Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

LIFE SCIENCES

COMMON TEST

JUNE 2017

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 150

TIME: 2½ hours

N.B. 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 answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. ALL drawings should be done in pencil and labelled in blue or black ink.
7. Draw diagrams, flow charts or tables 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.

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

1.1.1 Which ONE of the following CORRECTLY matches a visual defect with its corrective treatment?

A Short-sightedness – biconvex lens
B Cataracts – biconcave lens
C Astigmatism – biconcave lens
D Long sightedness – biconvex lens

1.1.2 The results of offspring obtained in an investigation into the inheritance of wing length in fruit flies are shown in the table below.

WING LENGTH	NUMBER OF FLIES
Long	182
Short	61

Which of the following are the genotypes of the parents?

A LL x ll
B LL x Ll
C Ll x Ll
D Ll x ll

1.1.3 A fragment of DNA has a total of 120 nitrogenous bases and 42 of these bases are thymine.

What is the percentage of cytosine in this fragment?

A 65%
B 18%
C 15%
D 36%

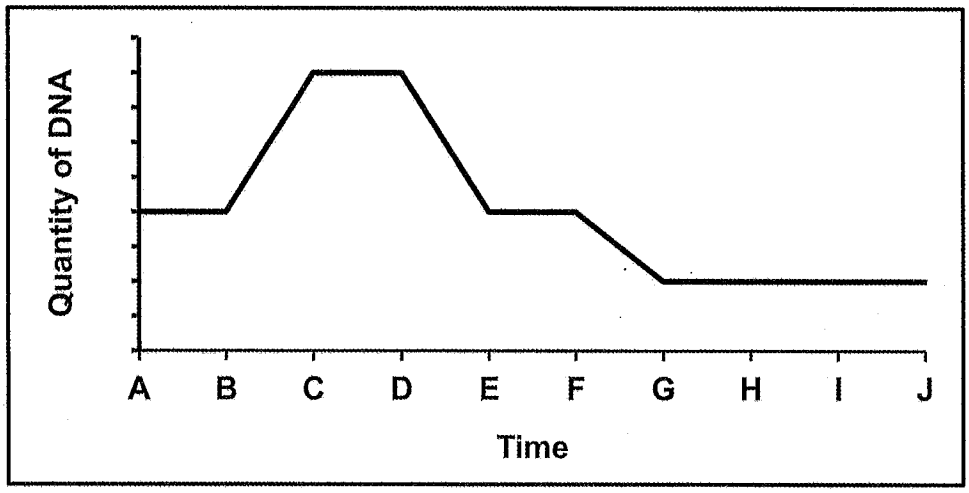
1.1.4 Which combination of reproductive strategies below, applies to birds?

A External fertilization and vivipary
B External fertilization and ovipary
C Internal fertilization and ovipary
D Internal fertilization and ovovivipary

1.1.5 Which one of the following is a DNA nucleotide?

A Deoxyribose, phosphate and uracil
B Deoxyribose, phosphate and adenine
C Ribose, phosphate and guanine
D Ribose, phosphate and thymine

1.1.6 The graph below shows the amount of DNA present in a cell during the process of cell division.



During which time period did meiosis I occur?

A A to D
B C to E
C C to F
D F to J

1.1.7 Study the list of functions below.

(i) Controls voluntary muscle movements
(ii) Controls higher thought processes
(iii) Regulates breathing rate
(iv) Interprets information from the receptors in the skin
(v) Controls involuntary actions

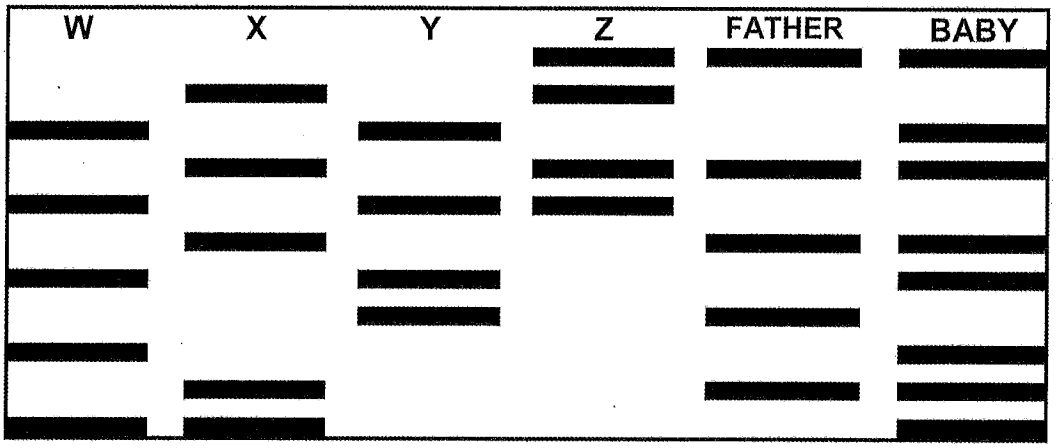
Which ONE of the following combinations of functions applies to the cerebrum?

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

1.1.8 Which part of the reflex arc is probably damaged if the person can feel the stimulus but cannot respond?

A The axon of the motor neuron
B The axon of the sensory neuron
C The dendrite of the sensory neuron
D The cell body of the sensory neuron

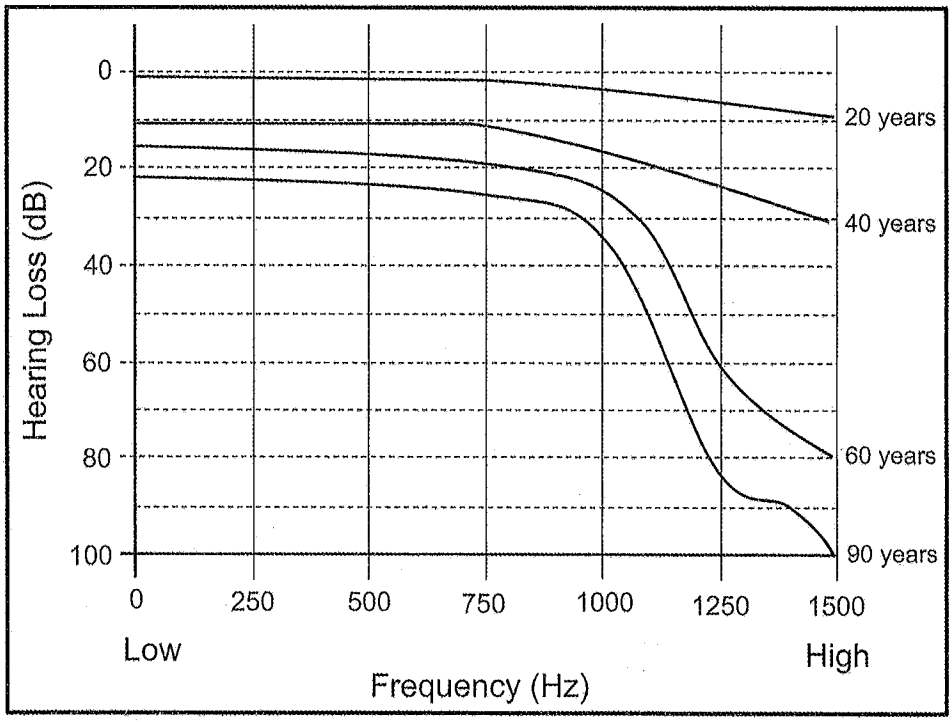
1.1.9 Four women (**W**, **X**, **Y** and **Z**) claim to be the mother of a baby. As part of the investigation, the DNA profiles of all four women, the father and the baby were produced and are provided below.



Based on the DNA profiles, which woman is the mother of the child?

A Woman **W**
B Woman **X**
C Woman **Y**
D Woman **Z**

1.1.10 The diagram below shows the effect of age on hearing ability.



A reasonable conclusion that can be made from this graph is that ...

A younger people have the same ability to hear at all frequencies.
B as people age they can hear higher frequencies better.
C 60 year olds can hear frequencies that younger people cannot hear.
D older people lose the ability to hear higher frequencies.

(10 x 2) **(20)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.7) in your ANSWER BOOK.

1.2.1 The type of bond between the nitrogenous bases of DNA

1.2.2 The organelle involved in the process of translation

1.2.3 The phase during cell division when DNA replication occurs

1.2.4 The division of the cytoplasm during cell division

1.2.5 An egg in which the embryo is protected by a shell

1.2.6 The failure of chromosomes to separate during meiosis

1.2.7 The natural shape of the DNA molecule **(7)**

1.3 Indicate whether each of the statements in COLUMN 1 applies to **A ONLY, B ONLY, BOTH A and B** or **NONE** of the items in COLUMN II. Write **A only, B only, both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Condition causing the lens of the eye to be cloudy	A: Cataracts B: Astigmatism
1.3.2	Small tube inserted into the tympanic membrane to drain excess fluid	A: Eustachian tube B: Grommet
1.3.3	Adult birds catch prey and take it back to the nest for their chicks to eat	A: Precocial deelopment B: Parental care
1.3.4	Allele that determines the phenotype when in a heterozygous condition	A: Dominant B: Recessive

(4 x 2) **(8)**

1.4 The size and colour of seeds in a single species of plant varies.

The allele for big seeds (**B**) is dominant to the allele for small seeds (**b**).
The allele for green seeds (**y**) is recessive to the allele for yellow seeds (**Y**).

Plant **A**, heterozygous for both seed size and colour, was crossed with a Plant **C** which had small, green seeds.

1.4.1 Name the type of genetic cross occurring between plants **A** and **C**. (1)

1.4.2 Write down the genotype of Plant **A**. (1)

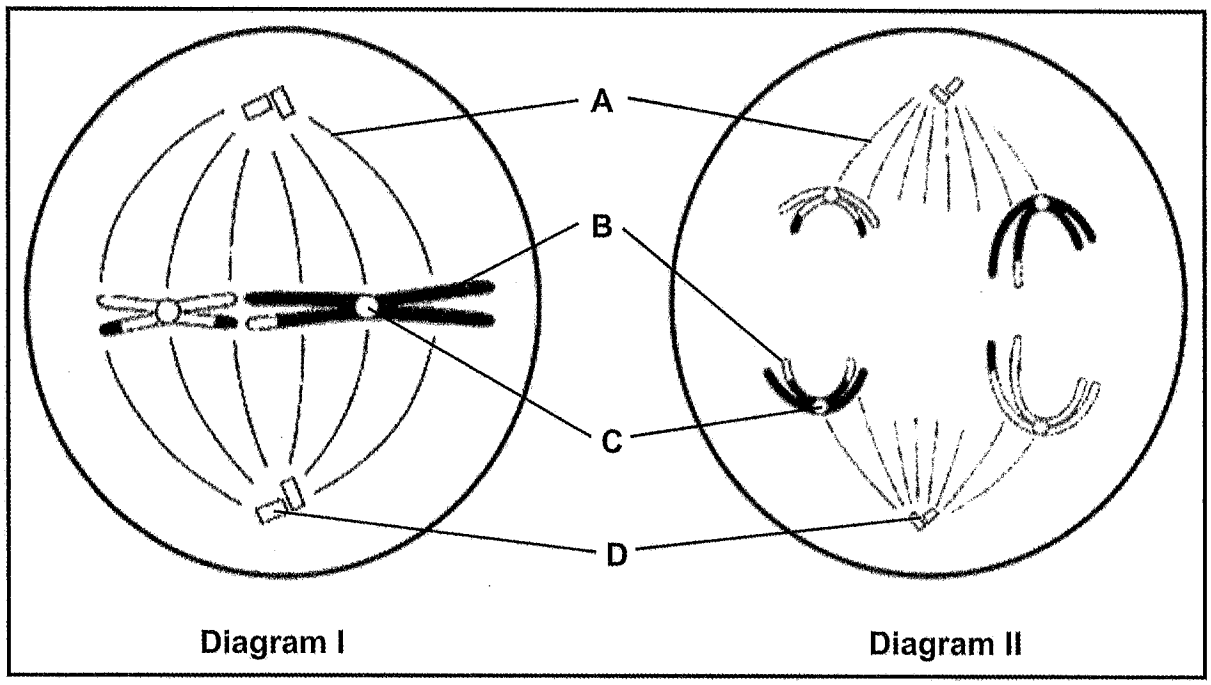
1.4.3 List the genotypes of ALL the possible gametes that could be produced by plant **A**. (2)

1.4.4 What percentage of the offspring from the cross between plant **A** and plant **C** will produce plants with seeds that are small and green? (2)

1.4.5 Give the phenotypic ratio of the offspring if plant **A** is self-pollinated. (2)

1.4.6 Which law of Mendel states that parents can pass on characteristics to their offspring in different combinations? (1)
(9)

1.5 The diagrams below represent phases of meiosis in a cell.



1.5.1 Name the part labelled:

(a) **B** (1)

(b) **C** (1)

1.5.2 Name the phase of meiosis represented in Diagram **I**. (1)

1.5.3 Give ONE visible reason for identifying the phase in Diagram **II** as being a part of meiosis I. (1)

1.5.4 What evidence suggests that crossing over has occurred in this cell? (1)

1.5.5 How many chromosomes will be present in the gametes formed from the cell in Diagram **II**? (1)
(6)

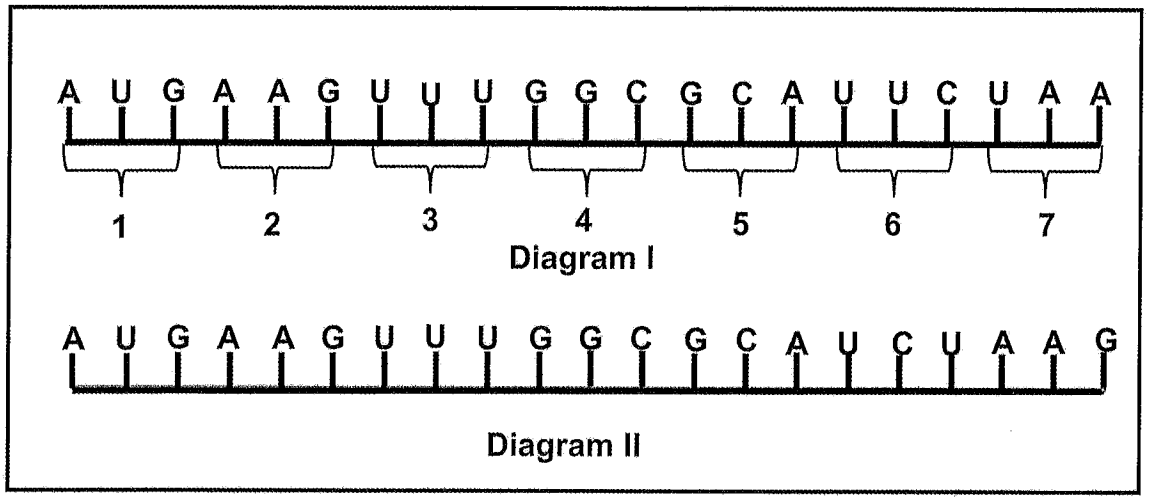
TOTAL SECTION A: [50]

SECTION B

QUESTION 2

2.1 Diagram I below shows the coding pattern on a section of mRNA.

Diagram II shows the same section of mRNA after a mutation has occurred where one nitrogenous base was deleted.



2.1.1 Describe the role of DNA in protein synthesis. (4)

2.1.2 Give each of the following:

(a) DNA base sequence for codon **1**. (1)
(b) Number of the codon where the the deletion occurred. (1)

2.1.3 The table below is an anticodon table for amino acids.

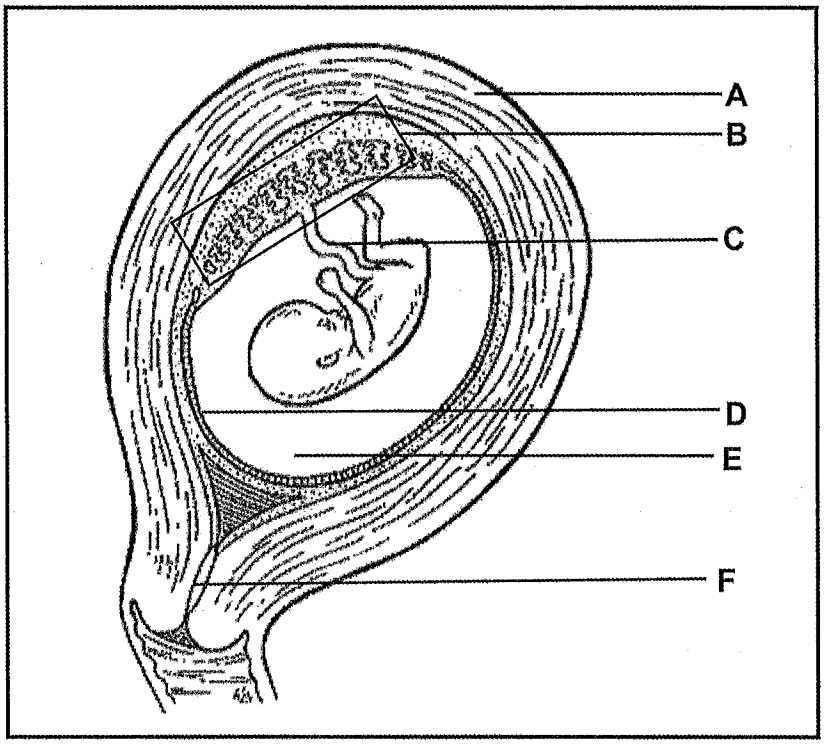
AMINO ACID	ANTICODON	AMINO ACID	ANTICODON
Leucine	CUU; CUC; CUA; CUG	Isoleucine	AUU; AUC; AUA
Histidine	CAU	Glycine	GGU; GGC; GGA; GGG
Lysine	AAA; AAG	Methionine	AUG
Arginine	AGA; AGG	Serine	UCU; UCC; UCA; UCG
Alanine	GCU; GCC; GCA; GCG	Phenylalanine	UUU; UUC

(a) Give the codon for histidine. (1)

(b) Tabulate TWO ways in which the amino acid chain produced by the molecule in Diagram **II** will differ from the one produced by the molecule in Diagram **I**. (5)

(c) State any THREE genetic disorders you studied which are caused by mutations. (3)
(15)

2.2 The diagram below shows a developing foetus inside the uterus of a human female.

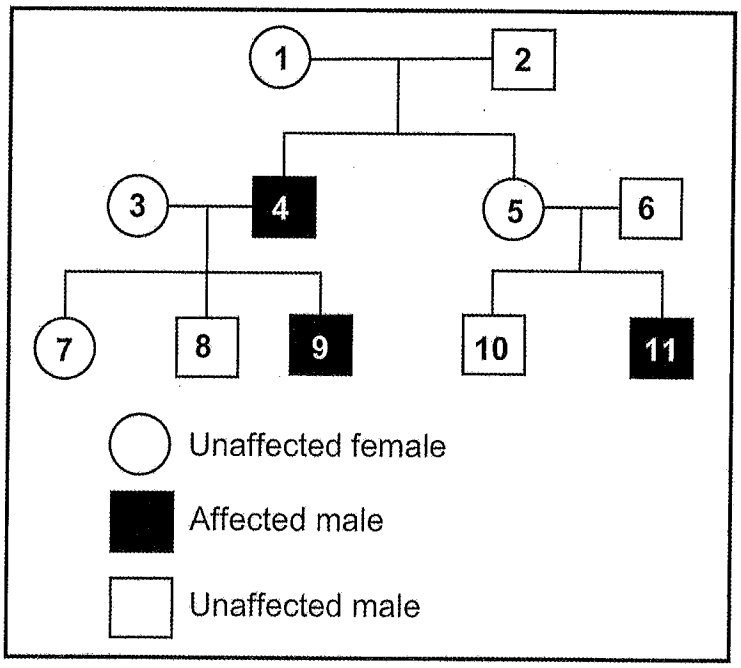


2.2.1 Identify parts **A**, **B**, **E** and **F**. (4)

2.2.2 Describe the feedback mechanism that exists between FSH and the hormone produced by structure **B**. (3)

2.2.3 State why structure **C** must remain attached to the foetus until the baby is born. (3)
(10)

2.3 The pedigree diagram below shows the inheritance of a sex-linked disorder, Icthyosis. Icthyosis is a genetic disorder characterised by dry, scaling skin. Having normal skin (**N**) is dominant to having dry, scaling skin (**n**). A person who has normal skin but who carries the recessive allele is called a 'carrier'.



2.3.1 How many generations of this family are represented in the pedigree diagram? (1)

2.3.2 Give the genotype of:

(a) Individual **4** (2)

(b) Individual **7** (2)

2.3.3 Individual **11** marries a woman who is homozygous for normal skin.

What are the chances that any of their children will be affected by the disease? (2)

2.3.4 Explain why males CANNOT be carriers of the disorder. (3)
(10)

2.4 Coat colour in Agouti rodents is controlled by a single gene with two alleles. The alleles code for brown or white hair. A rodent that is heterozygous has yellow hair.

Investigations into the inheritance of coat colour in these rodents were conducted and the researchers expected to see offspring with brown (**B**), yellow and white (**W**) hair.

The results of the investigation are provided in the table below.

Cross number	Colour of parents	Number of offspring
1	Yellow x Yellow	106 brown : 212 yellow
2	Brown x Yellow	98 brown : 100 yellow
3	Brown x Brown	All brown

2.4.1 Name the type of dominance that occurs in Agouti rodents with regards to coat colour. (1)

2.4.2 Give the genotype of the yellow rodents. (1)

2.4.3 Lethal alleles are alleles that cause the death of the organism that carries them.

Using the results obtained, explain how the investigators came to the conclusion that the allele for white coat is a lethal allele. (2)

2.4.4 Give the phenotypic ratio of cross number **1**. (1)
(5)

[40]

QUESTION 3

3.1 Two women, Mrs Ngcobo and Mrs Radebe, gave birth to their babies in a hospital on the same day. The nursing staff were unsure which baby belonged to which mother. The blood groups of all the individuals involved were determined and are given in the table below.

Individual	Blood Group
Baby 1	O
Baby 2	AB
Mrs Ngcobo	A
Mr Ngcobo	B
Mrs Radebe	A
Mr Radebe	O

3.1.1 How many alleles control the blood phenotypes? (1)

3.1 2 Give the possible genotype/s of:

(a) Mrs Ngcobo (2)

(b) Baby 2 (1)

3.1.3 Mrs Ngcobo is homozygous for her blood group and Mr Ngcobo is heterozygous.

(a) What are the possible phenotypes of their children? (2)

(b) What is the percentage chance that their next child will have the same blood type as Mrs Ngcobo? (1)

3.1.4 Mrs Radebe is heterozygous for her blood group.

Use a genetic diagram to show that Mr and Mrs Radebe cannot be the parents of Baby 2 but can be the parents of Baby 1. (6)

3.1.5 Explain ONE disadvantage of using blood groups to determine paternity. (2)
(15)

3.2 The extract below provides information about cochlear implants.

> A cochlear implant is an electronic device that is surgically placed under the skin behind the ear. It provides a sense of sound to a person who is profoundly deaf or severely hard of hearing by bypassing the damaged cochlea and sending sounds electronically to the brain. Cochlear implants were designed for people who obtain little or no benefit from hearing aids.

Adapted from: http://www.earinstitute.co.za

3.2.1 Describe the role of the cochlea in hearing. (5)

3.2.2 Normal hearing aids amplify the sound.

Explain why normal hearing aids will not benefit a person whose cochlea is damaged in each ear. (3)

3.2.3 Explain the benefit of cochlear implants for a deaf person. (2)
(10)

3.3 Dr Manzini, a local optometrist, helped Sipho with his school project. Sipho wanted to determine the effect of different light intensities on the diameter of the pupil in the eye.

They carried out the following procedure in the examination room:

Step 1 - Sipho sat on a chair with the light switched off for one minute.
Step 2 - The diameter of the pupil of his eye was measured.
Step 3 - The light was switched on at a specific light intensity for one minute.
Step 4 - The diameter of the pupil of his eye was measured again.

Steps 3 and 4 were repeated five more times at different light intensities in no particular order.

The results of the investigation are shown in the table below.

LIGHT INTENSITY	THE DIAMETER OF PUPIL (mm)
Darkness	5
Level **A**	3.5
Level **B**	2
Level **C**	2.5
Level **D**	3
Level **E**	3,2
Level **F**	4

3.3.1 State the following in this investigation:

(a) The independent variable (1)
(b) The dependent variable (1)

3.3.2 State TWO factors that should should be kept constant in this investigation. (2)

3.3.3 State TWO ways in which the results of this investigation can be made more reliable. (2)

3.3.4 Describe the changes that occurred in the eye to bring about the change in pupil diameter from level **C** to level **D**. (2)

3.3.5 Explain how we can conclude that the light intensity was the greatest at level **B**? (2)

(10)

3.4 Describe the changes that occur in the eye when a distant object approaches a person (near vision). **(5)**

[40]

SECTION C

QUESTION 4

Describe the development and release of an ovum in the ovary under the influence of hormones and how the zygote that forms after fertilization develops into a foetus with it's extra-embryonic membranes.

Content: 17
Synthesis: 3

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

TOTAL SECTION C: (20)

TOTAL MARKS: [150]

Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

LIFE SCIENCES

MEMORANDUM

COMMON TEST

JUNE 2017

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 150

This memorandum consists of 10 pages.

PRINCIPLES RELATED TO MARKING LIFE SCIENCES

1. **If more information than marks allocated is given**
   Stop marking when maximum marks is reached and put a wavy line and 'max' in the right-hand margin.

2. **If, for example, three reasons are required and five are given**
   Mark the first three irrespective of whether all or some are correct/incorrect.

3. **If whole process is given when only a part of it is required**
   Read all and credit the relevant part.

4. **If comparisons are asked for but descriptions are given**
   Accept if the differences/similarities are clear.

5. **If tabulation is required but paragraphs are given**
   Candidates will lose marks for not tabulating.

6. **If diagrams are given with annotations when descriptions are required**
   Candidates will lose marks.

7. **If flow charts are given instead of descriptions**
   Candidates will lose marks.

8. **If sequence is muddled and links do not make sense**
   Where sequence and links are correct, credit. Where sequence and links are incorrect, do not credit. If sequence and links become correct again, resume credit.

9. **Non-recognised abbreviations**
   Accept if first defined in answer. If not defined, do not credit the unrecognised abbreviation but credit the rest of the answer if correct.

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

11. **If language used changes the intended meaning**
    Do not accept.

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

13. **If common names are given in terminology**
    Accept, provided it was accepted at the national memo discussion meeting.

14. **If only the letter is asked for but only the name is given (and vice versa)**
    Do not credit.

15. **If units are not given in measurements**
Candidates will lose marks. Memorandum will allocate marks for units separately.

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

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

18. **Code-switching of official languages (terms and concepts)**
A single word or two that appear(s) in any official language other than the learners' assessment language used to the greatest extent in his/her answers should be credited if it is correct. A marker that is proficient in the relevant official language should be consulted. This is applicable to all official languages.

19. **Changes to the memorandum**
No changes must be made to the memoranda without consulting the provincial internal moderator who in turn will consult with the national internal moderator (and the Umalusi moderators where necessary).

20. **Official memoranda**
Only memoranda bearing the signatures of the national internal moderator and the Umalusi moderators and distributed by the National Department of Basic Education via the provinces must be used.

SECTION A

QUESTION 1

1.1

1.1.1 D✓✓

1.1.2 C✓✓

1.1.3 C✓✓

1.1.4 C✓✓

1.1.5 B✓✓

1.1.6 B✓✓

1.1.7 C✓✓

1.1.8 A✓✓

1.1.9 A✓✓

1.1.10 D✓✓ (10 x 2) **(20)**

1.2

1.2.1 Hydrogen✓

1.2.2 Ribosome✓

1.2.3 Interphase✓

1.2.4 Cytokinesis✓

1.2.5 Amniotic✓/ amniote

1.2.6 Non-disjunction✓

1.2.7 Double helix✓ (7 x 1) **(7)**

1.3

1.3.1 A only✓✓

1.3.2 B only✓✓

1.3.3 B only✓✓

1.3.4 A only✓✓ (4 x 2) **(8)**

1.4

1.4.1 Dihybrid✓ (1)

1.4.2 BbYy✓ (1)

1.4.3 BY; By; bY; by✓✓ (2)

1.4.4 25%✓✓ (2)

1.4.5 9 big and yellow: 3 big and green: 3 small and yellow: 1 small and green✓✓ (2)

1.4.6 Law of Independent assortment✓ (1)
(9)

1.5

1.5.1 (a) Chromatid✓ (1)

(b) Centromere✓ (1)

1.5.2 Metaphase II✓ (1)

1.5.3 Homologous chromosomes are separating✓/Chromosomes are moving apart (1)

1.5.4 - Each chromosome has DNA/a segment from the other chromosome✓
- Each has a mixture of maternal and paternal DNA✓
- Each chromosome has different colours✓ indicating different DNA
MARK FIRST ONE ONLY Any (1)

1.5.5 Two✓/2 (1)
(6)

TOTAL SECTION A: 50

QUESTION 2

2.1

2.1.1
- DNA provides the genetic code✓
- that determines the sequence of the amino acids✓ in the protein
- during transcription✓
- The DNA code is used to make mRNA✓ (4)

2.1.2 (a) TAC✓ (1)

(b) 6✓ (1)

2.1.3 (a) GUA✓ (1)

(b) ✓

Diagram I	Diagram II
The 6th amino acid is lysine✓	The 6th amino acid is arginine✓
The 7th amino acid is isoleucine✓	The 7th amino acid is phenylalanine✓

MARK FIRST TWO ONLY 1+ (2 x 2) (5)

(c)
- Down syndrome✓
- Haemophilia✓
- Colour-blindness✓
- Albinism✓(not for end of year)

MARK FIRST THREE ONLY (3)
(15)

2.2

2.2.1 A – Uterus/uterus wall✓
B – Placenta✓
E – Amniotic fluid✓
F – Cervix✓ (4)

2.2.2
- High levels of progesterone✓
- inhibits the production of FSH✓
- so that no new ovum/follicle is produced✓ (3)

2.2.3
- provides the foetus/baby with oxygen and food ✓
- from the mother✓/placenta
- carries carbon dioxide and wastes from the foetus/baby ✓
- to the mother✓/placenta Any (3)

(10)

2.3

2.3.1 Three✓/3 (1)

2.3.2 (a) X^nY✓✓ (2)

(b) X^NX^n✓✓ (2)

2.3.3 0%✓✓/ no chance (2)

2.3.4
- Males only inherit one X chromosome✓ from their mother
- If they inherit a dominant allele/X^N, they will be unaffected✓
- If they inherit a recessive allele/X^n, they will be affected✓ (3)

(10)

2.4

2.4.1 Incomplete✓ dominance (1)

2.4.2 BW✓ (1)

2.4.3
- There were no white offspring✓
- in cross 1✓/from parents yellow x yellow (2)

2.4.4 1 brown : 2 yellow✓ (1)

(5)

[40]

QUESTION 3

3.1

3.1.1 Three✓/3 (1)

3.1.2 (a) I^AI^A✓ and I^Ai✓ (2)
(b) I^AI^B✓ (1)

3.1.3 (a) AB✓ and A✓ (2)
(b) 50✓% (1)

3.1.4

P_1	Phenotype	A	x	O✓
	Genotype	I^Ai	x	ii✓
Meiosis				
	G/gamete	I^A, i	x	i, i ✓
Fertilisation				
F_1	Genotype	I^Ai;	I^Ai;	ii; ii ✓
	Phenotype	A; O✓		

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1	Phenotype	A	x	O ✓
	Genotype	I^Ai	x	ii✓

Meiosis

Fertilisation

Gametes	I^A	i
i	I^Ai	ii
i	I^Ai	ii

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype A; O✓

P_1 and F_1✓
Meiosis and fertilisation✓

Any (6)

3.1.5
- Many individuals can have the same blood type✓
- and therefore blood type cannot conclusively determine paternity✓/ can only show a possible parent (2)

MARK FIRST ONE ONLY

(15)

3.2

3.2.1

- Vibrations cause waves in the fluid of the cochlea✓
- which stimulates the organ of Corti✓
- The organ of Corti converts the waves into an electrical impulse✓
- and transmits them via the auditory nerve✓
- to the cerebrum✓ (5)

3.2.2

- The hearing aid increases the vibrations✓
- of the tympanic membrane✓/ossicles/oval window
- but the cochlea is unable to convert this into a nervous impulse✓
- therefore the person still cannot hear✓ Any (3)

3.2.3

- It send impulses electronically to the brain✓
- allowing a person to hear✓ (2)

(10)

3.3

3.3.1 (a) Light intensity✓ (1)
(b) The diameter of the pupil✓ (1)

3.3.2

- Measure the diameter of the same pupil each time✓
- Use the same instrument to measure the pupil size✓
- The same person should take all measurements✓

MARK THE FIRST TWO ONLY Any (2)

3.3.3

- Repeat the investigation✓
- Use a larger sample group✓
- Take more readings at each light intensity✓

MARK THE FIRST TWO ONLY Any (2)

3.3.4

- The circular muscles of the iris relaxed✓
- The radial muscles of the iris contracted✓ (2)

3.3.5

- The pupil diameter was smallest✓/2mm
- reducing the amount of light entering the eye✓ (2)

(10)

3.4

- The ciliary muscles contract✓
- The suspensory ligaments slacken✓
- The tension on the lens decreases✓
- The lens becomes more convex ✓
- increasing its refractive power ✓
- A clear image falls on the retina✓ Any **(5)**

[40]

SECTION C

QUESTION 4

Production of an ovum (O)

- Oogenesis✓ occurs
- under the influence of FSH✓
- Diploid cells in the ovary✓
- undergo mitosis✓
- to form numerous follicles✓
- One cell inside a follicle undergoes meiosis✓
- and the follicle develops into a Graafian follicle✓
- Of the four cells produced, only one survives✓
- to form a mature haploid ovum✓ Max 7

Release of the ovum(R)

- Ovulation✓ occurs
- around day 14✓
- This is stimulated by a rise in LH✓
- The ovum enters the Fallopian tube✓ Max 3

Development of the zygote into a foetus (Z)

- The zygote divides by mitosis✓
- to form a solid ball of cells✓
- called a morula✓
- The cells re-arrange to form a hollow ball of cells✓
- called a blastula✓/blastocyst
- which implants into the endometrium✓
- The chorion✓
- forms chorionic villi✓
- which together with the endometrium develops into the placenta✓
- The rest of the cells in the blastula/blastocyst differentiate✓ to form the parts of the foetus
- protected by the amnion✓ Max 7

Synthesis: 3
Content: 17
(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 - Production of an ovum - Release of the ovum - Development of the zygote into a foetus is given. No irrelevant information included.	The description of - Production of an ovum - Release of the ovum - Development of the zygote into a foetus are presented in a logical and sequential manner.	At least the following marks should be obtained: - Production of an ovum 4/7 - Release of the ovum 2/3 - Development of the zygote into a foetus 5/7
Mark	1	1	1

TOTAL SECTION C: 20

GRAND TOTAL: 150