Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2017

LIFE SCIENCES

MARKS: **150**

TIME: **2½ hours**

* J L F S C E *

This question paper consists of 15 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in your ANSWER BOOK.
3. Start the answer to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You may use a non-programmable calculator, protractor and a compass where necessary.
11. Write neatly and legibly.
12. Round off all calculations to two decimals after the comma.

SECTION A

QUESTION 1

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

1.1.1 The fusion of a sperm and ovum is known as …

A fertilisation.
B ovulation.
C implantation.
D ejaculation.

1.1.2 One of the functions of amniotic fluid is that it acts as a …

A shock absorber.
B medium in which secretions take place.
C source of oxygen for the growing embryo.
D medium that absorbs all the excretory products released by the growing embryo.

1.1.3 Which of the following represents the correct order of the parts through which spermatozoa pass?

A Vas deferens ⟶ Prostate gland ⟶ Urethra
B Testes ⟶ Epididymis ⟶ Vas deferens ⟶ Urethra
C Vas deferens ⟶ Seminal vesicle ⟶ Ureter
D Testes ⟶ Vas deferens ⟶ Epididymis ⟶ Ureter

1.1.4 The stages in the development of the human embryo are listed below:

(i) Foetus
(ii) Zygote
(iii) Morula
(iv) Blastula

Which ONE the following represents the correct sequence of human embryonic development?

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

1.1.5 In which part of the human body does spermatogenesis take place?

A Vas deferens
B Epididymis
C Germinal epithelium of seminiferous tubules
D Leydig cells

1.1.6 The hormone that activates testes to produce sperms is …

A oestrogen.
B follicle stimulating hormone.
C luteinising hormone.
D testosterone.

1.1.7 Which ONE of the following is an advantage of the testes being held in the scrotum, outside the body cavity?

A More sperm can be stored in the scrotum.
B Sperm formation is more efficient at temperatures below the normal body temperature.
C The testes are better protected in the scrotum than in the body cavity.
D There is more time for prostate secretions to be added to the sperm.

1.1.8 A pregnant woman was told by a genetic counsellor that her baby had equal chances of having blood type A or blood type AB. This means that the genotypes of the woman and her husband must have been …

A $I^A I^A$ and $I^B i$.
B $I^A I^B$ and $I^B i$.
C $I^A i$ and $I^B I^B$.
D $I^A I^B$ and $I^A i$.

1.1.9 A couple has four daughters. The chances of their fifth child being a son is …

A 20%.
B 50%.
C 100%.
D 80%.

1.1.10 Genetically identical individuals are produced by a process called …

A mutation.
B external fertilisation.
C artificial insemination.
D cloning. (10 x 2) (20)

1.2 Give the correct BIOLOGICAL term for each of the following descriptions. Write only the term next to the question number (1.2.1−1.2.10) in the ANSWER BOOK.

1.2.1 The part of the neuron that conducts impulses away from the cell body

1.2.2 A disorder of the nervous system that is characterised by the breakdown of the myelin sheath of neurons

1.2.3 The part of the autonomic nervous system that tends to slow down organ activity

1.2.4 Condition in which two alleles of a gene have equal expression in the phenotype of an organism

1.2.5 Variation in a characteristic among individuals of a population in which differences are slight and grade into each other

1.2.6 Phase of meiosis in which chromosomes are arranged singly at the equator

1.2.7 The blood vessel that carries oxygenated blood to the foetus

1.2.8 A mistake in the process of meiosis in which the members of a pair of homologous chromosomes, fail to separate

1.2.9 The site of protein synthesis

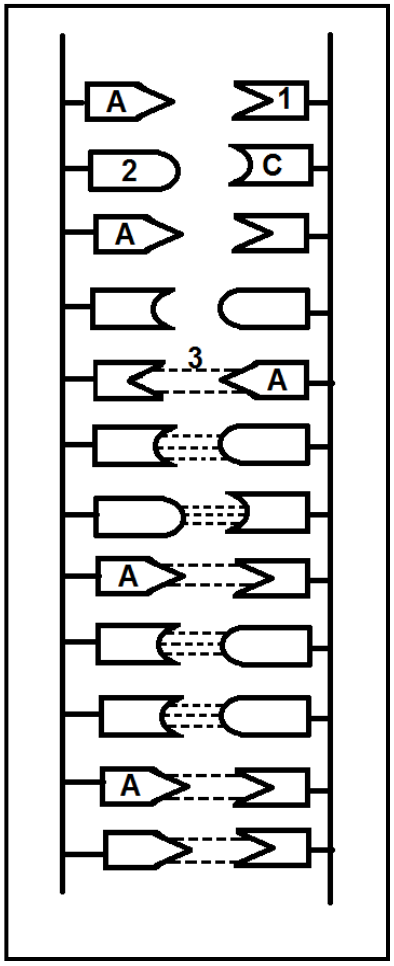
1.2.10 The triplet of bases on t-RNA (10 x 1) (10)

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

	COLUMN I	COLUMN II
1.3.1	A method of reproduction in which the young develop inside the uterus of the mother after the eggs are fertilised internally, receiving nutrients from the mother's blood	A: Ovovivipary B: Vivipary
1.3.2	A kind of fertilisation that always requires water	A: External fertilisation B: Internal fertilisation
1.3.3	The development in birds where the hatchlings can feed themselves soon after being born	A: Precocial development B: Altricial development

(3 x 2) (6)

1.4 The diagram below represents the two strands of a DNA molecule undergoing a certain process before the start of cell division in a human cell.



1.4.1 Name:

(a) Two human cell structures where DNA can be located (2)

(b) The process that is taking place in the above diagram (1)

(c) The period when this process normally takes place in the cell (1)

(d) The monomers of the molecule shown above (1)

(e) The components labelled **1**, **2** and **3** in the diagram (3)

1.5 In peas, round seed shape (R) is dominant to wrinkled seed shape (r), and yellow seed colour (Y) is dominant to green seed colour (y). A pea plant which is homozygous round seed and has green seed colour is crossed with a pea plant that is heterozygous round seed shape and heterozygous yellow seed colour. The cross is represented in a punnet square below:

Gametes	RY	Ry	rY	ry
Ry	RRYy	RRyy	RrYy	Rryy
Ry	RRYy	RRyy	RrYy	Rryy
Ry	RRYy	RRyy	RrYy	Rryy
Ry	RRYy	RRyy	RrYy	Rryy

1.5.1 What is the percentage chances of the offspring being:

(a) Homozygous for round seed (1)

(b) Heterozygous for both seed shape and colour (1)

1.5.2 Give the gametes that resulted in the following offspring:

(a) RRyy (1)

(b) RrYy (1)

1.5.3 Give the phenotype for offspring Rryy. (1)

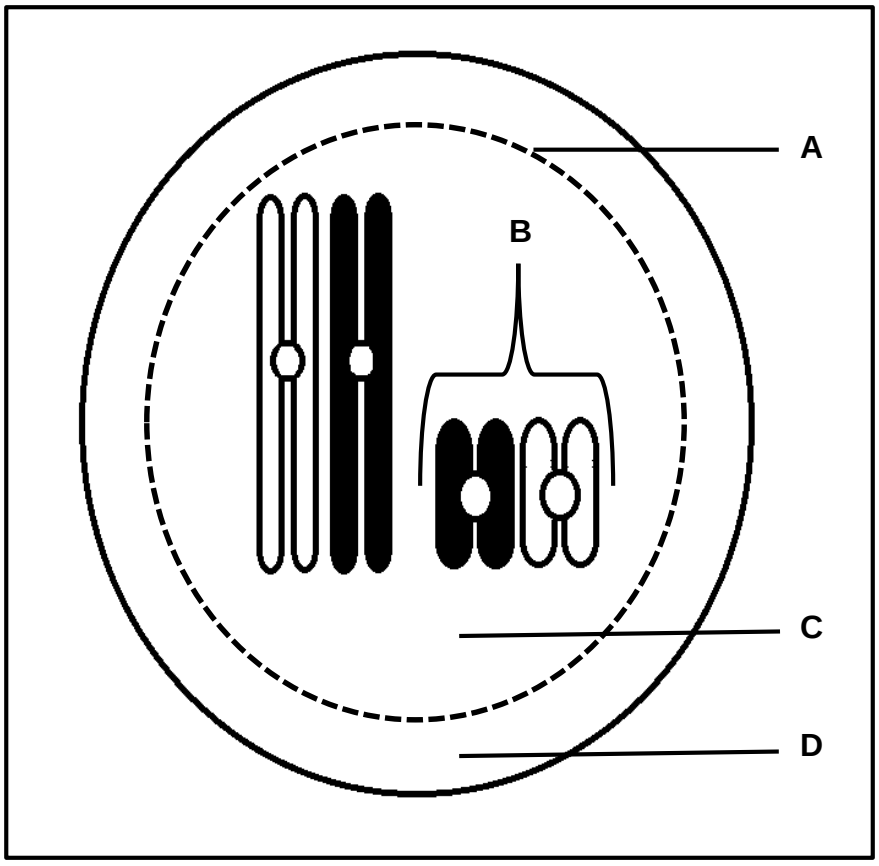
1.5.4 Give the phenotype ratio of offspring from the cross. (1)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents meiotic division in a cell.



2.1.1 Label **A**, **C** and **D**. (3)

2.1.2 Name the phase of meiotic division:

(a) Represented in the above diagram (1)

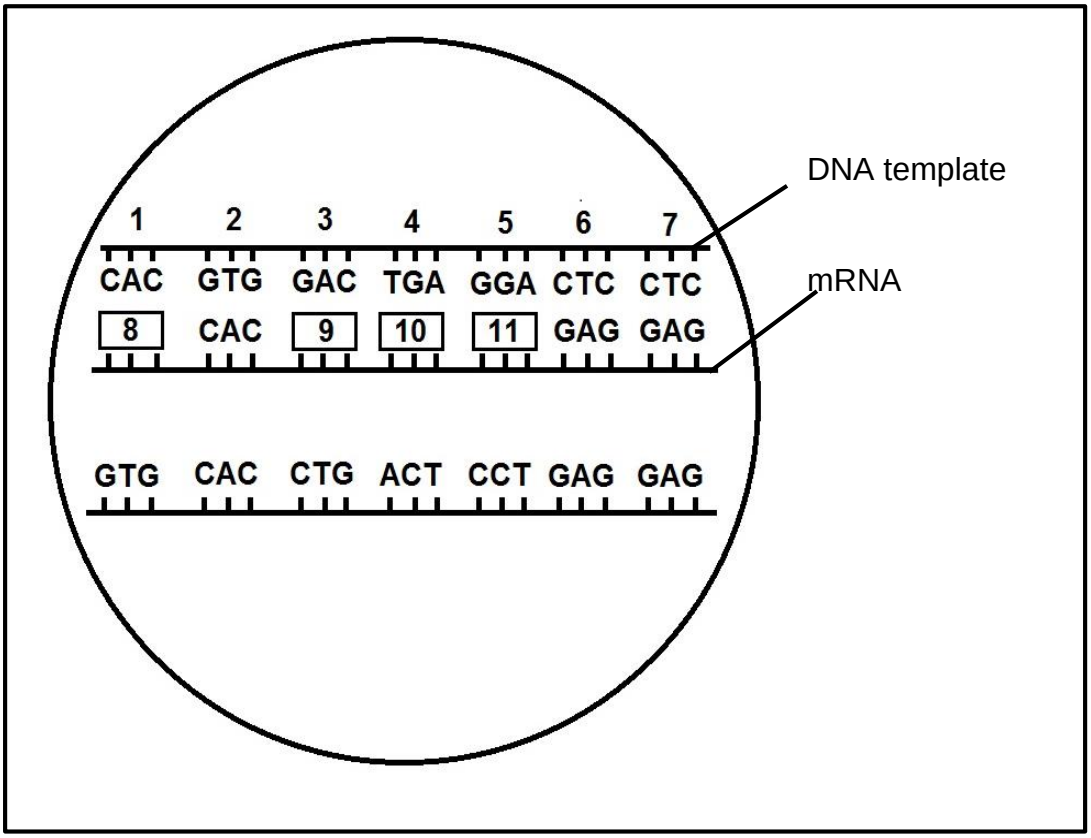
(b) That follows the one represented in the diagram (1)

2.1.3 What is the collective name given to label **B** in the diagram? (1)

2.1.4 What process at **B** leads to variation in the daughter cells produced? (1)

2.1.5 Draw and label a neat diagram of chromosomes at **B** as they appear after the process mentioned in QUESTION 2.1.4. (3)

2.2 The diagram below represents protein synthesis that takes place in a human cell. In the diagram, the first 7 triplets of nitrogenous bases that form part of the gene coding for one chain of the haemoglobin (protein) is represented.



2.2.1 How many of the following are coded for in the DNA template sequence represented in the above diagram:

(a) Nitrogenous bases (1)

(b) Different types of tRNA molecules that are required to form the polypeptide from this piece of DNA (1)

(c) Amino acids (1)

2.2.2 Write down the nitrogen base sequence of mRNA triplets labelled **8–11**. (4)

2.2.3 Using the table below, determine the amino acid sequence coded by triplet number 1 to triplet number 3.

Anticodons on tRNA coding for the amino acid	Amino acid coded for
CUC	Glutamate
GUG	Histidine
GGA	Proline
GAC	Leucine
UGA	Threonine
CAC	Valine

(3)

2.2.4 If the **A** in the **1**st triplet of bases changed to **T** in the DNA template above:

(a) State the type of mutation that has occurred. (1)

(b) Write down the new amino acid (using the table above) that this 1st triplet now codes for. (1)

2.2.5 Explain the effect of mutations on protein synthesis. (3)

2.3 An experiment was conducted to test the effect of light intensity on the diameter of the pupil of the eye. The procedure followed is given below:

- A physically healthy learner with no eye defect, was chosen.
- The diameter of the learner's eye was measured in a dark room with no light intensity (0 lux).
- The learner was exposed to different light intensities and the diameter of the pupil was measured each time.
- All measurements were recorded in a table as shown below.

Light intensity (lux)	Diameter of pupil (mm)
0	7
20	6
50	5,2
400	4
1 000	2

2.3.1 Formulate a hypothesis for this experiment. (2)

2.3.2 State:

(a) The dependent variable (1)

(b) One variable that should be kept constant (1)

2.3.3 Explain why the diameter of the pupil was measured at 0 lux. (2)

2.3.4 Calculate the percentage decrease in the diameter of the pupil from 0 lux to 1 000 lux. (2)

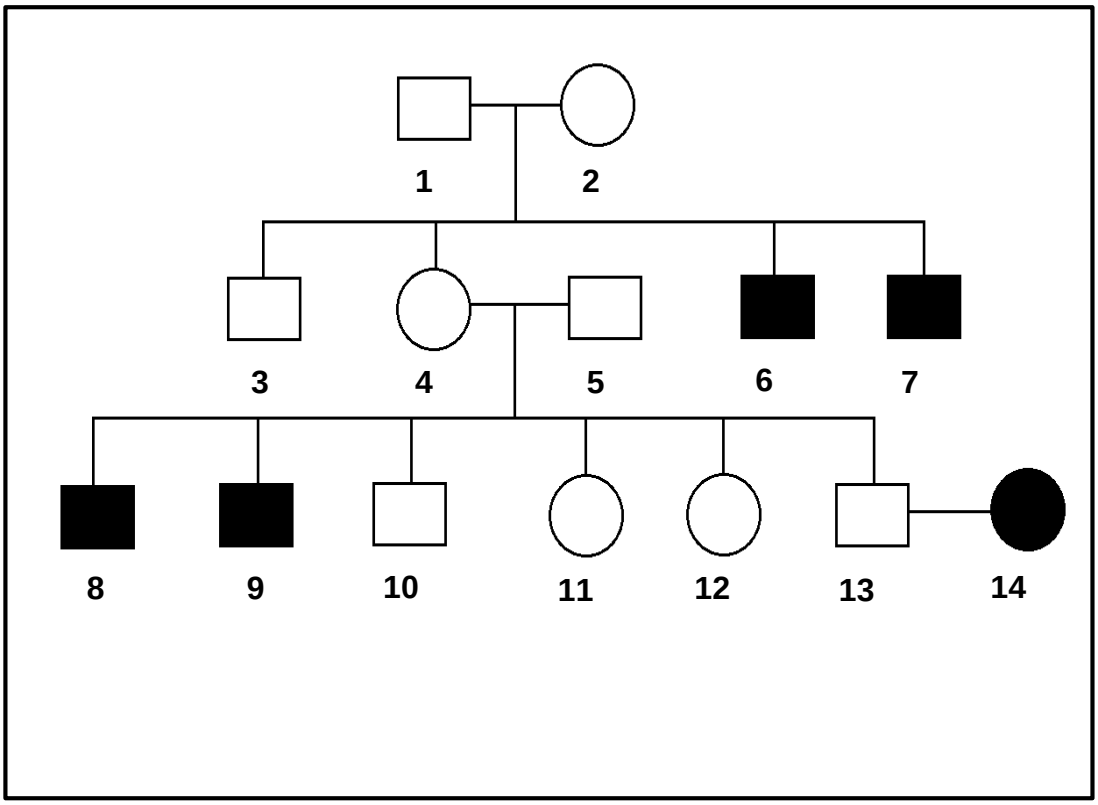
2.3.5 Describe the structural adjustments that take place in the eye when the learner is exposed to a light intensity of 1 000 lux, and the effects of such an adjustment. (4)

2.3.6 Explain the effect of continuous exposure to high intensity light on the retina. (3)

[40]

QUESTION 3

3.1 The pedigree diagram below shows the inheritance of colour blindness in a family. The allele causing colour blindness is represented by X^d and the normal allele is represented by X^D.



3.1.1 Determine the:

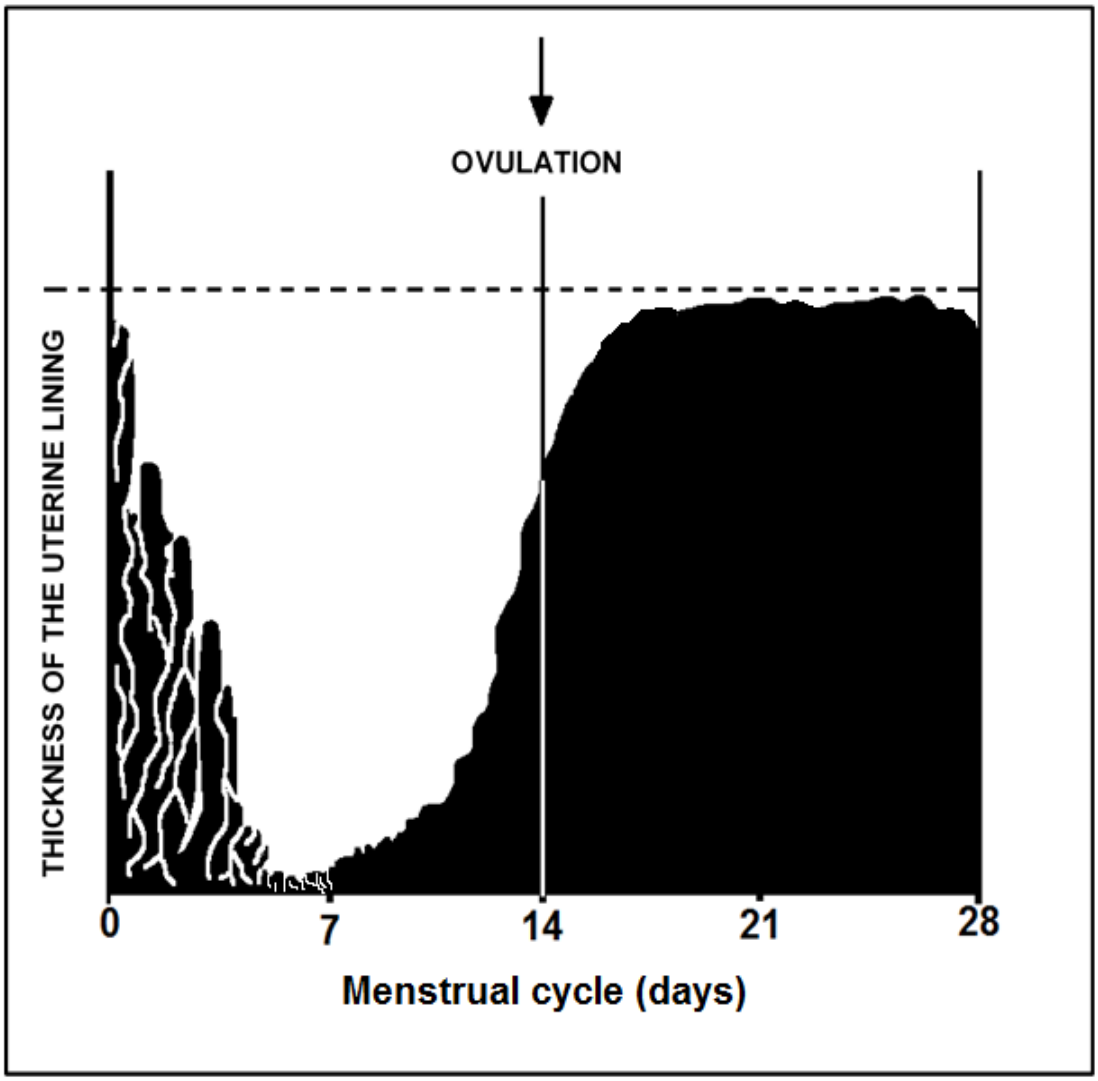
(a) Phenotype of individual **4** (1)

(b) Genotype of individual **2** (1)

3.1.2 Explain why females have a smaller chance of suffering from colour blindness. (3)

3.1.3 Represent a genetic cross to show the percentage chance of individuals **13** and **14** having a colourblind son. (7)

3.2 The diagram below represents the average thickness of the endometrial lining of the uterus over a period of 28 days.



3.2.1 Define the term *menstruation*. (1)

3.2.2 On which day of the menstrual cycle did ovulation occur? (2)

3.2.3 Describe the changes in the thickness of the endometrial lining that took place between the following days:

(a) Between day 0 and day 7 (1)

(b) Between day 7 and day 14 (1)

3.2.4 Explain the role of hormones between the 7th and 21st day of the menstrual cycle. (6)

3.2.5 Explain how the contraceptive injection containing progesterone, administered during the first 5 days of the cycle, prevents pregnancy. (4)

3.3 Read the extract below.

> Genetic engineering involves a process whereby a gene is isolated from one organism and transferred into another organism. This gene can become part of the new host's genome. Usually the gene transfer takes place between organisms from different kingdoms.
>
> For example, a gene from a certain bacterium code for an enzyme that deactivates a herbicide (weed-killer). This gene is isolated from the bacterium and inserted into the chromosome of a crop plant. The resulting plant will now be herbicide-resistant.
>
> Before the products of genetic engineering can be sold, many tests must be done.
>
> Some seed companies have exclusive rights to sell the seeds that they have genetically engineered. Farmers cannot use seeds harvested from the crops that they have grown. Farmers must buy the seeds from the seed companies every time they want to plant the crop.
>
> [Adapted from *Microbiology and Biotechnology*, 1994]

3.3.1 What is meant by the term *genome* referred to in the extract? (1)

3.3.2 State ONE way in which the technique involved in the cloning process differs from the process as described in the extract above. (2)

3.3.3 Give ONE reason why the products of genetic engineering must undergo many tests before they can be sold. (1)

3.3.4 State THREE advantages of genetic engineering in crop production other than those mentioned in the extract above. (3)

3.4 Explain why mitochondrial DNA is used to trace lines of inheritance and genetic linkages between organisms. (6)

[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Konile was riding his bicycle on a straight road towards a traffic junction. He saw the red light at the traffic robot from a distance of 150 m. As he was riding towards the junction, an ambulance came from behind him. Its loud siren caused him to swerve his bicycle towards the left side of the road. Fortunately, he was able to restore his balance instantly to avoid rolling down into a near-by pit.

Describe the changes in his eye that enable him to see the red light at a distance of 150 m. Describe also how he was able to hear the siren, and restore his balance instantly.

Content (17)
Synthesis (3)

NOTE: NO marks will be awarded for answers in the form of flow charts, tables or diagrams.

TOTAL SECTION C: 20
GRAND TOTAL: 150