education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 12

MARKS: 150

TIME: 2½ hours

This question paper consists of 16 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 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.　　　Only draw diagrams and flow charts when asked to do so.

8.　　　The diagrams in this question paper are not all drawn to scale.

9.　　　Do NOT use graph paper.

10.　　Non-programmable calculators, protractors and compasses may be used.

11.　　Write neatly and legibly.
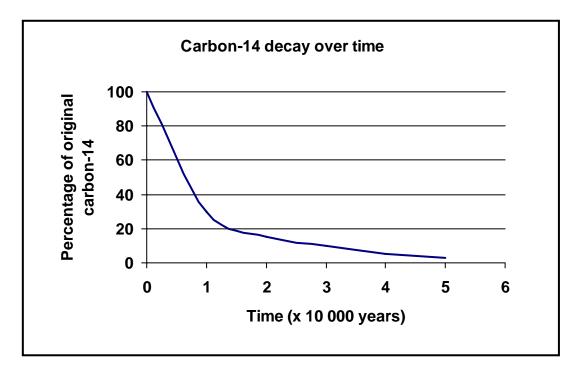
SECTION A

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 to D) next to the question number (1.1.1 to 1.1.5) in the ANSWER BOOK, for example 1.1.6 D.

    1.1.1   Structures that perform similar functions but have different evolutionary origins are called … structures.

        A   homologous
        B   homozygous
        C   analogous
        D   heterozygous

    1.1.2   Micro-evolution is a term that describes …

        A   the process by which new genera and families of organisms are formed.
        B   small changes that occur in the genotypes of organisms within the same species.
        C   changes that can be seen without a microscope.
        D   an increase in the size of individuals of a population over a long period of time.

    1.1.3   Study the following characteristics:

        1.   Olfactory brain centres reduced
        2.   Bare fingertips
        3.   Flat face (not prognathous)
        4.   Always bipedal

        Which combination of characteristics makes humans different from other primates?

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

1.1.4   One way to determine the age of a fossil is to use the rate of decay
of carbon-14. The graph below shows how carbon-14 decays over
time.

Carbon-14 decay over time

A fossil snail was found to have 30% of its carbon-14 remaining.
According to the above graph, the age of the fossil is
approximately …

A   5 000 years.
B   15 000 years.
C   10 000 years.
D   20 000 years.

1.1.5   The following list refers to events in meiosis and reproduction:

1.   Random fusion of gametes
2.   Random assortment of chromosomes
3.   Mutations
4.   The process of crossing over

The events that contribute to genetic variation include …

A   1, 2, 3 and 4.
B   1, 2 and 4 only.
C   4 only.
D   1, 2 and 3 only.   (5 x 2) (10)

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 1.2.5) in the ANSWER BOOK.

   1.2.1   An explanation for something that has been observed in nature, and which can be supported by facts, laws and tested hypotheses

   1.2.2   An increase in the level of nutrients in dams and lakes that leads to increased micro-organism activity and a decrease in the availability of oxygen

   1.2.3   The variety of living organisms on earth

   1.2.4   The study of fossils

   1.2.5   Species living in a habitat in which they are not naturally found   (5)

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 1.3.5) in the ANSWER BOOK.

COLUMN I	COLUMN II
1.3.1 Renewable sources of energy	A: Coal B: Oil
1.3.2 Evidence for evolution	A: Comparative anatomy B: Fossil records
1.3.3 Structures/organs in disuse will disappear	A: Darwin B: Lamarck
1.3.4 Characteristics of primates	A: Opposable thumb B: Many offspring
1.3.5 May lead to overexploitation of resources	A: Poverty B: Lack of food

(5 x 2) (10)

1.4   The use of non-biodegradable detergents contributes to pollution. Study the table below showing the domestic and industrial use of non-biodegradable detergents in a province over a period of time.

The use of non-biodegradable detergents in thousands of tons in a certain province in South Africa between 1994 and 2004.

Year	Domestic use (thousand tons)	Industrial use (thousand tons)
1994	10,5	2,5
1996	14,0	3,8
1998	29,0	6,0
2000	34,0	6,5
2002	34,1	6,9
2004	37,5	7,4

1.4.1   Which ONE of the two categories of use (domestic or industrial) contributed more to detergent pollution in this period?   (1)

1.4.2   How much detergent was used in 2000?   (2)

1.4.3   Between which years did the use of domestic detergents increase most rapidly?   (2)

1.4.4   Describe the trend that you observe in the domestic use and industrial use of detergents.   (2)
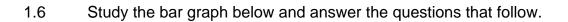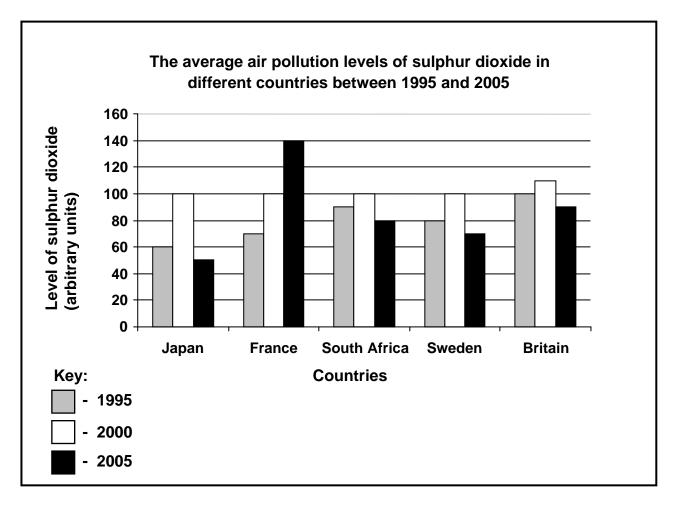
(7)

1.5 Study the diagram below which shows the relative number of species in the five vertebrate classes (fish, amphibians, reptiles, birds and mammals). The distance between the two lines in each class gives an indication of the number of species.

ERA	Period	Time (million years ago)	Vertebrate fossils
CENOZOIC	Quaternary		
	Tertiary	100	
MESOZOIC	Cretaceous	200	
	Jurassic		
	Triassic	300	
PALAEOZOIC	Permian		
	Carboniferous	400	
	Devonian		
	Silurian	500	
	Ordovician		
	Cambrian	600	
	Pre-Cambrian		

1.5.1 During which geological period were the most species of amphibians present? (1)

1.5.2 Describe the changes in the number of reptiles and mammals during the Cretaceous period. (4)

1.5.3 Which vertebrate classes were directly derived from the common ancestor labelled A in the diagram? (3)

1.5.4 Use the information in the diagram to explain which TWO of the three classes (birds, reptiles and mammals) are more closely related. (3)

(11)

1.6   Study the bar graph below and answer the questions that follow.

The average air pollution levels of sulphur dioxide in different countries between 1995 and 2005

Key:
- 1995
- 2000
- 2005

1.6.1   By how much did the level of sulphur dioxide pollution in Sweden decrease between 2000 and 2005?   (1)

1.6.2   Compare the general pattern of air pollution levels of France to that of the other countries. State the following:

          (a)   ONE similarity   (1)

          (b)   ONE difference   (2)

1.6.3   Which country had the lowest level of sulphur dioxide pollution in 2005?   (1)

1.6.4   Suggest TWO possible reasons for your answer to QUESTION 1.6.3.   (2)
                                                                           (7)
                                                                           [50]

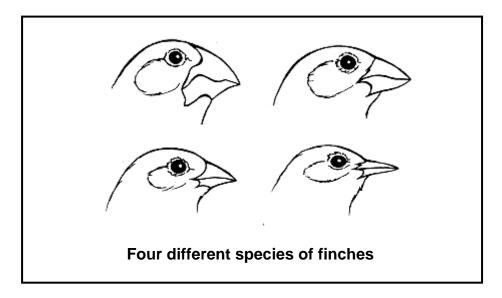   **TOTAL SECTION A: 50**

SECTION B

QUESTION 2

2.1   The diagrams below show the heads of four of the many species of finches inhabiting different islands in the Galapagos group, some 1 000 km from South America. The number of species of finches on the South American mainland is fewer than that found on the islands.

Four different species of finches

2.1.1   Explain ONE possible reason for the differences in the shape of the beaks.   (2)

2.1.2   According to Darwin, these finches probably descended from a common ancestral finch species. Give a geological explanation of how this ancestor probably came to be on these islands.   (2)

2.1.3   Describe how new finch species were formed on the different islands.   (7)

2.1.4   Explain why there is a lower species diversity of finches on the South American mainland than on the islands.   (3)
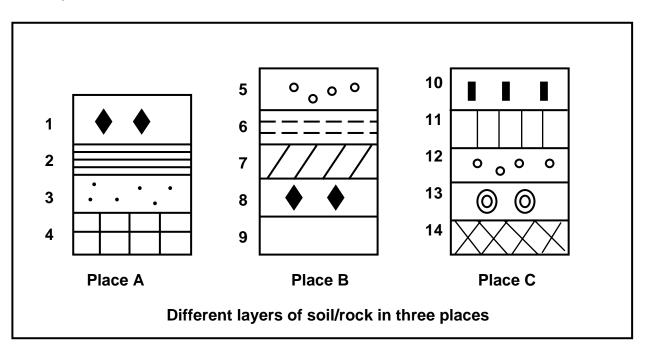   **(14)**

2.2   Both Darwin and Lamarck proposed theories to explain the origin of new species.

2.2.1   State the FOUR observations upon which Darwin based his theory.   (4)

2.2.2   Tabulate TWO differences between Lamarck's and Darwin's theories.   (5)
                                                                                        (9)

2.3 Some fossils are typical of a particular period of the earth's history. Fossil organisms have lived only in that period and it is then possible to tell the age of the rock in which they are found. Such fossils are called index fossils. A typical index fossil is the trilobite that lived in the oceans during the Palaeozoic era. At the end of this era they became extinct. If rock contains trilobites, we can conclude that the rock was formed during that era.

Three different strata (different layers of soil/rock) from three places in a particular area are illustrated below.

Place A　　　　**Place B**　　　　**Place C**

Different layers of soil/rock in three places

The symbols below are used to indicate the four different index fossils found in the different strata in places A, B and C.

2.3.1 Explain why layers 1 and 8 are of the same geological age. (2)

2.3.2 Indicate TWO layers, other than layers 1 and 8, that have the same geological age. (2)

2.3.3 Name a method used to determine the age of a fossil. (1)

2.3.4 State TWO reasons why there are gaps or missing information in the fossil record. (2)

(7)
[30]

QUESTION 3

3.1 The shell of the banded snail, *Cepaea nemoralis*, displays a wide variety of both colour and banding (rings). Birds, such as thrushes, eat these snails. The birds break open the shells by striking the snails against a stone.

It was found that there were equal numbers of light- and dark-banded snails in a specific grassland habitat where no thrushes were found. A population of thrushes was then introduced to this grassland habitat.

An investigation was done to determine which colour snails (dark-banded or light-banded) were eaten most by the thrushes.

The results are shown below:

Time (days)	Number of dark-banded shells found around stone	Number of light-banded shells found around stone
Day 1	2	1
Day 2	3	0
Day 3	5	1
Day 4	7	0
Day 5	8	1

3.1.1 Write a possible hypothesis for this investigation. (3)

3.1.2 What phenomenon does this investigation illustrate? (1)

3.1.3 Which snails were better adapted to prevent them from being eaten by the thrushes? (1)

3.1.4 Explain your answer to QUESTION 3.1.3. (2)

3.1.5 Why can the number of snails at the start of the investigation be considered a controlled variable? (1)
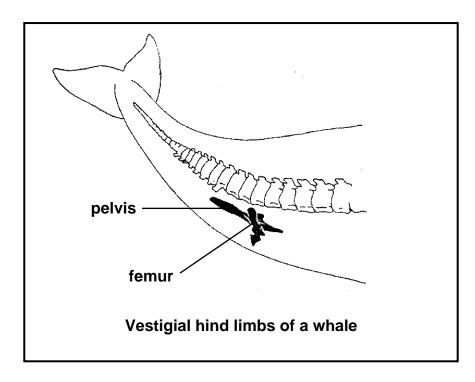
(8)

3.2   Darwin said in his book:

> "Organs or parts which seem useless are very common in nature. In many snakes there are small bones of the pelvis and hind limbs."
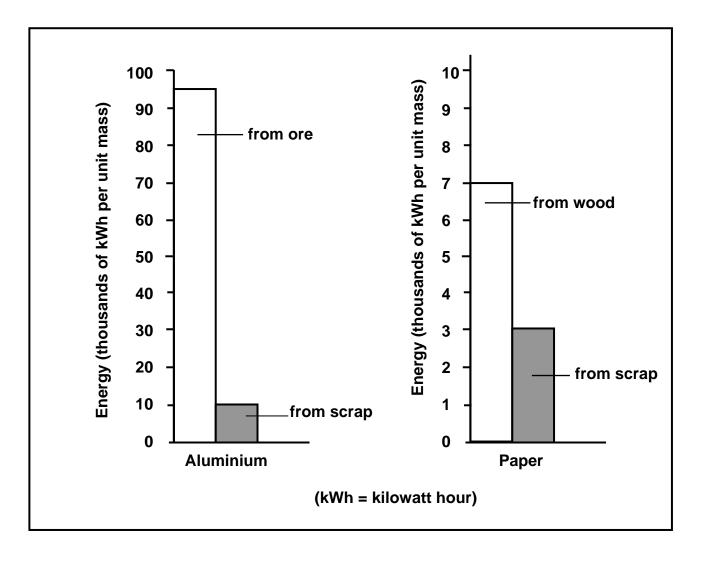> [*On the Origin of Species*, Darwin, 1858, p. 428]

The diagram below shows the vestigial (reduced) pelvis and femur of a whale.

Vestigial hind limbs of a whale

3.2.1   In terms of natural selection, explain how the pelvis and femur that were once useful to the whale's ancestor, could have become vestigial in modern whales.   (5)

3.2.2   Suggest ONE reason why a vestigial structure, once it has been reduced to a certain size, may not disappear altogether.   (2)
                                                                          (7)

3.3   The bar graphs below show the energy needed to make aluminium and paper from raw materials (ore, wood) or recycled materials (scrap).

(kWh = kilowatt hour)

   3.3.1   Calculate which ONE of aluminium production or paper production uses a smaller percentage of energy by using recycled material. Show ALL workings.   (5)

   3.3.2   Explain THREE reasons, other than saving energy, why recycling is important.   (6)

   (11)

3.4   Distinguish between biodegradable and non-biodegradable pollutants and give an example of each.   **(4)**
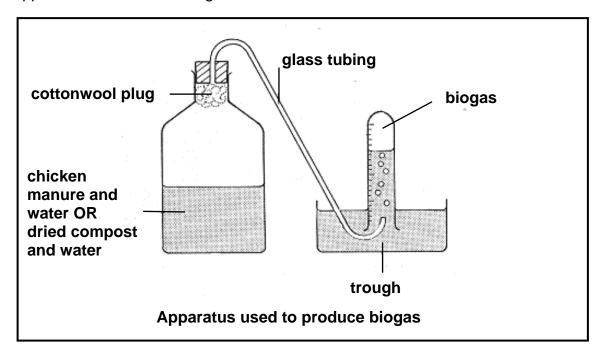
   [30]

   TOTAL SECTION B: 60

SECTION C

QUESTION 4

4.1   Organic waste materials, such as chicken manure and compost, can be used as a food source by micro-organisms. When micro-organisms break down the waste material in the absence of oxygen, a mixture of the gases methane (biogas) and carbon dioxide is produced. Biogas is an energy source and it can be used as a substitute for coal and gas.

Nkosi and John carried out an investigation to determine whether chicken manure is a better producer of biogas than compost. Both used the apparatus shown in the diagram below.

Apparatus used to produce biogas

Nkosi carried out the following procedure:

1.   100 g of chicken manure was mixed with distilled water, placed in a container and heated in a water bath to 35 °C.
2.   The volume of gas produced each hour was measured over a period of 5 hours.

John followed the same procedure, but replaced the chicken manure with dried compost.

The following results were obtained by Nkosi and John:

Time (hours)	Nkosi's results		John's results	
	Volume reading (cm^3)	Volume of biogas produced per hour (cm^3)	Volume reading (cm^3)	Volume of biogas produced per hour (cm^3)
0	0,0	0,0	0,0	0,0
1	1,0	1,0	0,5	0,5
2	3,0	2,0	1,5	1,0
3	7,0	4,0	3,5	2,0
4	15,0	8,0	7,5	4,0
5	31,0	16,0	15,5	8,0

4.1.1   Give the dependent variable for this investigation.   (1)

4.1.2   From Nkosi's results, predict what volume of gas will be produced if the investigation is continued for another hour. (Assume that the limiting factors do not play a role.)   (2)

4.1.3   State TWO ways in which the reliability of the results could be improved.   (2)

4.1.4   Plot two line graphs on the same set of axes of the volume of biogas produced per hour against time, for both Nkosi and John.   (13)
                                                                                       (18)

4.2   Study the passage below and answer the questions that follow.

> **Perlemoen: an important food resource**
>
> Perlemoen is a species of marine snail. It is in great demand as a source of food and it fetches extremely high prices in the Far East.
>
> Perlemoen live in shallow waters and are easily removed, which means that expensive fishing gear is not required to harvest or collect them. For these two reasons, illegal harvesting of perlemoen is a massive problem and the species faces extinction in South Africa.

4.2.1   State TWO reasons why it is easy to harvest perlemoen.   (2)

4.2.2   State TWO ways in which perlemoen can be saved from over-exploitation.   (2)

4.2.3   Explain how a reduction in the number of perlemoen can change the energy flow and the energy relationships in an ecosystem.   (3)

(7)

4.3   With the possible threat of cholera in the northern provinces of South Africa, the availability of safe water is essential for healthy living.

Describe FOUR management strategies to improve the quality of water and thereby ensuring healthy living. Your description must also include TWO sources of water pollution and TWO effects of water pollution on human health.   (12)

Synthesis   (3)

NOTE: NO marks will be awarded for answers in the form of flow charts or diagrams.   **(15)**

[40]

TOTAL SECTION C: 40

GRAND TOTAL: 150