GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2016

10832

LIFE SCIENCES

SECOND PAPER

MARKS: **150**

TIME: **2½ hours**

19 pages

X1Ø

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PREPARATORY EXAMINATION

LIFE SCIENCES
(Second Paper)

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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. ALL drawings must 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

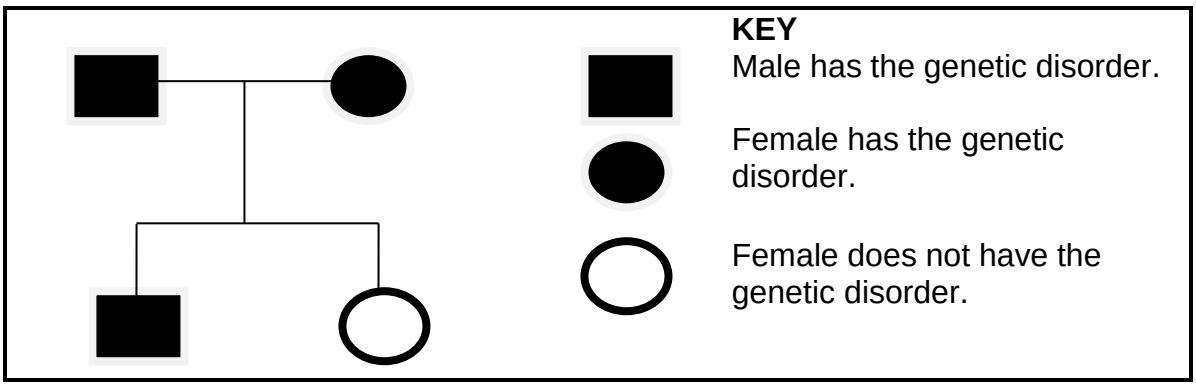
QUESTION 1

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

1.1.1 Which of the following is the correct base-pairing in DNA?

A G-C, A-T
B T-U, A-G
C G-T, A-C
D G-C, A-U

1.1.2 A researcher prepared a pedigree diagram (family tree) to trace a genetic disorder in a family.



How could the allele that causes the condition best be described?

A Co-dominant
B Dominant
C Recessive
D Sex-linked

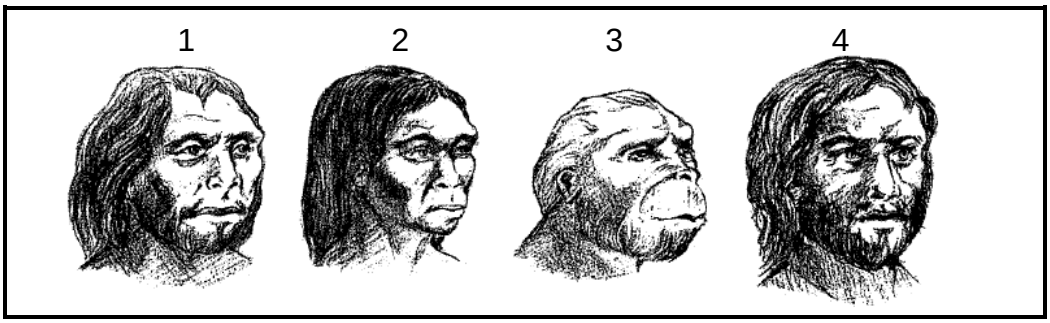
1.1.3 How many sex chromosomes does a normal human female inherit from her mother?

A 1
B 2
C 23
D 46

1.1.4 Which of the following is true of a mutation, that produces an allele that is dominant?

A It would be expected to cause death.
B It would not affect a population at all.
C It would give an observable functional phenotype in a heterozygous genotype.
D It would give an observable functional phenotype only in a homozygous genotype.

1.1.5 The diagrams below are an artist's impression of the appearance of several human or related species. The diagrams are drawn to scale.



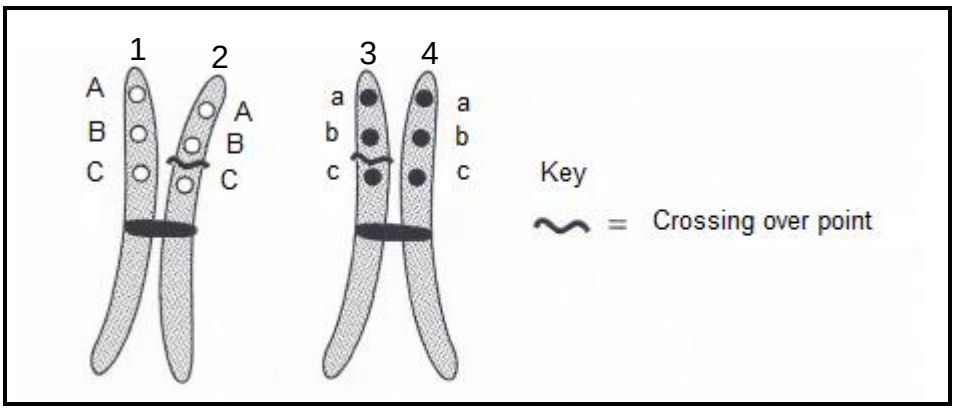
List the diagrams in order from the most primitive to the least primitive.

A 3, 1, 2, 4
B 2, 3, 4, 1
C 3, 2, 1, 4
D 3, 4, 2, 1

1.1.6 By whom and where was the famous *Australopithecus sediba* fossil found?

A Lee Burger at 'Cradle of Mankind'
B Robert Broom at 'Cradle of Mankind'
C Raymond Dart at Taung
D Louis and Mary Leaky in Tanzania

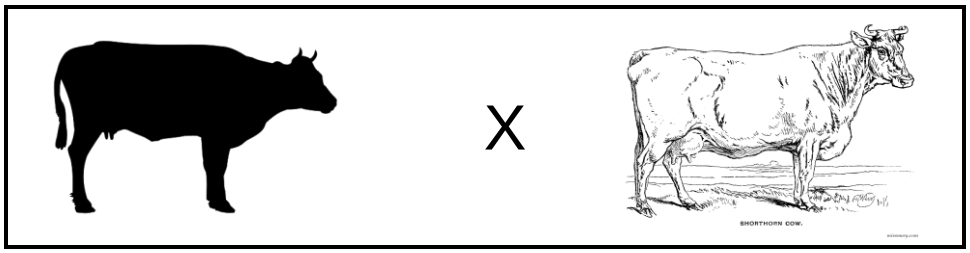
1.1.7 The diagrams represent one pair of homologous chromosomes during meiosis. Crossing over is about to take place.



The genotypes that are produced in the chromatids numbered 1 – 4 after crossing over has taken place are … .

A ABC, abC, ABc, abc
B ABC, aBC, Abc, abc
C ABC, ABC, abc, abc
D ABC, aBc, Abc, abc

1.1.8 A scientist studying the inheritance of coat colour in a herd of shorthorn cattle performed the following cross:



The results of the cross is shown in the table below.

Phenotype	Offspring number
White coat	0
Red coat	0
Red and white coat (Roan)	157
Total	**157**

Of which type of inheritance was the roan coat colour a result?

A Incomplete dominance
B Complete dominance
C Heterozygous parents
D Co-dominance

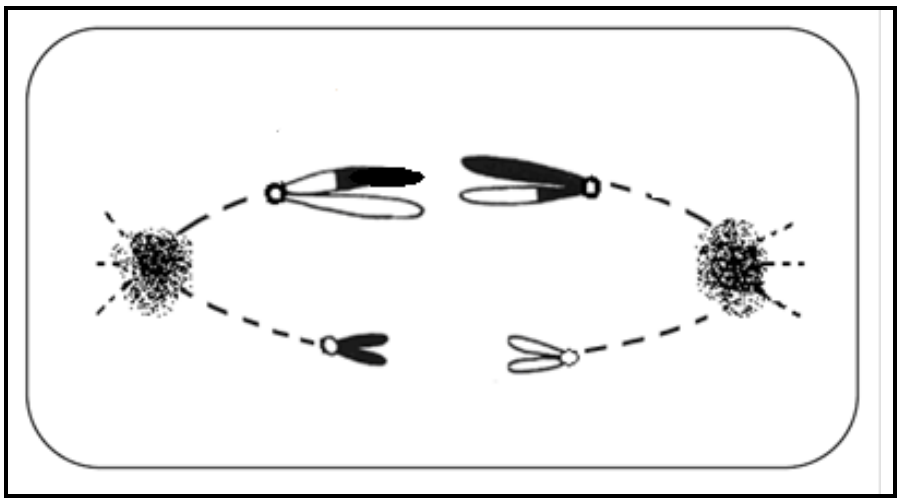
1.1.9 Below is a list of fossils discovered in South Africa.

1. Taung child
2. Little Foot
3. Karabo
4. Mrs Ples

Which of the fossils above are classified in the genus *Australopithecus*?

A 1, 2 and 3
B 1, 3 and 4
C 2, 3 and 4
D 1, 2, 3 and 4

1.1.10 Name the phase of meiosis represented in the diagram below.



A Metaphase I
B Anaphase I
C Telophase II
D Anaphase II

(10x2) **(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 – 1.2.8) in your ANSWER BOOK.

1.2.1 Site of DNA replication and transcription

1.2.2 Remains of organisms that existed millions of years ago

1.2.3 A block of DNA on a chromosome that codes for a particular characteristic

1.2.4 Having a face where the jaws project outwards

1.2.5 Arrangement of teeth on a jaw

1.2.6 Individual with two copies of the same allele for a particular characteristic

1.2.7 The act of walking on all four limbs

1.2.8 Non-separation of chromosomes during meiosis

(8x1) **(8)**

1.3 Indicate whether each of the descriptions 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 – 1.3.4) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Consists of the nucleotide bases: Adenine, Guanine, Cytosine and Uracil	A: DNA B: RNA
1.3.2	Sex-linked condition where blood fails to clot properly	A: Haemophilia B: Albino
1.3.3	A white flower is crossed with a red flower which produces pink flowers	A: Incomplete dominance B: Complete dominance
1.3.4	Environment is the selective force	A: Artificial selection B: Natural Selection

(4x2) **(8)**

1.4 Paternity testing involves TWO procedures used to determine the biological father of a child.

Procedure 1: ABO blood groups

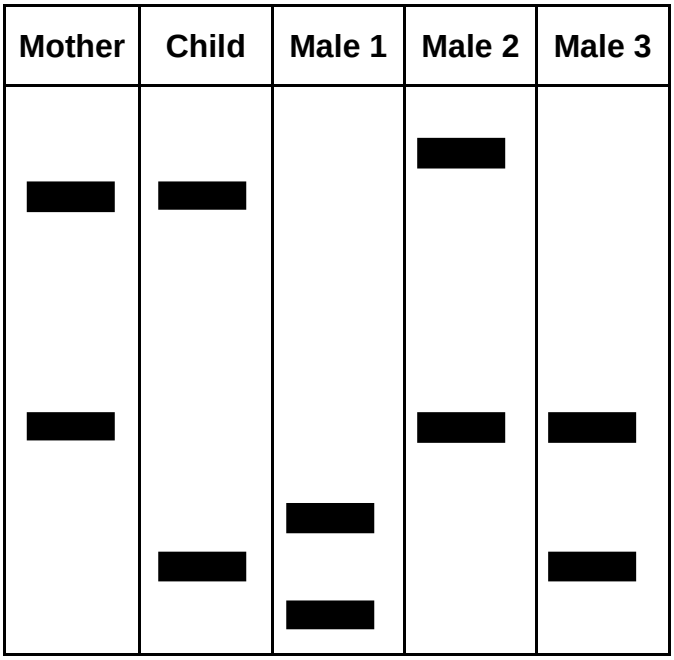
Procedure 2: DNA profiling

The following data shows the results of two different procedures attempting to identify the biological father of a child. The mother of the child is confirmed.

Procedure 1: ABO blood Groups

Mother	Child	Male 1	Male 2	Male 3
A	O	O	A	B

Procedure 2: DNA profiling data



1.4.1 From the ABO blood group data, identify which male(s) could be the biological father of the child. (1)

1.4.2 From the DNA profile, identify which male could be the biological father of the child. (1)

1.4.3 Give the genotype of the blood group:

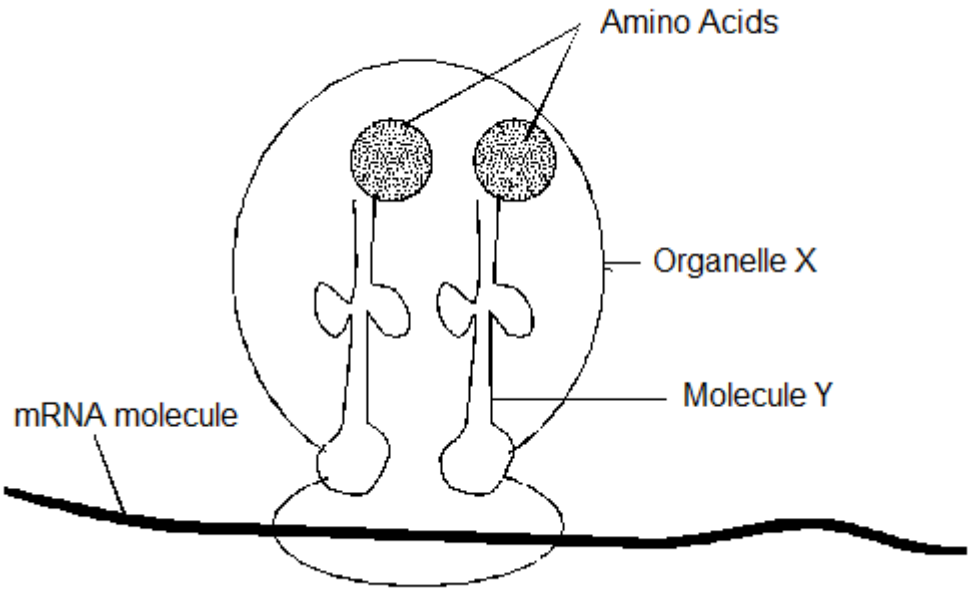
(a) Of the child (1)

(b) Of the mother (1)

1.4.4 Choose TWO ways from the list below (other than for paternity testing) in which DNA profiling is used. Write the numbers only.

(i) Test for specific alleles that can cause a genetic disorder
(ii) Growing tissues for organ transplants
(iii) Data research in population distribution
(iv) Identifying criminals (2)
(6)

1.5 The diagram shows a part of an mRNA molecule attached to an organelle in the cytoplasm.



The short length of mRNA sequence is shown below:

AUG	**GCC**	**UCG**	**AUC**	**ACG**	**GCC**	**AUC**	**AUG**

1.5.1 Where in the cell is mRNA formed? (1)

1.5.2 State the maximum number of amino acids in this polypeptide for which this piece of mRNA above could code. (1)

1.5.3 Give the DNA nitrogenous base triplet for the mRNA codon UCG. (1)

1.5.4 Which stage of protein synthesis is represented in the diagram? (1)

1.5.5 Name:

(a) Organelle X (1)

(b) Molecule Y (1)

1.5.6 Determine how many different types of Molecule Y would be used to produce a polypeptide from this piece of mRNA shown in the diagram. (1)

1.5.7 If the mRNA codon is AUC. Give the anticodon sequence in Molecule Y which would bind to the mRNA at this site. (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Haemoglobin is made up of two types of polypeptide chains. In people with sickle cell anaemia, one polypeptide chain has one amino acid which is different from the normal sequence. This is due to a mutation which produces the base sequence CAT instead of CTT in the DNA molecule.

The table below shows the mRNA codons for some amino acids.

mRNA base codon	Amino acid
CAU	histidine
CAA	glutamine
GUA	valine
GAA	glutamic acid
CUU	leucine
GAU	aspartic acid

2.1.1 State what is meant by *a mutation*. (1)

2.1.2 Is the mutation mentioned above an example of a gene mutation or a chromosomal aberration? (1)

2.1.3 Explain your answer to Question 2.1.2. (2)

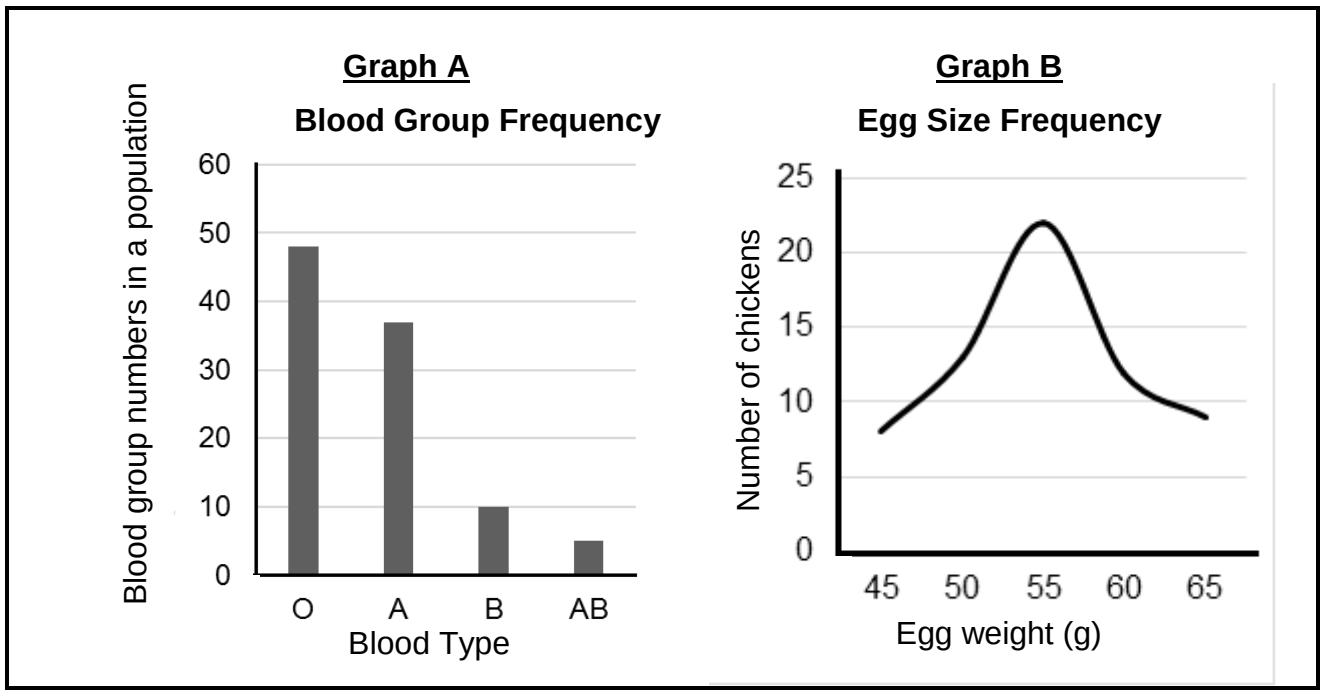
2.1.4 Use ALL the information above and the table to determine the:

(a) Amino acid present in normal haemoglobin (1)

(b) Amino acid present in sickle cell haemoglobin (1)
(6)

2.2 Describe the process of how a polypeptide is formed in the ribosome during protein synthesis. (6)
(6)

2.3 In two separate experiments, blood group frequency in humans and egg size in chickens were investigated. The following data was collected and the results graphed.



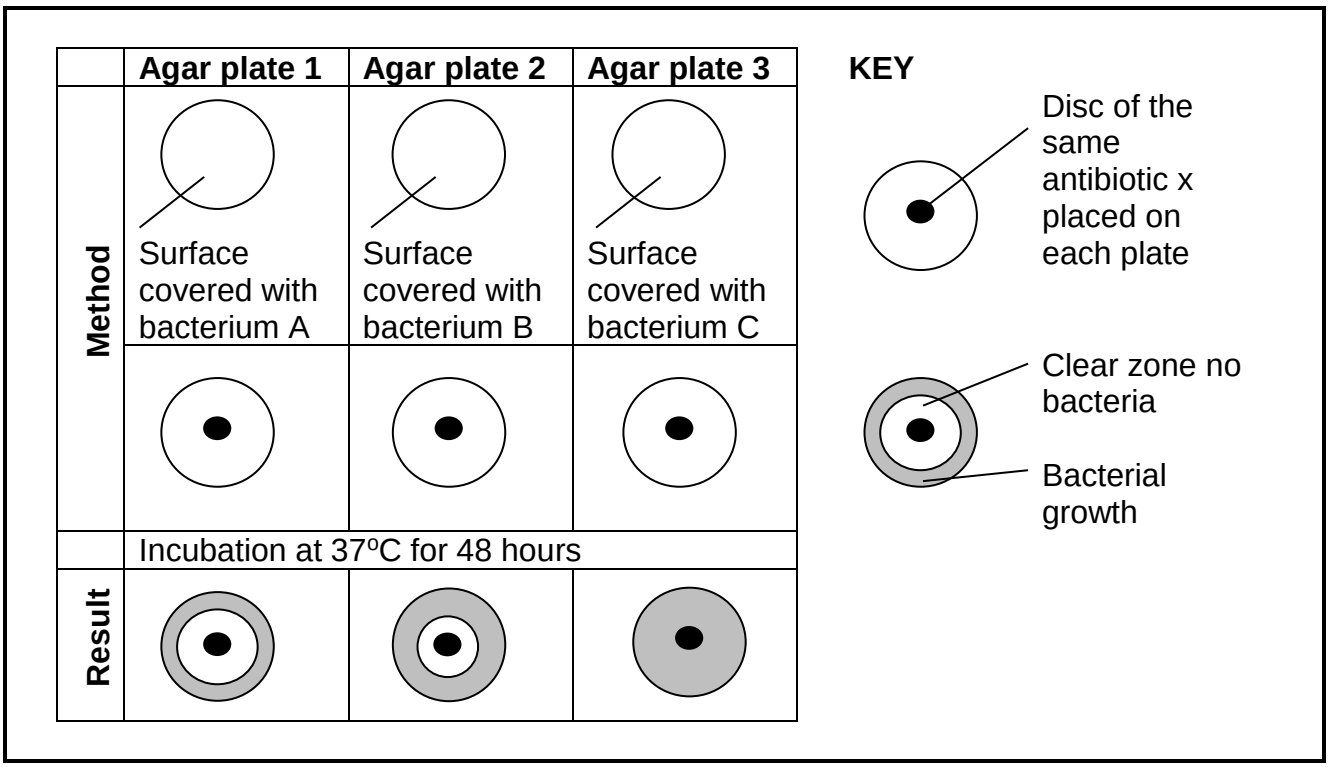
2.3.1 Identify which graph represents:

(a) Continuous variation (1)

(b) Discontinuous variation (1)

2.3.2 Describe the differences between the graphs, supporting your answer with a description of continuous and discontinuous variation. (4)
(6)

2.4 An investigation was set up to study the effect of an antibiotic on three strains of bacteria (A, B and C). Agar plates were set up as shown below.



[Adapted from 2004 HSC NSW: Section I - Part B Q27]

The plates were incubated at 37°C for 48 hours. The diagram of plates 1, 2 and 3 in the bottom row show the results of the investigation.

2.4.1 Formulate a hypothesis for this investigation. (2)

2.4.2 State the dependent variable in this investigation. (1)

2.4.3 Write a conclusion to the experiment. (2)

2.4.4 State TWO other factors, not stated in the question, that must be kept constant in the investigation. (2)

2.4.5 Identify ONE safe work practice used to minimise risks associated with handling or identifying bacteria. (1)

2.4.6 Suggest ONE way in which the reliability of the results can be improved. (1)

2.4.7 The widespread use of antibiotics for the treatment of bacterial infections has led to the development of antibiotic resistance in some species of bacteria. From your knowledge of evolution explain how resistance has developed in bacteria. (5)

(14)

2.5 Cloning is a technique that could be used to increase numbers of an endangered species.

2.5.1 Explain the effect that cloning could have on the genetic diversity of a species. (2)

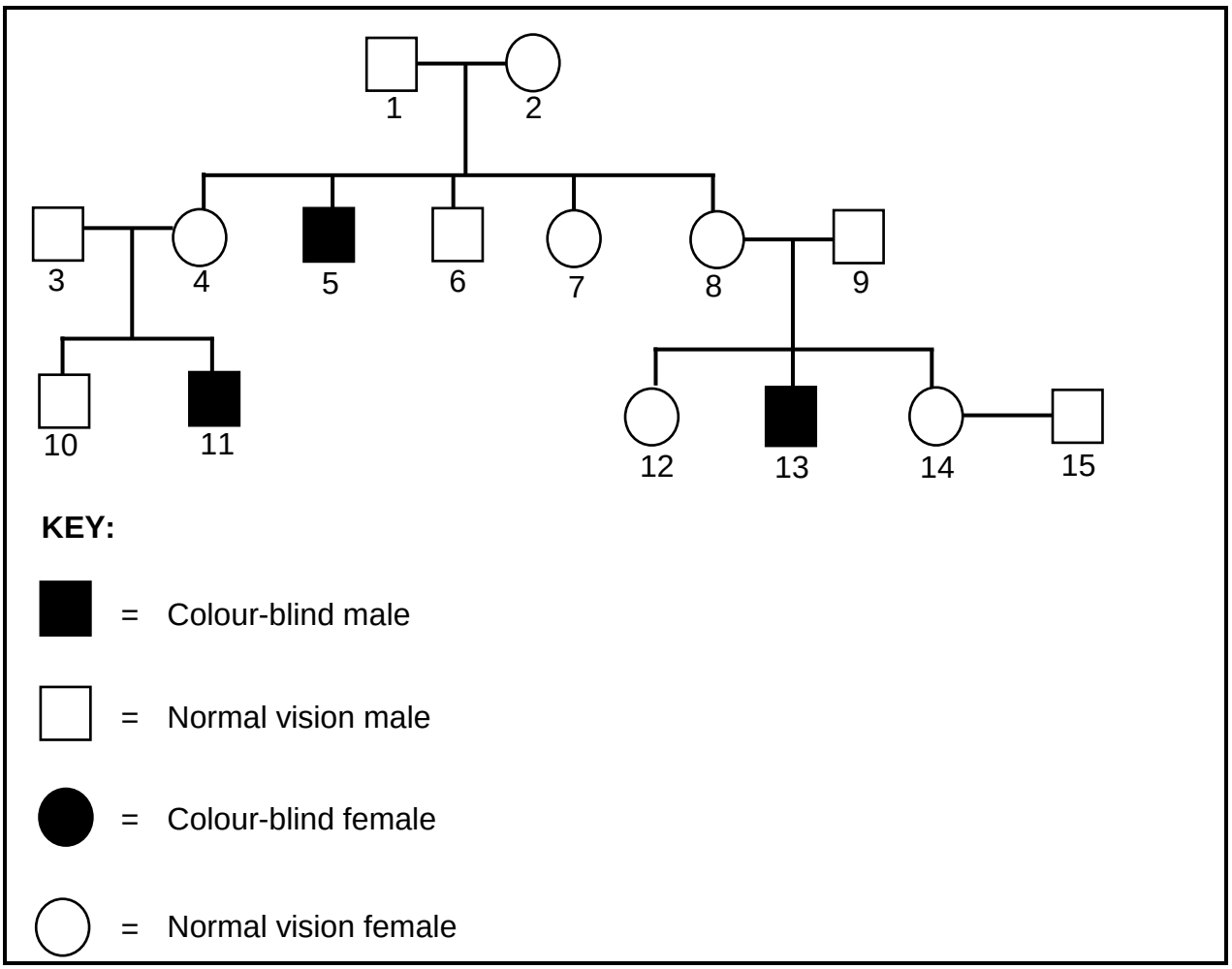
2.5.2 Describe TWO ways in which cloning in animals or plants can be beneficial to humans. (2)
(4)

2.6 Describe TWO ways in which punctuated equilibrium differs from Darwin's Theory of natural selection. **(4)**

[40]

QUESTION 3

3.1 Colour-blindness is a sex-linked inherited condition which affects the photoreceptors of the eye. It is caused by a recessive allele. The diagram shows the inheritance of colour-blindness in one family.



3.1.1 Give evidence from the diagram which suggests that colour-blindness is:

(a) Sex-linked (1)
(b) Caused by a recessive allele (1)

3.1.2 Use the following symbols.

X^D = an X chromosome carrying the normal allele
X^d = an X chromosome carrying the allele for colour-blindness

Identify all the possible genotypes for the following persons:

(a) 5
(b) 7
(c) 8 (4)

3.1.3 Assume that Person 14 is a carrier of the colour-blindness allele. She has recently married Person 15.

Represent a genetic cross to determine the probability of their first child being born colour-blind. (6)
(12)

3.2 Indian maize has four grain types that involve combinations of colour and appearance. Four alleles are involved, which are located on two pairs of homologous chromosomes (each gene on a separate chromosome). The alleles are:

B = black b= yellow R = round r = wrinkled

The table below shows the results of a cross between two hybrid Indian maize plants.

Grain phenotype	Observed number of offspring
Black and round	144
Black and wrinkled	48
Yellow and round	48
Yellow and wrinkled	16
TOTAL	**256**

3.2.1 State the type of genetic cross represented in the above table. (1)

3.2.2 State the phenotype of the parents. (2)

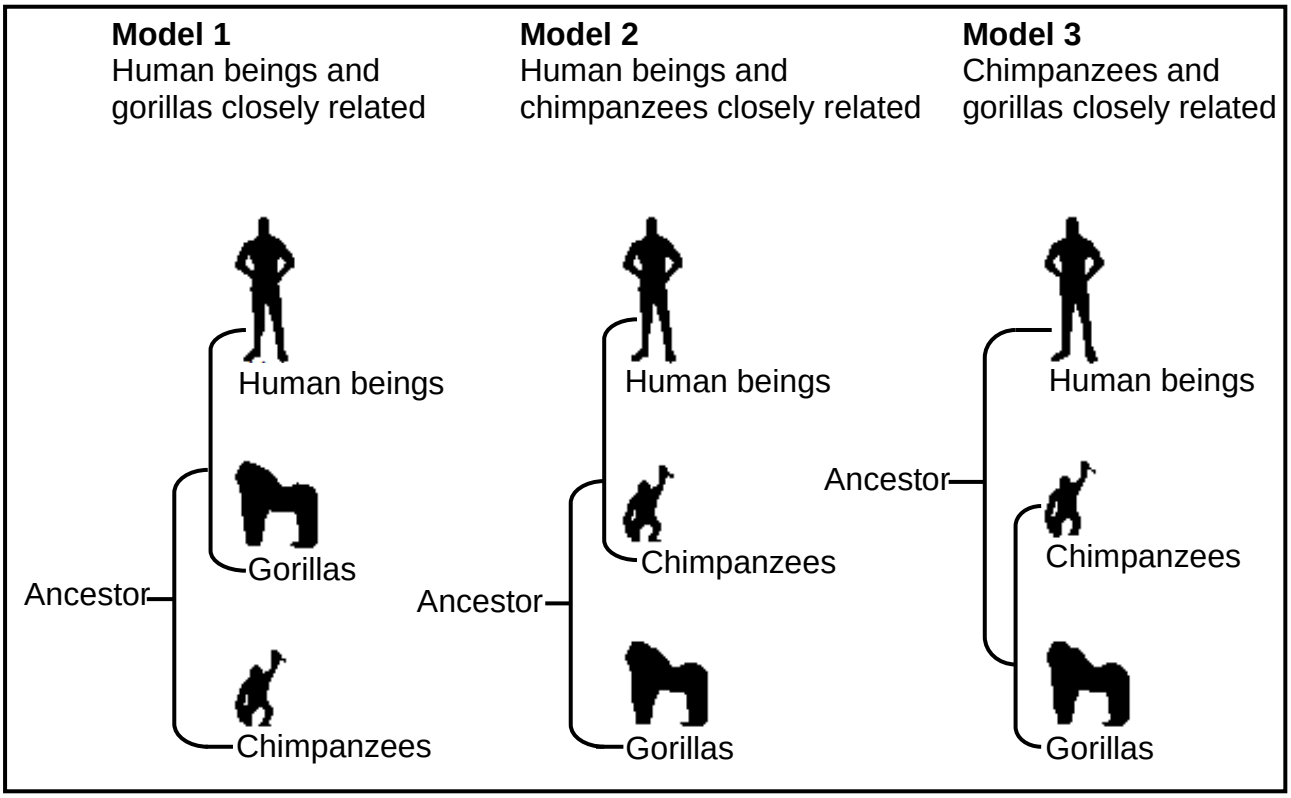
3.2.3 Determine the genotypes of the yellow and round offspring. (2)

3.2.4 Predict the possible gametes produced by the parents. (2)

3.2.5 Using the data, calculate the phenotype ratio in this cross. (2)
(9)

3.3 Biologists believe that human beings, gorillas and chimpanzees share a common ancestor. They do not agree as to how this common ancestor evolved into these three species.

The diagram shows three models to represent the evolutionary relationship between the three species and the ancestor.



[Adapted from AQA-AHSH.20-QP-NOV07]

The table below summarises some of the available evidence concerning the relationship among the three species.

Characteristic	**Gorillas**	**Humans**	**Chimpanzee**	**Model indicated**
Limb length	Legs shorter than arms	Arms shorter than legs	Legs shorter than arms	**3**
Thumbs	Short	Long	Short	**A**
Molecules Human haemoglobin	Slight difference	Not applicable	Identical	**B**

3.3.1 State the relevant evolutionary relationship for:

(a) A (1)

(b) B (1)

3.3.2 Tabulate the anatomical differences of the cranial ridge and spine between African Apes and humans. (4)

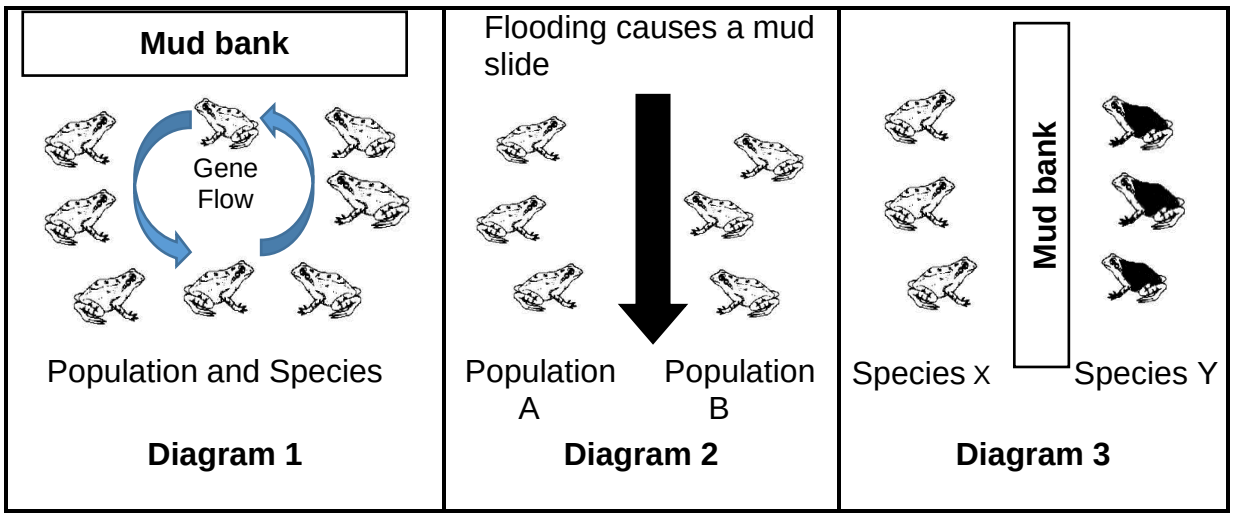
3.3.3 Much of the evidence for the evolution of humans comes from studying fossils. State TWO ways why fossil evidence is often difficult to interpret. (2)

3.3.4 (a) Define the term *transitional species*. (2)

(b) Explain why *Australopthecines* are regarded as a transitional species between *Ardipithecus* and *Homo species* with regard to the position of the foramen magnum. (3)

(13)

3.4. Use the information in the diagram below to explain the formation of a new species of frog.



(6)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how meiosis, mutations, chance fertilisation and random mating contribute to variation among individuals of the same species.

Content: (17)
Synthesis: (3)
(20)

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

TOTAL SECTION C: 20

TOTAL: 150

END