basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

LIFE SCIENCES P2

FEBRUARY/MARCH 2015

MARKS: 150

TIME: 2½ hours

This question paper consists of 14 pages.

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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. Make ALL drawings in pencil and label them 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 must use a non-programmable calculator, protractor and a compass where necessary.
11. Write neatly and legibly.

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SECTION A

QUESTION 1

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

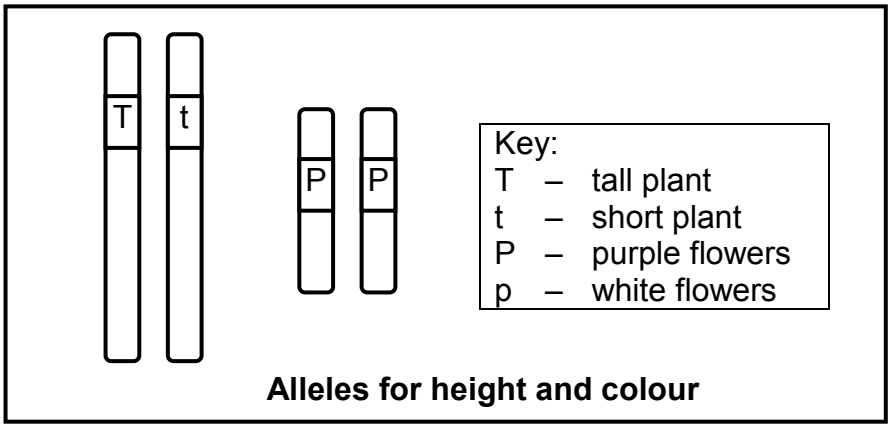
1.1.1 The shape of the DNA molecule was discovered by ...

A Franklin, using evidence obtained from Watson and Crick.
B Franklin, working independently of anyone else.
C Watson and Crick, working independently of anyone else.
D Watson and Crick, using some evidence obtained from Franklin.

1.1.2 Scientists have created a genetically modified zebrafish, a 'GloFish'. This fish has a gene that makes it glow in the dark. This gene was introduced into the species by ...

A interbreeding with another species of fish that is able to glow.
B removing the gene from a glowing fish and inserting it into a chromosome of the zebrafish.
C the process of natural selection.
D inbreeding.

1.1.3 The diagram below shows the alleles for height and flower colour in a flowering plant.



Alleles for height and colour

The plant is ...

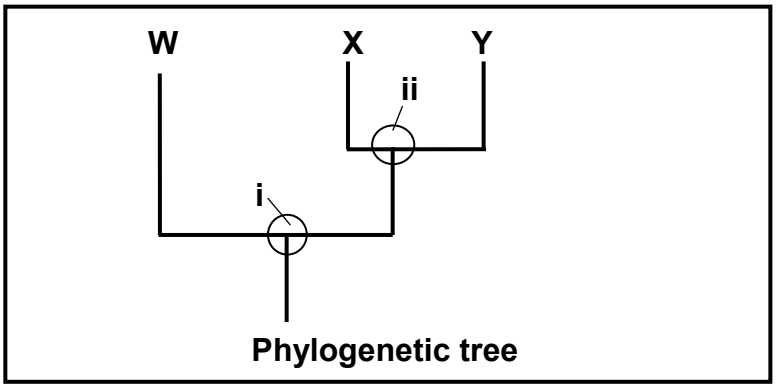
A homozygous dominant for height and heterozygous for flower colour.
B heterozygous for height and homozygous dominant for flower colour.
C homozygous recessive for height and homozygous dominant for flower colour.
D heterozygous for height and heterozygous for flower colour.

1.1.4 A phylogenetic tree represents …

A the number of species on Earth.
B only species that belong to the same genus.
C only organisms that are now extinct.
D possible evolutionary relationships.

1.1.5 The diagram below shows a generalised phylogenetic tree.

The different ancestors in the phylogenetic tree are represented by **i** and **ii**.



Phylogenetic tree

Which ONE of the following is the most appropriate conclusion that can be made from the phylogenetic tree?

A **ii** is a common ancestor of **X** and **Y** only.
B **i** is a common ancestor of **W** and **X** only.
C **W** and **X** are more closely related than **X** and **Y**.
D **X** and **Y** belong to the same species.

1.1.6 A messengerRNA (mRNA) molecule consists of 300 nitrogenous bases. The maximum number of amino acids that it can code for is ...

A 300.
B 150.
C 100.
D 30.

1.1.7 Which ONE of the following resulted from Gregor Mendel's experiments with pea plants?

A The 'law' of inheritance of acquired characteristics
B The principle of independent assortment
C The 'law' of use and disuse
D The theory of evolution

1.1.8 The modern human skull ...

A has small canines.
B has pronounced brow ridges.
C is prognathous.
D has a U-shaped arrangement of teeth on each jaw.

1.1.9 Which ONE of the following represents the correct order for the evolution of modern humans?

A *Ardipithecus → Australopithecus → Homo*
B *Australopithecus → Ardipithecus → Homo*
C *Homo → Australopithecus → Ardipithecus*
D *Ardipithecus → Homo → Australopithecus*

1.1.10 Which ONE of the following represents a trend in human evolution?

A More developed brow ridges
B Increased size of canines
C More developed cranial ridges
D More forward position of the foramen magnum (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 1.2.10) in the ANSWER BOOK.

1.2.1 Similar structures on different organisms that suggest they have a common ancestor

1.2.2 The complete set of chromosomes in the cell of an organism

1.2.3 A bar code pattern formed from DNA

1.2.4 The condition that results from the absence of skin pigmentation

1.2.5 The bonds formed between amino acids

1.2.6 A representation of the number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell

1.2.7 Openings in the nuclear membrane that allow mRNA to leave the nucleus

1.2.8 A copy of an organism that is genetically identical to the original organism

1.2.9 A tentative explanation of a phenomenon that can be tested

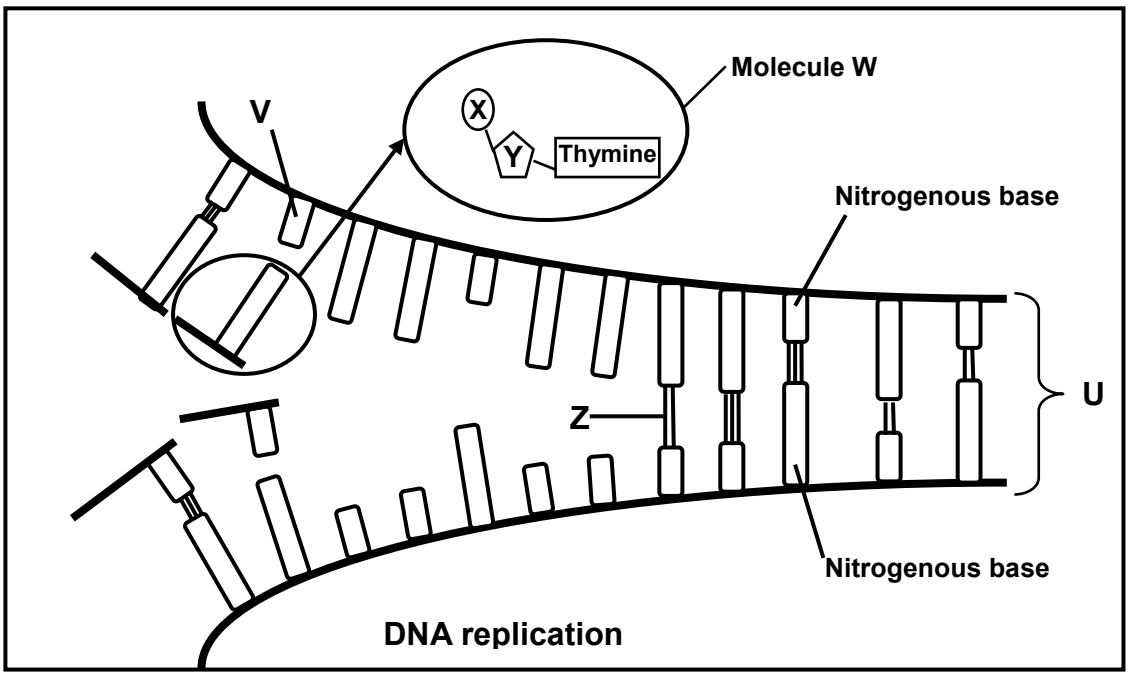
1.2.10 The distribution of species in different parts of the world (10 x 1) **(10)**

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 to 1.3.6) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Evidence for evolution	A: fossils B: genetics
1.3.2	Used as evidence for the 'Out of Africa' hypothesis	A: cultural evidence (tool making) B: mitochondrial DNA
1.3.3	The code for an amino acid on mRNA	A: codon B: anticodon
1.3.4	Example of a reproductive isolating mechanism	A: breeding at the same time of the year B: adaptation to different pollinators
1.3.5	Distinctive difference between the apes and the hominids	A: shape of the jaw B: shape of the spinal column
1.3.6	An example of discontinuous variation in humans	A: skin colour B: height

(6 x 2) **(12)**

1.4 The diagram below represents DNA replication.



1.4.1 Identify the following:

(a) Molecules **W** and **U** (2)

(b) Parts of molecule **W** labelled **X** and **Y** (2)

(c) Bond **Z** (1)

(d) Nitrogenous base **V** (1)

1.4.2 Where in the cell does this process take place? (1)

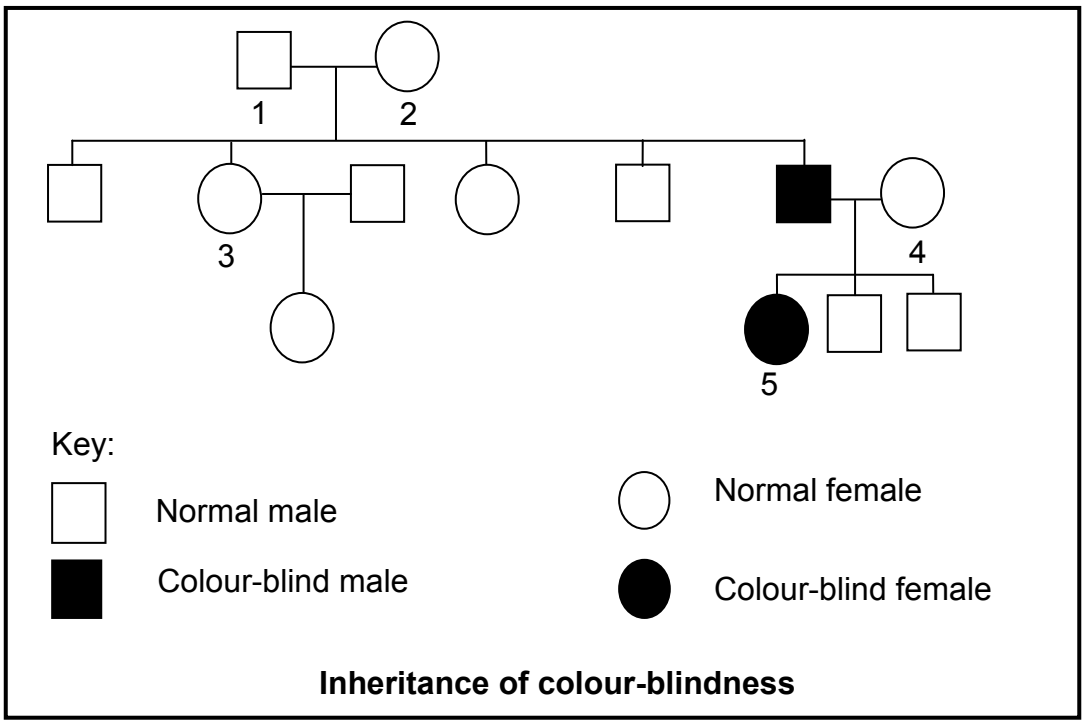
1.4.3 Name the phase of the cell cycle where replication takes place. (1)
(8)

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 The pedigree diagram below shows the inheritance of colour-blindness (Daltonism) in a family. Colour-blindness is sex-linked and is caused by a recessive allele (**d**). The ability to see colour normally is caused by a dominant allele (**D**).



Inheritance of colour-blindness

2.1.1 How many of the male offspring of parents **1** and **2** were normal? (1)

2.1.2 State the genotype of:

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

(b) Individual **5** (2)

2.1.3 A person with a recessive allele for colour-blindness may not be colour-blind. Explain why males with an allele for colour-blindness are always colour-blind. (4)

2.1.4 If individual **5** marries a normal male, what percentage of their daughters will have an allele for colour-blindness, but will NOT be colour-blind? (2)
(11)

2.2 In humans the allele for short fingers (brachydactyly), represented by **B**, is dominant over the allele for normal fingers (**b**). The allele for curly hair (**H**) is dominant over the allele for straight hair (**h**).

Andrew, with genotype **Bbhh**, married Susan, with genotype **bbHh**.

2.2.1 State how the phenotypes of Andrew and Susan differ from each other. (2)

2.2.2 Give ALL the possible genotypes of the gametes produced by Andrew. (2)
(4)

2.3 Mr and Mrs Phonela are concerned that their baby girl does not appear to resemble either of them. They suspect that the baby they were given at the hospital was not theirs. Mr Phonela is blood type **AB**, Mrs Phonela is blood type **B** and the baby they were given is blood type **O**.

2.3.1 Give the possible genotypes of:

(a) Mrs Phonela (2)

(b) The baby girl (1)

2.3.2 Explain why the baby girl with blood type **O** cannot be Mr and Mrs Phonela's daughter. (3)

2.3.3 Explain why the use of blood type for paternity testing is not conclusive. (2)

2.3.4 Using your knowledge of sex chromosomes, explain why the sex of a child is determined by the male gamete. (5)
(13)

2.4 An investigation was conducted by a scientist to determine if two plant populations, Population 1 and Population 2, belonged to the same species. The scientist collected seeds from each of the populations.

He used the following steps in his investigation:

- He planted 20 seeds from Population 1 and 20 seeds from Population 2 in two separate plots close to each other.
- The stamens of all the flowers of Population 1 were removed.
- Pollen from the flowers of Population 2 was used to pollinate the flowers of Population 1.
- The scientist harvested the seeds of the plants in Population 1.
- He grew these seeds under ideal conditions in a laboratory.
- None of the seeds germinated.

2.4.1 Explain the advantage of removing the stamens from the flowers of Population 1. (2)

2.4.2 What evidence indicates that the two populations do not belong to the same species? (1)

2.4.3 State TWO factors that the scientist would have kept constant in the laboratory. (2)

2.4.4 State ONE way in which the scientist could increase the reliability of his results. (1)
(6)

2.5 Describe how new species may form through geographic isolation. **(6)**
[40]

QUESTION 3

3.1 An investigation was conducted on the chances of women of different ages having a baby with Down syndrome as a result of errors in Meiosis I and Meiosis II.

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

Maternal age (years)	Incidence of Down syndrome (per 1 000 births)	
	Error in Meiosis I	Error in Meiosis II
<25	0,4	0,1
25–29	0,5	0,2
30–34	0,8	0,3
35–39	1,2	0,5
40+	5,9	1,9

[Adapted from *Developmental Biology Online: Human Meiosis 2014*]

3.1.1 Draw a histogram to represent the information in the table above regarding the error occurring in Meiosis II that leads to Down syndrome. (6)

3.1.2 Name the error during meiosis that could eventually result in a child with Down syndrome. (1)

3.1.3 According to the information in the table, is the error mentioned in QUESTION 3.1.2 more likely to occur during Meiosis I or Meiosis II? (1)

3.1.4 Over a five-year period a hospital recorded a total of 44 Down syndrome babies born to mothers who were forty years and older. How many of these babies were likely to have had the error that caused Down syndrome occurring during Meiosis II? Show ALL working. (3)

(11)

3.2 The table below shows a partial DNA sequence from a human, as well as a codon table that can be used to determine which amino acids are required to make a protein.

Base triplet number	1	2	3	4	5	6	7
Human DNA sequence	ATG	TGT	CCA	TTA	ACG	TGC	ACA

CODON TABLE	
Valine	GUU, GUG, GUA
Cysteine	UGU, UGC
Proline	CCA, CCU
Leucine	UUG, CUC, CUG, UUA
Threonine	ACG, ACA
Tyrosine	UAC, UAU

3.2.1 State ONE way in which the DNA molecule is biologically important. (1)

3.2.2 Name the codon that is formed from base triplet number **2** on the DNA sequence. (1)

3.2.3 Write down the names of the amino acids coded for by base triplets **6** and **7**. (2)

3.2.4 If a mutation changes base triplet **1** from ATG to ATA, why will this not change the protein formed? (2)

3.2.5 Describe the process of translation in protein synthesis. (5)
(11)

3.3 A farmer has an orchard of apple trees. Each apple produced expressed red and yellow colour equally (red-yellow apples). To extend his apple orchard, the farmer collected seeds from the red-yellow apples and grew them.

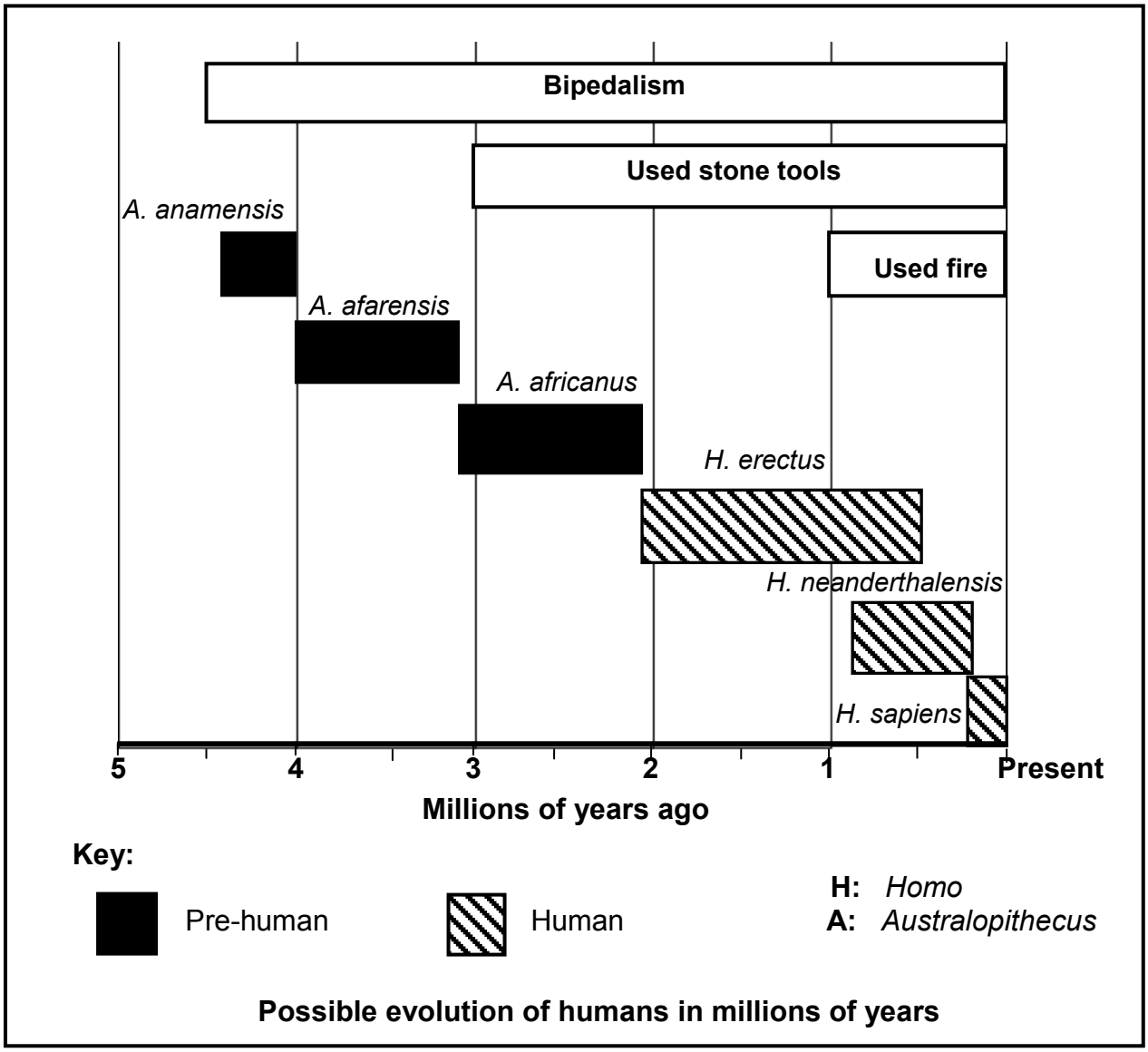
When the new trees matured, he found that some of the trees produced red apples (**R**), others produced yellow apples (**Y**) and the rest produced apples that were red-yellow.

3.3.1 Use a genetic cross to explain his results in the F_1 generation. (6)

3.3.2 What proportion of apples in the F_1 generation will be red-yellow apples? (1)

3.3.3 The farmer saw that the red-yellow apples sell the best. Name the phenotypes of the trees that he should cross in the future in order to ensure that any new trees will definitely produce only red-yellow apples. (2)
(9)

3.4 The diagram below represents the possible evolution of humans, as well as the time period for the development of bipedalism, the use of fire and the use of tools.



Possible evolution of humans in millions of years

3.4.1 Use the diagram above and identify TWO bipedal organisms that did not use stone tools or fire. (2)

3.4.2 How long after developing the ability to walk on two feet did pre-humans develop the ability to use stone tools? Show ALL working. (3)

3.4.3 Explain the significance of the characteristic of the skull which allowed for the development of the ability to use tools in the *Homo* species. (2)

3.4.4 Explain the relationship between the use of fire and changes in dentition in the *Homo* species. (2)
(9)
[40]

TOTAL SECTION B: 80

SECTION C

QUESTION 4

Describe how Lamarck and Darwin explained evolution, and compare Darwin's ideas to the ideas of Punctuated Equilibrium.

Content: **(17)**
Synthesis: **(3)**

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

TOTAL SECTION C: 20
GRAND TOTAL: 150

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