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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2021

LIFE SCIENCES: PAPER I

EXAMINATION NUMBER

Time: 3 hours 200 marks

ANSWER BOOKLET

There are (xv) pages in the Answer Booklet. Please write your examination number in the blocks above.

QUESTION 1

1.1 Select the term in Column B that best matches a description in Column A. Write the letter of the term in the corresponding space provided between the brackets. Each letter may only be used once.

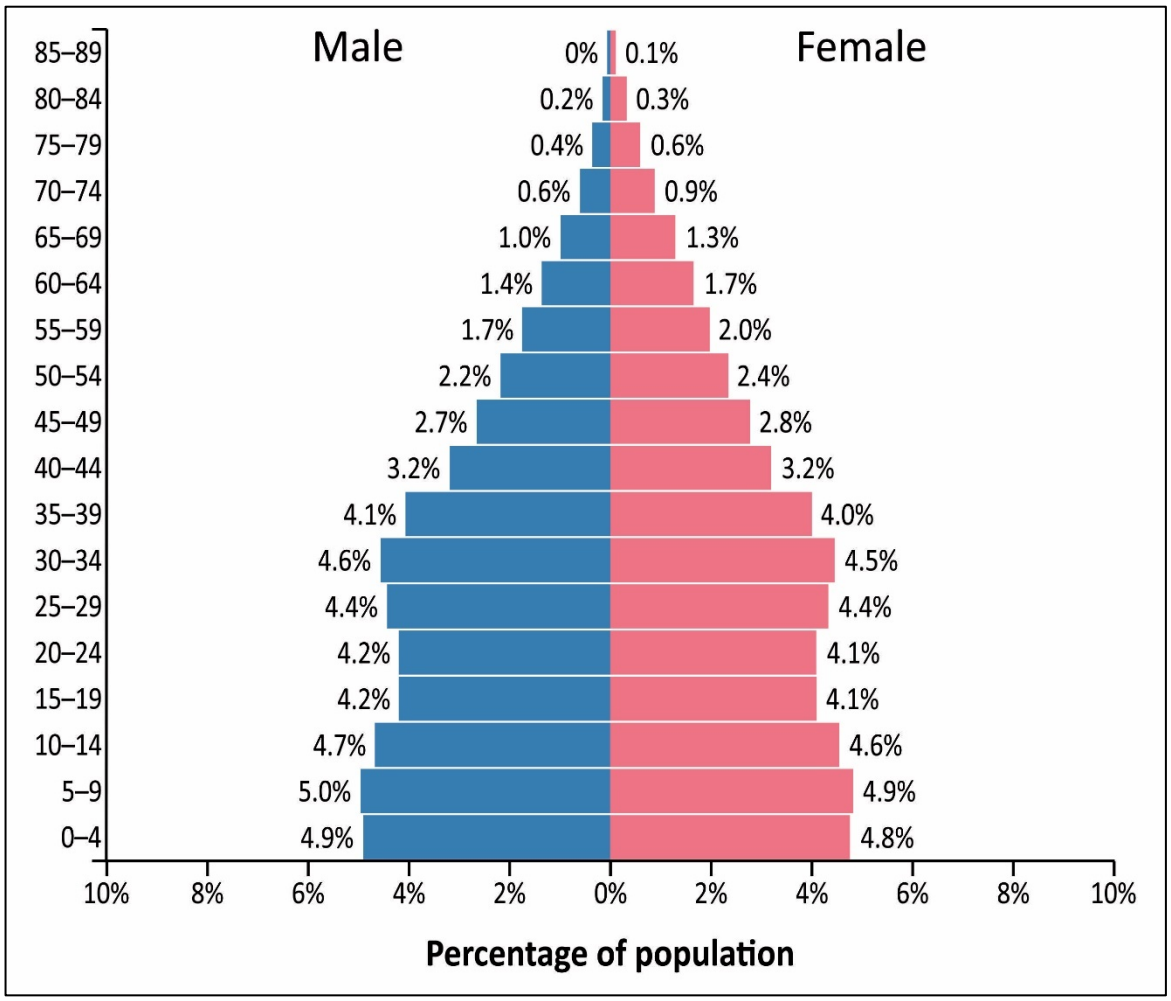
	COLUMN A		COLUMN B
[ ]	An organism that possesses two complete sets of chromosomes in their body cells.	A	Autosomes
[ ]	A gene expressed only in a homozygous condition.	B	Haploid
[ ]	A substance that can cause a mutation.	C	Genetics
[ ]	Chromosomes 1 to 22 in humans.	D	Translation
[ ]	The process that involves the assembly of a polypeptide chain.	E	Gonosomes
[ ]	X and Y chromosomes in humans.	F	Diploid
[ ]	The study of inheritance and variation in organisms.	G	Transcription
[ ]	A gamete that possesses only one set of chromosomes.	H	Mendel
[ ]	The scientist that conducted breeding experiments in pea plants.	I	Dominant
[ ]	A gene that is expressed in the phenotype whether an individual is heterozygous or homozygous for the trait.	J	Recessive
		K	Darwin
		L	Mutagen

(10)

1.2 Five multiple-choice questions are given below. Choose the most correct option for each question and write the letter of your choice in the space provided in the table below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5
Answer					

The population pyramid of South Africa in 2020 is shown below. It shows the current percentage of people by age and gender. Questions 1.2.1 and 1.2.2 are based on the diagram below.



[Source: <https://www.populationpyramid.net>]

1.2.1 What percentage of the male population is under 10 years old?

A 19,6%
B 14,6%
C 9,9%
D 9,7%

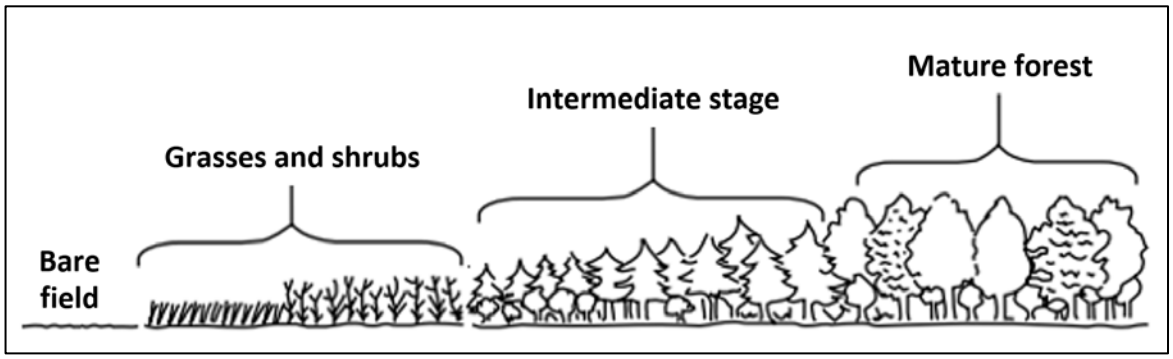
(1)

1.2.2 South Africa is classified as a growing population. Which statement below would suggest that it is becoming a stable population as seen from the pyramid?

A The population is growing rapidly as seen by the large base of the pyramid
B The growth of the population is slowing as seen by a more uniform population size in the age groups below 35
C A larger percentage of the population are in their reproductive years so there is much potential for growth
D Life expectancy in South Africa has increased to ages 85 to 89

(1)

The diagram below represents the changes in plant growth over time in an area during primary succession. Questions 1.2.3 and 1.2.4 are based on the diagram below.



1.2.3 The first stage of primary succession is a pioneer community.

Which of the following statements about a pioneer community are correct?

1. the biomass is low
2. there are many lichens and mosses
3. the presence of many diverse, large animals

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

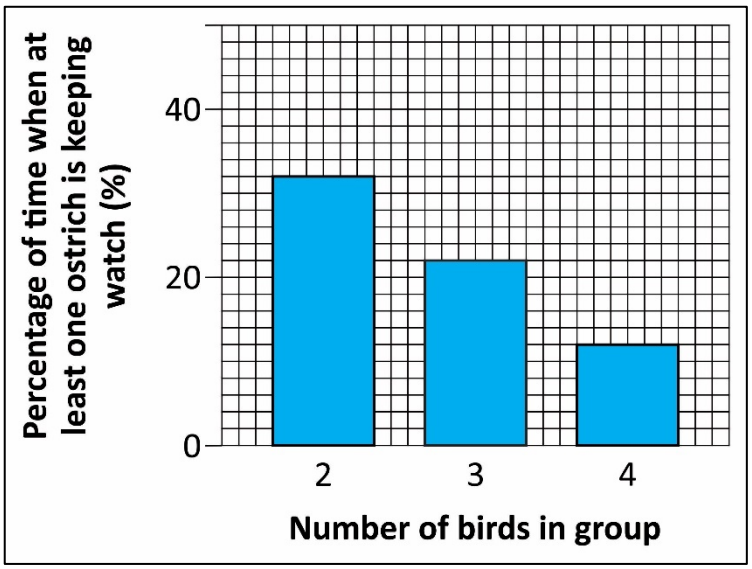
(1)

1.2.4 Which of the following examples is NOT a natural process that would return a mature forest back to the grass stage?

A severe storm or flooding
B forest fire caused by lightning strike
C the aging and falling of trees
D clearance of land for agriculture

(1)

1.2.5 Ostriches divide their time between feeding on vegetation and raising their heads to look for predators. The graph below shows the results of a study on the effect of the group size on the ostriches' behaviour.



[Adapted from: <http://people.eku.edu>]

Which of the following is a valid conclusion from these results?

In a larger group, ONE ostrich spends …

A less time with its head raised as it is less likely to be eaten by a predator.
B less time with its head raised but the group is collectively more likely to notice approaching predators.
C more time with its head raised as the group is less likely to notice approaching predators as they feed.
D more time with its head raised as there are more birds to notice approaching predators.

(2)

1.3 Study the images below showing the skulls of two different hominids. The skulls belong to *Homo erectus* and *Homo sapiens.*

IMAGES SKULL 1

IMAGES SKULL 2

[Adapted from: Victoria Certification of Education. 2009. Biology exam <www.vcaa.vic.edu.au>]

1.3.1 Which skull, images at 1 or 2, belong to *Homo sapiens?*

_____

(1)

1.3.2 Provide TWO visible reasons from the images shown above for your answer in Question 1.3.1.

_____

_____

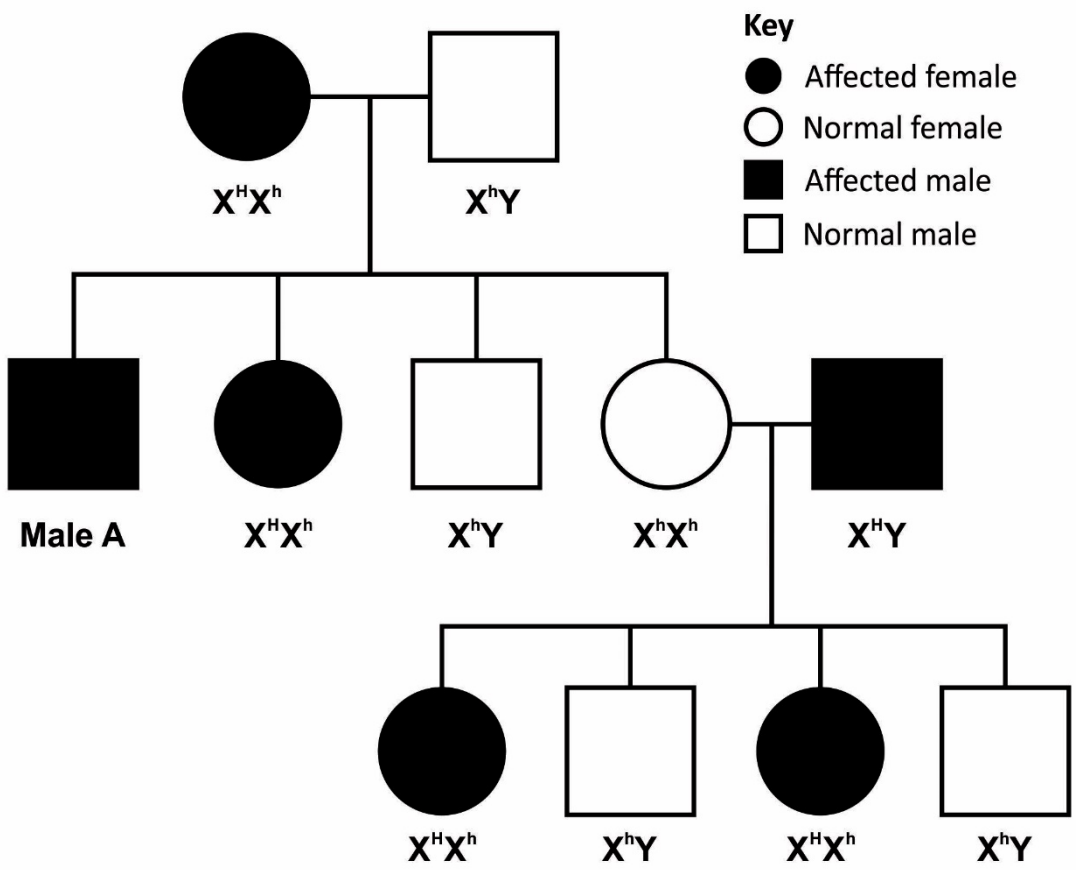
_____

_____

(2)

1.4 Study the family tree showing the inheritance of a **dominant** X-linked genetic disorder.

Family tree showing the inheritance of an X-linked dominant disorder



[Adapted: <https://migrc.org>]

1.4.1 Use the information depicted in the family tree shown above and your own knowledge to determine whether the following statements are TRUE or FALSE.

	Statement	True/T or false/F
(a)	Females who are heterozygous will not have the genetic condition.	
(b)	All daughters of a male who has the trait will also have the trait.	
(c)	There is no father to son transmission; the trait follows the inheritance of the X-chromosome.	
(d)	Sons can have the trait only if their father also has the trait.	
(e)	Males can be carriers of the allele that causes the genetic condition.	
(f)	The chance of an unaffected father and unaffected mother producing a child with the genetic condition is 0%.	

(6)

1.4.2 Determine the genotype of Male A indicated in the diagram.

_____

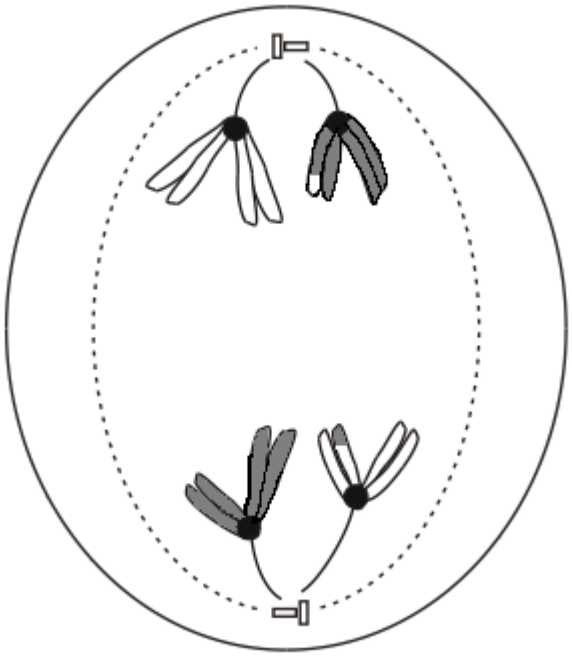
(1)

1.4.3 Name ONE example of a **recessive** sex-linked disease/disorder.

_____

(1)

1.5 The diagram below shows a cell undergoing meiosis.



1.5.1 What phase of meiosis is depicted in the diagram?

_____

(1)

1.5.2 Give TWO pieces of evidence that indicate that this cell is undergoing meiosis.

_____

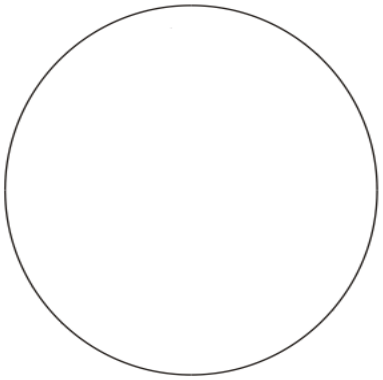
_____

_____

_____

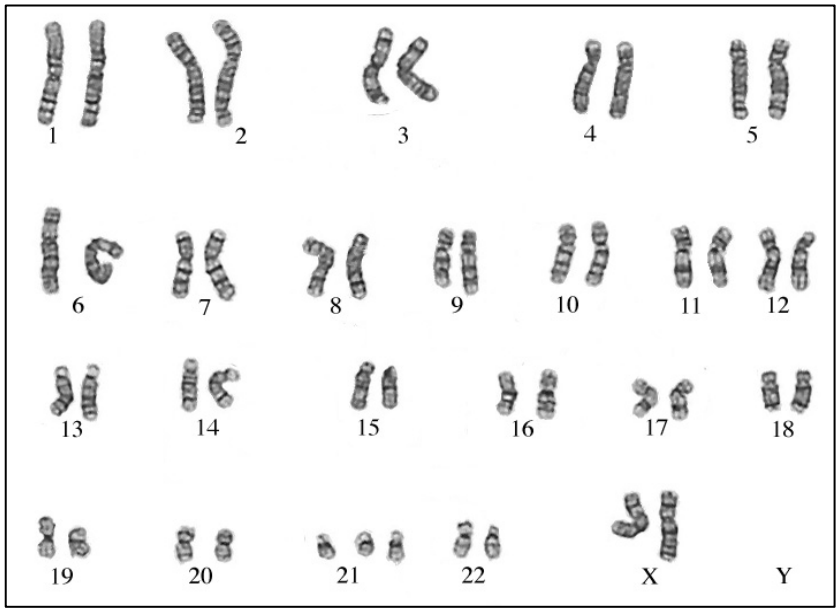
(2)

1.5.3 Draw the chromosomes that would be present in any ONE gamete that would be formed at the end of meiosis in this cell.



(2)

1.5.4 Chromosomal mutations can arise when meiosis occurs abnormally. Study the karyotype below.



[Source: <http://worms.zoology.wisc.edu>]

(a) Name the particular chromosome mutation seen in this karyotype.

_____

_____

(1)

(b) Explain clearly how this abnormality occurred.

_____

_____

_____

_____

(2)

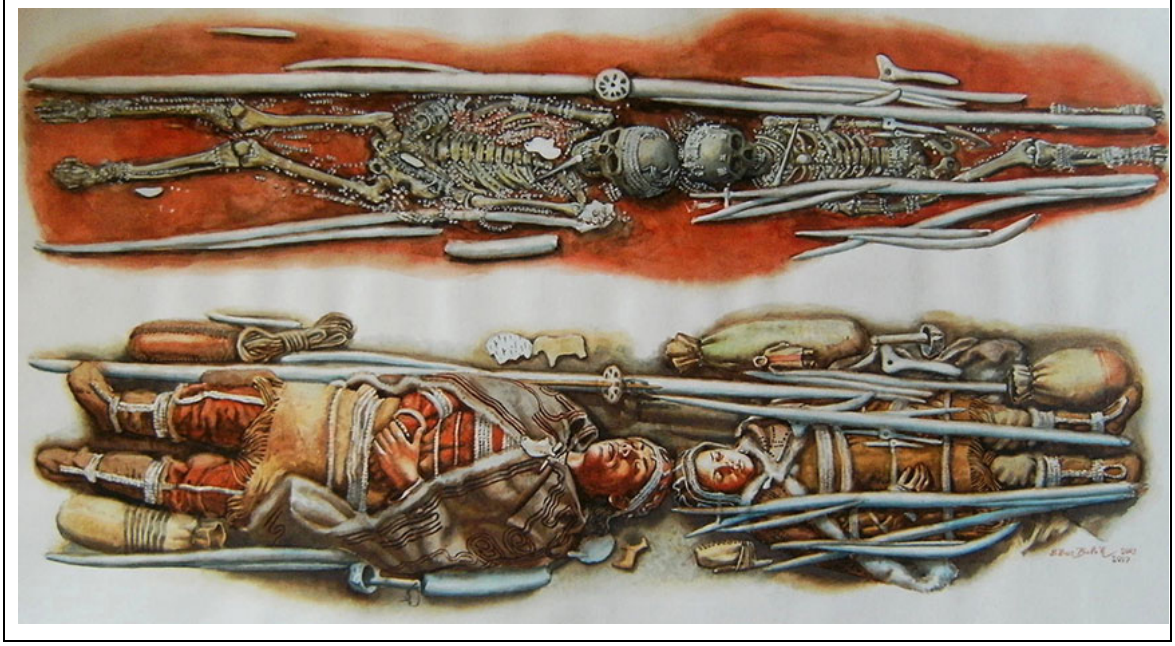
1.6 Read the article below and use the information and your own knowledge to answer the questions that follow:

Ancient humans avoided inbreeding by networking

DNA from 34 000 years ago suggests hunter-gatherers left home to find mates. The hunter-gatherers had to forage (search for food) over large areas to survive, and mate exchanges among different groups reduced inbreeding. It is likely that adolescents of both sexes found mates in communities other than their own, encouraging social ties among groups that might otherwise have avoided or fought with each other.

Skeletons of four people buried at a Russian site called Sunghir provided DNA for analysis. Genetic comparisons found no signs of close family connections. No parent, grandparent, sibling, aunt, uncle, niece or nephew relationships turned up. The DNA from the four Sunghir individuals includes parts of the sex chromosomes, indicating that all of them were male.

Image of two of the skeletons found at Sunghir. The top image shows how they looked when found. The bottom image indicates what they probably looked like at the time of death.



[Source: <https://www.sciencenews.org>]

1.6.1 What was the source of DNA used by the researchers?

_____

(1)

1.6.2 How were the researchers able to identify that the skeletons were male?

_____

_____

_____

(2)

1.6.3 Other than a source of DNA, state TWO other pieces of evidence that the grave sites could have provided about the hunter-gatherers.

(2)

1.6.4 What is meant by the term *inbreeding*?

(1)

1.6.5 Explain how minimising inbreeding would contribute to the successful survival of the hunter-gatherers.

(3)

1.7 Study the following table which consists of two items (numbered 1 and 2) in the first column and a term in the second column. **Decide which item(s) relate to the term.**

Write down your choice in the space provided in the **ANSWER** column, making use of the following codes:

A only item 1 relates to the term
B only item 2 relates to the term
C both item 1 and 2 relate to the term
D neither item 1 or 2 relates to the term

Item	Term	Answer
1. Increase in complexity over time 2. Increase in diversity	Fossil record	
1. Inheritance of acquired characteristics 2. Use and disuse of body parts	Alfred Wallace	
1. Small changes over a long period of time 2. Changes occur in sudden bursts with long periods of no change	Gradualism	
1. First tool maker of hominid species 2. Oldest extant people	*Homo erectus*	
1. The study of the distribution of species and ecosystems 2. A divergence from a single lineage giving rise to many new species	Adaptive radiation	

(5)

1.8 Read the following text and answer the questions.

Insulin for use by diabetic patients was originally obtained from the pancreases of cows and pigs. Genetic engineering technologies allow products specific to humans to be made. One such example is the production of human insulin by recombinant DNA technology. Our increasing knowledge of the human genome and the interaction of genes have given scientists the opportunity to develop treatments for genetic diseases, using genetic engineering techniques.

Scientists thought it would not be long before gene therapy could cure disorders by inserting "normal" alleles into cells. However, this process has proved to be more difficult than was originally thought. Currently all attempts to treat diseases with gene therapy have involved treatment of body (somatic) cells. However, with the development of CRISPR another possibility would be to insert the allele into germ cells – cells involved in sexual reproduction. At present, this is illegal in humans.

[Adapted from: Fullick, A. *Biology*, 2nd edition. (2000)]

1.8.1 Suggest TWO reasons why using human insulin is preferable to using animal insulin.

(2)

1.8.2 In the space below, draw a flow diagram to outline the steps involved in obtaining and inserting the gene coding for human insulin into an *E. coli* bacterium. The following terms must be part of the steps in your flow diagram:

plasmid	***human insulin gene***	***restriction enzymes***
ligase enzymes	***recombinant DNA***	***E. coli bacterium***

(7)

1.8.3 Do you think the use of CRISPR and gene editing in human germ cells should remain illegal? Motivate your answer fully.

(4)

1.9 Study the image below which depicts the predator-prey relationship between lion and zebra.

[Source: <https://www.spheremartialarts.com>]

1.9.1 Give the meaning of the term 'population'.

(3)

1.9.2 State whether the lion or the zebra population would be larger and explain why this population you have chosen has more individuals.

(2)

1.9.3 Describe ONE strategy used by a herd of zebra to avoid predation by lion.

(2)

1.10 The table below shows data collected on a zebra population in a large game reserve over a 12 year period.

Table showing number of zebra in a large game reserve from 2000 to 2012

Year	Number of zebra
2000	45
2002	54
2004	92
2006	140
2008	158
2010	148
2012	150

1.10.1 Plot an appropriate graph of the data in the table on the graph paper provided on the following page.

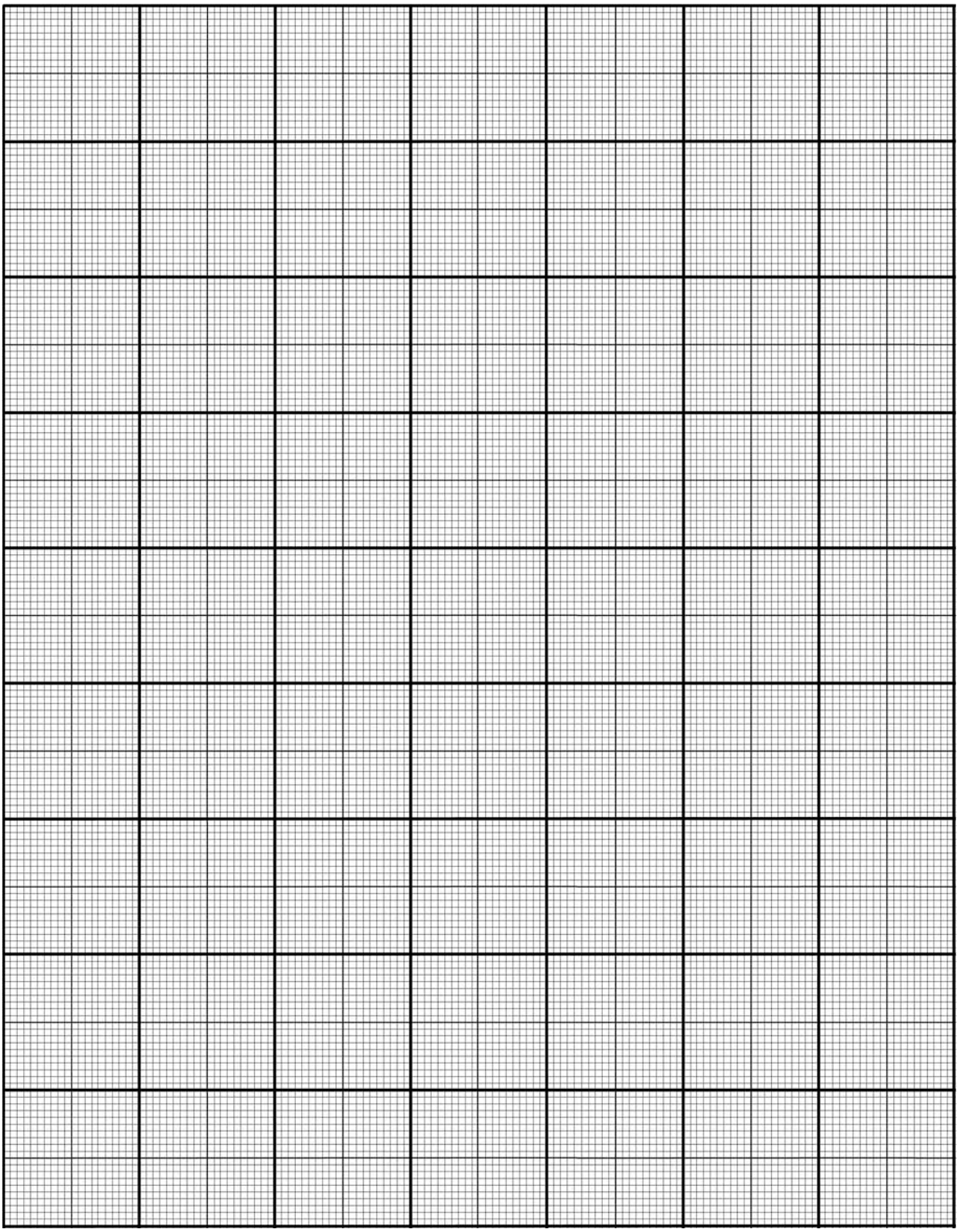
(8)

1.10.2 Draw and label a line on the graph that would represent the carrying capacity for zebra in this large game reserve.

(2)

1.10.3 On the graph line indicate with an "X" one place where mortality of the zebra exceeded natality.

(1)



[80]