



# Basic Education

KwaZulu-Natal Department of Education  
REPUBLIC OF SOUTH AFRICA

**LIFE SCIENCES**

**COMMON TEST**

**JUNE 2015**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**MARKS: 150**

**TIME: 2½ hours**

**N.B. This question paper consists of 14 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 is a building block of nucleic acids?

- A Glucose
- B Fatty acids
- C Nucleotides
- D Glycerol

1.1.2 RNA differs from DNA in that it ...

- A has uracil and is single stranded.
- B is helical in shape.
- C has thymine and a phosphate group.
- D has cytosine and is double stranded.



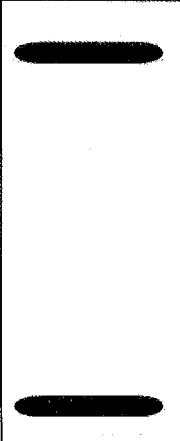
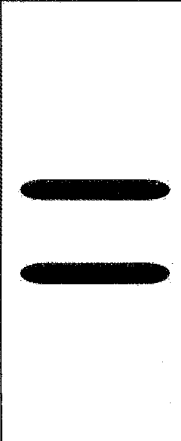
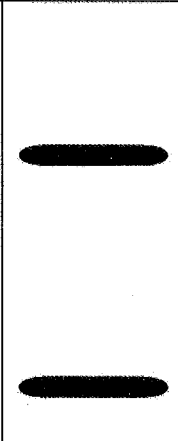
1.1.3 A fragment of DNA was found to have 120 guanine bases and 80 thymine bases. What is the percentage of adenine molecules in this DNA fragment?

- A 60%
- B 40%
- C 59%
- D 20%

1.1.4 Which combination of reproductive strategies is characteristic of most mammals?

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

1.1.5 The DNA profiles shown below is taken from a crime scene investigation.

Victim	Suspect X	Suspect Y	Sample 1 from crime scene	Sample 2 from crime scene
				

What conclusion can be drawn from the DNA analysis?

- A Only suspect X was involved
- B Only suspect Y was involved
- C Both suspects X and Y were involved
- D Neither suspect X nor Y were involved

1.1.6 A white chicken was crossed with a brown chicken. Each offspring's coat is brown with white patches. This is an example of ...

- A complete dominance.
- B co-dominance.
- C recessive alleles.
- D incomplete dominance.

1.1.7 A structure that carries impulses from a receptor to the central nervous system is a/an ...

- A motor neuron.
- B interneuron.
- C ganglion.
- D sensory neuron.

1.1.8 Random arrangement of chromosomes and random fertilization both ...

- A ensure that offspring are genetically identical to each other.
- B occur during asexual reproduction.
- C occur during meiosis.
- D introduce genetic variation.

1.1.9 The microscopic gap between the branches of one neuron and those of the next neuron is called a ...

- A ganglion.
- B synapse.
- C neuro-transmitter.
- D receptor.

1.1.10 A possible effect of damage to the cerebellum is ...

- A difficulty in maintaining balance.
- B lack of sensation in the fingers and toes.
- C inability to move the legs.
- D loss of hearing.

(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 1.2.8) in your ANSWER BOOK.

1.2.1 The weak bonds that join nitrogenous bases together

1.2.2 A corresponding strand that is made on the template

1.2.3 The point at which crossing over of chromosomes takes place during meiosis

1.2.4 The chromosome condition in gametes characterized by the presence of a single set of chromosomes

1.2.5 Outermost hard covering of an amniotic egg

1.2.6 The structure in a neuron that carries impulses away from a cell body

1.2.7 A structure in the reflex arc which produces a reaction to a stimulus

1.2.8 Vision that allows the visual field of both eyes in the human to overlap, allowing them to focus on the same object

(8)

- 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 1.3.6) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Decreases the heart rate	A: Sympathetic system B: Parasympathetic system
1.3.2 Condition where the cornea is affected	A: Cataracts B: Astigmatism
1.3.3 Circular muscles of the iris contract and radial muscles relax	A: Bright light vision B: Dim light vision
1.3.4 Small tube inserted into the middle ear to drain excess fluid	A: Cochlear implant B: Grommet
1.3.5 Inherited sex-linked genetic disease	A: Multiple sclerosis B: Alzheimer's
1.3.6 Baby zebras walk 30 minutes after birth	A: Precocial B: Altricial

(6 x 2) (12)

- 1.4 In mice, the ability to run normally is a dominant trait. Mice with this trait are called running mice (**R**). The recessive trait causes mice to run in circles only. Mice with this trait are called waltzing mice (**r**).

Fur colour is also inherited in mice, with black fur (**B**) being dominant over brown fur (**b**).

A male mouse, homozygous for both running and black fur is mated with a female, heterozygous for running with brown fur:

- 1.4.1 State why this is an example of a dihybrid cross. (1)
- 1.4.2 State the genotypes of both parents. (2)
- 1.4.3 Write down the genotype of the gametes that can be produced by the female mouse. (2)
- 1.4.4 What percentage of the offspring from these parents will be heterozygous for both characteristics? (1)
- 1.4.5 Give the phenotypes of the offspring. (2)
- 1.4.6 Two of the offspring that are heterozygous for both characteristics are interbred. Give the phenotypic ratio of their offspring. (2)

(10)

**TOTAL SECTION A: [50]**

## SECTION B

## QUESTION 2

- 2.1 Use the **table** below that shows the amino acids coded for by various tRNA base triplets during protein synthesis.

Base triplets on tRNA	Amino acid coded for
AUU	Tyrosine
GGU	Glycine
UUU	Phenylalanine
CCG	Proline
UCC	Arginine
GUU	Glutamate
AGC	Serine
CGG	Alanine

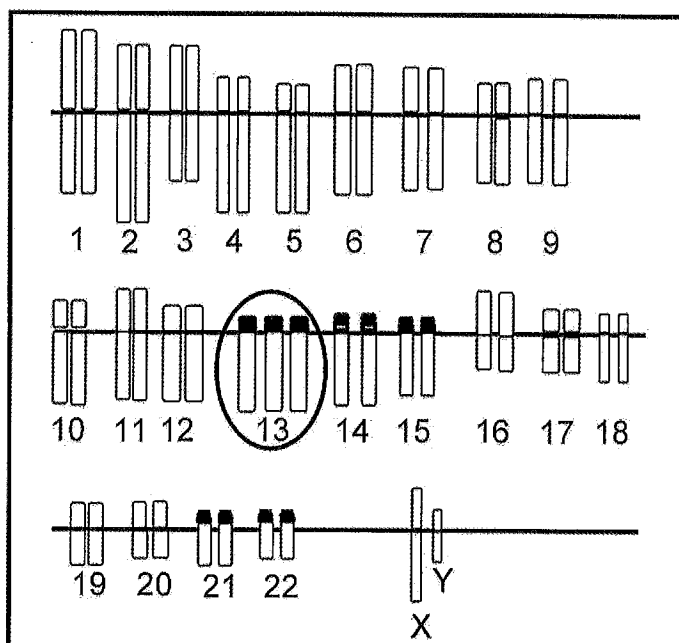
- 2.1.1 Provide the term for 'base triplets' on tRNA. (1)
- 2.1.2 Name the stage of protein synthesis that requires tRNA. (1)
- 2.1.3 Describe the stage of protein synthesis named in QUESTION 2.1.2. (4)
- 2.1.4 Cystic fibrosis is a genetic disorder caused by a mutation in a gene where triplet 507 is removed.

The normal sequence and the mutated part of the gene is shown below.

Triplet No.	502	503	504	505	506	507	508	509	510	511
Normal	GTT	TTT	CGG	GTT	CGG	AGC	TTT	GGT	GTT	TCC
Mutated	GTT	TTT	CGG	GTT	CGG	TTT	GGT	GTT	TCC	

- (a) How do we know that the base triplets represented are those of DNA? (1)
- (b) Define a mutation. (2)
- (c) How many nitrogen bases are present in the portion of the mutated gene that is provided in the table? (1)
- (d) How many different types of amino acids are coded for in the portion of the normal gene that is provided in the table? (1)
- (e) Write down the mRNA triplets that correspond with the triplets numbered **502** and **506**. (2)
- (f) Describe the effect that the mutation has on the formation of the protein. (3)
- (16)**

- 2.2 The following karyotype diagram is that of a child with Patau's syndrome and is referred to as a 'killer karyotype'. Some of Patau's syndrome symptoms include slow breathing, heart defects and kidney malformations.



- 2.2.1 Name the error in meiosis that results in the abnormality occurring at chromosome number 13. (1)
- 2.2.2 Describe how the process named in QUESTION 2.2.1 would have led to Patau's syndrome. (3)
- 2.2.3 Explain why Patau's syndrome karyotype is referred to as a 'killer karyotype.' (2)

- 2.3 In humans, brown tooth enamel is inherited as a sex-linked recessive characteristic. A man who carries the recessive allele will have brown tooth enamel. A female will only display the characteristic if she has two recessive alleles.

A man with brown tooth enamel marries a woman with normal tooth enamel whose father had brown tooth enamel.

Use  $X^B$  for normal teeth and  $X^b$  for brown tooth enamel.

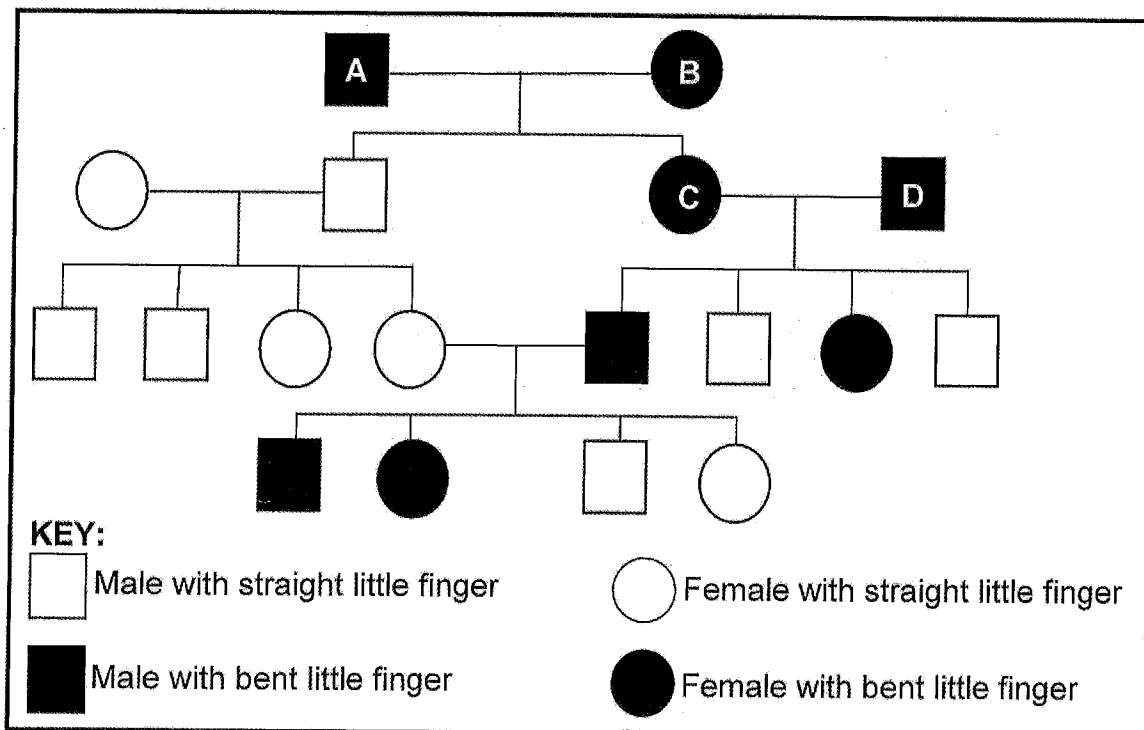
- 2.3.1 Explain why a female will not display the characteristic of brown tooth enamel if she is heterozygous for tooth enamel colour. (2)
- 2.3.2 Using the information provided, explain why the woman with normal tooth enamel has to be heterozygous for tooth enamel colour. (3)



2.3.3 Represent a genetic cross to show the possible genotypes and phenotypes of their children. (6)

2.3.4 What is the percentage chance of their sons having brown tooth enamel. (1)  
(12)

2.4 A gene causes the last joint of the little finger to bend inwards towards the ring finger. The family tree shown below shows the inheritance of a bent finger over four generations.



2.4.1 Give the phenotypes of the children of parents C and D. (3)

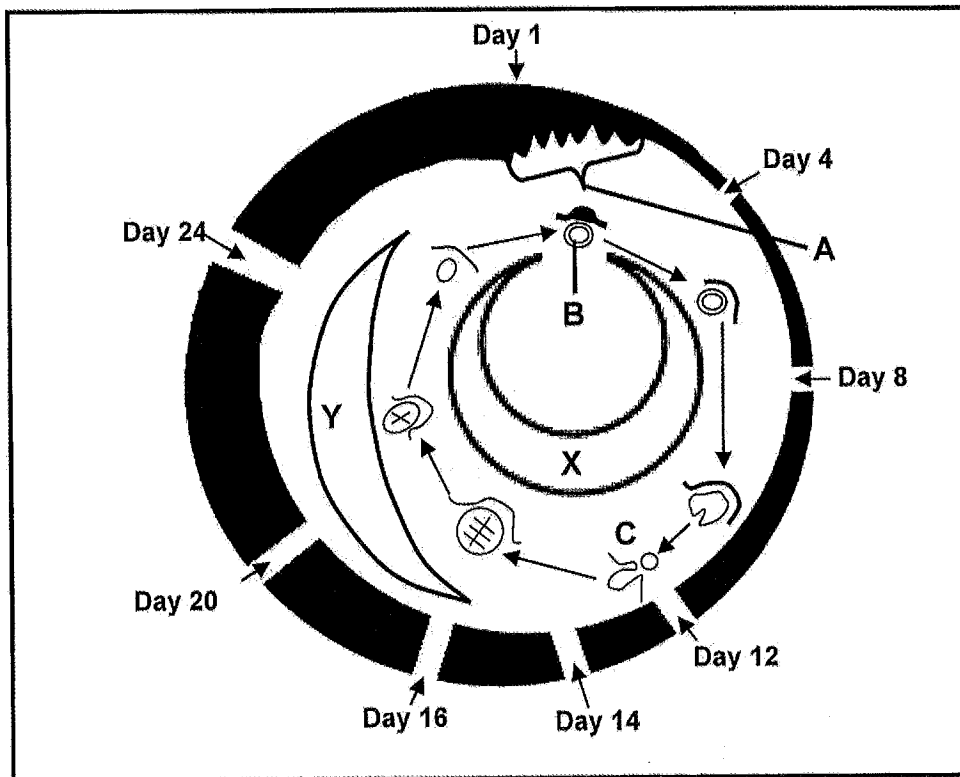
2.4.2 Which type of finger is controlled by the dominant allele? (1)

2.4.3 Explain your answer to QUESTION 2.4.2 based on evidence from the above pedigree diagram. (2)

(6)  
[40]

**QUESTION 3**

3.1 The following diagram represents the menstrual cycle in a female.



LETTER	REPRESENTATION
A	Process in uterus
B	Primary follicle
C	Process in ovary
X, Y	Hormones released by ovary. The thickness of the shapes which represent these hormones shows their levels during the menstrual cycle. A thicker shape represents a higher level of hormone and vice versa.

3.1.1 Name each of the following processes in the above diagram.

- (a) **A** (1)
- (b) **C** (1)

3.1.2 Describe the changes that occur in structure **B** from day 1 to day 16 in the menstrual cycle above. (3)

3.1.3 (a) Describe how the level of hormone **Y** would be different from that shown in the diagram if fertilisation were to take place. (1)

(b) Explain how the change in the level of hormone **Y** mentioned in QUESTION 3.1.3 (a) is brought about. (2)  
(8)

- 3.2 The following table represents the results obtained in an investigation on the frequency of the different blood groups in a population.

TYPE OF BLOOD GROUP	FREQUENCY IN A POPULATION (%)
A	42
B	10
AB	4
O	44

3.2.1 How many alleles are there for the gene for blood group? (1)

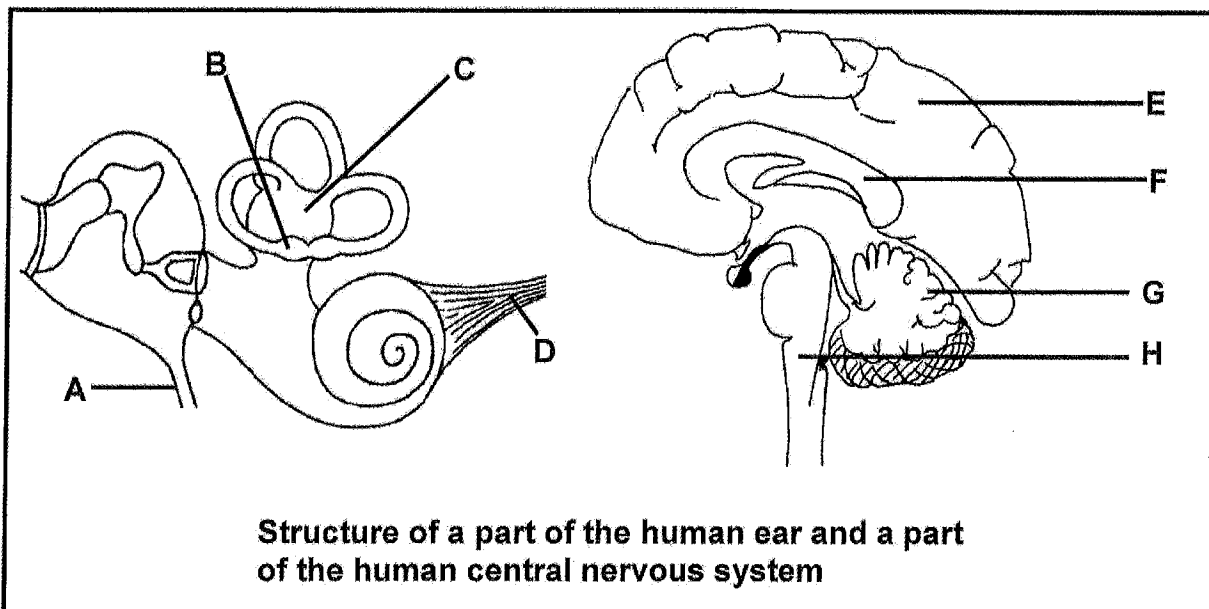
3.2.2 According to the table, which is the LEAST frequently occurring blood group? (1)

3.2.3 Draw a bar graph to represent the results of the investigation. (6)

3.2.4 Give the genotypes of a set of parents who may have children with four different blood groups. (2)

(10)

- 3.3 The following diagrams represent parts of the human nervous system.



3.3.1 Identify parts A and F. (2)

- 3.3.2 Complete the table provided below by identifying the receptor and the stimulus that each receptor responds to in each case. Write only the letters **(i)** to **(iv)** and next to each letter write down your answer.

Structure	Receptor	Stimulus that receptor responds to
<b>B</b>	(i)	(ii)
<b>C</b>	(iii)	(iv)

(4)

- 3.3.3 Only after the sensitive coverings of the brain were injected to make them insensitive, part **E** of a normal person was pierced with a sharp object, but the person did **NOT** experience any pain.

- (a) Provide a possible explanation for the person not experiencing a pain sensation. (3)
- (b) Explain **ONE** possible disadvantage if a body part is pierced with a sharp object, but the person does not experience any pain. (2)

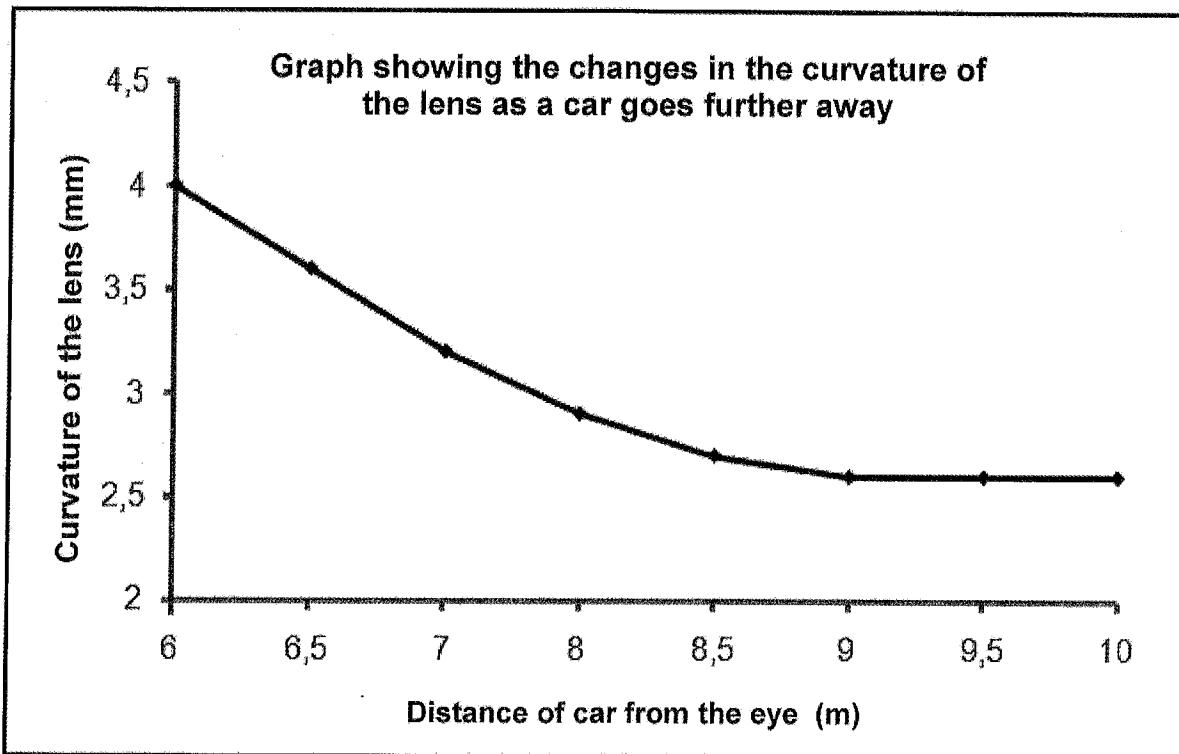
- 3.3.4 Explain why damage to part **H** may lead to immediate death. (2)

(13)

3.4 Theresa did an investigation to determine the effect of distance on the curvature (thickness) of the lens of the human eye.

- She sat in a well-lit large gymnasium.
- She covered one eye with an eye patch.
- A car was parked in front of her at a distance of 6m.
- Her uncovered eye was allowed to adjust for 10 seconds
- She focused on the car until a clear image was formed and at the same time, the curvature of her lens was measured with an optical instrument.
- The curvature of the lens was measured every 0,5m as the car drove away from her.

The **results** of the investigation are recorded in the graph below:



3.4.1 In this investigation:

- (a) Name the independent variable (1)
- (b) Name the dependent variable (1)

3.4.2 Provide an explanation as to why certain factors in this investigation must be kept constant. (3)

3.4.3 Describe the relationship between the distance of the car from the eye and the curvature of the lens of the eye. (4)

(9)  
[40]

**TOTAL SECTION B: [80]**

**SECTION C**

**QUESTION 4**

Describe how a human foetus is protected and maintained during the gestation period.

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]**



# Basic Education

KwaZulu-Natal Department of Basic Education  
REPUBLIC OF SOUTH AFRICA

LIFE SCIENCES  
COMMON TEST  
JUNE 2015  
MEMORANDUM

NATIONAL  
SENIOR CERTIFICATE

GRADE 12

MARKS: 150

*Memo*  
This question paper consists of 10 pages.

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## PRINCIPLES RELATED TO MARKING LIFE SCIENCES 2015

- 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.
- If, for example, three reasons are required and five are given**  
Mark the first three irrespective of whether all or some are correct/incorrect.
- If whole process is given when only part of it is required**  
Read all and credit relevant part.
- If comparisons are asked for and descriptions are given**  
Accept if differences / similarities are clear.
- If tabulation is required but paragraphs are given**  
Candidates will lose marks for not tabulating.
- If diagrams are given with annotations when descriptions are required**  
Candidates will lose marks
- If flow charts are given instead of descriptions**  
Candidates will lose marks.
- If sequence is muddled and links do not make sense**  
Where sequence and links are correct, credit. Where sequence and links is incorrect, do not credit. If sequence and links becomes correct again, resume credit.
- Non-recognised abbreviations**  
Accept if first defined in answer. If not defined, do not credit the unrecognized abbreviation but credit the rest of answer if correct.
- Wrong numbering**  
If answer fits into the correct sequence of questions but the wrong number is given, it is acceptable.
- If language used changes the intended meaning**  
Do not accept.
- Spelling errors**  
If recognizable accept provided it does not mean something else in Life Sciences or if it is out of context.
- If common names given in terminology**  
Accept provided it was accepted at the National memo discussion meeting.
- If only letter is asked for and only name is given (and vice versa)**  
No credit
- If units are not given in measurements**  
Candidates will lose marks. Memorandum will allocate marks for units separately

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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 appears 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. No changes must be made to the marking memoranda without consulting the Provincial Internal Moderator who in turn will consult with the National Internal Moderator (and the External moderators where necessary)

20. Only memoranda bearing the signatures of the national Internal Moderator and the UMALUSI moderators and distributed by the National Department of Education via the Provinces must be used during training and during the marking period.

**SECTION A**

**QUESTION 1**

- 1.1 1.1.1 C ✓✓
- 1.1.2 A ✓✓
- 1.1.3 D ✓✓
- 1.1.4 C ✓✓
- 1.1.5 D ✓✓
- 1.1.6 B ✓✓
- 1.1.7 D ✓✓
- 1.1.8 D ✓✓
- 1.1.9 B ✓✓
- 1.1.10 A ✓✓

(10 x 2) (20)

- 1.2 1.2.1 Hydrogen ✓
- 1.2.2 Complementary ✓
- 1.2.3 Chiasm✓/ichiasmata
- 1.2.4 Haploid ✓
- 1.2.5 Shell ✓
- 1.2.6 Axon ✓
- 1.2.7 Effector ✓/ muscle
- 1.2.8 Binocular ✓

(8)

- 1.3 1.3.1 B only ✓✓
- 1.3.2 Both ✓✓
- 1.3.3 A only ✓✓
- 1.3.4 B only ✓✓
- 1.3.5 None ✓✓
- 1.3.6 A only ✓✓

(6 x 2) (12)

- 1.4 1.4.1 Two characteristics ✓ are involved
- 1.4.2 RRBB ✓; Rrbb ✓
- 1.4.3 Rb ✓; rb ✓
- 1.4.4 50% ✓
- 1.4.5 Running ✓; black furred ✓
- 1.4.6 9: running black: 3 running, brown: 3 waltzing, black: 1 waltzing, brown ✓ ( Don't accept 9:3:3:1)

(1) (2) (2) (1) (2) (2) (10)

**TOTAL SECTION A: 50**



## SECTION B

## QUESTION 2

2.1

- 2.1.1 Anticodon ✓ (1)
- 2.1.2 Translation ✓ (1)
- 2.1.3 - When the anticodon on the tRNA ✓  
 - matches the codons ✓ on mRNA / is complementary  
 - each tRNA brings the required amino acids ✓ to the ribosome  
 - Amino acids become attached by peptide bonds ✓  
 - to form the required protein ✓ (Any 4) (4)
- 2.1.4 (a) Nucleotides have thymine present ✓ (1)  
 (b) A sudden change ✓ in the genetic make-up of a cell ✓ (2)  
 (c) 27 ✓ (1)  
 (d) 6 ✓ (1)  
 (e) CAA ✓; GCC ✓ (2)  
 (f) - One amino acid is omitted ✓ from the amino acid chain  
 - This results in the formation of a different protein ✓  
 - The protein may still function ✓ / not function / have a different function (3)

2.2

- 2.2.1 Non-disjunction ✓ (1)
- 2.2.2 - Chromosome pair 13 fails to separate during anaphase I ✓ / meiosis I  
 - leading to one cell / gamete having 24 ✓ chromosomes / 1 extra chromosome  
 - and the other having 22 ✓ / 1 less chromosome  
 - If the cell with 24 chromosomes is fertilised by a normal sperm/ovum with 23 chromosomes ✓  
 - the resulting zygote will have 47 ✓ chromosomes / three copies of chromosome 13 / Trisomy 13 (Any 3) (3)

2.2.3

- The slow breathing will result in insufficient oxygen ✓  
 - being supplied to the brain ✓ / cells of the body  
 OR  
 - Blood will not be pumped efficiently ✓ around the body due to the heart defect  
 - therefore the body will have insufficient oxygen and nutrients ✓ / accumulate waste

OR

- The kidney will not function efficiently ✓  
 - leading to the accumulation of wastes ✓ (2) (6)
- 2.3 2.3.1 - The dominant allele ✓ / allele for normal tooth enamel  
 - will mask the influence of the recessive allele ✓ / the allele for brown tooth enamel (2)
- 2.3.2 - Her father had brown tooth enamel therefore his genotype must have been  $X^bY$  ✓  
 - She had normal teeth which means that she had at least one dominant allele  $X^B$  ✓  
 - Since she is female, she will only be able to inherit the X chromosome from the father ✓ / the father has only one X chromosome  
 - containing the recessive allele ✓ /  $X^b$  therefore she must be heterozygous (any 3) (3)

2.3.3

**P** Phenotype Man with brown enamel  $\times$  Woman with normal enamel ✓  
 Genotype  $X^B Y$   $\times$   $X^B X^b$  ✓  
**G/gametes**  $X^B, Y$   $\times$   $X^B, X^b$  ✓  
**F** Phenotype 1 son with normal enamel : 1 son with brown enamel ✓  
 Phenotype 1 daughter with normal enamel : 1 daughter with brown enamel ✓

P and F ✓

Meiosis and fertilisation ✓

Any 6

OR

**P** Phenotype Man with brown enamel  $\times$  Woman with normal enamel ✓  
 Genotype  $X^B Y$   $\times$   $X^B X^b$  ✓  
**Gametes**  $X^B, X^b$   $\times$   $X^B, X^b$  ✓  
**Fertilisation**  $Y, X^b$   $\times$   $X^B, X^b$  ✓  
 1 mark for correct gametes  
 1 mark for correct genotypes

P and F ✓

Meiosis and fertilisation ✓

Any 6

2.3.4 50% ✓

(1)

(12)

(3)

(1)

2.4 2.4.1 Male with bent little finger ✓

Male with straight little finger ✓

Female with bent little finger ✓

2.4.2 Bent little finger ✓

2.4.3 - Parents A and B/C and D have bent little fingers ✓

- To produce a child with straight little fingers ✓

- both parents had to have had one recessive allele ✓

Any 2

(2)

(6)

[40]

QUESTION 3

3.1 3.1.1 (a) Menstruation ✓ (1)  
 (b) Ovulation ✓ (1)

3.1.2

- The primary follicle develops into a Graafian follicle ✓
- which becomes empty after the ovum is released ✓ / ovulation occurs
- The empty Graafian follicle becomes a corpus luteum ✓ (3)

3.1.3 (a)

(1)

- The levels of hormone Y / progesterone would remain high ✓ / increase

(b)

- The corpus luteum remains ✓
- and continues to secrete hormone Y ✓ / progesterone

OR

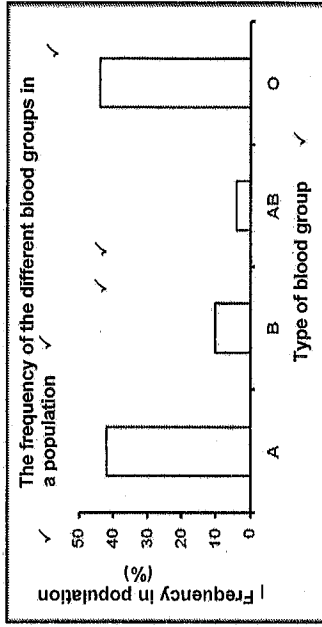
- The placenta forms ✓
- and starts to produce hormone Y ✓ / progesterone

3.2

3.2.1 Three ✓ (2)

3.2.2 AB ✓ (8)

3.2.3 (1)



Check list for the mark allocation of the graph.

Correct type of graph	1
Title of graph	1
Correct label, equal space between bars and equal width of the bars for X-axis	1
Correct label and appropriate scale for Y-axis	1
Plotting of bars	1-1 to 3 bars plotted correctly 2-all 4 bars plotted correctly

NOTE: If the wrong type of graph is drawn marks will be lost for 'correct type of graph'

(6)

3.2.4  $I^A I^A$  and  $I^B I^B$  ✓

(2)

(10)

3.3 3.3.1 A – Eustachian tube ✓  
F – Corpus callosum ✓

(2)

3.3.2 (i) Cristae ✓  
(ii) Changes in direction ✓/speed  
(iii) Maculae ✓  
(iv) Changes in the position of the head ✓

(1)  
(1)  
(1)  
(1)

3.3.3 (a) – Absence/damaged (pain) receptors ✓  
– thus no impulse generated ✓  
– to be interpreted by the brain ✓  
(b) – It can cause further damage ✓ to the body  
– since the person is not aware ✓ of the damage

(3)  
(2)

3.3.4 – Breathing will stop ✓  
– Heartbeat will stop ✓

(2)  
(13)

3.4 3.4.1(a) Distance of the car from the eye ✓  
(b) Curvature of the lens ✓

(1)  
(1)

3.4.2 – To ensure that all the results obtained are due to the distance  
of the car from the eye ✓  
– and no other factor ✓  
– ensuring a valid investigation ✓

(3)

3.4.3 – The curvature of the lens of the eye decreases ✓  
– as the car moves further away ✓ from the eye  
– beyond 9m ✓  
– The curvature/ shape of lens remains the same ✓

(4)  
(9)

TOTAL SECTION B: [80]  
[40]

SECTION C

QUESTION 4

- The chorion ✓
- develops chorionic villi ✓
- which allows the foetus to attach to ✓/implant in the uterine wall ✓/endometrium
- together forming the placenta ✓
- The placenta will act as a micro-filter ✓
- to prevent the entry of pathogenic ✓ organisms into the blood of the foetus
- The placenta also produces antibodies ✓
- to protect the foetus against disease ✓
- The placenta continues to produce progesterone ✓
- to ensure that pregnancy is maintained ✓
- The umbilical vein ✓
- carries oxygenated ✓ blood
- and nutrients ✓
- from the placenta to the foetus ✓
- The umbilical artery ✓
- carries deoxygenated ✓ blood
- and nitrogenous waste ✓
- from the foetus to the mother's body ✓ for removal
- The amnion ✓
- secretes amniotic ✓ fluid
- which allows the foetus to move freely ✓
- protects the foetus from shocks ✓
- prevents dehydration ✓
- and reduces fluctuations in temperature ✓

Max17 (17)

ASSESSING THE PRESENTATION OF THE ESSAY

Criterion in this essay	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Only information relevant to protecting and maintaining the foetus is given (there is no irrelevant information)	1	1	1
Described the role of ALL of the following in protecting and maintaining the foetus: the amnion, chorion, umbilical artery & vein and the placenta			1
Marks			

Content

Synthesis (17)  
(3)  
TOTAL SECTION C: (20)  
TOTAL MARKS: [150]

