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 Section A on the Answer Sheet provided

o Insert Answer Sheet inside front cover of Answer Book

o Answer Section 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 21 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.

Indicate the correct answer by making a cross (X) over the appropriate letter on your ANSWER SHEET.

Questions 1.1.1 and 1.1.2 are based on the extract below:

Pesticides have caused a decline in the number of peregrine falcons, blue cranes and vultures in the world. In the mid-1950's the population numbers of these birds dropped rapidly. It took scientists 20 years to discover that the highly toxic insecticide DDT was the cause. DDT was sprayed on plants to rid them of harmful insects. Insects and birds were both affected by DDT but not mammals. DDT was passed through these animals in the food chain and the poison eventually reached the birds. This concentration of chemicals in the bird's system caused females to lay eggs with thin shells. These did not survive or were crushed when incubated. Some birds' behaviour even changed due to the chemicals and they stopped feeding and caring for their young.

1.1.1   The reason why the bird numbers dropped so drastically is because …

    A   they ate DDT directly

    B   the DDT accumulated in the tissues of the animals lower down in the food chain

    C   they absorbed the DDT from the water that was contaminated from the crops

    D   the young birds hatched easier from eggs with thin shells

1.1.2   A logical, possible solution to the bird problem would be to ….

    A   incubate the eggs of all peregrine falcons, blue cranes and vultures

    B   dilute the DDT sprayed on the plants

    C   teach the birds better maternal instincts

    D   use a suitable biological control alternative to DDT

1.1.3   The accompanying graph shows ….

A   interspecific competition –

a density- independent factor

B   intraspecific competition –

a density-dependent factor

C   interspecific competition –

a density-dependent factor

D   intraspecific competition –

a density-independent
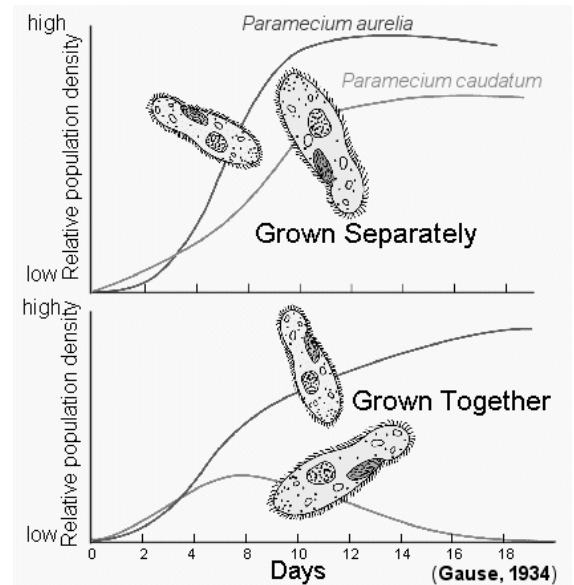
1.1.4   Population size can be estimated using the formula below:

P = population estimate
M = number of organisms captured and marked
C = number of organisms recaptured (second capture)
R = number of marked organisms in second capture

$$P = \frac{M \; x \; C}{R}$$

In an investigation to estimate the fish population in a certain dam, the following data was obtained:

Fish captured, marked and released = 40
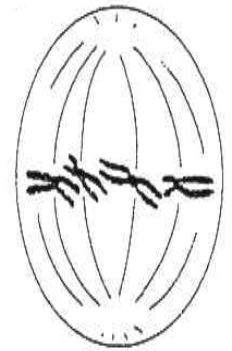Marked fish in the second capture = 12
Unmarked fish in the second capture = 48
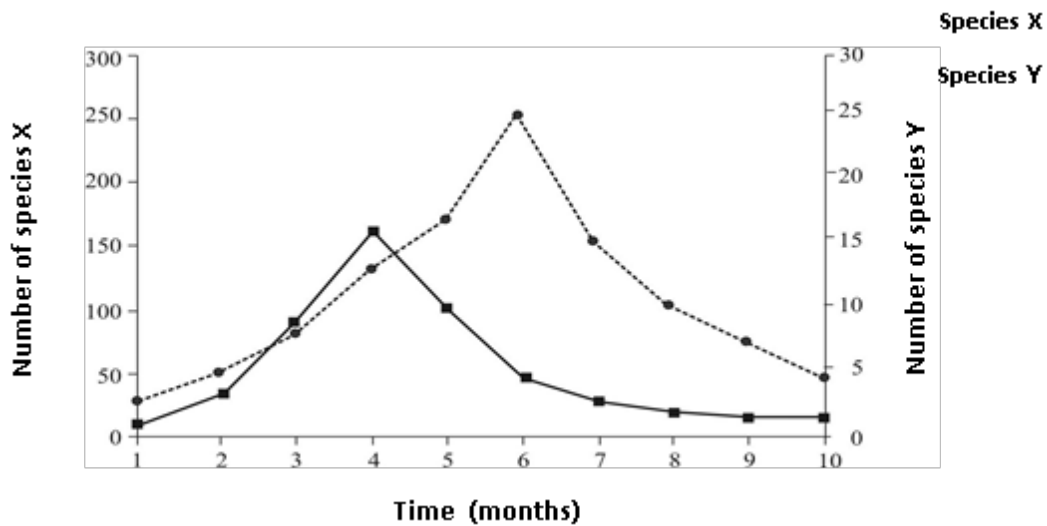
The estimated size of the fish population is ...

A   1 920.

B   160.

C   200

D   100

1.1.5   The cell shown is …

A   in Metaphase of meiosis with a diploid number of 8

B   in Anaphase 1 with a diploid number of 6

C   in Metaphase 1 with 4 pairs of homologous chromosomes

D   in Metaphase with a diploid number of 4

1.1.6   This graph shows the relationship between two species of mammals.

Which deduction made from the information provided in the graphs is correct?

A   Species X is the predator and Y its prey.

B   Species X and species Y are competing for the same resources.

C   Species Y is the predator and species X its prey.

D   An increase in species X causes a decrease in species Y.

1.1.7   The diagrams show four ways in which human twins may be formed.

Which letter indicates the formation of identical boy twins?
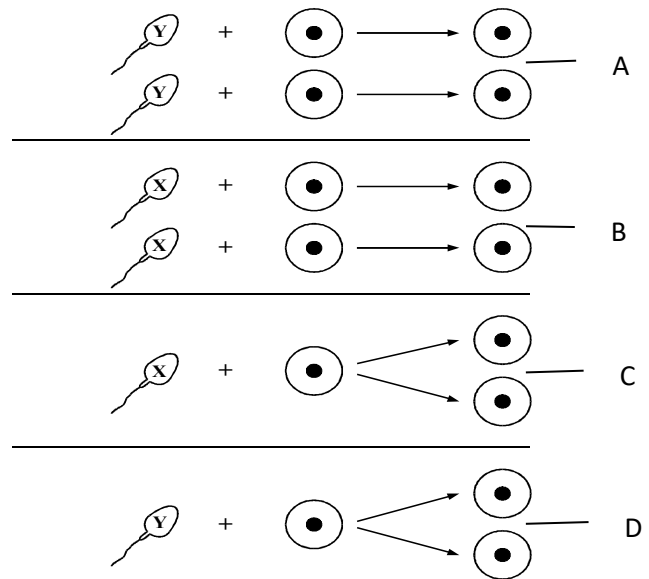
1.1.8   What is a cause and a direct result of the increased greenhouse effect?

	Cause of the increased greenhouse effect	Result of the increased greenhouse effect
A.	release of CFCs	skin cancer
B.	burning of fossil fuels	acid rain
C.	burning of fossil fuels	climate change
D.	release of CFCs	urban pollution

1.1.9   What are the final products when a diploid onion cell, containing 16 chromosomes undergoes meiosis?

   A   4 cells, each with 8 chromosomes

   B   2 cells, each with 8 chromosomes

   C   4 cells, each with 4 chromosomes

   D   2 cells, each with 16 chromosomes

1.1.10   A possible aim to research the quality of water in rivers near rubbish dumps
could be to determine whether:

A   water quality in rivers affects rubbish dumps.

B   rubbish dumps form toxins.

C   rubbish dumps impact on river water quality.

D   rubbish dumps must be only contain non-toxic substances .   10 X 2 /20/

1.2   Write the correct biological term/s for each of the following next to the corresponding
number on the ANSWER SHEET

1.2.1   The sum total of all the factors that prevent a population from reaching its maximum
growth

1.2.2   Bond formed between adjacent amino acids

1.2.3   The alternate form of a gene on the other homologous chromosome

1.2.4   Abnormal growth of cells caused by pollutants that cause mutations

1.2.5   Phase in logistic growth where natality = mortality & immigration = emigration

1.2.6   The maximum number of individuals that an environment can support

1.2.7   A gas produced by sewerage that may be used as fuel

1.2.8   When one species outcompetes another for the same resource

8 x 1 /8/

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 ANSWER SHEET by using the following codes:

A   if only item A relates to the statement

B   if only item B relates to the statement

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

D   if neither of the items relates to the statement

1.3.1	Eusocial animals	A	Dominant breeding pair
		B	Independent organisms which exist as individuals
1.3.2	Indiscriminate removal of indigenous medicinal plants	A	Threatens biodiversity
		B	Destroys natural habitats
1.3.3	Territoriality	A	Leads to more competition for food
		B	Leads to more competition for mates
1.3.4	Density-dependent factors	A	An earthquake
		B	Lack of space for burrowing
1.3.5	Management of indigenous resources	A	Includes re-planting programs
		B	Ensures habitats for alien vegetation
1.3.6	Source of variation in meiosis	A	Random fertilization of gametes
		B	Random assortment in Metaphase I

6 X 2 /12/

1.4   The table shows the number of chromosomes found in each body cell of some different organisms. Study the table and answer the questions that follow.

	Animals		Plants	
Species	Number of chromosomes in each body cell	Species	Number of chromosomes in each body cell	
Fruit fly	8	Tomato	24	
Goat	60	Potato	44	
Human	46	Rice	24	

1.4.1   Plot a pie chart showing the chromosome number of the animals shown in the table above. Show all working.   (5)

1.4.2   Nearly every organism on earth has an even number of chromosomes in its body cells. Suggest why this is so.   (2)

1.4.3   Chromosomes contain DNA molecules. Give ONE function of DNA.   (1)

1.4.4   When a horse and a donkey mate they produce offspring known as mules. Horses have 64 chromosomes and donkeys have 62 chromosomes.

Mules are sterile. When the mule attempts to produce gametes, what problem occurs? Explain your answer.   (2)

/10/

TOTAL MARKS SECTION A: [50]

S E C T I O N   B

QUESTION 2

2.1   The diagram below shows part of a DNA molecule. Study the diagram and answer the questions that follow.
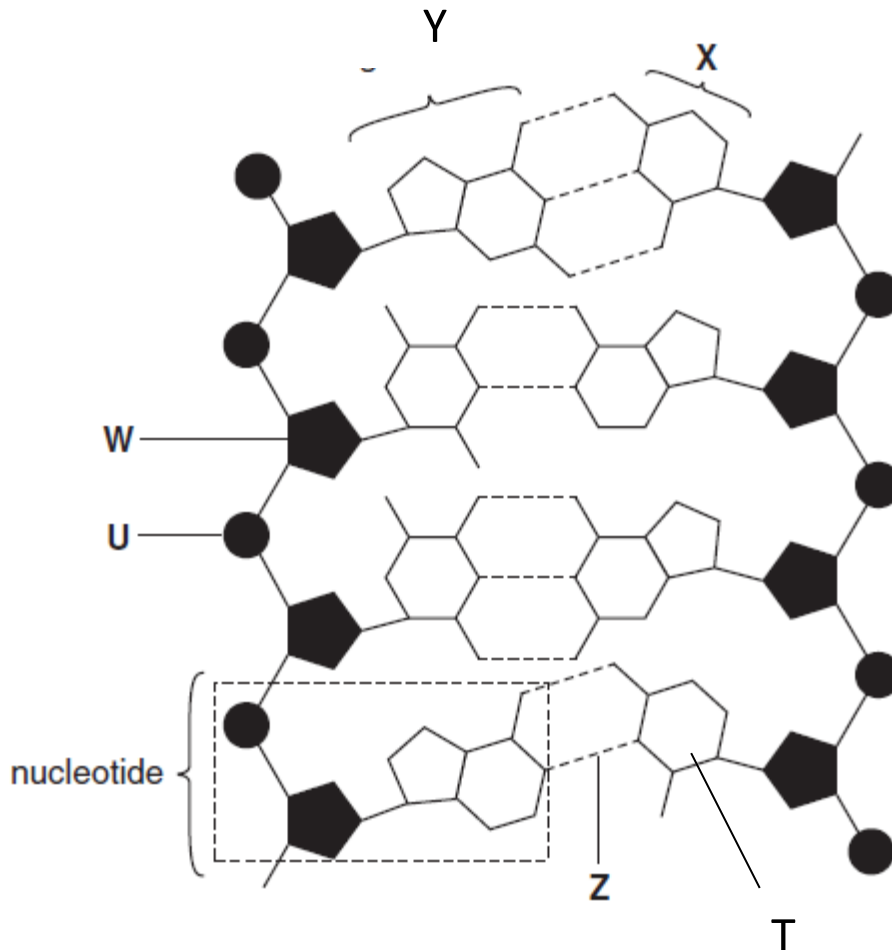
2.1.1   Provide labels for each of the following:

      a) T

      b) U

      c) Y   (3)

2.1.2   Tabulate TWO features of a polypeptide molecule that are different from those found in a DNA molecule.   (4)
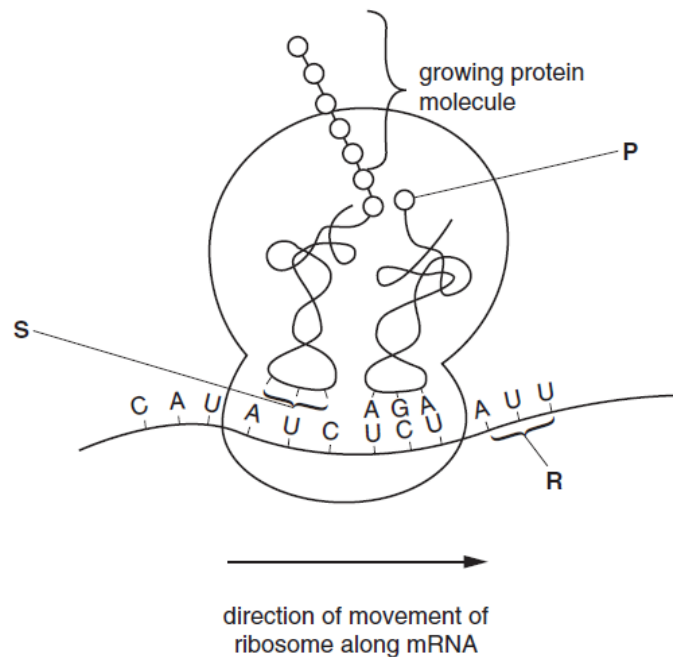
                                                                                      /7/

2.2 The diagram below shows the process of translation occurring at a ribosome in a cell that synthesises enzymes that are secreted into the gut.

growing protein molecule

P

S

C A U A U C A G A U C U A U U

R

direction of movement of
ribosome along mRNA

The table below shows some triplet base sequences of mRNA and the amino acids for which they code.

mRNA	amino acid
AUU	isoleucine
AUC	isoleucine
AUG	methionine
UUU	phenylalanine
UCU	serine
CAU	histidine

Study both the diagram and the table and answer the questions that follow.

2.2.1 Name the amino acid P. (1)

2.2.2 State the base sequence at S. (1)

2.2.3 State the name given to the triplet base sequences on mRNA. (1)

2.2.4 The anticodon sequence shown below forms part of the beginning of a protein sequence shown in diagram. Study this sequence and answer the questions that follow.

UAC – AGA – GUA – UAA

a) Write down the amino acid sequence (4)

b) How many amino acids are found in the final sequence? (1)

/8/

2.3   The table below shows the bases on part of a strand of DNA and the effects on
        the bases of four different gene mutations.

Original DNA strand	Gene mutation	Mutated DNA strands
G T C G C T A	1	G T C G G C T A
	2	G T C C T A
	3	G T T G C T A
	4	G T C G C C A

The table below shows the base sequence of mRNA and the amino acids for
which they code.

Study both tables and answer the questions that follow.

Use numbers from the table below to identify the TWO gene mutations that would
result in the greatest changes to the structure of the protein coded for by the
original DNA strand and explain how these mutations would lead to major
changes in the structure of the protein.   /5/

[20]

QUESTION 3

3.1   The hormone insulin helps to keep blood glucose levels within a narrow, normal range.

The graph below shows changes in blood glucose levels during a period of eight hours and the points when more insulin was released into the blood. Study the graph and answer the questions that follow.
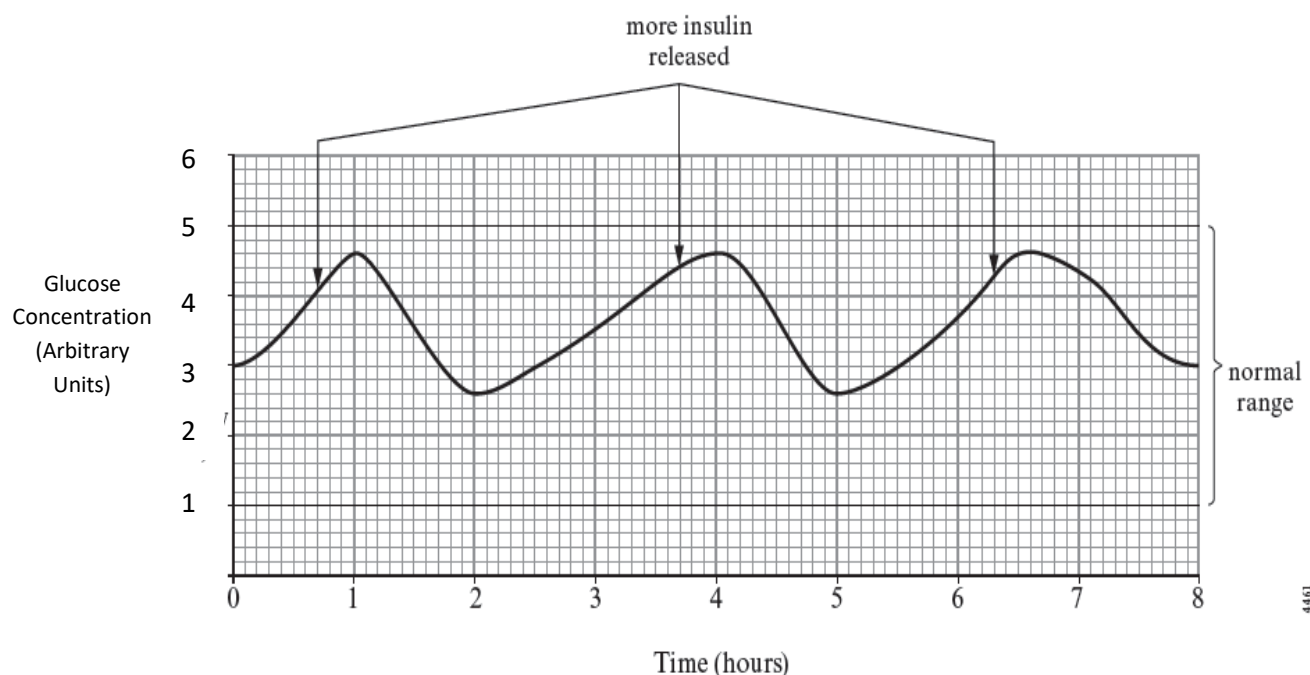
3.1.1   What is the difference between the minimum and maximum blood glucose concentrations?   (1)

3.1.2   Suggest what may have caused the increase in blood glucose concentration at 0.5 hours.   (1)

3.1.3   Give TWO reasons why the blood glucose concentration falls when insulin enters the blood?   (2)

3.1.4   The normal blood glucose concentration is 60–90 mg per 100cm3 of blood.

Describe what happens in the body to prevent the blood glucose from falling below this level.   (4)

/8/

3.2   The diagrams below represent two different phases in meiosis of two different cells. Study the diagrams and answer the questions that follow.

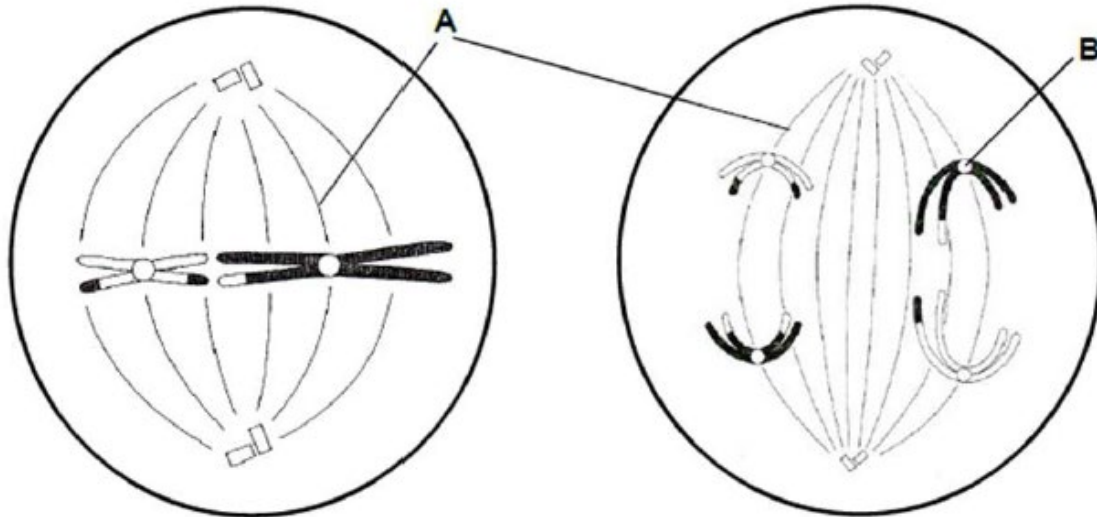Diagram 1   Diagram 2

3.2.1   Give the names of the parts labelled:

a) A

b) B   (2)

3.2.2   Identify the phase represented in:

a) Diagram 1

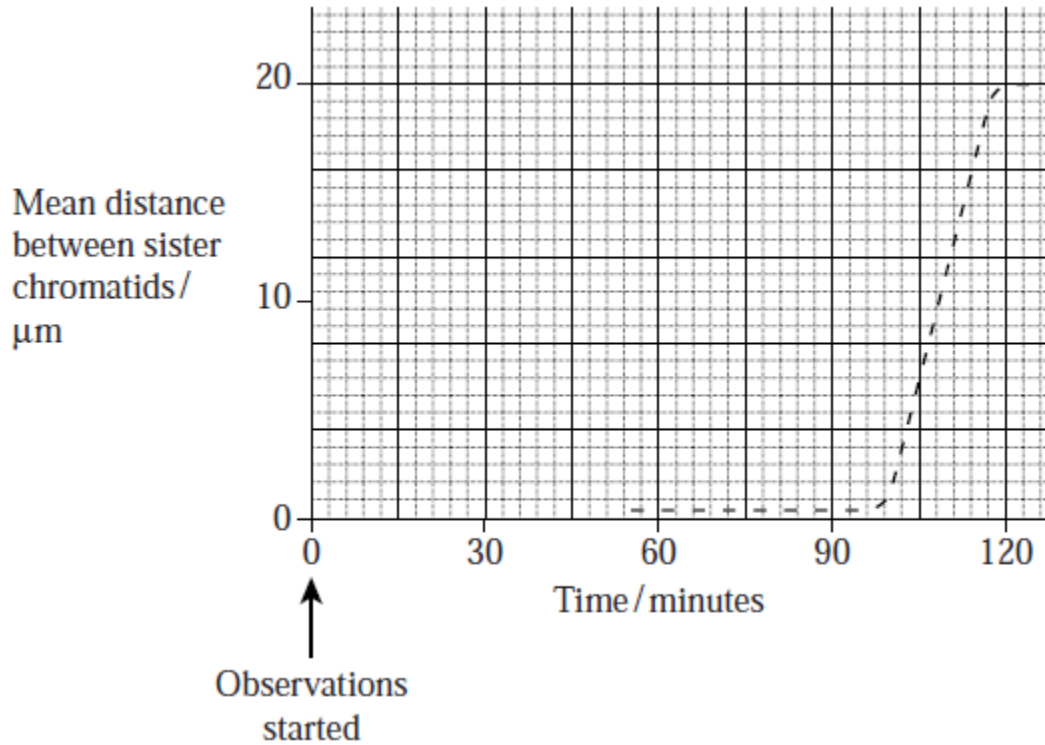b) Diagram 2   (2)

3.2.3   Draw a fully labelled diagram to show what one cell of diagram one would like at the end of the phase shown in Diagram 1.   (4)

/8/

3.3   An investigator observed a cell during part of one cell cycle. The graph shows the mean distance between sister chromatids.

3.3.1   At what time did anaphase start? Give ONE reason for your answer   (2)
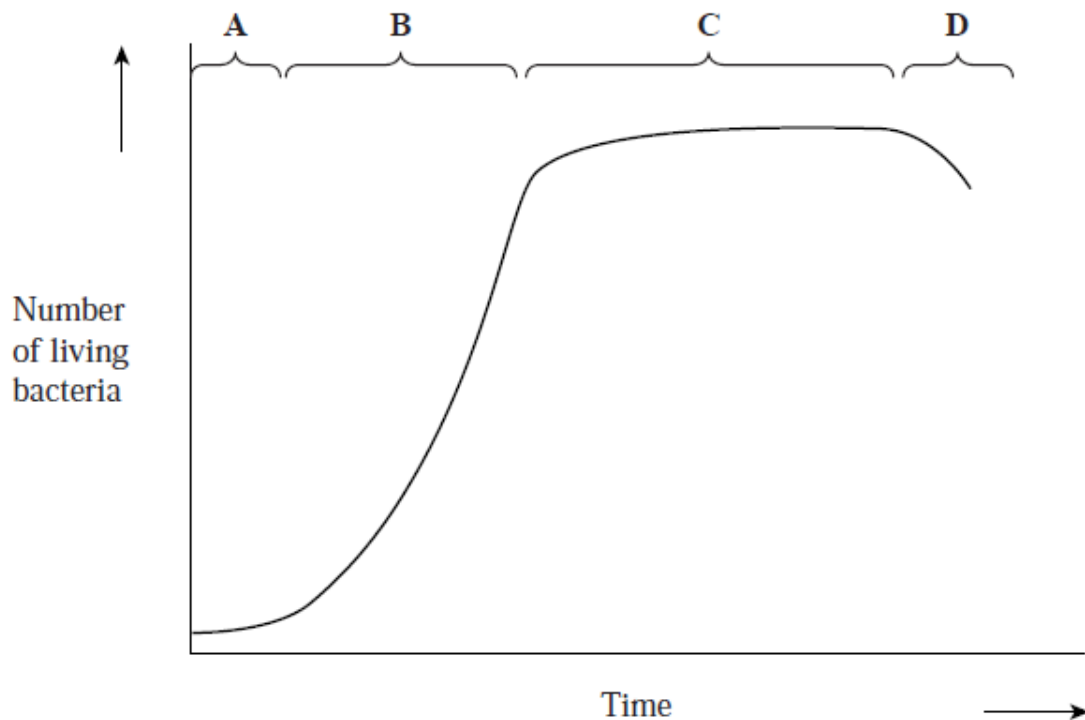
3.3.2   The investigator was not able to obtain measurements between 0 and 60 minutes. Use your knowledge of the cell cycle to explain why.   (2)

/4/

[20]

QUESTION 4

4.1   The graph shows the changes in the number of living bacteria in a bacterial population. Study the graph and answer the questions that follow.

4.1.1 Name the type of growth curve shown in the graph above. (1)

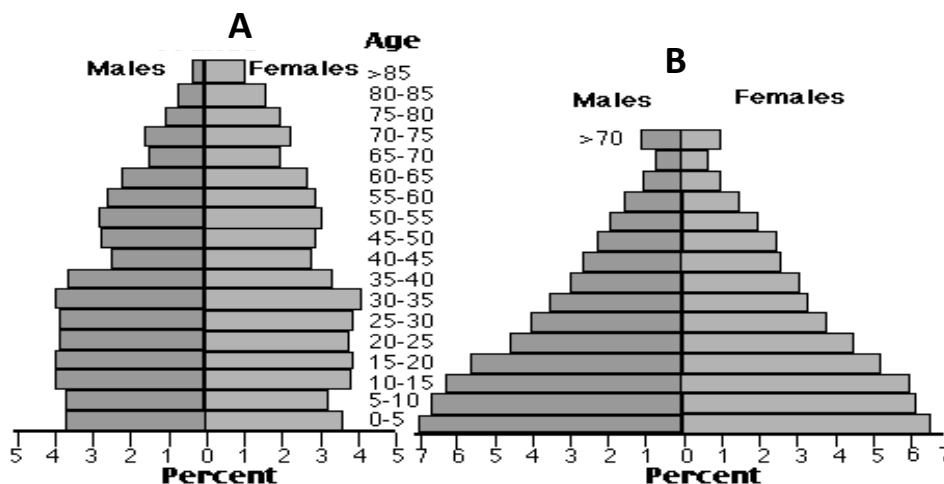4.1.2 Give **ONE** explanation for:

    a) the slow initial rise in the number of bacteria during **A**, (1)

    b) the rapid rise in numbers during **B**, (1)
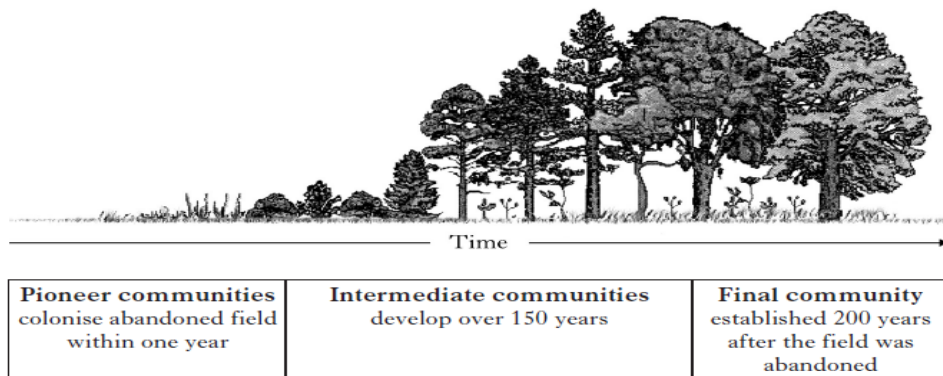
    c) the decrease in numbers during **D**. (1)

    /4/

4.2 The diagrams below represent the age distribution of the human population of a developed country and a developing country in one year at a certain time.

4.2.1	What percentage of the female population is aged between 5 and 10 years in Pyramid A?	(1)
4.2.2	Which age group makes up exactly 4% of the female population in Pyramid A?	(1)
4.2.3	What percentage of the female population are aged 65 to 69 years in Pyramid B?	(1)
4.2.4	Which group (male or female) has the larger percentage reaching old age in Pyramid B?	(1)
4.2.5	Which pyramid represents the population distribution of a developed country?	(1)
4.2.6	Give ONE reason for your answer to QUESTION 4.2.5.	(1)

/6/

4.3 The diagram below shows the changes in the plant communities present at various times after a field was abandoned.

Time

Pioneer communities colonise abandoned field within one year	Intermediate communities develop over 150 years	Final community established 200 years after the field was abandoned

4.3.1	Give the term used to describe the process of gradual change in plant communities shown in the diagram.	(1)
4.3.2	Give the term used to describe the final community in this process.	(1)
4.3.3	State TWO differences between a pioneer community and a final community.	(2)

/4/

4.4 Taxol is a drug used to treat cancer. Research scientists investigated the effect of injecting taxol on the growth of tumours in mice. Some of the results are shown in the table below.

Number of days of treatment	Mean volume of tumour / mm³	
	Control group	Group injected with taxol in saline
1	1	1
10	7	2
20	21	11
30	43	20
40	114	48
50	372	87

4.4.1   Suggest how the scientists should have treated the control group.   (1)

4.4.2   Suggest TWO factors which should be considered when deciding the number of mice to be used in this investigation.   (2)

4.4.3   The scientists measured the volume of the tumours. Explain the advantage of using volume rather than length to measure the growth of tumours.   (1)

4.4.4   In cells, taxol disrupts spindle activity. Use this information to explain the results in the group that has been treated with taxol.   (2)

/6/

[20]

QUESTION 5

5.1   A survey conducted in 2008 showed that South Africa produces 1,48% of the total global annual carbon dioxide emission. That ranks South Africa 13th out of 216 countries.

5.1.1   Give TWO possible reasons why South Africa produces such high levels of carbon dioxide emissions.   (2)

5.1.2   Explain TWO reasons why excessive carbon dioxide emissions are harmful to Earth.   (2)

5.1.3   Suggest TWO ways in which individual South Africans could reduce their 'carbon footprint'.   (2)

5.1.4   What is a carbon footprint?   (2)

/8/

5.2   The pie chart below shows the different types of waste from an average household in England.

Non-recyclable 8%
Glass 5%
Metal 10%
Plastic 12%
Organic kitchen waste 35%
Paper 30%
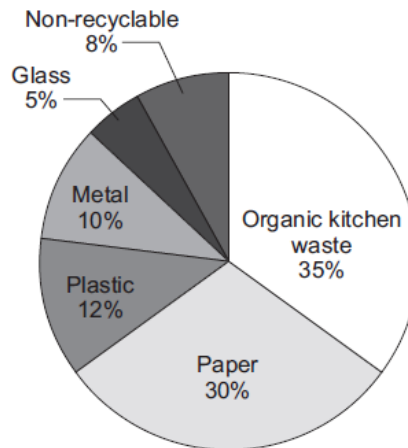
In 2010, councils in England collected 23 million tonnes of waste from households.

Most of the waste was put into landfill sites.

Councils pay to use landfill sites.

Organic kitchen waste can be put onto compost heaps.

5.2.1   Calculate the mass of organic kitchen waste from households that could have been put onto compost heaps in 2010   (2)

5.2.2   Some householders put organic kitchen waste onto their compost heaps:

        a) Suggest ONE advantage of this to the council.   (1)

        b) Suggest ONE advantage of this to the householder.   (1)

        c) Name TWO importance's of managing a dump site   (2)

                                                                                    /6/

5.3   Look at the diagram showing how nitrate fertiliser can reach a river.

nitrogen

nitrate fertiliser

X

Y

uptake by plant roots   denitrification   river
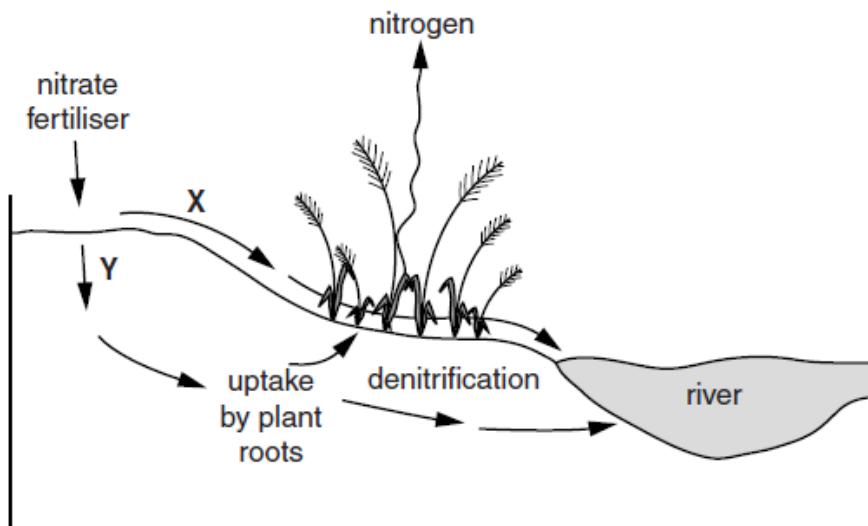
5.3.1   The arrows labelled **X** and **Y** on the diagram show two ways in which pollutants can move to the river as part of the water cycle. Name the TWO processes.   (2)

5.3.2   From the diagram, state TWO ways in which nitrates can be prevented from reaching the river.   (2)

5.3.3   Algae and water plants grow quickly when large amounts of nitrate reach rivers. Explain TWO effects of this increased growth.   (2)

/6/

TOTAL MARKS SECTION B: [80]

S E C T I O N   C

QUESTION 6

Moo has been running the Comrades Marathon for eight hours. She is hot and thirsty, and the sweat is pouring off her body and she is breathing rapidly. Even though she has been drinking fluids continually since the start of the marathon, she has not yet needed to urinate.

Write an essay that describes how Moo's body is regulating body temperature and the amount of water, and why she is breathing rapidly.   (17)

Synthesis   (3)

[20]

TOTAL MARKS SECTION C: [20]

TOTAL MARKS: [150]

H E R Z L I A   S E N I O R   H I G H   S C H O O L

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

NAME:……………………………………………………………..……...   CLASS: …………..

A	B	C	TOTAL : 150	%	SYMBOL

A N S W E R   S H E E T

QUESTION 1.1					QUESTION 1.2	
1.1.1	A	B	C	D	1.2.1	
1.1.2	A	B	C	D	1.2.2	
1.1.3	A	B	C	D	1.2.3	
1.1.4	A	B	C	D	1.2.4	
1.1.5	A	B	C	D	1.2.5	
1.1.6	A	B	C	D	1.2.6	
1.1.7	A	B	C	D	1.2.7	
1.1.8	A	B	C	D	1.2.8	
1.1.9	A	B	C	D		(8)
1.1.10	A	B	C	D		
10 X 2 (20)						

QUESTION 1.3							
1.3.1			1.3.5				
1.3.2							
1.3.3							
1.3.4				(10)			

TOTAL [50]