basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P1

EXEMPLAR 2011

MARKS: 150

TIME: 2½ hours

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 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 or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT all drawn to scale.
9. You may NOT use graph paper.
10. You may use a non-programmable calculator, protractor and compass.
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–D) next to the question number (1.1.1–1.1.9) in the ANSWER BOOK, for example 1.1.10 D.

1.1.1 In humans, the allele for brown eyes is dominant over the allele for blue eyes. The probability of two parents, heterozygous for brown eyes, having children with blue eyes is …

A 75%.
B 50%.
C 25%.
D 0%.

1.1.2 The nitrogenous base which replaces thymine in a RNA molecule is …

A guanine.
B uracil.
C adenine.
D cytosine.

1.1.3 Human blood type is determined by three different alleles known as I^A, I^B and i. The I^A and I^B alleles are codominant and the i allele is recessive.

The possible human phenotypes for blood groups are type A, type B, type AB and type O.

Blood type A and B individuals can be either homozygous (I^AI^A or I^BI^B respectively) or heterozygous (I^Ai or I^Bi respectively).

A woman with type A blood and a man with type B blood could have offspring with the following blood types:

A A and B only
B B and AB only
C O only
D A, B, AB or O

1.1.4 During an investigation the DNA of an animal cell was analysed in a laboratory and the results are shown in the table below.

BASE COMPOSITION			
X	Adenine	Y	Z
30,0%	20,0%	30,0%	20,0%

Which of the following is a CORRECT identification of the bases called X, Y and Z?

	X	Y	Z
A	Cytosine	Guanine	Thymine
B	Adenine	Thymine	Cytosine
C	Thymine	Cytosine	Adenine
D	Guanine	Adenine	Thymine

1.1.5 Assume that plant A has an unknown genotype but shows the dominant trait. This means that plant A could be either homozygous or heterozygous for that trait. To determine which of these two genotypes apply, plant A can be crossed with another plant showing the recessive trait.

Which of the following predictions can be made by studying the offspring from such a cross of complete dominance?

A If all the offspring show the dominant phenotype, then plant A is heterozygous.
B If all the offspring show the recessive phenotype, then plant A is homozygous.
C If 50% of the offspring show the dominant phenotype and 50% of the offspring show the recessive phenotype, then plant A is homozygous.
D If all the offspring show an intermediate characteristic, then plant A is heterozygous.

1.1.6 If all 18 nucleotides of a DNA strand code for amino acids, how many amino acids will be present in the polypeptide that is formed?

A 9
B 18
C 7
D 6

QUESTIONS 1.1.7 and 1.1.8 refer to the information below.

Some characteristics are controlled by more than one gene. Human skin colour is controlled by at least three genes (three different pairs of alleles). There is incomplete dominance between the allele for dark pigmentation and the allele for light pigmentation. A heterozygous individual will therefore have an intermediate colour. Assume that the alleles A, B and C control dark pigmentation and the alleles a, b and c control light pigmentation. A person with the genotype **AABBCC** would have a very dark skin colour and someone with the genotype **aabbcc** would have a very light skin colour.

1.1.7 The phenomenon whereby a characteristic is controlled by more than one pair of alleles is called …

A incomplete dominance.
B complete dominance.
C polygenic inheritance.
D dihybrid cross.

1.1.8 Which ONE of the following is a possible heterozygous combination of the three genes for skin colour?

A AABBCC
B AaBbCc
C aabbcc
D ABC

1.1.9 Study the following statements:

1 The same characteristic has more than two different alleles for the same gene.
2 The different alleles for the same characteristic are on the same locus.
3 The alleles for the same characteristic are on different loci.
4 More than one gene controls a characteristic.

The following combination of statements refer to multiple alleles:

A 1, 2, 3 and 4
B 1 and 2 only
C 1, 2 and 3 only
D 3 and 4 only (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 number (1.2.1–1.2.6) in the ANSWER BOOK.

1.2.1 The pair of chromosomes in a diploid individual that have the same shape and size, and control the same set of characteristics

1.2.2 The type of genetic cross where an intermediate phenotype is expressed in F_1, while parental phenotypes reappear in F_2

1.2.3 The law that accounts for gametes having only one allele for a characteristic due to a separation of the pair of alleles during meiosis

1.2.4 A ring of DNA found in bacteria that is used in the production of insulin

1.2.5 A study of the transmission of characteristics from parents to offspring

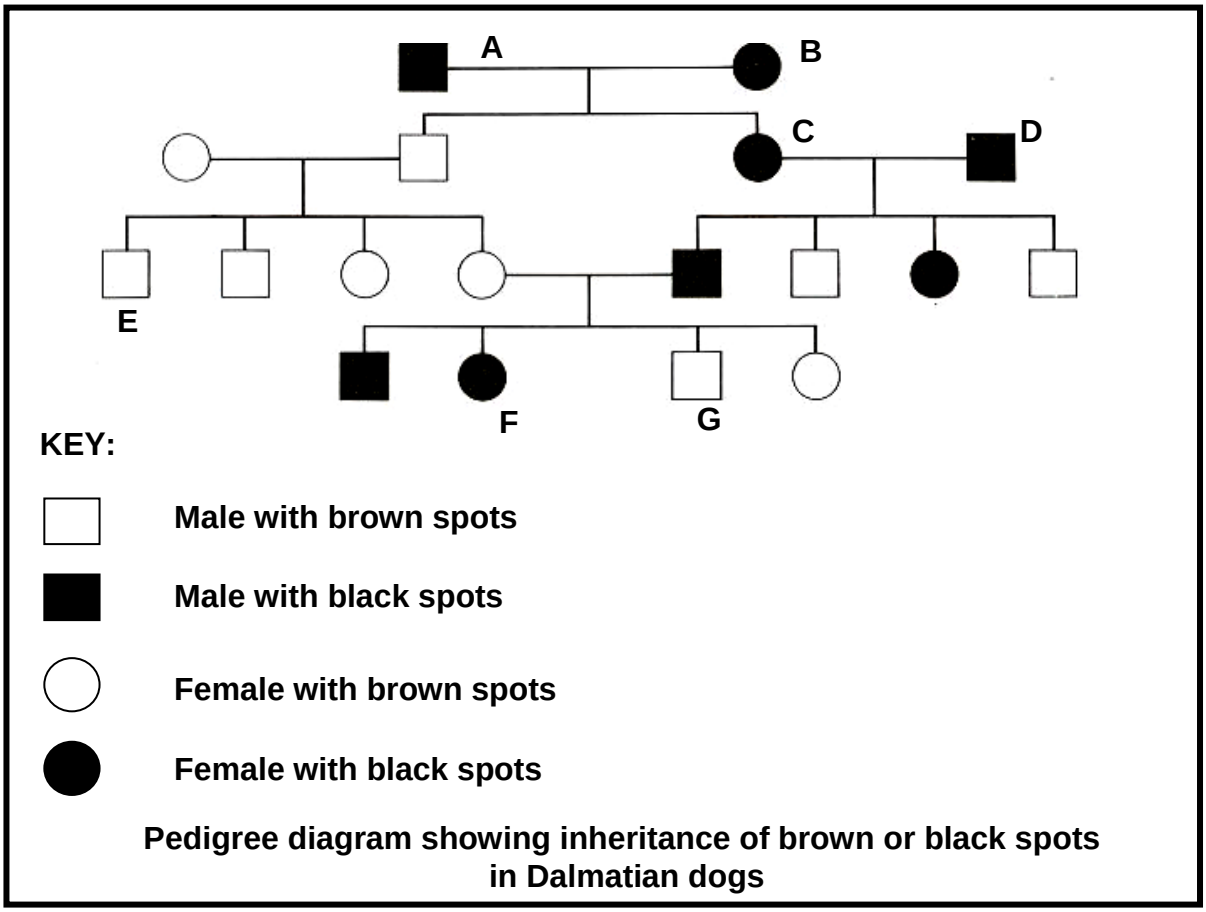
1.2.6 Chromosome condition of a cell resulting from meiosis, having only one set of chromosomes (6 x 1) **(6)**

1.3 Indicate whether each of the statements in COLUMN I applies to **A only**, **B only**, **both A and B** or **none** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1–1.3.8) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Provides genetic evidence for the 'out of Africa' hypothesis	A: Mitochondrial DNA B: DNA from X chromosomes
1.3.2 Organism(s) which is/are bipedal	A: *Homo habilis* B: *Australopithecus africanus*
1.3.3 Proposed natural selection as an explanation of evolution	A: Wallace B: Lamarck
1.3.4 Genetic disorder(s) which lead(s) to absence of blood-clotting factors	A: Down's syndrome B: Haemophilia
1.3.5 Natural shape of a DNA molecule	A: Double helix B: Single-coiled strand
1.3.6 Evidence for evolution	A: Biogeography B: Fossil records
1.3.7 Fossil(s) found in South Africa	A: *Australopithecus sediba* ('karabo') B: 'Nutcracker Man'
1.3.8 Transfer of a gene for drought-resistance from one species to another	A: Cloning B: Genetic engineering

(8 x 2) **(16)**

1.4 Study the pedigree diagram below showing the inheritance of black or brown spots in Dalmatian dogs. The colour of the spots is determined by a gene which has two alleles. The allele for black spots (B) is dominant over the allele for brown spots (b).



Pedigree diagram showing inheritance of brown or black spots in Dalmatian dogs

1.4.1 Name the colour and gender of each of the following:

(a) B (2)

(b) G (2)

1.4.2 Name the genotype of:

(a) A (1)

(b) F (1)

(c) E (1)

1.4.3 If C and D have another puppy, what is the percentage probability of each of the following:

(a) The puppy being female (1)

(b) The puppy having black spots (2)
(10)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Study the genotypes and phenotypes below that show how the alleles for colour-blindness are inherited. X and Y represent sex chromosomes. A carrier does not suffer from colour-blindness but can pass the allele for colour-blindness to their children.

NAME OF PERSON	GENOTYPE	PHENOTYPE
Lindi	X^BX^B	Normal female
Beauty	X^BX^b	Carrier female
Sarah	X^bX^b	Colour-blind female
Paul	X^BY	Normal male
Thabani	X^bY	Colour-blind male

2.1.1 State why colour-blindness is referred to as a sex-linked disorder? (2)

2.1.2 Is colour-blindness caused by a dominant or a recessive allele? (1)

2.1.3 Explain your answer to QUESTION 2.1.2 above. (2)

2.1.4 Explain why Thabani is colour-blind. (2)

2.1.5 Sarah and Paul marry and have two children, a son and a daughter.

Represent this genetic cross by using the information in the table above to determine the genotypes and phenotypes of the son and the daughter. (6)
(13)

2.2 People with the phenotype known as 'hitch-hiker's thumb' are able to curve their thumb backwards without assistance, so that it forms an arc shape. The allele for 'hitch-hiker's thumb' is dominant over the allele for the normal thumb.

After making their own observations, Grade 12 learners formulated the following question around which they were then required to develop an investigation:

Is the 'hitch-hiker's thumb' more common than the normal thumb in a population?

2.2.1 Formulate a hypothesis for this investigation. (3)

2.2.2 State FOUR planning steps for the investigation. (4)

2.2.3 Name the scientist who formulated the concept of dominance after experimenting with pea plants. (1)

2.2.4 State TWO ways of ensuring that the findings of the investigation are reliable. (2)
(10)

2.3 Study the diagram of a phase in meiosis below and answer the questions that follow.

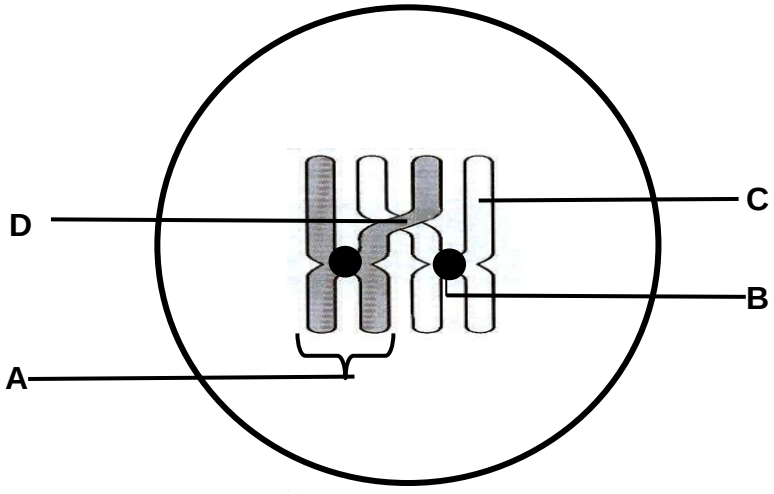


Diagram representing a process taking place during meiosis

2.3.1 Give labels for parts B, C and D. (3)

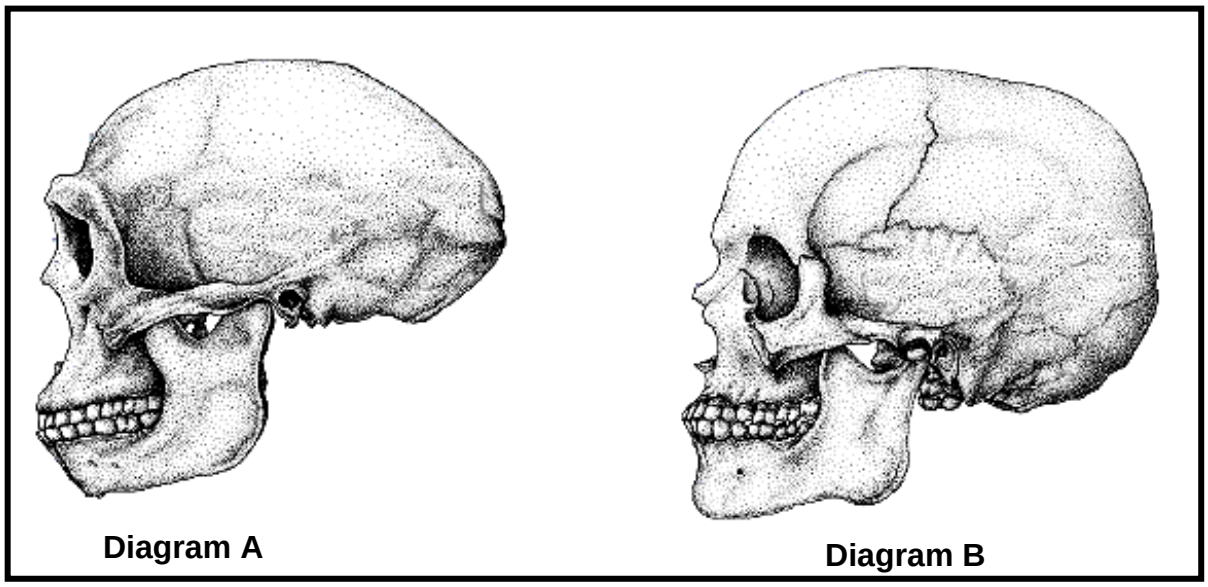
2.3.2 Name the process in meiosis that is illustrated in the diagram above. (1)

2.3.3 State ONE importance of the process named in QUESTION 2.3.2. (1)

2.3.4 Draw a diagram of the structure labelled **A** to show its appearance immediately after the process named in QUESTION 2.3.2. (2)
(7)
[30]

QUESTION 3

3.1 Diagrams A and B below illustrate the skulls of *Homo sapiens* and *Homo erectus*. The diagrams are drawn to scale.



3.1.1 Which of the diagrams (A or B) represents the following:

(a) *Homo sapiens* (1)

(b) *Homo erectus* (1)

3.1.2 Tabulate TWO visible differences between the skulls in diagrams A and B that represent changes in the structure that characterises human evolution. (5)

3.1.3 Describe the significance of *Homo erectus* to the 'out of Africa' hypothesis. (3)

3.1.4 List FOUR similarities between *Homo sapiens* and other primates. (4)
(14)

3.2 Read the passage below about the evolution of wheat and answer the questions that follow.

Thousands of years ago, wheat was one of many wild grasses, producing few, small seeds. The wild wheat which has a diploid number of 14 crossed in a 'genetic accident' with a natural goat grass, which also had a diploid number of 14 chromosomes. A new fertile hybrid species called Emmer, which had 28 chromosomes, was produced.

Emmer had many more seeds which were also larger than the wild wheat and the seeds were attached to the husk in such a way that it could easily be dispersed by wind.

There was a second 'genetic accident' in which Emmer crossed with another species of goat grass which had a diploid number of 14, to produce a hybrid with 42 chromosomes.

This hybrid is the present-day bread wheat with seeds that are larger in size and number than any of the species from which it was formed. This wheat can only be propagated by humans, since the seeds are attached to the husk in such a way that it cannot easily be dispersed by wind.

[Adapted from *The Ascent of Man* – J Bronowski]

3.2.1 How many chromosomes are normally found in the gametes of the wild wheat plant? (1)

3.2.2 How many chromosomes are normally found in the offspring grown from the seed of the wild wheat plant? (1)

3.2.3 Name and explain the mechanism that accounts for Emmer having a chromosome number that was twice that of each of the two species from which it was formed. (5)

3.2.4 The term 'diploid' refers to the presence of two sets of chromosomes in a cell, whereby each chromosome is present with its homologous partner.

(a) Name the general term used to describe the presence of many sets of chromosomes in cells of the present-day bread wheat. (1)

(b) Using the information in the passage above, name TWO advantages of the concept named in QUESTION 3.2.4 (a). (2)

3.2.5 Explain why bread wheat cannot grow in the wild and must therefore be cultivated by humans. (2)

3.2.6 What type of speciation occurred in the production of the hybrid wheat? (1)

3.2.7 Name the other type of speciation that you have studied. (1)

3.2.8 State ONE difference between the two types of speciation. (2)
(16)
[30]

TOTAL SECTION B: 60

SECTION C

QUESTION 4

4.1 The information and question below are based on natural selection.

> Antibiotics are used to kill bacteria that cause diseases. In 1972, there was an epidemic of typhoid in Mexico. Normally, an antibiotic called chloramphenicol cured it. This time the antibiotic did not work and more than 14 000 people died. Eventually, doctors found an antibiotic that did work.

Using your understanding of natural selection, explain why chloramphenicol did not control the epidemic mentioned above. **(5)**

4.2 Study the information below on an investigation based on artificial selection, and answer the questions that follow.

> In 1965, an investigation was started to find out if artificial selection could increase the milk yield of cows. In one set of cows, artificial selection for high milk yield was carried out in each generation. This set of cows was called the SELECTED LINE. In the other set of cows, there was no artificial selection. This set was called the CONTROL LINE.
>
> Both sets of cows were kept under the same conditions. The average milk yield from both sets of cows that were born in each year from 1965 to 1990 was recorded. The results are shown in the table below.

YEAR OF COW'S BIRTH	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Selected line: average milk yield (litre per kg)	7,2	8,2	8,8	10,0	9,7	11,0
Control line: average milk yield (litre per kg)	7,2	7,1	6,0	6,8	6,6	5,8

4.2.1 Plot line graphs, on the same set of axes, using the information in the table above. (12)

4.2.2 Calculate the change in average milk yield (litre per kg) between 1965 and 1990 for the selected line. Show your workings. (3)
(15)

4.3 Describe how proteins are formed in a cell and explain the impact of the two types of gene mutations on the formation of proteins. Content: (17)
Synthesis: (3)
(20)

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

TOTAL SECTION C: 40
GRAND TOTAL: 150