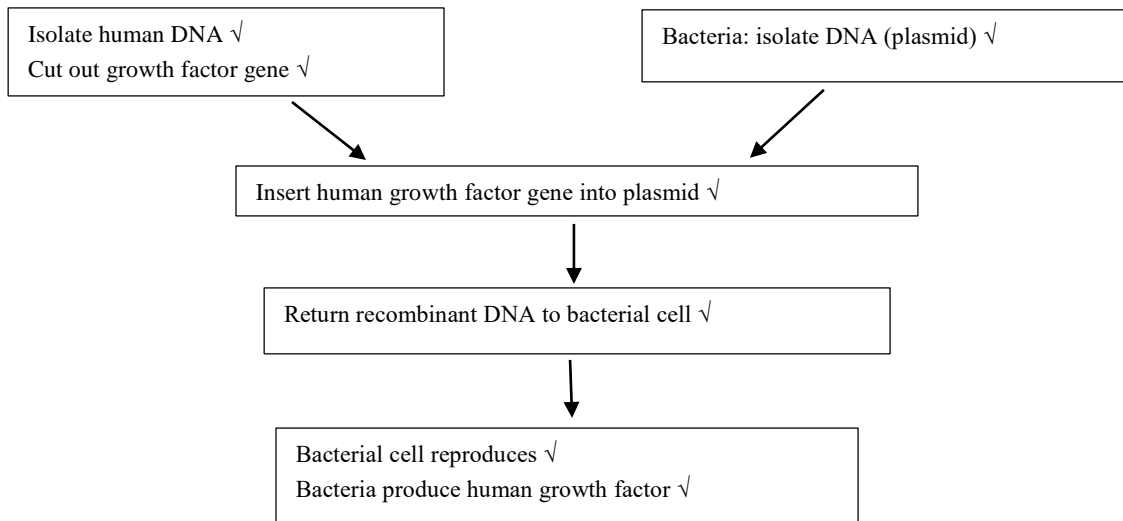
(13)

1.5 Bacteria are becoming resistant to antibiotics, ✓ therefore the antibiotics are not effective against the infections that they could treat. ✓

A new way of managing these infections must be found. ✓

New antibiotics can be developed to treat ✓ the infection or vaccines can be developed to prevent ✓ the infection. (any 3)

1.6 Flow chart of recombinant DNA technology for the production of human growth factor.



Mark allocation:

Content: 7

Flow chart: Information in blocks: 1

Arrows: 1

(9)

.....

[34]

EXAM-TYPE QUESTIONS

SECTION A

Question 1

1.1 B only

1.2 both

1.3 none

1.4 A only

[2 x 4: 8]

SECTION B

Question 2

2.


2.1.1 A and B: co-dominance ✓ (1)

2.1.2 B and O: complete dominance ✓ (1)

2.2 Cross 1: Father 1

P 1 Blood group AB x blood group AB
I^A I^B x I^A I^B

Meiosis

Gametes  ✓

Fertilisation

F 1 I^A I^A : 2 I^A I^B : I^B I^B ✓

Blood group A : 2AB : B ✓

↑
Baby ✓

Cross 2: Father 2

P 1 Blood group AB x blood group B
I^A I^B x (I^B i)

Meiosis

Gametes  ✓

Fertilisation

F 1 I^A I^B : I^A i : I^B I^B : I^B i ✓

Blood group AB : A : 2B ✓

↑
Baby ✓

P 1 and F 1 ✓

Meiosis and fertilisation ✓

Both men could be the father ✓ (11)

2.3 DNA profiling ✓ (1)

2.4 Each person's DNA is unique, ✓ except for identical twins. ✓ Therefore, each person's DNA profile will be different ✓ and people can be identified much more accurately. ✓ (any 3)

.....

[17]

Question 3

3.1 The gene ✓ for the condition is located on the X-chromosome ✓ (2)

3.2 3 ✓. (1)

3.3 A: mother: $X^M X^m$, ✓ normal, but carrier. ✓

B: father: $X^M Y$, ✓ normal

Person E: $X^m Y$ ✓

Received Y from father (B) ✓ and X^m from mother (A). ✓ (6)

3.4 Parents of H:

Father (G) and mother (C)

P 1 male with muscular dystrophy x normal female ✓
 $X^m Y$ x $X^M X^m$ ✓

Meiosis

Gametes



Fertilisation

F 1 $X^M X^m$: $X^m X^m$: $X^M Y$: $X^m Y$ ✓

Normal female: female with muscular dystrophy: normal male: male with muscular dystrophy ✓

Person H: $X^m Y$, normal male ✓ or: $X^m Y$, male with muscular dystrophy ✓

P 1 and F 1 ✓

Meiosis and fertilisation ✓ (9)

3.5 P 1 male x female ✓

XY x XX ✓

Meiosis

Gametes



Fertilisation

..... X X

X..... XX XX

Y..... XY XY

F 1 XX: XY ✓

Female: Male ✓

Chances of having another son is 50% ✓

Punnett square ✓

P 1 and F 1 ✓

Meiosis and fertilisation ✓ (9)

.....

[27]

Question 4

4.1 P 1 pink and long x red and short

RWLl x RRll ✓

Meiosis

Gametes

.....



Fertilisation

RL Rl WL Wl
Rl RRLl RRll RWLl RWll

F 1 RRLl: RRll: RWLl: RWll ✓

Red and long : red and short : pink and long : pink and short ✓

Punnett square ✓

P 1 and F 1 ✓

Meiosis and fertilisation ✓ (7)

4.2 90 ✓ (1)

4.3 Red: 180 ✓ (1)

4.4 Incomplete ✓ (1)

.....

.....

[10]

[Total: 62]

Topic 4 Answers

Worksheet 1

1.

- 1.1 Receive or collect stimuli. ✓(1)
- 1.2 Protect the brain ✓. Arachnoid membrane secretes cerebrospinal fluid ✓ (2)
- 1.3 Conduct impulses ✓ away from the cell body ✓. (2)
- 1.4 Conduct impulses from the photoreceptors ✓ to the brain ✓ (2)
- 1.5 Transmit sound waves ✓ to middle ear (ossicles, hammer or malleus) ✓ (2)
- 1.6 Changes the diameter of the pupil ✓ to control the amount of light that enters the eye ✓ (2)
- 1.7 Conduct impulses ✓ between different parts of the CNS ✓ (2)
- 1.8 Light rays are refracted (bent) to fall exactly on the retina (yellow spot or fovea) ✓ (1)

.....

[14]

2.

- 2.1 Multipolar ✓ (1)
- 2.2 Many outgrowths (dendrites and axon) ✓ (1)
- 2.3 Motor neuron ✓ (1)
- 2.4 A. dendrite ✓
B. Cell body ✓
C. Axon ✓
D. Node of Ranvier ✓
E. Schwann cell ✓ (5)
- 2.5 X ✓ (1)
- 2.6 Myelin sheath ✓ (1)
- 2.7 protects axon; ✓ electrically insulates axon; ✓ increases the speed of transmission of the impulse ✓ (3)

.....

[13]

Worksheet 2.

- 1.1 Path of a nerve impulse ✓ from receptors ✓ to effectors ✓ during a reflex action. ✓ (3)
- 1.2 A. dorsal root ganglion ✓
E. grey matter ✓
F. central canal ✓
G. white matter ✓ (4)
- 1.3 E. cell bodies ✓
G. myelin sheaths ✓ (2)
- 1.4 B. sensory neuron ✓
C. interneuron (connector) ✓
D. motor neuron ✓ (3)
- 1.5 unipolar neuron ✓ (1)
- 1.6 One outgrowth (fibre) ✓ from the cell body. ✓ (2)
- 1.7 B. sense organ ✓ D. muscle ✓ (2)
- 1.8 Central nervous system (1)
- 1.9 cerebrum (1)
- 1.10 Impulse moves through spinal cord first ✓ and ensures the response. ✓
The impulse only reaches the brain later. ✓ (3)
- 1.11 The response will always be the same ✓ (1)
- 1.12 The stimulus will be sensed ✓ and perceived, ✓ the person will know that there has been a stimulus. ✓
However, the muscle will not be able to respond, ✓ because the nerve impulse will not reach it ✓ to give the instruction. ✓
(any 4)

Worksheet 3.

1.1 Diameter of pupil (1)

1.2 Only one person was used for the experiment. ✓

The light bulb was at each position once. ✓

The experiment was only conducted once. ✓(any 2)

1.3 The eye (iris) had to be given time to respond ✓ to the new position or the light intensity (brightness) of the light bulb. ✓
(2)

| | | |
|-----|---|-----|
| 1.4 | At position 3: 8 mm At position 4: 5 mm $\% \text{ decrease} = \frac{\text{Difference}}{\text{original}} \times 100$ ✓ $\% = \frac{\text{difference: } (8-5)}{8} \times 100 = 37.5\%$ ✓ $\% = \text{now: } 3/8 \times 100$ ✓ $\% = 37.5\%$ | (5) |
|-----|---|-----|

1.5 Position 2 (1)

1.6 The diameter of the pupil is the smallest. ✓ The light is the brightest, ✓ because the light bulb is the closest to the person. ✓
(3)

1.7 Iris (1)

1.8 Circular muscles relax ✓ and radial muscles contract. ✓ Therefore the pupil dilates (diameter increases) ✓ (3)

Worksheet 4.

1.1 longitudinal ✓ (1)

1.2.1 Surface has folds (convolutions). ✓ (1)

1.2.2 Grey matter on outside ✓ and white matter on inside. ✓ (2)

1.3 Table of parts of the brain and their functions.

| Label | Part of brain | Functions |
|-------|---------------------|--|
| A | Cerebrum ✓ | Associated with: higher thought processes ✓, intelligence ✓, memory ✓, language ✓, consciousness ✓ Higher thought processes ✓ Intelligence ✓ Memory ✓ Language ✓ Consciousness ✓ |
| B | Medulla oblongata ✓ | Transmits nerve impulses between brain and spinal cord ✓ Controls: involuntary actions ✓ (heart rate, ✓ blood vessel diameter ✓ and breathing ✓) Controls: swallowing, ✓ coughing ✓ and sneezing ✓ |
| C | Corpus callosum ✓ | Connects: left and right hemisphere ✓ Communication between left and right hemispheres ✓ |
| D | Cerebellum ✓ | Coordinates voluntary movements ✓ Controls muscle tone ✓ Controls balance ✓ |

Mark allocation:

Labels: A - D: 4

Any 2 functions per part: 8

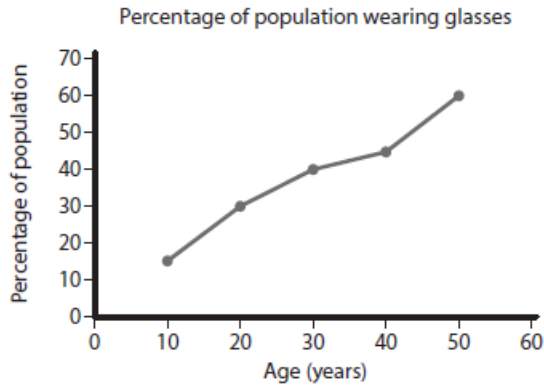
Table set out clearly (1)

(11)

[15]

Worksheet 5.

1.1 Line graph of the percentage of the population who wore glasses at different ages



Mark allocation:

Type of graph: line: 1

Heading, including both variables (age and percentage): 1

X-axis: Title (age), unit (years) and scale: 1

Y-axis: Title (percentage) and scale: 1

Plotting: 4–5 points plotted correctly: 2; OR
1–3 points plotted correctly: 1; OR

No points plotted correctly: 0 (6)

1.2 Age 20: 30 %

$$(30 \div 100) \times 16\,730\,000$$

OR

$$0,3 \times 16\,730\,000 \quad \checkmark$$

$$= 5\,019\,000 \quad \checkmark$$

Age 40: 45%

$$(45 \div 100) \times 16\,730\,000$$

OR

$$0,45 \times 16\,730\,000 \quad \checkmark$$

$$= 7\,528\,500 \quad \checkmark$$

$$\text{Difference: } 7\,528\,500 - 5\,019\,000 \quad \checkmark$$

$$= 2\,509\,500 \quad \checkmark \quad (6)$$

1.3 40–44% \checkmark (1)

1.4 Eyes weaken as one ages; \checkmark damage (e.g. from sun) have accumulated in eyes over time; \checkmark young people might not want to wear glasses, even though they must. \checkmark (accept any 1 valid reason) (1)

1.5 There are people with eye problems that are not treated with glasses; \checkmark some people wear contact lenses; \checkmark some people do not wear glasses, even though they should; \checkmark they might not be able to afford glasses. \checkmark (accept any 1 valid reason) (1)

1.6 Someone that is short-sighted can see objects close to them clearly, \checkmark but not distant objects. \checkmark Someone that is farsighted can see distant objects well, \checkmark but not those that are close. \checkmark (4)

1.7 short-sighted: concave \checkmark far-sighted: convex \checkmark (2)

.....

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION 1

Question 1

- 1.1 B
- 1.2 D
- 1.3 B
- 1.4 A
- 1.5 C

[2 x 5 = 10]

Question 2

- 2.1 outer, ✓ middle ✓ and inner ear ✓ (3)
- 2.2 external auditory meatus ✓ (1)
- 2.3 Cerumen ✓ (1)
- 2.4 Cerumen traps dust ✓ and keeps tympanic membrane moist ✓ (2)
- 2.5 A. semi-circular canals
- B. oval window
- C. round window
- D. cochlear/auditory nerve
- E. cochlea (5)
- 2.6 stapes (stirrup) ✓ (1)
- 2.7 Transmit sound waves ✓ from tympanic membrane ✓ to oval window (inner ear) ✓
Amplify sound waves ✓ (4)
- 2.8 Organ of Corti ✓ (1)
- 2.9 Mechanoreceptors ✓ (1)
- 2.10 Cochlear nerve ✓ (1)
- 2.11 When the head moves, the endolymph ✓ in the ampullae ✓ of the semi-circular canals move in the opposite direction. ✓
This movement is a stimulus ✓ for the hair cells in the cristae. ✓
This movement is converted to nerve impulses. ✓ (any 4)
- 2.12 cerebellum ✓ (1)

.....

[25]

Question 3

- 3.1 40 ✓ (1)
- 3.2 accommodation ✓ (1)
- 3.3 retina ✓ and sclera ✓ (2)
- 3.4 choroid ✓ (1)
- 3.5 sensory ✓ (1)
- 3.6 Nearest: B: 120 arbitrary units
Furthest: C: 25 arbitrary units
Difference: 120 – 25 ✓
= 95 ✓ arbitrary units ✓ (3)
- 3.7 The lens must change shape, from less convex (thinner, less curved) ✓ to more convex (bulged, more curved). ✓
Ciliary body contracts, ✓ suspensory ligaments become slack ✓ and lens bulges. ✓
Light rays refracted ✓ so that a clear image (the words of the program) ✓ form on the retina ✓ (any 6)

.....

[15]

.....

[Total: 50]

Topic 5 Answers

Worksheet 1

1.

[8]

| Organ or tissue | Effect |
|-------------------------------------|---------------------------------|
| Cardiac muscles ✓ | Increase heart rate ✓ |
| Liver ✓ | Glycogen converted to glucose ✓ |
| Muscles in iris ✓ | Dilate pupils ✓ |
| Diaphragm and intercostal muscles ✓ | Increase rate of breathing ✓ |

2.

2.1 A. Lost

B. low

C. pituitary

D. more

E. more

F. reabsorbed

G. low

H. normal (8)

2.2 Antidiuretic hormone (1)

2.3 Adrenal gland (1)

2.4 Renal tubules become less permeable ✓ to salts (sodium) ✓ (2)

.....

[12]

Worksheet 2

1.1 C

1.2 E

1.3 A

1.4 B

1.5 D

(5)

1.6

1.6.1 Swollen thyroid gland

1.6.2 Child is small (short) OR does not develop (grow) to normal body size (2)

1.7

1.7.1 Pituitary gland

1.7.2 Thyroid gland (2)

1.8 Endocrine (1)

1.9

1.9.1 Gland without a duct

1.9.2 Gland with a duct (2)

1.10

1.10.1 Secretions transported in blood stream

1.10.2 Secretions transported in the duct (2)

1.11 The organ which the hormone controls (1)

1.12 No (1)

.....

[16]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

- 1.1 Exocrine gland
- 1.2 Gigantism
- 1.3 Prolactin
- 1.4 Medulla

[4]

Question 2

2.1 Patient A: 90 \checkmark mg/dL \checkmark (accept anything just under 100, but more than 70)

Patient B: 150 \checkmark mg/dL \checkmark (4)

2.2 120 \checkmark mg/dL \checkmark (accept 120 – 125) (2)

2.3 3,5 \checkmark h \checkmark (2)

2.4 3,75 \checkmark h \checkmark (accept anything just below 4h) (2)

2.5 Patient A (1)

2.6 Insulin answers:

The body (pancreas) produces insulin fast enough \checkmark to decrease the glucose concentration. \checkmark

The body (pancreas) produces enough insulin \checkmark to decrease the glucose concentration. \checkmark

Other answers:

Glucose concentration is low \checkmark at the beginning. \checkmark

Glucose concentrations do not increase \checkmark so much \checkmark after the meal was eaten.

It takes a shorter time \checkmark for the glucose concentration to decrease. \checkmark

The glucose is removed from the blood so efficiently that the concentration decreases to below the initial value. \checkmark

(must have at least 1 insulin answer) (4)

.....

[15]

.....

[Total: 19]

Topic 6 Answers

Worksheet 1

1.

1.1 How does temperature influence the rate of sweating?

OR Does temperature influence the rate of sweating?

OR Does an increase in temperature cause an increase in sweating?

Accept any relevant answer, it must include both variables (temperature and rate of sweating) ✓

Must be a question. ✓ (2)

1.2 The sample size was big (15 jockeys were used) ✓ (1)

1.3 The investigation must be repeated. ✓ (1)

1.4 Validity ✓ (1)

1.5 Temperature does influence the rate of sweating ✓

OR An increase in temperature causes an increase in sweating. ✓ (1)

1.6 25 °C to 33 °C ✓ (1)

1.7 25 °C: 108 J/s

33 °C: 147 J/s

Difference = 147 – 108 ✓

= 39 ✓ J/s ✓ (3)

1.8 Sweat glands ✓ (1) del s [Q singular]

1.9 Dermis ✓ (1)

1.10 Enzymes would denature. ✓ They will lose their structure ✓ and therefore their function. ✓ (3)

1.11 The temperature and rate of sweating increases as the morning progresses. ✓

The higher the rate of sweating, ✓ the more water is lost, ✓ leading to a decrease ✓ in water concentration in their bodies. (4)

1.12 The pituitary gland ✓ secretes more ADH, ✓ which makes the renal tubules ✓ more permeable to water. ✓

More water is re-absorbed into the body (capillaries), ✓ so that less water is lost in urine. ✓ A low volume ✓ of concentrated ✓ urine is produced. (any 6)

.....

[25]

Worksheet 2.

1.1 A ✓ (1)

1.2 There is an increase ✓ in blood glucose at 09:00 (early in the day) ✓

OR B: There is not an increase ✓ in blood glucose early in the day ✓ (2)

1.3 4 times ✓ (1)

1.4 4,5 ✓ mmol/ℓ ✓ (2)

1.5 Normal: 4,5 mmol/ℓ

Low: 4,3 mmol/ℓ

Difference = 4,5 – 4,3 ✓

= 0,2 mmol/ℓ ✓ (2)

1.6 When the blood glucose concentration is too high, it is lowered by insulin ✓ and when it is too low, it is increased by glucagon. ✓ (2)

1.7

Meal eaten: blood glucose increases

↓

pancreas: ✓ β cells ✓ in Islets of Langerhans: ✓ insulin ✓

↓

blood ✓

↓

liver: ✓ convert glucose to glycogen ✓

↓

blood glucose decreased ✓ (any 6)

1.8 The glucose concentration in the blood is not so high after lunch ✓ (1)

.....

[17]

Worksheet 3

A Increases ✓

B Pituitary ✓

C ADH ✓

D Renal ✓

E Less ✓

F Less ✓

G Capillaries ✓

H Dilute /low ✓

I Large /high ✓

J Decreases ✓

[10]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

1.1 Chemoreceptors

1.2 Hyperthermia

1.3 Adrenal

1.4 Tissue fluid

1.5 Intercostal

1.6 Glucagon

[6]

Question 2

2.1 36,5 ✓ °C ✓ (2)

2.2 15 min. ✓ (1)

2.3 Highest: 12:15 or 12:20 ✓

Lowest: 12:25 or 12:30 ✓ (2)

| | | |
|-----|---|-----|
| 2.4 | End of race: 38°C Lowest: 35,5°C $\% \text{ decrease} = \frac{\text{Difference}}{\text{First}} \times 100 \checkmark$ $= \frac{38 - 35,5 \checkmark}{38 \checkmark} \times 100 \checkmark \quad \text{OR} \quad \frac{2,5 \checkmark}{38 \checkmark} \times 100 \checkmark \text{ ---}$ $= 6,58 \checkmark \% \checkmark$ | (6) |
|-----|---|-----|

2.5 Blood vessels in the skin dilate (vasodilation). ✓

Therefore more blood ✓ flows through them to the surface of the skin, ✓ from which the heat in the blood ✓ is radiated (lost) to the outside. ✓ (any 4)

2.6 Carbon dioxide concentration increases. ✓ (1)

2.7 Medulla oblongata ✓ sends nerve impulses ✓ to the diaphragm ✓ and intercostal muscles ✓ to increase the rate ✓ and depth of breathing. ✓ The heart also beats faster. ✓ Carbon dioxide-rich blood is pumped to the lungs ✓ to be exhaled. ✓ (any 6)

.....

[22]

[Total: 28]

Topic 7 Answers

Worksheet 1

1.

1.1 Auxin (1)

1.2 Phototropism: growth movement ✓ in plants in response to light. ✓ (2)

1.3 Positively phototropic (1)

1.4 Seedling A grows towards the light. (1)

1.5 Auxin is produced in the tip of the stem ✓ and moves downwards. ✓

The tip is covered and does not have the light stimulus. ✓

Seedling grows straight up. ✓ (4)

1.6 Seedling C would grow towards the light. (1)

1.7 The tip of the seedling would receive light from the right. ✓

Auxins would move to the left. ✓

High concentration of auxins cause cell elongation on the left. ✓ (3)

1.8 Auxins moved from the tip of the seedling ✓ and through the strip of gelatine ✓ (2)

.....

[15]

Worksheet 2.

1.1 Gibberellin concentration (1)

1.2 Percentage of seeds that germinated (1)

1.3 Same species of seeds (radish), ✓ 15 seeds used at each concentration, ✓ same time period (2 weeks), ✓ constant temperature, same laboratory ✓ (any 3)

1.4 At 1 500 mg/ℓ gibberellin: 80% germination

$$0,8 \times 15 \checkmark = 12 \checkmark$$

$$\text{OR: } 80 / 100 \times 15 \checkmark = 12 \checkmark \text{ (2)}$$

1.5 The higher the gibberellin concentration, ✓ the more seeds germinate, ✓ up to 1 000 mg/ℓ, ✓ which is the optimum concentration. ✓

After that the concentration is too high ✓ and seed germination starts being inhibited. ✓ (any 4)

1.6 Tips of stems ✓ and roots ✓ (2)

1.7 Gibberellins can be used to stimulate root growth ✓ so that plants can absorb more water and minerals from the soil. ✓

Roses (or other flowers) with long stems can be produced. ✓

Gibberellins stimulate the development of flowers, ✓ therefore plants can be treated with gibberellins to produce more flowers ✓ or to produce flowers throughout the year. ✓ (any 3)

.....

[16]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

1.1 C

1.2 A

1.3 D

1.4 C

[2 x 4 = 8]

SECTION B

Question 2

2.1 Geotropism or gravitropism (1)

2.2 Gravity (1)

2.3 Root: it grows down into the soil ✓ so that it can absorb water ✓

Stem: it grows up and away from the soil (towards the sun) ✓ so that photosynthesis can take place ✓ (4)

2.4 Auxins ✓ move to the lower side of the root ✓ due to gravity. ✓

The auxin concentration is too high in the lower part of the root ✓ which inhibits cell elongation. ✓

The auxin concentration is lower in the upper part of the root. ✓

This stimulates cell elongation. ✓

As a result of this uneven growth, ✓ the root curves down. ✓ (any 7)

.....

[13]

Question 3

3.1 Mechanical ✓ and chemical ✓ (2)

3.2

3.2.1 Abscisic acid (1)

3.2.2 Auxin (1)

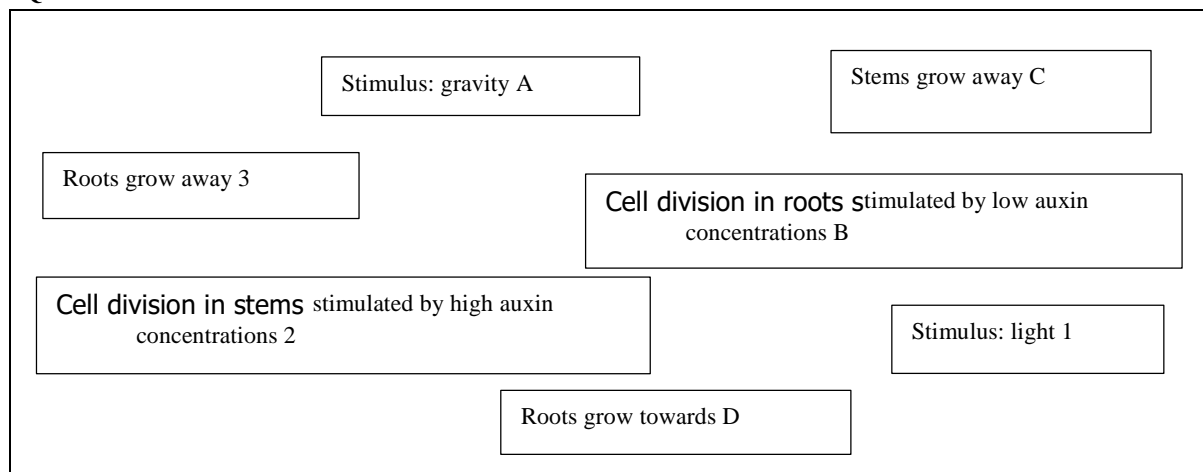
3.3 As the growing season progresses, the trees need ethylene gas to stimulate the ripening of the fruit ✓ and when the fruit are ripe, they must fall from the tree (abscission) ✓ (2)

3.4 Herbivores damage the tree, ✓ it loses leaves, which it needs for photosynthesis. ✓ Pathogens can enter the plant at the damaged parts. ✓ (any 2)

.....

[8]

Question 4



.....

[7]

[Total: 36]

Worksheet 3.

1.1 Artificial selection ✓

Horse breeders decide ✓ which characteristic they want (fast) ✓

Horses run at different speeds (genetic variation). ✓

Breeders only use fast mares and stallions to breed. ✓

The gene(s) for speed are transferred to their offspring. ✓

Result: faster horses. ✓

The frequency of the gene(s) for speed increases in the population. ✓

Important: it is the breeders that decide which characteristic is the most beneficial (8)

1.2 Natural selection ✓

Genetic variation with regards to running speed exists in a zebra population. ✓

Zebra that run faster are less likely to be caught by predators. ✓

Their fitness is high: ✓ they survive and reproduce. ✓

The gene(s) for speed are transferred to their offspring. ✓

Result: faster zebras ✓

The frequency of the gene(s) for speed increases in the population. ✓

Important: it is the environment that determines which characteristic is beneficial. (7)

.....

[15]

2.1 Human ✓

Gorilla ✓

Chimpanzee ✓ (3)

| Organism | DNA sequence |
|-----------------|---|
| Common ancestor | A G G C C G G C T C C A A C C A G G C C |
| Human | A G G C A T A A A C C A A C C G A T T A |
| Gorilla | A G G C C C C T T C C A A C C A G G C C |
| Chimpanzee | A G G C C C C T T C C A A C C G A T T A |

| Organism | DNA sequence |
|-----------------|---|
| | Human Gorilla |
| Common ancestor | A G G C C G G C T C C A A C C A G G C C |
| Human | A G G C A T A A A C C A A C C G A T T A |
| Gorilla | A G G C C C C T T C C A A C C A G G C C |
| Chimpanzee | A G G C C C C T T C C A A C C G A T T A |

2.2.1 50% ✓

2.2.2 85% ✓

2.2.3 60% ✓

2.2.4 50% ✓

2.2.5 75% ✓

2.2.6 75% ✓ (6)

2.3 Gorilla and chimpanzee ✓ (1)

2.4 The other primates shared a common ancestor longer ago. ✓ (1)

.....

[11]

Worksheet 4.

1.1 *Australopithecus afarensis* (1)

1.2 *Homo heidelbergensis* ✓

(1)

1.3 Family tree A: *Homo habilis* and *Australopithecus boisei* occurred at about the same time ✓

Family tree B: *Homo habilis* occurred later than *P. boisei* ✓ (2)

1.4 *Homo erectus* migrated out of Africa ✓

Some did not occur in Africa: ✓

Homo mauritanicus (*antecessor*) ✓

Homo neanderthalensis, ✓ *Homo floresiensis*, ✓ *Homo heidelbergensis*, ✓ *Homo georgicus* ✓ (any 2)

.....

[6]

Worksheet 5

1.1 Shape of shell ✓

Length of neck ✓ (2)

1.2 Hood Island: the plants that the tortoises use as food are taller. ✓

The Isabela Island tortoises have short necks, ✓ therefore they will not be able to reach the food. ✓

Consequently, they will die of starvation. ✓ (4)

1.3 Water (the sea) ✓ (1)

1.4 Mountain, river, canyon (any 2)

1.5 A genetically diverse population ✓ becomes separated by a geographic barrier.

Each part of the population experiences different selection pressures ✓ in the environment ✓ of the island where they occur.

They will adapt to these conditions. ✓ After many generations (a long time), ✓ the tortoises have become so different ✓ that they cannot mate. ✓ (any 5)

1.6 Mating and courtship rituals ✓

Breeding seasons ✓

Incompatible reproductive organs, gametes and chromosomes ✓

Infertile offspring ✓ (any 2)

.....

[16]

Worksheet 6.

1.1 Diagram A: Prophase ✓ I ✓

Diagram B: metaphase ✓ I ✓

Diagram C: metaphase ✓ II ✓ (6)

1.2 Crossing over: ✓

Non-sister chromatids ✓ of homologous pairs of chromosomes ✓ cross over at chiasmata. ✓

Parts of these chromatids are exchanged between chromosomes. ✓

Each gamete receives a different daughter chromosome ✓ at the end of meiosis. (any 4)

1.3 Every pair of homologous chromosomes ✓ or chromosomes ✓ assort independently ✓ from each other pair.

They align at the equator ✓ in an unpredictable ✓ and different way ✓ each time meiosis takes place during the formation of gametes. All gametes are therefore different. ✓ (any 4)

1.4 Random mating ✓ Random (chance) fertilisation ✓ (2)

1.5 Natural selection can take place. ✓ The population can adapt to the changing environmental conditions ✓ and not become extinct. ✓ (any 2)

.....

[18]

Worksheet 7.

1.1 Out of Africa (1)

1.2 *Homo erectus* (1)

1.3 No evidence (fossils) of early humans that lived before *Homo erectus* have been found outside of Africa, ✓ while *H. erectus* fossils have been found in Africa ✓ and other places. ✓ (3)

1.4 Mutations ✓ that occur on the Y chromosome ✓ can be used to trace males in families. ✓ Y chromosomes are passed on

directly (unchanged) from men to their sons. ✓ They are not involved with crossing over, ✓ because they do not have homologous partners. ✓ (any 4)

1.5 Mitochondrial DNA is passed on maternally (from mothers to their children), ✓ independently from nuclear DNA. ✓ It is also transferred directly (without crossing over). ✓ Mutations ✓ can be used to trace the female line of a family. ✓ (any 3)

.....

[12]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

1.1 C

1.2 D

1.3 B

1.4 A

1.5 A

[2 x 5 = 10]

Question 2

2.1 Punctuated equilibrium

2.2 Geographical barrier

2.3 Non-opposable

2.4 Cradle of Humankind

2.5 *Homo habilis*

[5]

Question 3

3.1 B only

3.2 A only

3.3 both A and B

3.4 none

3.5 none

[2 x 5 = 10]

Question 4

4.1 Ape:

Skull B ✓

Pelvis A ✓

Foot C ✓

Australopithecus africanus:

Skull A ✓

Pelvis C ✓

Foot B ✓

Homo sapiens:

Skull C ✓

Pelvis B ✓

Foot A ✓ (9)

4.2

4.2.1 Skull C: foramen magnum is below the skull ✓

4.2.2 Foot B: big toe is in line with the other toes ✓ (2)

4.3 See further: ✓ predators and food

More energy-efficient (requires less energy) ✓

Body does not overheat easily ✓
 The hands are free for various activities (carry, use tools) ✓ (any 2)

4.4 Table not required, given for ease of marking and comparison

| Skull B | Skull C |
|--|---|
| Jaw: two sides are parallel ✓ | Jaw: in a more gentle curve (sides not parallel) ✓ |
| Teeth: sharp incisors ✓ Large canines ✓ | Teeth: all the teeth about the same size ✓ Small canines ✓ |
| Diet: contains a lot of meat ✓ | Diet: more plant matter ✓ Softer (cooked) food ✓ (9) [22] |

Question 5

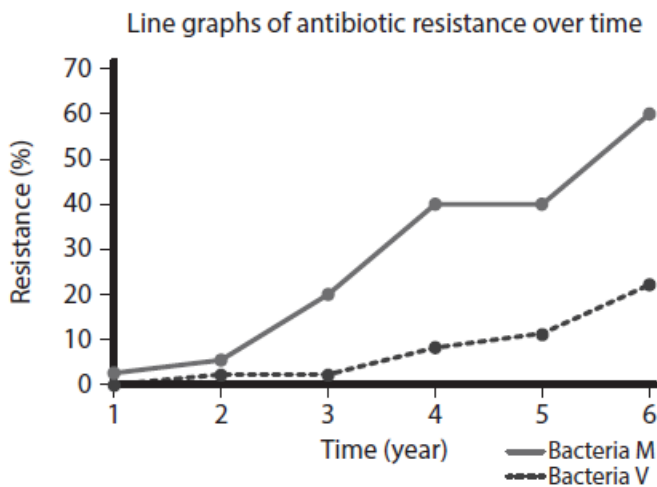
5.1

5.1.1 Resistance ✓

5.1.2 Year ✓

(2)

5.2



Mark allocation:

Heading, including both variables (resistance and time): 1

Type of graph: line graphs on one set of axes: 1

Graphs labelled: 1

X-axis: Title (time), unit (year) and scale: 1

Y-axis: Title (resistance), unit (%) and scale: 1

Plotting:

9–12 points plotted correctly: 2; OR

1–8 points plotted correctly: 1; OR

No points plotted correctly: 0

(7)

5.3 The percentage resistance doubled. ✓ (1)

5.4 From year 5 to year 6 ✓ (1)

5.5 When the study was started a bit more of Bacteria M was resistant. ✓

The resistance of Bacteria M increased faster ✓ and more ✓ than that of Bacteria V.

The resistance of bacteria M doubled between year 3 and 4, ✓ while this only happened between year 5 and 6 for Bacteria V. ✓

For Bacteria V the resistance remained constant (at 2%) between year 2 and 3, ✓ whereas the resistance was constant for year 4 and 5 for Bacteria M. ✓ (any 4)

5.6 There is genetic variation ✓ in the bacteria population, therefore all the bacteria are not exactly the same. ✓
Some are susceptible ✓ while others are resistant to the antibiotic. ✓ Antibiotic resistance would be a useful characteristic. ✓
The resistant bacteria are not destroyed by the antibiotic, ✓ they reproduce ✓ and pass on this characteristic to their offspring. ✓
As this continues the proportion of the population that is resistant will increase. ✓ (any 7)

.....

[22]

[Total: 69]

Topic 9 Answers

Worksheet 1

1.

1.1 Greenhouse gases form a layer (blanket) in the atmosphere ✓ that traps heat ✓ and prevents it from escaping from the atmosphere. ✓ (any 2)

1.2 It ensures that the temperature of the Earth is high ✓ enough to sustain life. ✓ (2)

1.3 Greenhouse effect: reduced, ✓ because less methane is produced. ✓

Food security: increased, ✓ more rice is being produced. ✓

Water availability: increased, ✓ less water is used in the rice paddies. ✓ (6)

.....

[10]

2.

2.1 12 353 ✓ (1)

2.2 USA, China, Russia, India, SA ✓ (1)

2.3 SA generates a lot of electricity in coal-fired power stations. ✓ Combustion of coal releases carbon dioxide. ✓

There are many vehicles in SA. ✓ Combustion of fuel releases carbon dioxide. ✓

There are many industries ✓ which emit pollutants, including carbon dioxide. ✓ (any 2: 3)

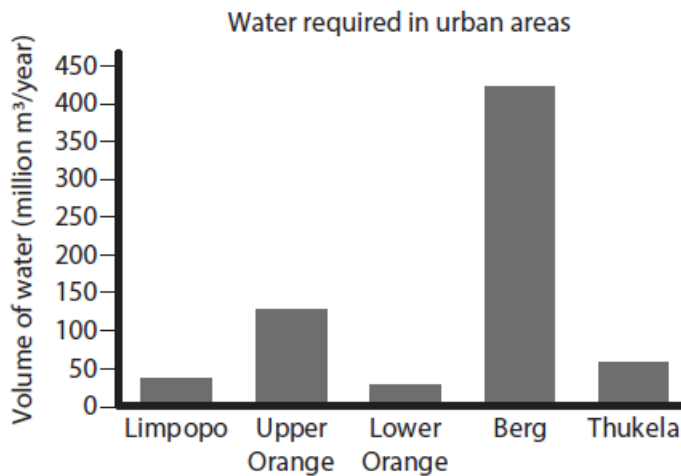
.....

[6]

Worksheet 2

1.1 Bar graph of the volume of water required in urban areas of the different water management areas.

Heading of graph: Volume of water required in urban areas of the different water management areas



Label x-axis: Water management areas

Mark allocation:

Heading: including both variables (volume and urban area): 1

Correct type of graph: bar graph: 1

X-axis: title (water management area) and spacing: 1

Y-axis: title (volume), unit (million m³/ year) and scale: 1

Plotting: all 5 bars correct: 2; OR

1–4 bars correct: 1; OR

0 correct: 0 (6)

1.2

1.2.1 Thukela: Most: Irrigation ✓ Least: Rural ✓ (2)

1.2.2 Limpopo: Most: Irrigation ✓ Least: Industries ✓ (2)

1.3 More water is required for irrigation than for industries. ✓ (1)

1.4 Limpopo: 14 million m³/ year

Lower Orange: 9 million m³/ year

Difference: 14 - 9 ✓ = 5 ✓

= 5 million m³/ year ✓ (3)

1.5..... (5)

For Berg:

Urban: 423 million m³/ year

Rural: 14 million m³/ year

% decrease = Difference x 100 ✓

$$= \frac{\text{First}}{14} \times 100 \quad \checkmark$$

$$= \frac{423 - 14}{14} \times 100 \quad \checkmark$$

$$= 2921 \quad \checkmark \quad \% \quad \checkmark$$

1.6 There has been an influx of people ✓ into the Western Cape (WC) ✓ from other parts of the country. ✓

The urban population of the WC has increased ✓ over the time period. Much more water ✓ would be required in 2018. (any 3)

1.7 It might be true, ✓ because more water is used in the Lower Orange for irrigation than in Thukela. ✓ However, as the Lower Orange is in a drier part of the country, the more crops need irrigation. ✓ It does not rain frequently, ✓ therefore crop farming will not be successful. ✓ It rains more and more frequently in the Thukela region (KwaZulu Natal). ✓ The crops do not need to be irrigated so much. ✓ (any 5)

.....

[27]

Worksheet 3

1.1 More food is lost or wasted by production to retailing than by consumers. ✓

Consumers in less developed regions waste much less food than consumers in more developed regions. ✓

OR Consumers in more developed regions waste much more food than consumers in less developed regions. ✓ (2)

1.2 Europe:

Consumers: 90 kg/year

Production to retailing: 190 kg/year

Total waste = 90 + 190 = 280 kg/year ✓

$$\frac{90}{280} \times 100 \quad \checkmark$$

$$= 32,1 \quad \checkmark \quad \% \quad \checkmark$$

Sub-Saharan Africa:

Consumers: 10 kg/year

Production to retailing: 155 kg/year

Total waste = 10 + 155 = 165 kg/year ✓

$$\frac{10}{165} \times 100 \quad \checkmark$$

$$= 6,1 \quad \checkmark \quad \% \quad \checkmark$$

(8)

1.3 Food produced: 460 kg/year

Food lost: 50 kg/year + 200 kg/year ✓

$$= 250 \checkmark \text{ kg/year } \checkmark$$

Food consumed:

$$460 \text{ kg/year} - 250 \text{ kg/year } \checkmark$$

$$= 210 \text{ kg/year } \checkmark \text{ (5)}$$

1.4 Consumers might buy more food than they can consume while it is fresh enough. \checkmark They might not be able to keep it fresh.
 \checkmark They might throw food away if it is left over from a meal, \checkmark they do not keep it to eat it later. \checkmark (any 2)

1.5 glass, plastic, paper, aluminium cans (any 3)

1.6 Recycling reduces the amount of raw materials that is required to make a product. \checkmark

Recycling reduces the amount of solid waste (land pollution) \checkmark (2)

.....

[22]

Worksheet 4.

1.1

1.1.1 Gas A: Carbon dioxide (CO₂) (1)

1.1.2 B: 17% (1)

1.1.3 C: cows, sheep, swamps, rice paddy fields, natural gas leakage, rubbish dumps, landfill sites and water treatment works (any 2)

1.1.4 D: fridges, foams, aerosol sprays, solvents (any 2)

1.2 Pie chart (9)

Calculations of sectors for pie chart.

$$\text{Carbon dioxide: } \frac{53}{100} \times \frac{360}{1} = 190.8^\circ/191 \checkmark$$

$$\text{Methane: } \frac{17}{100} \times \frac{360}{1} = 61^\circ \checkmark$$

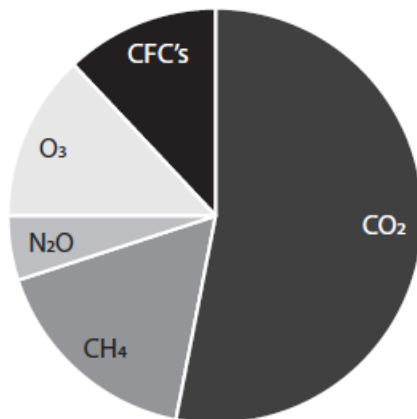
$$\text{Nitrous oxide: } \frac{5}{100} \times \frac{360}{1} = 18^\circ \checkmark$$

$$\text{Ozone: } \frac{13}{100} \times \frac{360}{1} = 47^\circ \checkmark$$

$$\text{CFC: } \frac{12}{100} \times \frac{360}{1} = 43^\circ \checkmark$$

(5)

Pie chart of % gases that contribute to Green House Effect



Mark allocation:

Type of graph: pie chart: 1

Heading, including both variables (percentage and gases): 1

Plotting:

3–5 correct: 2; OR

1–2 correct: 1; OR

0 correct: 0 (4)

1.3 No ✓

Holes have developed in the ozone layer ✓ (2)

1.4 Ozone protects life on Earth against the harmful ultraviolet rays of the Sun. (1)

[18]

Worksheet 5

1.1 Metal ✓ (1)

1.2 Paper ✓ (1)

1.3 17 ✓ (1)

1.4 Glass ✓. (1)

1.5 Paper:

Highest: D: 31%

Lowest: A: 5%

Difference: $31 - 5$ ✓

$= 26$ ✓ % ✓ (3)

1.6 Country A, B, C ✓ (1)

1.7 Country D ✓ (1)

1.8 Paper makes up the highest percentage of their waste. ✓ Their percentage paper is far higher than in any other country ✓ or globally. ✓ (any 2)

1.9 Countries B, C and D ✓ (3)

1.10 Organic waste: egg shells, vegetable and fruit peels and remains, garden refuse, tealeaves, coffee grounds, food (any 3)

1.11

1.11.1 **Glass:** $3 + 3 + 5 + 7$ ✓

$= 18$ ✓

$18 \div 4$ ✓

$= 4,5\%$ ✓ (4)

1.11.2 **Paper:** $5 + 9 + 14 + 31$ ✓

$= 59$ ✓

$59 \div 4$ ✓

$= 14,75\%$ ✓ (4)

1.12 Both are lower ✓ than the global percentage. (1)

.....

[26]

EXAM-TYPE QUESTIONS – MEMORANDUM

SECTION A

Question 1

1.1 D

1.2 A

1.3 C

[2 x 3 = 6]

Question 2

- 2.1 none
- 2.2 both A and B
- 2.3 A only
- 2.4 none

[2 x 4 = 8]

SECTION B

Question 3

- 3.1 A wetland is an area that is covered by water for all or part of the year. ✓ (1)
- 3.2 Water flows into and out of the wetland. ✓ In the process the flow rate of the water is decreased, ✓ thereby decreasing flooding. ✓ Water is stored ✓ and filtered in the wetland. ✓ Pollutants are removed from the water ✓ as it slowly ✓ flows through the wetland. (any 5)
- 3.3 Decrease in biodiversity, ✓ as plants, animals and their habitats will be lost. ✓ It might even lead to extinction. ✓ Crop farming is usually a monoculture, ✓ which means that there is mostly one species ✓ in the area. (any 3)
- 3.4 Food security will increase. ✓
More farmland is created where food can be produced. ✓

OR

- Food security will decrease. ✓
- Some people might have caught fish in the wetland and have now lost that source of food. ✓ (2)

.....

[11]

Question 4

- 4.1 Having access to enough food ✓ on a daily basis ✓ to ensure healthy living. ✓ (3)
- 4.2 floods, droughts, infertile soil, erosion, desertification or alien invaders (any 3)
- 4.3 Highest: Western Cape: 84%
Lowest: Eastern Cape: 64%
Difference: $84 - 64 = 20$ ✓ % ✓ (3)
- 4.4 $84 + 78 + 64 + 71 + 72 + 81 + 69 + 70 = 589$ ✓
 $589 \div 8 = 73,63$ ✓ % ✓ (4)
- 4.5 People in Gauteng might be more affluent ✓ and be able to afford food. ✓ Food might be cheaper ✓ and more accessible. ✓ (any 2)
- 4.6 Overgrazing is when too many animals (higher than carrying capacity) are allowed to feed in a particular area. ✓ They remove many plants ✓ and do not give the plants the opportunity to re-grow ✓ and reproduce. ✓ (any 2)
- 4.7 Initially it increases food security, ✓ because there are many animals to provide food. ✓ However, as the vegetation (environment) gets damaged, the area cannot sustain so many animals, or none at all. ✓
A smaller number of animals are available, ✓ which decreases food security. ✓ (any 3)

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[20]

Question 5

- 5.1 Poaching is the illegal ✓ killing of animals. ✓ (2)
- 5.2 pets, ✓ skins, ✓ meat, ✓ ornaments, ✓ status symbols ✓ (any 2)
- 5.3 The numbers of the animal that is poached decreases. ✓ The animal is part of a food web and other organisms might depend on it for their survival. ✓ The poached animal might provide food for another animal, ✓ which will now lose a source of food. Just removing one animal species from an ecosystem already decreases the biodiversity. ✓ As a result of its interactions with other organisms, ✓ further losses in biodiversity might occur. ✓ (any 4)
- 5.4 Deforestation (1)
- 5.5 wood ✓ for furniture, ✓ building, ✓ paper ✓ or fuel ✓ mining, ✓ building roads ✓ (any 2)
- 5.6 Old animals might be beyond their reproductive years. ✓ They are not giving birth to offspring to ensure that the population grows. ✓ They have already made a contribution to the population. ✓ (any 2)
- 5.7 Human population is bigger, ✓ so more resources are required. ✓ Many people live in poverty and supplement their income by poaching. ✓ There are also many people who have become very affluent and can afford status symbols (like carved

ivory objects). ✓ A greater human population will also need more medication ✓ and there are many who prefer natural products. ✓ (4)

5.8 Resources are used in such a way that it can satisfy current needs ✓ and that it will last for future generations. ✓ (2)

5.9 Only the parts of the plant that is needed should be collected. ✓ The rest of the plant is left intact, so that it can re-grow. ✓ Harvesters should not collect plants in the same area all the time, ✓ as this could cause local extinction of the plant. ✓

There should be limits / quotas for the amount of plant matter that can be collected. ✓ A permit should be required. ✓ Harvesting might be limited to certain seasons / times of the year. ✓

Plants should be grown in nurseries or at home. ✓ (any 5)

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[24]

[Total: 69]