TIME: 2 ½ HOURS   P A P E R   I I   MARKS: 150

I N S T R U C T I O N S

o Answer ALL questions

o Answer Sections A, B & C in the Answer Book

o Draw a right hand margin on each page to facilitate marking

o Start each main question on a **new page**

o Write your NAME on the Question Paper and hand in separately

o Make sure your numbering is precise and clear

o Make sure your answers are concise, logical and neat

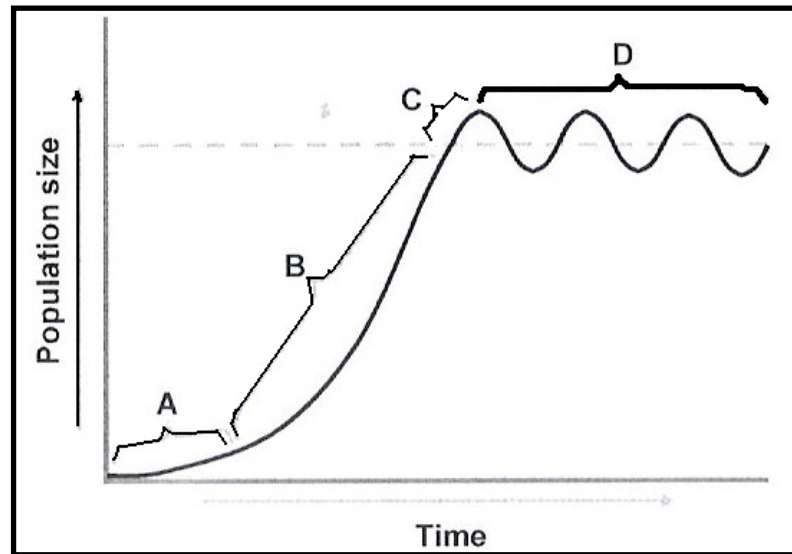o Check the mark allocation for each question and write accordingly

This paper consists of 18 pages including the coversheet

S E C T I O N   A

Q U E S T I O N   1

1.1   Various possibilities are given as answers to the following questions.
       Answer by writing ONLY the letter of the most correct answer on your foolscap provided.

1.1.1   The part of the graph labelled D represents:

A   The biodiversity within the species.

B   A stable population.

C   The fluctuations within an unstable population

D   A predator brought into the area.

QUESTIONS 1.1.2 AND 1.1.3 REFER TO THE TABLE BELOW.

The foods listed in the following data table were left in plastic bags in a warm container for five days. Observations were made and recorded at the end of the experiment. Use this information below to answer the questions that follow.

Food	Observations for Five Days
Bread	Covered with black, fuzzy stuff
Banana	Banana turned slimy, black, and soft
Hamburger	Turned brown with green spots
Cheese	Has white and green areas

1.1.2   Which of these hypotheses might have been tested in this experiment?

   A   Foods left in the dark will rot differently than foods in light.

   B   Will foods react differently to plastic bags?

   C   If different foods are decayed, they will not decay the same way.

   D   What kind of bacteria is best for making cheese?

1.1.3   Which of the following is a conclusion you could make concerning these data?

   A   Different microorganisms prefer different kinds of food.

   B   Bread is better for you to eat than cheese.

   C   Bananas take longer to rot than meat.

   D   Meat is less safe to eat than other foods because it smells bad.

1.1.4   Which of the following occurs during complementary base pairing?

   A   Bonds break between phosphates and sugars.

   B   Bonds break between amino acids and phosphates.

   C   Bonds form between cytosine and guanine.

   D   Bonds form between uracil and thymine.

1.1.5   The diagram shows a portion of a DNA molecule. How many nucleotides are represented?
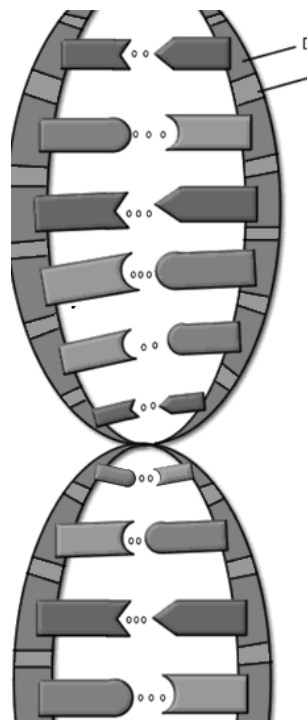
A   25

B   20

C   22

D   10

1.1.6   RNA differs from DNA in that it …

A   has thymine and a phosphate group.

B   has a deoxyribose sugar and cytosine.

C   is a double stranded molecule.

D   has uracil and ribose sugar.

1.1.7   The list below provides information relating to the replication of DNA:

1. Complementary nucleotides bind to each of two strands.
2. Sugar phosphate bonds form between the nucleotides.
3. The newly formed DNA molecules are identical to each other.
4. After unwinding, the DNA molecule forms two single strands.

The correct order of these events as they occur in DNA replication is…

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

1.1.8   Which of the following is CORRECT regarding scientific investigations?

A   Increasing the sample size decreases the validity

B   Allowing many variables increases the reliability

C   Controlling the variables decreases the validity

D   Repeating the investigation increases the reliability

1.1.9   Desertification is the process by which …

A   People try to cultivate land near a desert.

B   Fertile land changes to barren land or desert.

C   People abandon a rural way of life for city life.

D   Large areas of natural forest are cleared for timber.

1.1.10   Which are two ways in which a population can decrease in size?

     A   Immigration and emigration

     B   Increased death rate and immigration

     C   Decreased birth rate and emigration

     D   Emigration and increased birth rate

10 X 2 /20/

1.2   Write the correct biological term for each of the following on your foolscap page.

1.2.1   A process where species with similar requirements divide up resources so that different niches can be created

1.2.2   Enzyme involved in DNA replication

1.2.3   The enhanced growth of algae due to too many nutrients

1.2.4   The skin receptor that responds to touch

1.2.5   Hormone used during positive feedback to enhance muscle contractions during birth

1.2.6   All the conditions necessary for an organism to survive and reproduce

1.2.7   The part of the brain that involves the monitoring of homeostatic levels

1.2.8   A population that far exceeds the carrying capacity

1.2.9   The highest level of social organisation

1.2.10   A species that grows in an area where they do not naturally grow

/10/

1.3   Each of the following questions consists of a statement in the first column and two items (a and b) in the second column. Decide which item/s relate/s to the statement.

Write your choice on the foolscap by using the following codes:

A   if only item A relates to the statement

B   if only item B relates to the statement

A & B   if both items, A and B relate to the statement

NONE   if neither of the items relates to the statement

1.3.1	ADH	A	Controls body water balance
		B	Control pH
1.3.2	DNA replication	A	Forms gametes
		B	Has triplet codons
1.3.3	Fracking	A	Uses large volumes of water
		B	Low foreign investment
1.3.4	Purine bases	A	Cytosine
		B	Uracil
1.3.5	Thermal pollution	A	Heavy metal toxicity
		B	Lowers dissolved oxygen

5 X 2 /10/

1.4   Study the human population pyramids shown below and answer the questions
       that follow. Pyramid A is for 1990 and Pyramid B is for 2010.
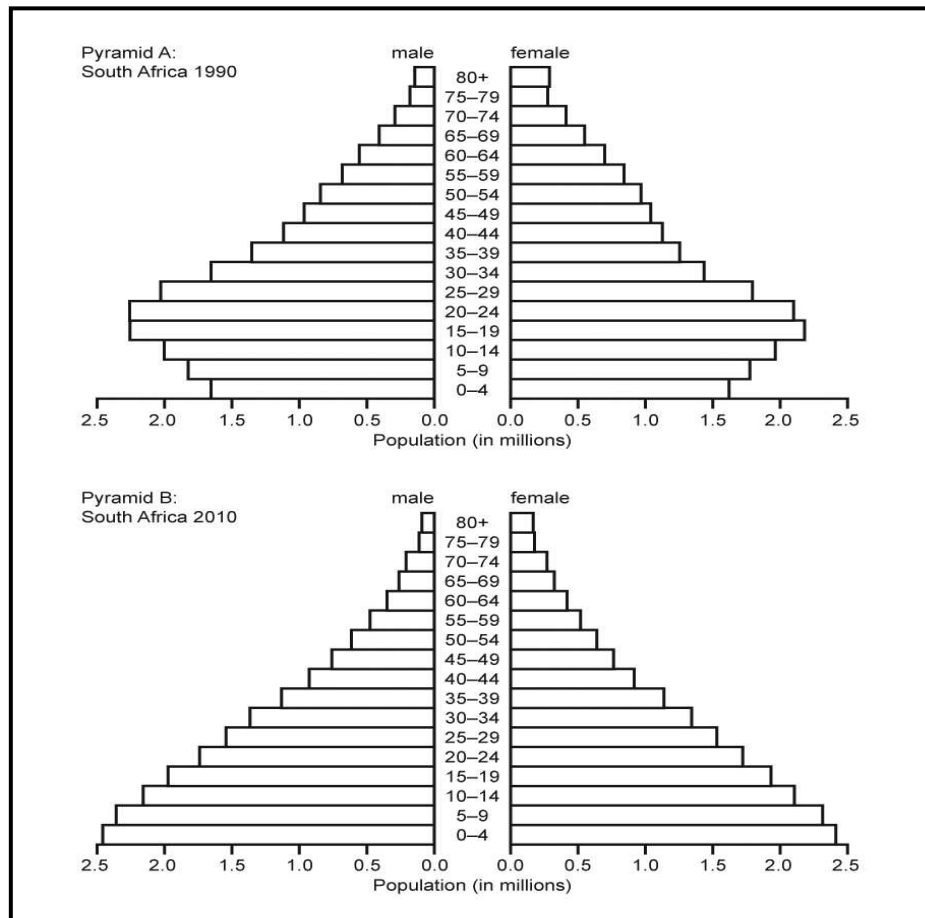
1.4.1   Provide ONE reason for the shape of Pyramid A for 1990.   (1)

1.4.2   Calculate the total number of individuals in the 15-to-19 age group in Pyramid B
         for 2010.   (2)

1.4.3   Tabulate TWO visible differences in the shape of Pyramid A and Pyramid B.   (5)

1.4.4   Suggest TWO possible reasons for the change in the shape of the pyramids
         over the past 20 years.   (2)

/10/

Section A: [50]

SECTION B

QUESTION 2

2.1   During the work to establish the structure of DNA, Watson and Crick were interested in the proportion of nucleotides in the DNA of skin cells of a particular organism. They considered the results from three different samples done in the same laboratory, as shown in the table below. Study the table and answer the questions that follow.

Nucleotides in DNA	Percentage of each nucleotide		
	Sample 1	Sample 2	Sample 3
A	29	31	30
T	31	29	30
C	21	20	19
G	19	21	20

2.1.1   Why did Watson and Crick consider results from three samples?   (1)

2.1.2   What is the ratio of adenine to thymine in the overall experiments?   (1)

2.1.3   Give a reason for your answer to 2.1.2.   (1)

2.1.4   Draw a pie chart illustrating the percentages of the different nucleotides in sample 1.   (6)
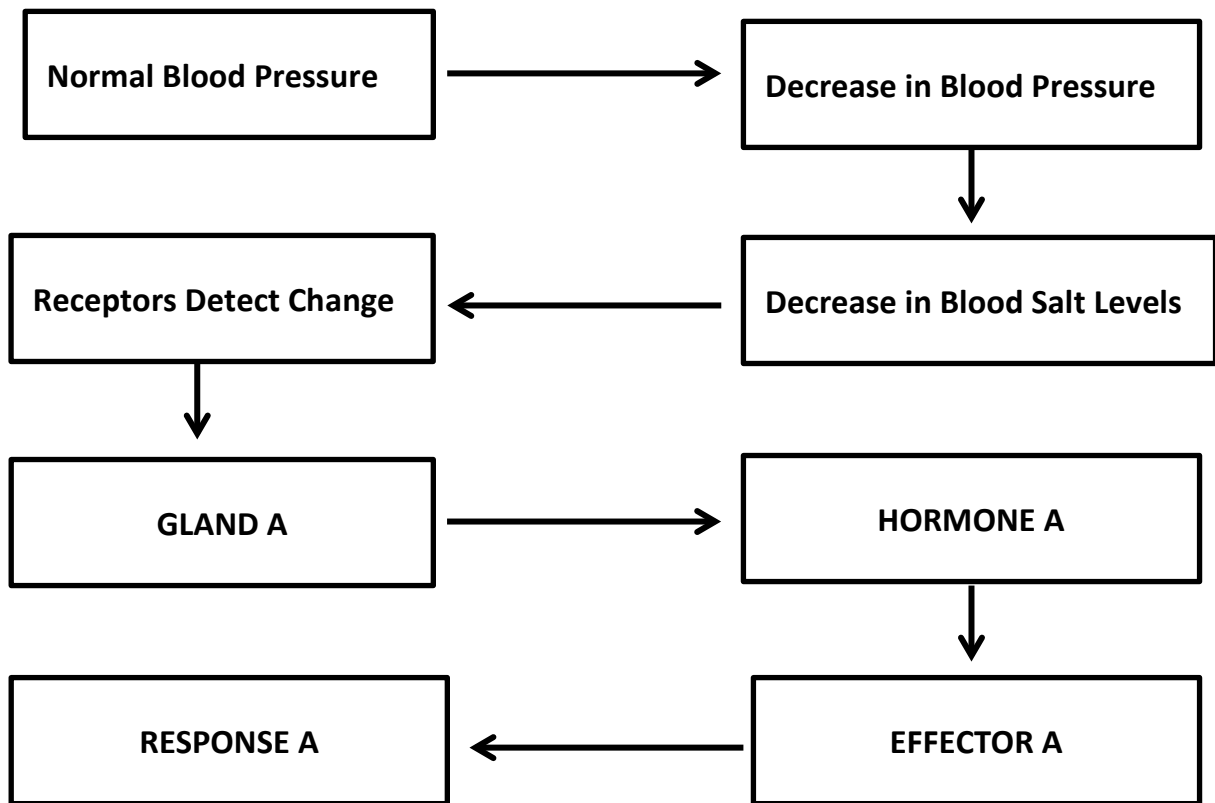
                                                                                        /9/

2.2   Read the following points on the history of DNA research and answer the questions that follow.

- 1950's – scientists found out that DNA consisted of sugars, phosphates and 4 nitrogen bases and there were equal numbers of certain bases. They did not understand the shape of DNA.

- 1951 – American James Watson and Francis Crick worked together on the structure of DNA at Cambridge University, UK. Watson attended a lecture by Rosalind Franklin on DNA and tried unsuccessfully to build a model of DNA based on her X-ray photographs.

- 1952 – Watson visited Maurice Wilkins in London and was given one of Franklin's X-ray photographs without her permission. This gave Watson the clue he needed to determine the DNA shape. He returned to Cambridge and started building a new DNA molecule.

- 1953 –English physicist, Maurice Wilkins worked closely with Rosalind Franklin at King's college, London and they used a new X-ray method (used to show the shape of polymers) and the resulting photographs to show that DNA had a regular shape.

- February 1953 – Crick took over Watson's model of cut-out cardboard and by the end of the month they found out the spiral staircase shape of DNA.

- April 1953 – Watson and Crick published their paper on the DNA structure
- 1958 – Rosalind Franklin died of cancer
- 1962 – Watson & Crick & Wilkins were awarded a Nobel prize for discovering the structure of DNA

2.2.1   What is another name for the "spiral staircase" shape of DNA?   (1)

2.2.2   Do you think Watson and Crick could have discovered the structure of DNA independently of the other scientists? Explain your answer.   (2)

2.2.3   Do you think Watson and Crick were ethical in their dealings with Rosalind Franklin? Explain your answer.   (2)

/5/

2.3   The diagram below outlines the effect of salt levels humans when their blood volume decreases, for example due to significant blood loss. Study the events below and answer the questions that follow.

Normal Blood Pressure	→	Decrease in Blood Pressure

↓

| Receptors Detect Change | ← | Decrease in Blood Salt Levels |

↓

| GLAND A | → | HORMONE A |

↓

| RESPONSE A | ← | EFFECTOR A |

2.3.1   Provide labels for each of the following:

a) Gland A
b) Hormone A
c) Effector A   (3)

2.3.2   Briefly describe what happens at RESPONSE A in order to restore blood salt levels back to normal.   (2)

2.3.3   What will happen to amount of urine the above person produces during the process shown above.   (1)

/6/

[20]

QUESTION 3

3.1 An investigation to measure the ozone concentration and the chlorine levels in the stratosphere have been done in Antarctica since 1950 and the results are shown in the graph below:
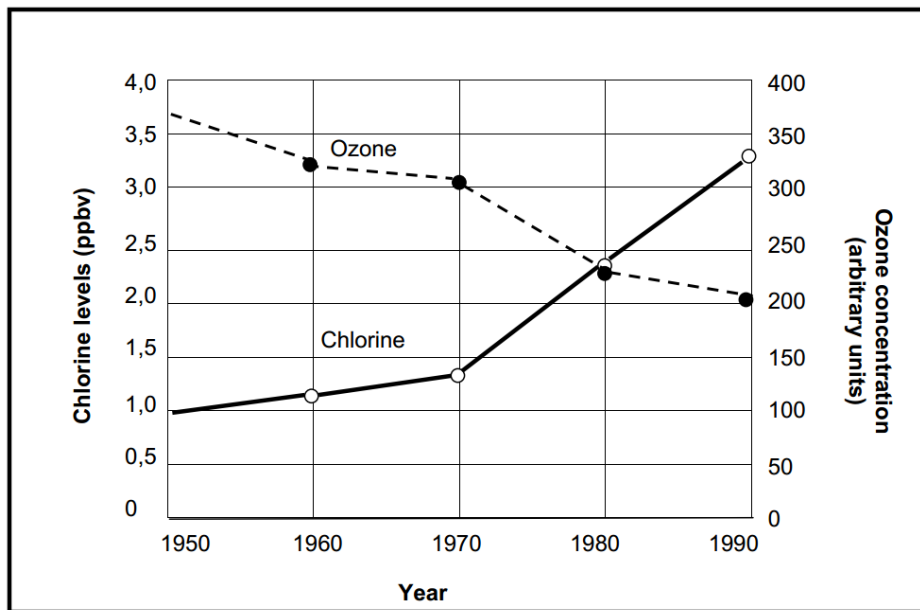
[Adapted from *Ecology and Conservation*, Cambridge University Press]

3.1.1 Identify the obvious error in the graph above. (1)

3.1.2 Describe how the change in the level of chlorine gas affects the level of ozone gas. (2)

3.1.3 Name the independent variable for the investigation. (1)

3.1.4 What is the most likely chemical source of the chlorine in the atmosphere? (1)

3.1.5 The Montreal Protocol was signed in 1987, to reduce air pollution. Despite this, the graph shows a continued decline in ozone levels. Explain **TWO** possible reasons for this. (2)

3.1.6 Predict the effect of the ozone levels on human health from 1950-1990, and give a scientific reason to support your prediction. (2)
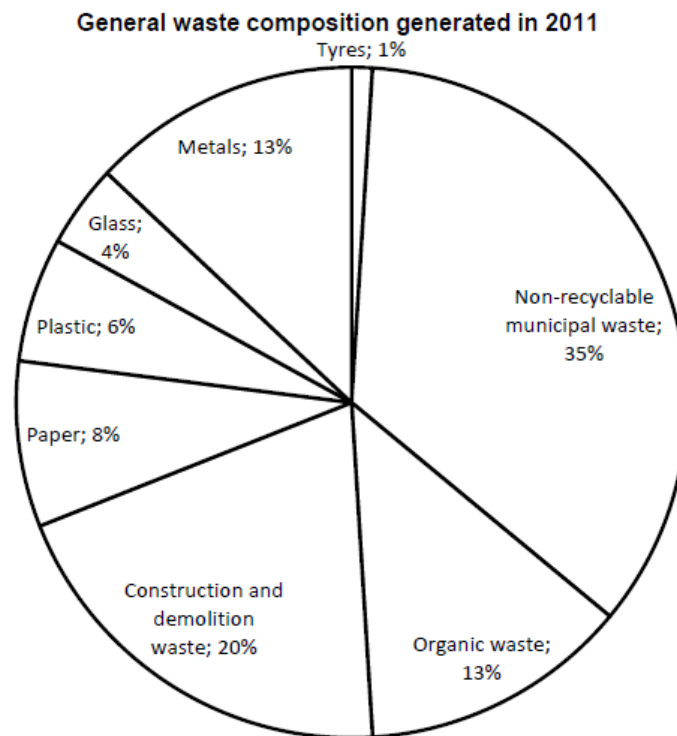
/9/

3.2   South Africa generated 59 million tons of general waste in 2011. An estimated 10% of all waste generated in South Africa was recycled in 2011.

The remaining quantity of general waste was thrown in landfill sites.

3.2.1   Calculate the estimated quantity of general waste that was thrown in landfill sites in 2011. Show all working.   (2)

3.2.2   The graph below shows the percentage of each component that form part of general waste generated in South Africa in 2011.

General waste composition generated in 2011
Tyres; 1%
Metals; 13%
Glass; 4%
Plastic; 6%
Paper; 8%
Non-recyclable municipal waste; 35%
Construction and demolition waste; 20%
Organic waste; 13%

a) With reference to the pie chart shown above, what is the total percentage of waste that could have been re-cycled?   (2)

b) State ONE way in which organic waste could be used to our advantage.   (1)

c) State TWO reasons why dumping of waste in a residential area is strictly prohibited by municipalities in South Africa.   (2)

/7/

3.3   Study the diagram below which shows the relationship between a population of wolves and a moose population. Study the graph and answer the questions that follow.
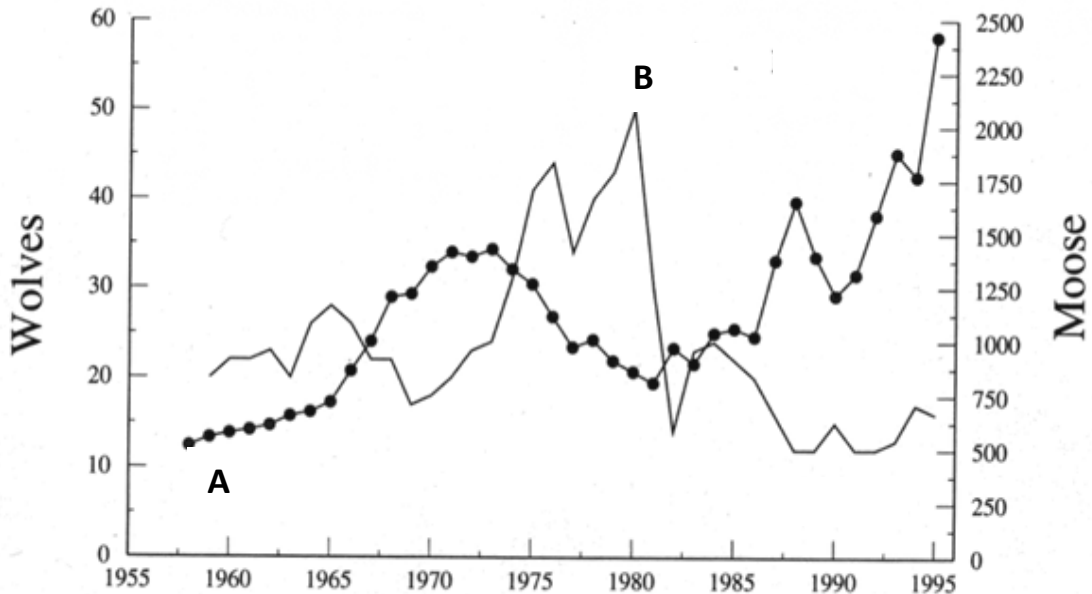
Rolf O. Peterson:
Ecological Studies of Wolves in Isle Royale
Annual Report 1994-95

3.3.1   Which population A or B represents the moose population?   (1)

3.3.2   Give a reason for your answer in 3.3.2.   (1)

3.3.3   Describe and explain the trend of the wolf population each time the number of Moose increases.   (2)

/4/

[20]

QUESTION 4

4.1   The following sequence of diagrams shows the process taking place in a mammalian cell. Study the diagram and answer the questions that follow.
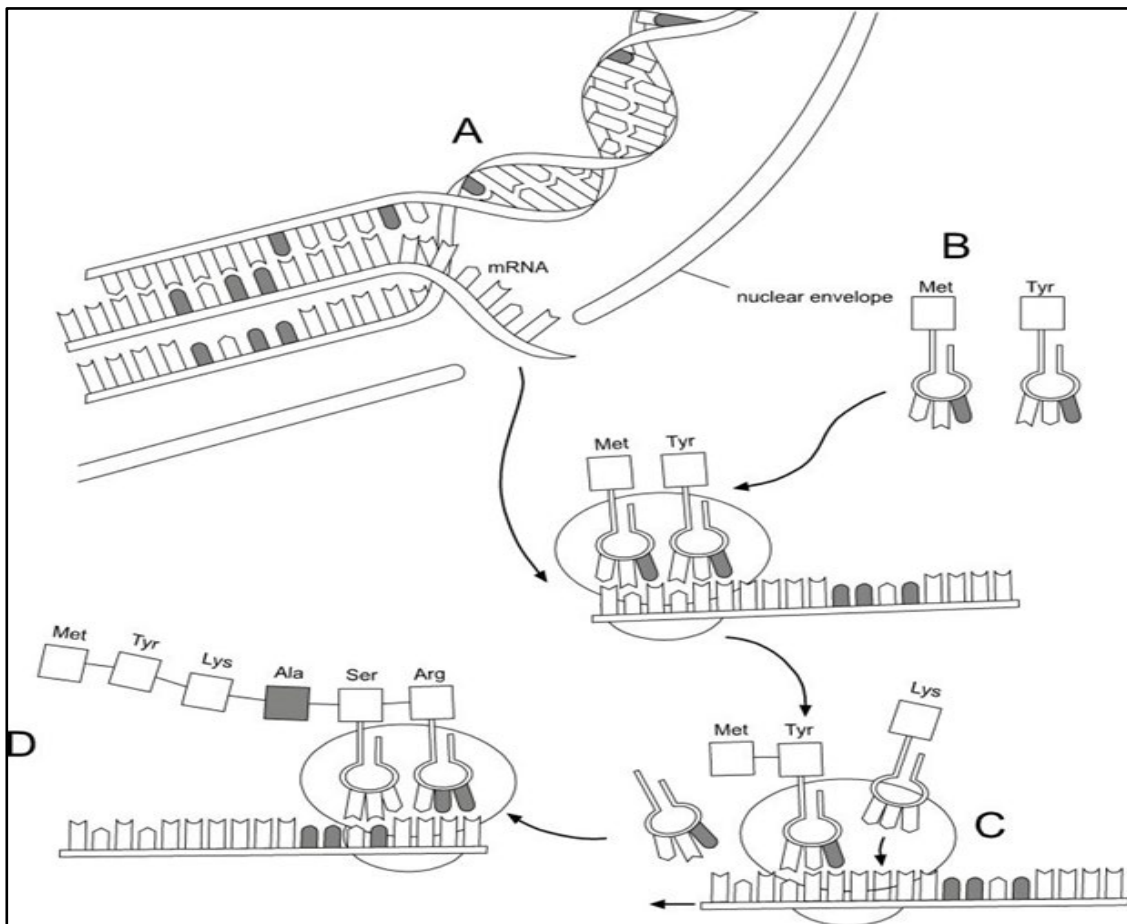
4.1.1   Name the process taking place from A – D.   (1)

4.1.2   Provide a brief explanation for each of the following steps:

      a) A   (2)
      b) B   (2)
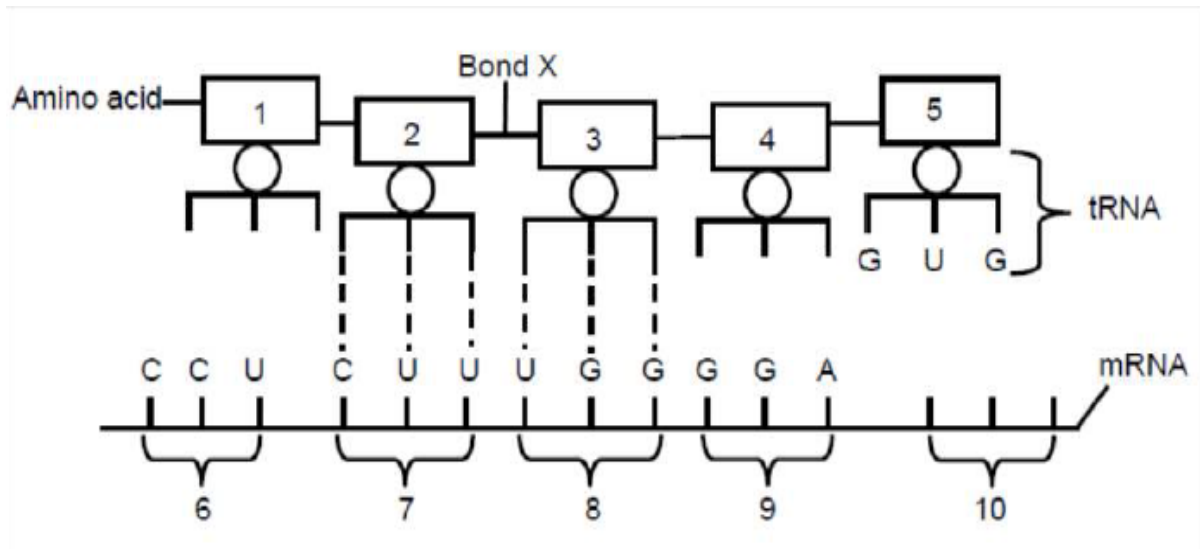   c) C   (2)

                                                                                                                          /7/

4.2   Study the diagram below, which shows a stage in the process named above and answer the questions that follow.

4.2.1   Write down the DNA base triplets that correspond to the codons numbered 6, 8   (3) and 10.

4.2.2   Name:

      a) The bond represented by X   (1)

      b) The organelle in which the process represented in the diagram above takes place   (1)

4.2.3   The table below shows the amino acids coded for by various tRNA anticodons. Study the table and answer the questions that follow.
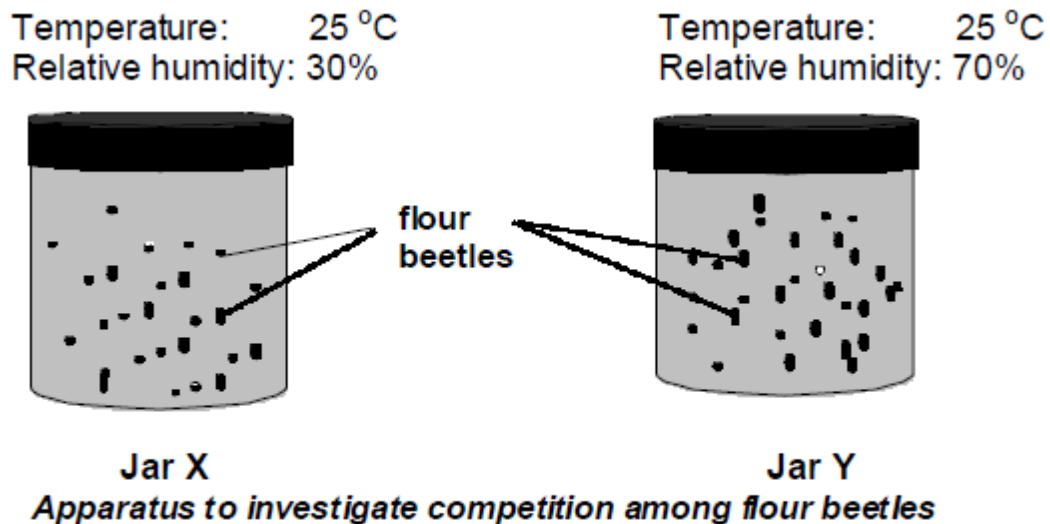
First Base	Second Base				Third Base
	A	G	U	C	
A	Phe (AAA) Phe (AAG) Leu (AAU) Leu (AAC)	Ser (AGA) Ser (AGG) Ser (AGU) Ser (AGC)	Tyr (AUA) Tyr (AUG) Stop (AUU) Stop (AUC)	Cys (ACA) Cys (ACG) stop (ACU) Tryp (ACC)	A G U C
G	Leu (GAA) Leu (GAG) Leu (GAU) Leu (GAC)	Pro (GGA) Pro (GGG) Pro (GGU) Pro (GGC)	His (GUA) His (GUG) Glun (GUU) Glun (GUC)	Arg (GCA) Arg (GCG) Arg (GCU) Arg (GCC)	A G U C
U	Ileu (UAA) Ileu (UAG) Ileu (UAU) Meth* (UAC) *(start)	Thr (UGA) Thr (UGG) Thr (UGU) Thr (UGC)	Aspn (UUA) Aspn (UUG) Lys (UUU) Lys (UUC)	Ser (UCA) Ser (UCG) Arg (UCU) Arg (UCC)	A G U C
C	Val (CAA) Val (CAG) Val (CAU) Val (CAC)	Ala (CGA) Ala (CGG) Ala (CGU) Ala (CGC)	Asp (CUA) Asp (CUG) Glu (CUU) Glu (CUC)	Gly (CCA) Gly (CCG) Gly (CCU) Gly (CCC)	A G U C

4.2.4   Use the information in the table above and write down the names of the amino acids
        coded for by the codons numbered 7 and 9   (4)

                                                                                          /9/

4.3   An experiment was carried out with two different species (A and B) of flour beetles.
        Two jars were each filled with 500 g of flour. 25 males and 25 females of species A
        and 25 males and 25 females of species B were placed in each jar.

Temperature: 25 °C
Relative humidity: 30%

Temperature: 25 °C
Relative humidity: 70%

flour
beetles

Jar X   Jar Y
Apparatus to investigate competition among flour beetles

NOTE: The optimum relative humidity under normal conditions for
      species A is 25 % and for species B is 60 %.

The beetles were counted every week over a period of three months. The results are
shown in the table below.

Jars	Species A	Species B
X	Number of beetles increased	Number of beetles decreased until all died
Y	Number of beetles decreased until all died	Number of beetles increased

4.3.1   What type of competition occurs in the jars? Give a reason for your answer.   (2)

4.3.2   State a hypothesis for this investigation.   (2)

4.3.3   State the independent variable in this investigation   (1)

4.3.4   Besides those already mentioned, name TWO more variables that will need to be
        controlled.   (2)

4.3.5   Why do you think they used 25 males and 25 females of each species in each jar? (1)

4.3.6   Which species, A or B, is more tolerant to high humidity?   (1)

4.3.7　What would you expect to happen to the populations if a third jar with the same quantity of flour and the same number of beetles was kept at 25°C and at 10% humidity? Give a reason for your answer.　(2)

/11/

[25]

QUESTION 5

5.1　The graph below shows the change in body temperatures of two different organisms. Study the graph and answer the questions that follow.
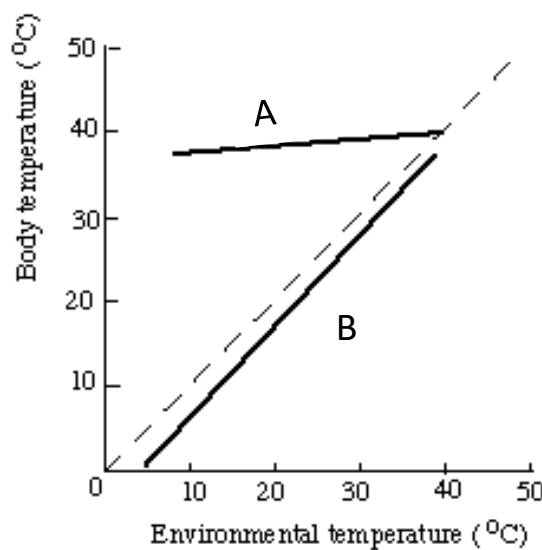
5.1.1　Name the types of organisms at A and B.　(2)

5.1.2　Name TWO mechanisms through which organism B controls its body temperature.　(2)

5.1.3　Describe how organism A controls its body temperature on a hot day　(6)

/10/

5.2　Describe how the human body restores the carbon dioxide concentration in the blood when it rises above normal levels.　/5/

[15]

SECTION B: **[80]**

SECTION C

QUESTION 6

6.

Diabetes Mellitus the commonest form of diabetes, caused by a deficiency of the pancreatic hormone insulin, which results in a failure to metabolize sugars and starch. Sugars accumulate in the blood and urine, and the by-products of alternative fat metabolism disturb the acid–base balance of the blood, causing a risk of convulsions and comas

Write an essay to explain the process of how humans can genetically engineer bacteria to produce insulin, how this insulin controls blood sugar and how the body responds when blood sugar levels drop below normal. /17/

Synthesis /3/

SECTION C: [20]

TOTAL MARKS: [150]