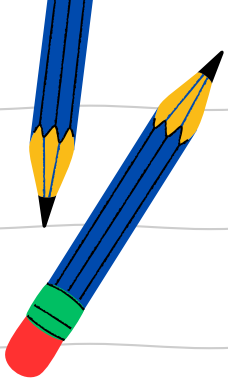

Inside Education
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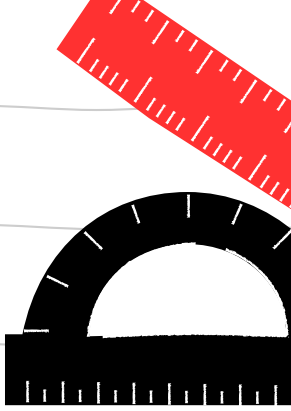
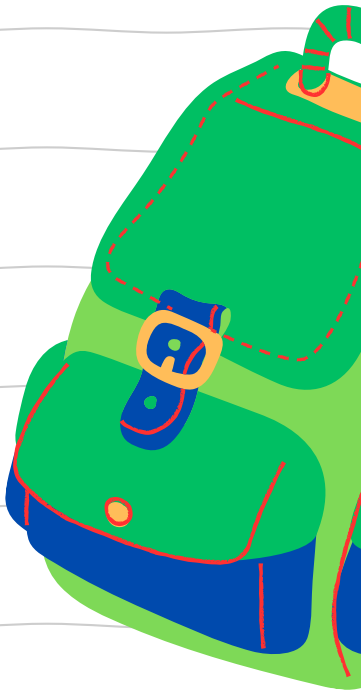


MATRIC EXAM REVISIONS

LIFE SCIENCES PAPER 2 (2021)

QUESTION PAPER



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2021

MARKS: 150

TIME: 2½ hours

This question paper consists of 17 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the 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. 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 must 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 answer and write only the letter (A to D) next to the question numbers (1.1.1 to 1.1.9) in the ANSWER BOOK, e.g. 1.1.10 D.

1.1.1 DNA and RNA are examples of …

A amino acids.
B enzymes.
C nucleic acids.
D proteins.

1.1.2 Which ONE of the following is a product of meiosis?

A Muscle cell
B Ovary
C Nerve cell
D Ovum

1.1.3 An individual is heterozygous for a harmful recessive allele but is unaffected by it.

Which ONE of the following best represents the genetic composition of this individual?

A Two dominant normal alleles
B One harmful recessive allele and one harmful dominant allele
C One harmful recessive allele and one normal dominant allele
D One harmful dominant allele and one normal recessive allele

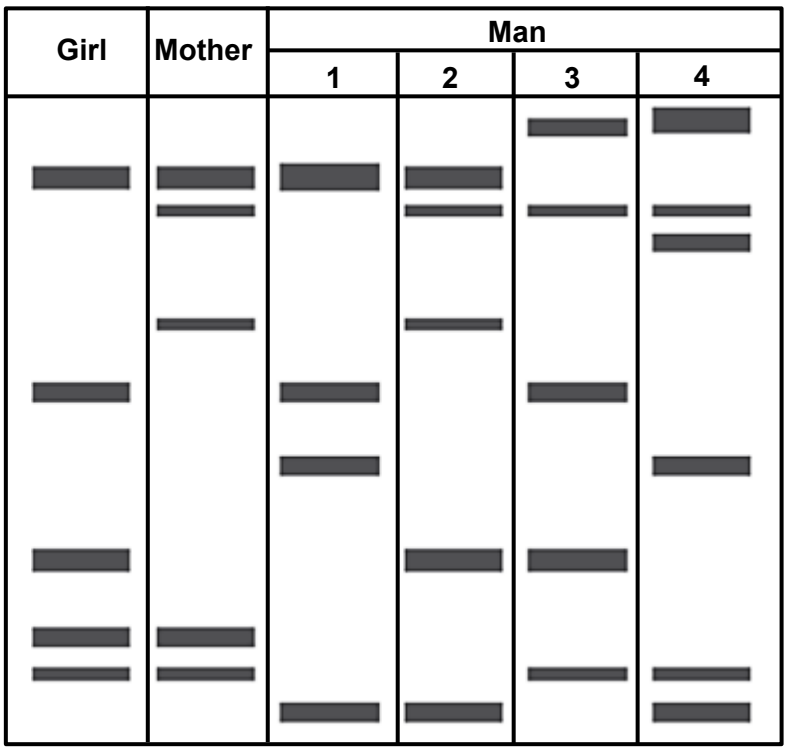
1.1.4 A person has the genotype $\mathbf{I^Ai}$ for blood type.

What is this person's blood group?

A A
B B
C O
D AB

1.1.5 In a car accident, the biological father of a girl and three other men were killed. The men could not be identified due to their injuries. DNA profiling was used to identify the girl's father.

The diagram below shows the DNA profiles of the girl, her mother and the four men.



Which ONE of the men is most likely to have been the father of the girl?

A 4
B 3
C 2
D 1

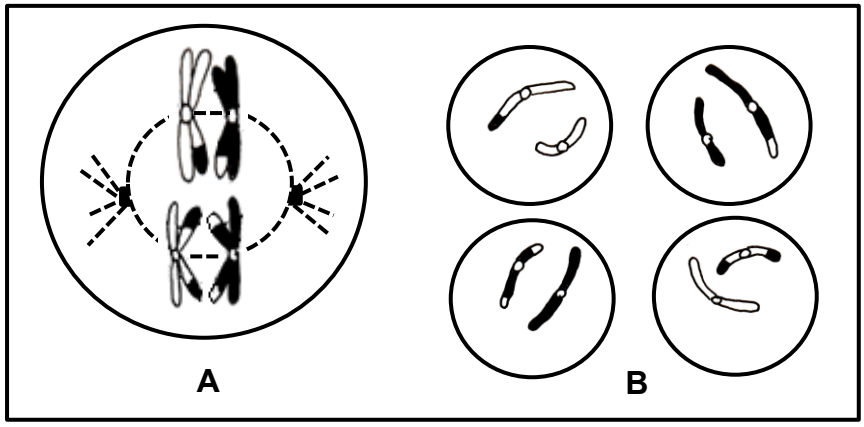
1.1.6 A DNA template strand codes for the amino acid serine with any of the following base triplets:

AGA AGG AGT TCA TCG AGC

The anticodon that codes for the amino acid serine is …

A AGT.
B UGA.
C TCG.
D UCG.

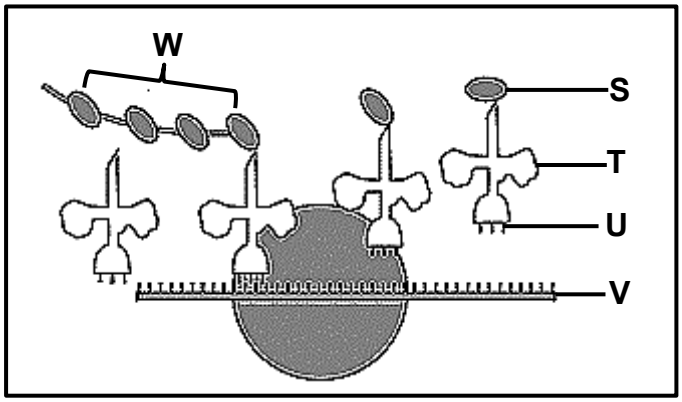
1.1.7 The diagram below represents two phases of meiosis.



Which ONE of the following represents the correct sequence of phases between phase **A** and phase **B**?

A Anaphase I, Metaphase I, Prophase II and Telophase II
B Metaphase I, Telophase I, Prophase II and Metaphase II
C Anaphase I, Telophase I, Prophase II, Metaphase II and Anaphase II
D Prophase I, Telophase I, Prophase II, Metaphase II and Telophase II

1.1.8 The diagram below represents a process that occurs during protein synthesis.



Which ONE of the following is CORRECT?

A **S** represents an anticodon
B **W** represents mRNA
C **T** represents tRNA
D **U** represents an amino acid

1.1.9 Evidence of hominid cultural evolution can be found in the fossil record.

This evidence would include the …

A position of the attachment of the spine to the head.
B length of the upper limbs compared to the length of the lower limbs.
C number of teeth present in the skull.
D presence of stone tools. (9 x 2) **(18)**

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question numbers (1.2.1 to 1.2.6) in the ANSWER BOOK.

1.2.1 A diagrammatic representation showing possible evolutionary relationships between different species

1.2.2 The type of bond found between amino acids

1.2.3 The theory that describes evolution as consisting of long periods of little/no change alternating with short periods of rapid change

1.2.4 Similar structures that perform different functions in different organisms

1.2.5 The breeding of plants and animals by humans for desired characteristics

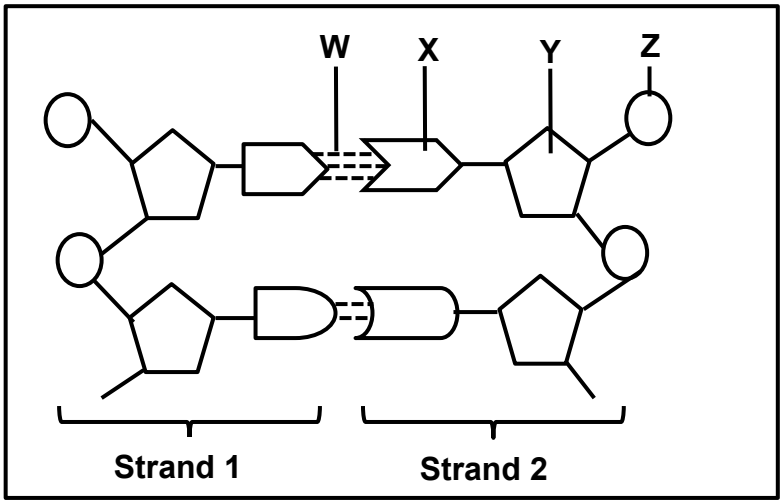
1.2.6 The type of dominance where both alleles of a gene are expressed in the phenotype in the heterozygous condition (6 x 1) **(6)**

1.3 Indicate whether each of the statements in COLUMN I apply 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 Mechanisms of reproductive isolation	A: Species-specific courtship behaviour B: Breeding at different times of the year
1.3.2 Fossils found in South Africa	A: Little Foot B: Taung Child
1.3.3 Proposed the 'law' of use and disuse'	A: Eldredge B: Gould

(3 x 2) **(6)**

1.4 The diagram below represents part of a DNA molecule.



1.4.1 Identify the:

(a) Molecule **X** (1)

(b) Sugar at **Y** (1)

(c) Bond **W** (1)

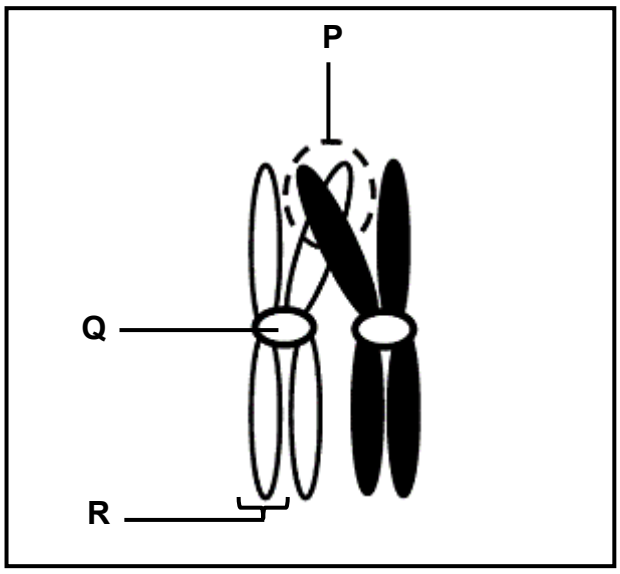
1.4.2 Give the collective name of parts **X**, **Y** and **Z**. (1)

1.4.3 State the natural shape of the DNA molecule. (1)

1.4.4 Name the process whereby DNA makes a copy of itself. (1)

1.4.5 Name TWO places in an animal cell where DNA is located. (2)
(8)

1.5 The diagram below represents a chromosome pair undergoing a process during meiosis.



1.5.1 Name the:

(a) Organ in the human male where meiosis occurs (1)

(b) Process represented in the diagram (1)

1.5.2 Label:

(a) Area **P** (1)

(b) Structure **Q** (1)

(c) Structure **R** (1)
(5)

1.6 In humans, short fingers (**F**) and a widow's peak (**H**) are dominant over long fingers and continuous hairline. A man and a woman, both heterozygous for the two characteristics, plan on having a child.

The table below shows the possible genotypes of the offspring.

Gametes	**FH**	**Fh**	**fH**	**fh**
FH	FFHH	FFHh	FfHH	FfHh
Fh	FFHh	FFhh	FfHh	Ffhh
fH	FfHH	FfHh	ffHH	**Z**
fh	FfHh	Ffhh	ffHh	ffhh

1.6.1 State the genotype at **Z**. (1)

1.6.2 Give the:

(a) Genotype of the parents (2)

(b) Number of genotypes that could result in offspring with short fingers and a continuous hairline (1)

(c) Allele for a continuous hairline (1)

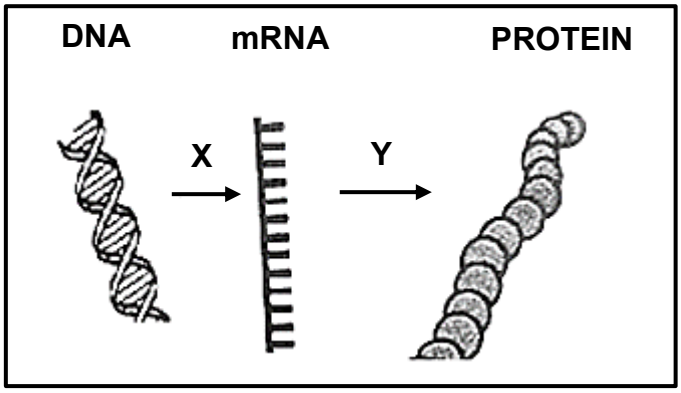
(d) Phenotype of a child who is homozygous recessive for both characteristics (2)
(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The diagram below represents two processes that occur during protein synthesis.



2.1.1 Where in the cell does EACH of the following processes occur?

(a) **X** (1)

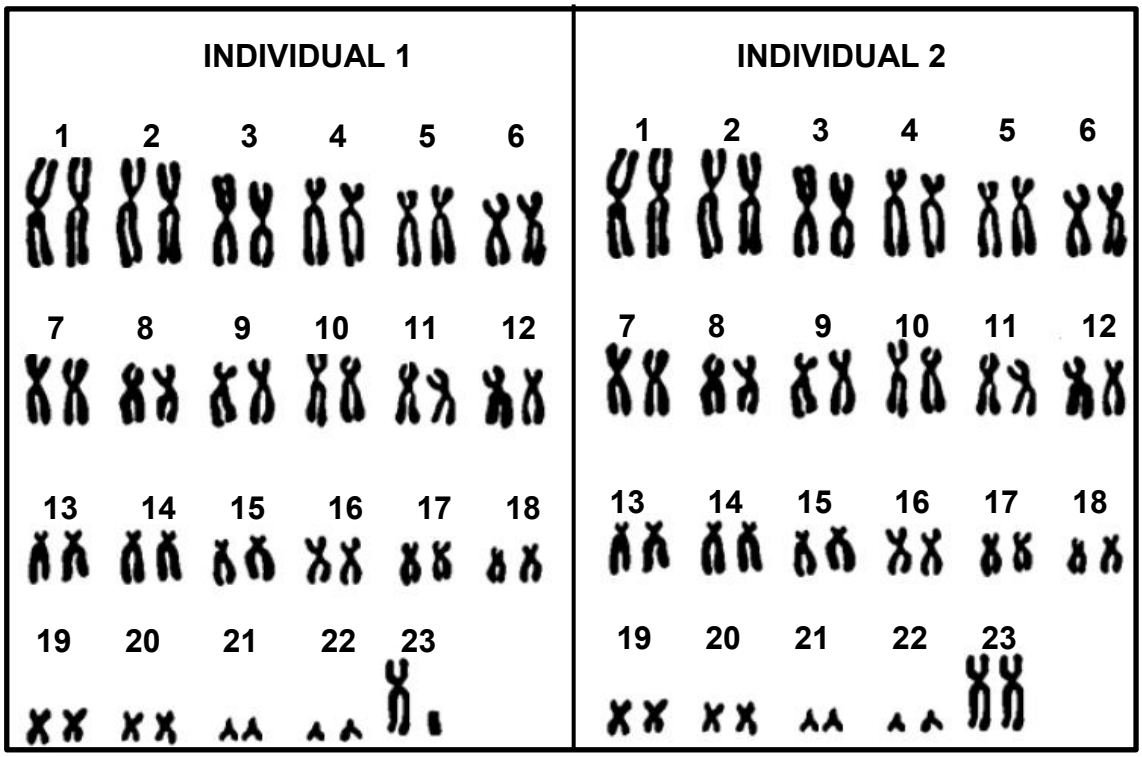
(b) **Y** (1)

2.1.2 State ONE difference between the types of nitrogenous bases found in DNA and RNA. (2)

2.1.3 Name and describe process **X**. (6)
(10)

2.2 Describe how non-disjunction may lead to Down syndrome. **(5)**

2.3 The diagram below represents the chromosomes from the human somatic cells of two individuals who are twins.



2.3.1 What are *somatic cells*? (1)

2.3.2 Name the specific type of chromosomes numbered 1 to 22. (1)

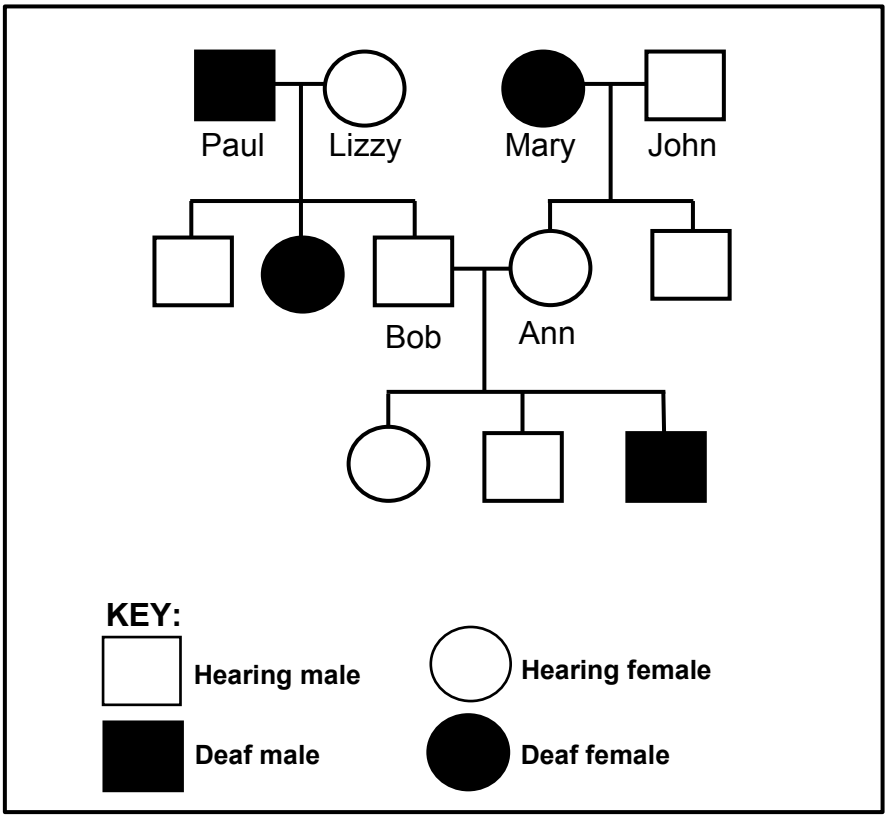
2.3.3 Each of the pairs shown is a homologous pair of chromosomes.

(a) State the origin of each chromosome in a homologous pair during zygote formation. (2)

(b) List THREE characteristics that chromosomes in a homologous pair have in common. (3)

2.3.4 Explain ONE observable reason why the two individuals are not identical twins. (3)
(10)

2.4 One type of deafness in humans is carried on a single allele. The diagram below shows the inheritance of deafness in a family.



2.4.1 How many:

(a) Generations are represented in this pedigree diagram (1)

(b) Children of Paul and Lizzy are able to hear (1)

2.4.2 Which phenotype is dominant? (1)

2.4.3 Use the offspring of Bob and Ann to explain your answer to QUESTION 2.4.2. (4)

2.4.4 Use the letter '**A**' to represent the dominant allele and the letter '**a**' for the recessive allele to give ALL the possible genotypes for a hearing individual. (2)
(9)

2.5 Use a genetic cross to show how gender in human offspring is determined by the sex chromosomes of the parents. **(6)**

2.6 Read the extract below.

> Researchers have discovered that members of a particular family have high bone density that may be caused by a gene mutation. High bone density reduces the risk of bone fractures.
>
> Twenty members of the family had their bone density measured and DNA samples taken. Seven had high bone density. The high bone density occurred throughout their bodies but especially in the spine and hips.

2.6.1 From the extract, identify TWO areas in the body where bone density can mainly be measured. (2)

2.6.2 Describe what a *gene mutation* is. (2)

2.6.3 Explain why it was necessary for the researchers to collect DNA samples. (2)

2.6.4 State the effect of this mutation. (1)

2.6.5 Calculate the percentage of the family members who had normal bone density. Show ALL your workings. (3)

(10)
[50]

QUESTION 3

3.1 Some horses have straight hair and others have curly hair. A scientist wanted to clone a straight-haired male horse to meet the demand for horses with straight hair.

The scientist used the following procedure:

- The nucleus of a somatic cell was taken from a straight-haired male horse (horse **S**).
- An unfertilised ovum was removed from a curly-haired female horse (horse **T**).
- The nucleus from the somatic cell of horse **S** was placed into the ovum taken from horse **T**.
- This ovum was then placed into the uterus of a female surrogate horse (horse **R**).

3.1.1 Explain why a somatic cell and NOT a sperm cell from horse **S** would provide the nucleus for the procedure. (3)

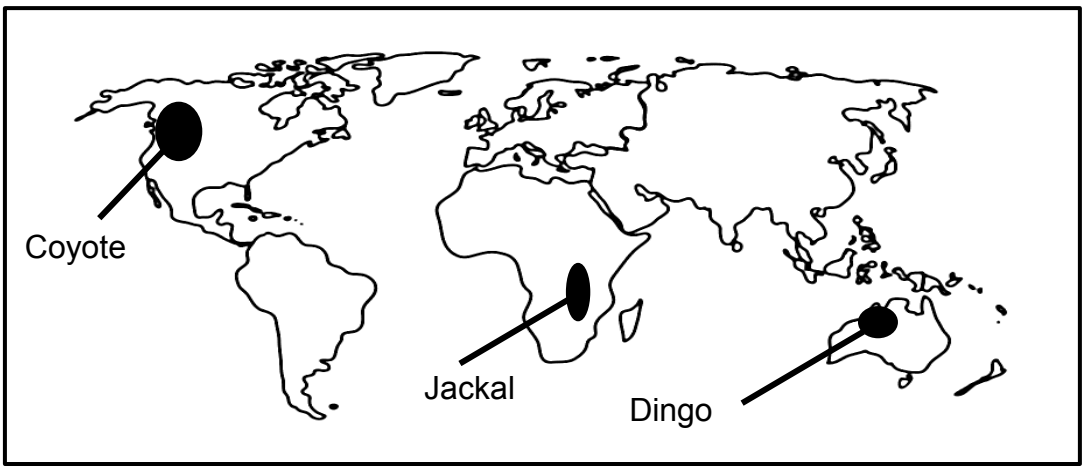
3.1.2 Before inserting the nucleus from the somatic cell of horse **S**, the nucleus from the ovum of horse **T** was removed.

Explain the significance of this procedure. (2)

3.1.3 To which of the three horses (**S**, **T** or **R**) will the cloned offspring be genetically identical? (1)

3.1.4 State TWO benefits of cloning. (2)
(8)

3.2 The present-day distribution of three closely related species of the dog family, the coyote, jackal and dingo, is shown on the world map below.



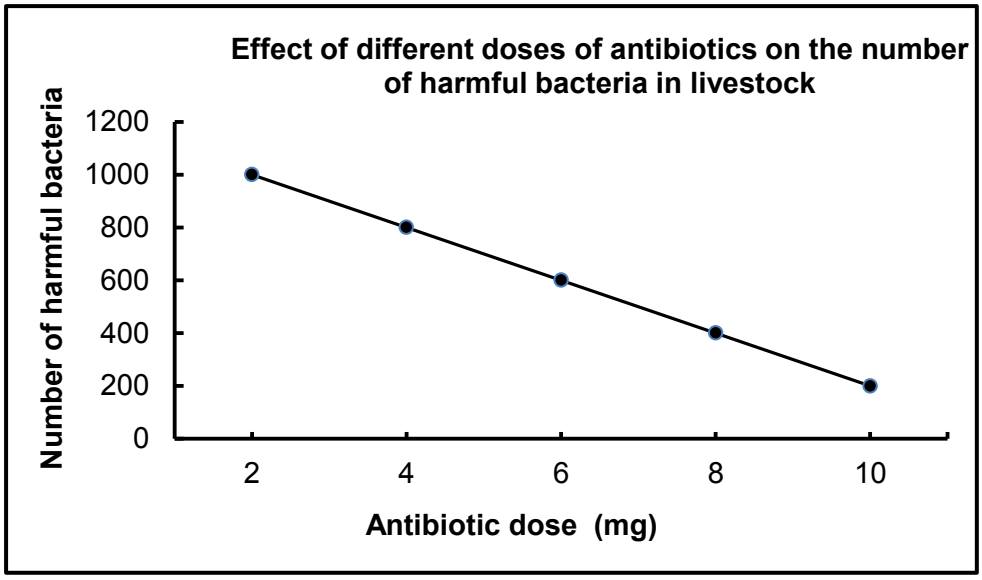
3.2.1 What type of evidence for evolution is represented here? (1)

3.2.2 What is a *biological species*? (3)

3.2.3 Describe how these three species could have evolved from a common ancestor. (7)
(11)

3.3 Some farmers add low doses of antibiotics to the feed for cattle. The use of antibiotics in cattle feed could result in the evolution of antibiotic-resistant bacteria.

The graph below shows the effect of different doses of antibiotics on the number of harmful bacteria in the cattle.



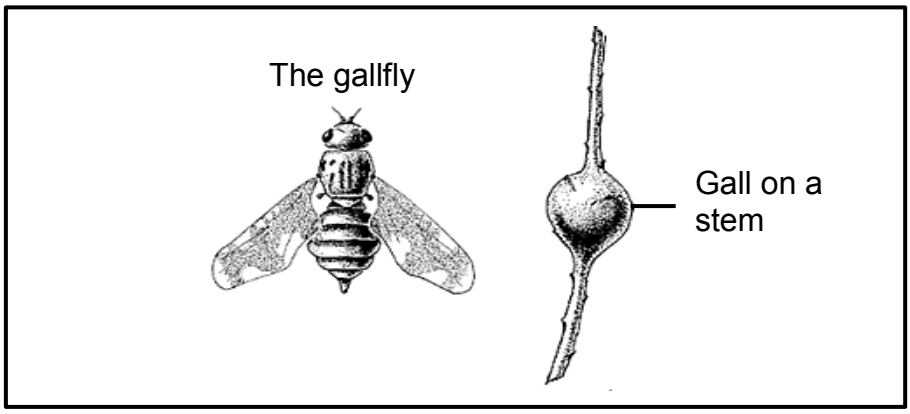
3.3.1 Use evidence from the graph to explain why higher doses of antibiotics will benefit the farmer economically. (4)

3.3.2 Explain how the use of antibiotics in animal feed may result in the evolution of antibiotic resistant bacteria. (6)
(10)

3.4 Female gallflies lay eggs on the stems of plants. The eggs hatch to form larvae that secrete a substance into the plant tissue. The secretions cause the plant cells to grow and form ball-like structures, called galls, which are high in nutrients. Predatory birds feed on the larvae in the galls.

The size of the galls produced actually depends on genetic variation in the gallfly.

The diagram below shows the gallfly and a gall on a plant stem.



Scientists wanted to investigate whether the size of the galls had an effect on the percentage of gallfly larvae killed by predatory birds.

The table below shows the results of their investigation.

Gall size (mm)	Gallfly larvae killed by predatory birds (%)
10	1
15	0
20	1
25	2
30	10

3.4.1 State the:

(a) Independent variable (1)

(b) Dependent variable (1)

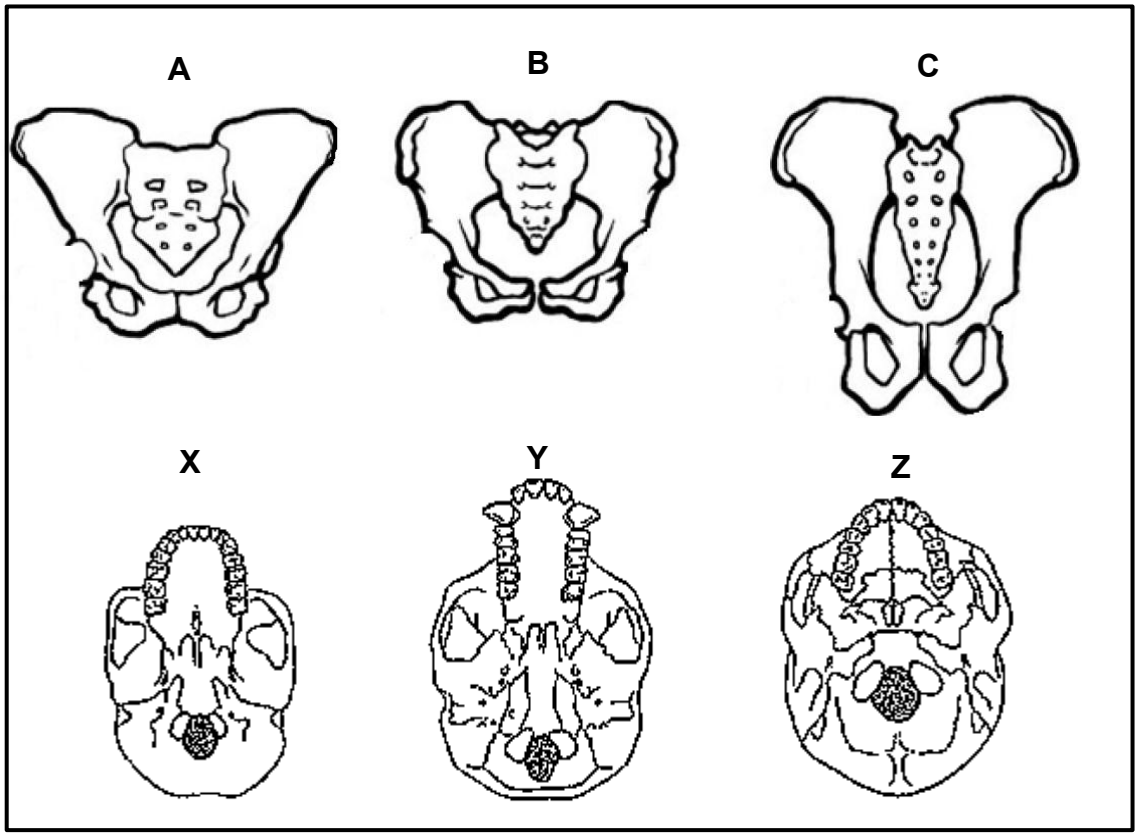
3.4.2 Give ONE advantage of the gall to the gallfly larvae. (1)

3.4.3 State why the size of the galls produced is an example of continuous variation. (1)

3.4.4 Explain how the percentage of gallfly larvae killed by predatory birds is influenced by the size of the gall. (3)

3.4.5 Draw a line graph to represent the information in the table. (6)
(13)

3.5 The diagram below represents the pelvic structure and the ventral view of the skulls of three organisms. The diagrams are drawn to scale.



3.5.1 Write down the LETTER(S) of the diagram(s) that represent the:

(a) Skulls of bipedal organisms (2)

(b) Pelvic structure of a quadrupedal organism (1)

3.5.2 Give a reason for your answer to QUESTION 3.5.1(b). (2)

3.5.3 Describe ONE other structural difference between a *bipedal* and a *quadrupedal* organism. (3)
(8)
[50]

TOTAL SECTION B: 100
GRAND TOTAL: 150

Inside Education
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MATRIC EXAM REVISIONS

LIFE SCIENCES PAPER 2 (2021)

ANSWER PAPER

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

NOVEMBER 2021

MARKING GUIDELINES

MARKS: 150

These marking guidelines consist of 12 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 learner's 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. The provincial internal moderator must be consulted, 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	C✓✓		
	1.1.2	D✓✓		
	1.1.3	C✓✓		
	1.1.4	A✓✓		
	1.1.5	B✓✓		
	1.1.6	D✓✓		
	1.1.7	C✓✓		
	1.1.8	C✓✓		
	1.1.9	D✓✓	(9 x 2)	**(18)**
1.2	1.2.1	Phylogenetic tree✓/cladogram		
	1.2.2	Peptide✓bond		
	1.2.3	Punctuated equilibrium✓		
	1.2.4	Homologous✓ structures		
	1.2.5	Artificial selection✓/selective breeding		
	1.2.6	Co-dominance✓	(6 x 1)	**(6)**
1.3	1.3.1	Both A and B✓✓		
	1.3.2	Both A and B✓✓		
	1.3.3	None✓✓	(3 x 2)	**(6)**
1.4	1.4.1	(a) Nitrogenous base✓/Guanine/Cytosine		(1)
		(b) Deoxyribose✓sugar		(1)
		(c) Hydrogen✓ bond		(1)
	1.4.2	Nucleotide✓		(1)
	1.4.3	Double helix✓		(1)
	1.4.4	(DNA) Replication✓		(1)
	1.4.5	- Nucleus✓ /Chromosome/Chromatid/ Chromatin/ Nucleoplasm		
		- Mitochondria✓		(2)
		(Mark first TWO only)		**(8)**

1.5	1.5.1	(a)	Testis✓	(1)
		(b)	Crossing over✓	(1)
	1.5.2	(a)	Chiasma✓	(1)
		(b)	Centromere✓	(1)
		(c)	Chromatid✓	(1)
				(5)
1.6	1.6.1		ffHh✓	(1)
	1.6.2	(a)	FfHh✓✓	(2)
		(b)	3✓	(1)
		(c)	h✓	(1)
		(d)	Long fingers and continuous hairline✓✓	(2)
				(7)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 2.1.1 (a) Nucleus✓/nucleoplasm (1)
(b) Ribosome✓/cytoplasm (1)

2.1.2 DNA contains thymine✓/T whereas RNA contains uracil✓/U (2)
(Mark first ONE only)

2.1.3 Transcription✓*****
- The double helix (DNA) molecule unwinds✓
- The double-stranded DNA unzips✓/weak hydrogen bonds break
- to form two separate strands✓
- One strand is used as a template✓
- to form mRNA✓
- using free RNA nucleotides✓ from the nucleoplasm
- The mRNA is complementary to the DNA✓/ A-U, G-C
- mRNA now has the coded message for protein synthesis✓

***1 compulsory mark** + Any 5 (6)
(10)

2.2
- When chromosome pair 21/chromosome 21 fails to separate✓
- during Anaphase✓
- the daughter cells (gametes) will have 24 chromosomes✓/ an extra chromosome
- When this gamete is fertilised by a normal gamete✓ with 23 chromosomes
- the zygote will have 47 chromosomes✓/3 chromosomes at position 21/ Trisomy 21

(5)

2.3 2.3.1 Body cells✓/cells in the body except the sex cells (1)

2.3.2 Autosomes✓ (1)

2.3.3 (a)
- One chromosome comes from the sperm✓/father
- and the other comes from the ovum✓/mother (2)

(b)
- Shape✓
- Size✓/length
- Position of genes✓/alleles
- Genes coding for same characteristic✓
- Location of centromere✓ Any (3)

(Mark first THREE only)

2.3.4
- Gonosomes are not identical✓/chromosomes at position 23 are not identical
- Individual 1 has XY gonosomes✓/is a male
- Individual 2 has XX gonosomes✓/is a female (3)

(10)

2.4 2.4.1 (a) 3✓/Three (1)
(b) 2✓/Two (1)

2.4.2 Hearing✓ (1)

2.4.3
- Bob and Ann can both hear✓
- They have a child who is deaf✓/who has the genotype aa
- This means that each parent carries an allele for deafness✓/are heterozygous/Aa
- but it is masked✓by the dominant allele/which is for hearing (4)

2.4.4 AA✓ and Aa✓ (2)
(9)

2.5

P_1	Phenotype	Male	x	Female✓	
	Genotype	XY	x	XX✓	
Meiosis					
	G/gametes	X, Y	x	X, X✓	
Fertilisation					
F_1	Genotype	XX; XX;		XY; XY✓	
	Phenotype	female	:	male✓	

P_1 and F_1✓
Meiosis and fertilisation✓

OR

P_1	Phenotype	Male	x	Female✓	
	Genotype	XY	x	XX✓	

Meiosis

Fertilisation

Gametes	X	Y
X	XX	XY
X	XX	XY

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype female: male✓

P_1 and F_1✓
Meiosis and fertilisation✓ Any **(6)**

2.6 2.6.1
- Spine✓
- Hips✓ (2)

(Mark first TWO only)

2.6.2
- A change in the sequence✓
- of nitrogenous bases✓/nucleotides in DNA (2)

2.6.3
- To check for the gene mutation✓
- and if it results in the high bone density✓ (2)

2.6.4 Produces high bone density✓/reduces the risk of bone fractures (1)

2.6.5 $\frac{13}{20}$✓ x 100✓ = 65✓% **OR** $\frac{7}{20}$ x 100✓ = 35%
(100 – 35)✓ = 65✓% (3)

(10)

[50]

QUESTION 3

3.1 3.1.1
- The nucleus of the somatic cell is diploid✓/ has a full set of chromosomes/has all the genetic material whereas
- the nucleus of the sperm cell is haploid✓/contains half the set of chromosomes/ has half the genetic material
- The somatic cell carries the desired characteristic✓/straight hair (3)

3.1.2 To ensure that:
- The DNA (of the ovum)/characteristic of curly hair is removed✓
- Only the desired DNA is present in the clone✓
- Correct number of chromosomes is present in the clone✓ Any (2)

3.1.3 (Horse) S✓ (1)

3.1.4
- To produce organisms with desired traits✓ e.g. health, appearance, nutritious, yield, shelf life etc.
- Conservation of threatened species✓
- To create tissue/organs for transplant✓ Any (2)

(Mark first TWO only) **(8)**

3.2 3.2.1
- Biogeography✓ (1)

3.2.2
- Similar organisms✓
- that can interbreed✓
- to produce fertile offspring✓ (3)

3.2.3
- The original population /common ancestor once lived on a large continent✓
- and became separated by continental drift✓/oceans
- There was no gene flow amongst the three populations✓*****
- Each population experienced different environmental conditions✓
- and underwent natural selection independently✓
- The individuals in each population became different✓
- genotypically and phenotypically✓
- Even if the (three) populations are mixed again✓
- they would not be able to interbreed✓/produce fertile offspring
- forming the different species, the coyote, jackal and dingo ✓*****

2 compulsory***** + any 5 (7)

(11)

3.3.1
- It decreases the number of harmful bacteria the most✓
- thereby preventing disease in cattle✓/resulting in less medical expenses
- Decreasing mortality✓/maintaining the number of cattle
- to sell✓/breed /increase profit (4)

3.3.2
- Natural selection✓ occurs
- There is variation✓/mutation in the population of bacteria
- Some are resistant to antibiotics, some are non-resistant✓
- When antibiotic is added✓ to the animal feed
- The bacteria that are non-resistant are killed by the antibiotic✓
- Those that are resistant survive and reproduce✓
- The characteristic for resistance to antibiotics is passed on to the offspring✓
- The next generation will have a higher proportion of antibiotic resistant bacteria✓ (6)

Any **(10)**

3.4 3.4.1 (a) Gall size✓ (1)

(b) Percentage of gallfly larvae killed✓ (1)

3.4.2
- Nutrition✓/food
- Protection✓
- Space✓

Any (1)

(Mark first ONE only)

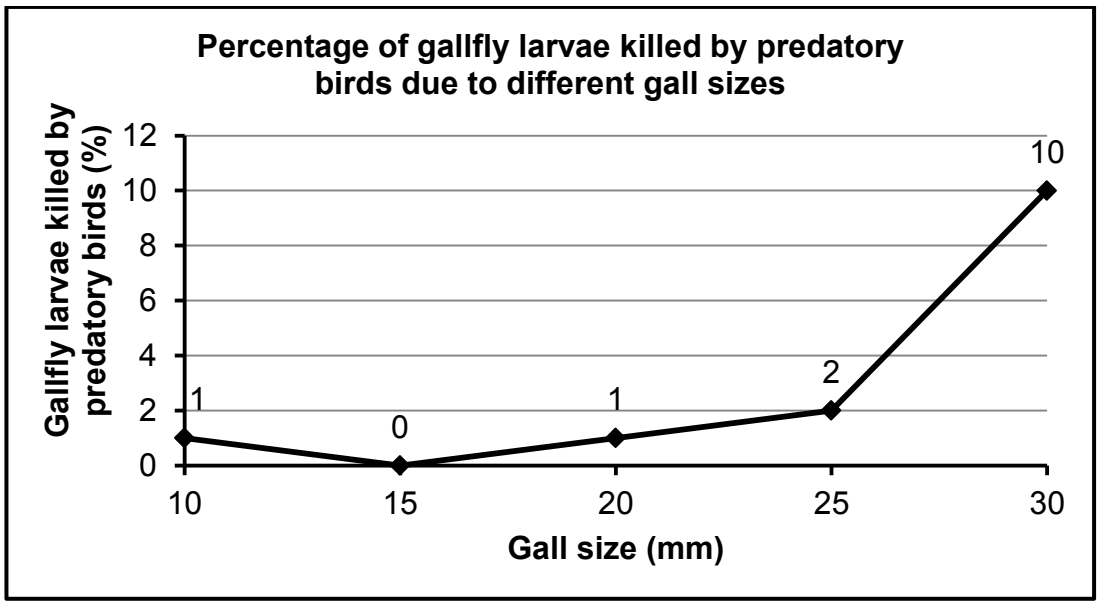
3.4.3 - There is a range of (intermediate) values✓in gall size (1)

3.4.4
- Larvae in 30mm galls are eaten more✓
- since they are more visible✓ to birds and
- contain more/larger larvae✓

OR

- Larvae in galls that are 25mm and smaller are eaten less✓
- since they are less visible✓ to birds and
- contain fewer/smaller larvae✓ (3)

3.4.5



Guideline for the assessing of the graph

CRITERIA	ELABORATION	MARK
Correct type of graph **(T)**	Line graph drawn	1
Caption of graph **(C)**	Both variables included	1
Axes labels **(L)**	Correct labels and units on X- and Y-axes	1
Scale for X- and Y-axes **(S)**	Equal spacing between intervals for each axis	1
Plotting of points **(P)**	1 to 4 points plotted correctly All 5 points plotted correctly	1 2

(6)
(13)

3.5	3.5.1	(a)	X✓, Z✓ **(in any order)** **(Mark first TWO only)**	(2)
	3.5.1	(b)	C✓	(1)
	3.5.2		- The pelvis is long✓ - and narrow✓	(2)
	3.5.3		- The spine✓ - is S-shaped for the bipedal organism✓ - and C-shaped for the quadrupedal organism✓ **OR** - The foramen magnum✓ - is in a more forward position in bipedal organisms✓ - and in a backward position in quadrupedal organisms✓ **(Mark first ONE only)**	(3) **(8)** **(50)**

TOTAL SECTION B: 100
GRAND TOTAL: 150