



NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION – MARCH 2018

LIFE SCIENCES: PAPER I

Time: 3 hours

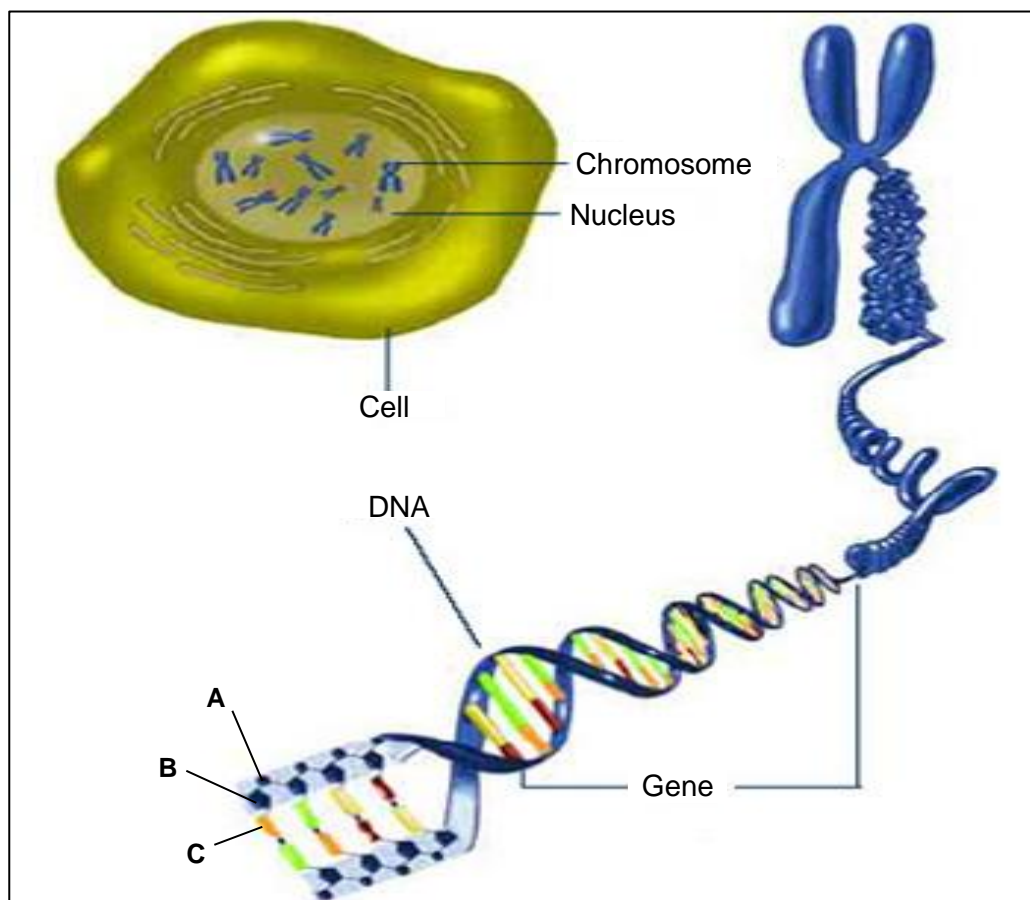
200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 12 pages and a yellow Answer Booklet of 10 pages (i–x). Please check that your question paper is complete. Detach the yellow Answer Booklet from the middle of the question paper. Remember to write your examination number in the blocks provided.
 2. This question paper consists of four questions.
 3. Question 1 must be answered in the yellow Answer Booklet provided. Questions 2, 3 and 4 must be answered in your Answer Book.
 4. Start **each question** on a **new** page.
 5. Read the questions carefully.
 6. Number the answers exactly as the questions are numbered.
 7. Use the total marks that can be awarded for each of Questions 1, 2, 3 and 4 as an indication of the detail required.
 8. It is in your own interest to write legibly and to present your work neatly.
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QUESTION 2

2.1 Study the diagram below and answer the questions that follow:



[Adapted from: <<http://studylib.net>>]

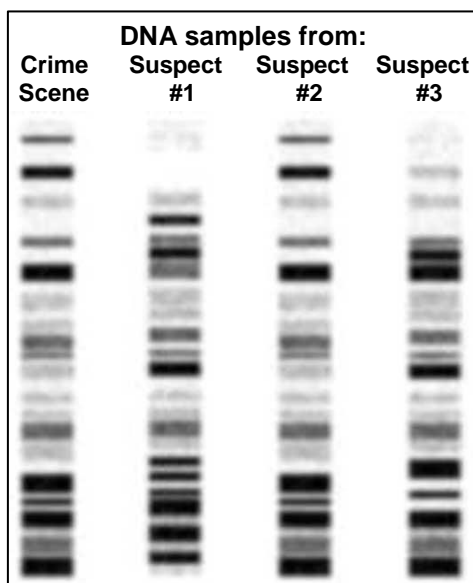
- 2.1.1 Explain the relationship between a chromosome, DNA and a gene. (3)
- 2.1.2 Provide labels for structures A, B and C. (3)
- 2.1.3 One structural element/component of the chromosomes is not evident in the diagram. Name this component. (1)

2.2 Read the following true story and answer the questions that follow:

In 1987, Michael Morton was sentenced to life in prison for the murder of his wife. Christine Morton was raped and murdered in their bed one morning, after Michael had gone to work. Semen found at the scene matched Michael's DNA. Another piece of evidence that was presented was a bandana found close to their home that had blood on it. In 2010 Michael was granted permission to have the bandana examined. DNA testing revealed that it contained Christine Morton's blood and hair. It also contained the DNA of a man – but not Michael. The profile was run through a DNA databank and matched that of another man. After 25 years jailed for a crime he did not commit, estranged from his son, and having never been able to properly grieve for his wife, Michael Morton was finally a free man.

[Adapted from: <<http://www2.le.ac.uk>>]

- 2.2.1 Study the DNA samples analysed below. The crime scene evidence was the semen found on Christine's bed. Which of the suspects was Michael? Give a reason for your answer.



[Source: <<https://image.slidesharecdn.com>>]

(3)

- 2.2.2 During the process of DNA analysis, a technique known as Polymerase Chain Reaction (PCR) is used. Explain the purpose of PCR in the formation of DNA profiles.

(2)

- 2.2.3 Do you think that Michael's DNA profile should have remained in the national database after he was released? Give a reason for your answer.

(2)

2.3 Read the article below and answer the questions that follow:

New report claims GMOs are safe, but not magical

The National Academy of Sciences, one of the most prestigious sources of scientific inquiry, **announced in a new report that genetically modified organisms (GMOs) are safe to eat.** The report also says that there is no proven effect to plants and animals on farms with GMOs. These findings have angered several advocacy groups such as Food and Water Watch who say that the committee has too many ties to the biotechnology industry to be impartial.

Despite the criticism of bias, it is intriguing to note that the report itself isn't all glowing. In addition to saying that GMOs are safe for human consumption, the National Academy of Sciences also reported that **the benefits of GMOs are overrated.** Interestingly, they allocated more space within their report to the social and economic consequences of GMOs than they have in the past.

[Adapted from: <<http://bigthink.com>>]

2.3.1 What is meant by the following terms?

(a) Genetically Modified Organisms (2)

(b) Biotechnology (2)

2.3.2 List THREE of the possible "benefits of GMOs". (3)

2.3.3 On what grounds would advocacy groups be opposed to the use of GMOs? Discuss TWO objections they might have to the GMOs. (4)

2.4 Haemophilia is caused by a recessive X-linked mutation which prevents the synthesis of Factor VIII by the body. This condition will lead to uncontrolled bleeding and possibly death. Unless haemophiliacs receive injections of Factor VIII, their blood will not be able to clot.

2.4.1 Explain why this condition occurs predominantly in males. (4)

2.4.2 A carrier mother (heterozygous for haemophilia) and a normal healthy father decide to have a child. The mother falls pregnant with a son. What are the chances that he will suffer from haemophilia? (You do not need to do a full genetic diagram. Just provide a key, draw a Punnett square/genetic cross, and use it to work out the odds. Make sure that you state your conclusion.) (5)

- 2.4.3 Researchers succeeded in inserting the human gene for Factor VIII into hamster cells, where it joined with the genetic material of the hamsters. The hamster cells then used the new genetic instructions to make pure human Factor VIII.



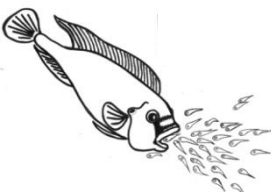
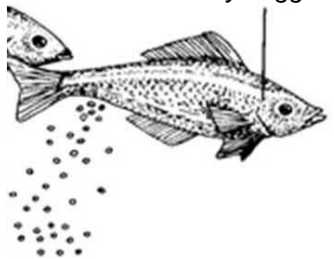

[Source: <<https://3.imimg.com>>]

Using a flow diagram, summarise the process by which human Factor VIII is manufactured using hamsters. Mention must be made of the enzymes involved in the process.

(6)
[40]

QUESTION 3

3.1 Fish show a variety of reproductive strategies. Most of them fall into three groups:

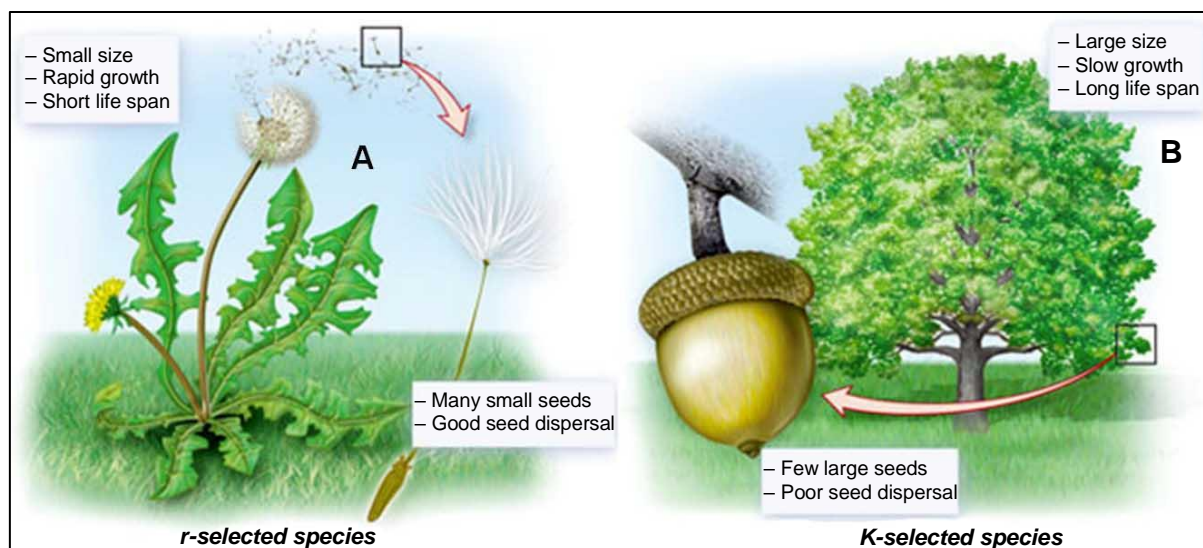
<p>With mouth brooders, the male and female will start to circle each other. The female will lay one of her eggs and swim over it. The male will then swim over the egg and spray semen to fertilise it, then the female will pick up the fertilised egg in her mouth. This procedure is repeated until all of the eggs (20–50) have been fertilised and collected by the female. The female will carry her brood in her mouth for about three weeks, then will release the babies and will protect and guard them until they become independent and can survive on their own.</p>  <p>[<http://www.reed.edu/>]</p>	<p>With egg scatterers, the male chases the female. While doing this he butts and nips around her stomach and vent area. This is to encourage and provoke the female to release eggs (300+). There is no care taken here, and the eggs will just fall wherever the female is swimming. Whilst they are falling, the male will spray semen onto the eggs. The fertilised eggs will then fall onto the substrate, into plants, or it will even float to the surface where they will hatch unattended.</p>  <p>female fish lays eggs</p> <p>[<http://friendsseminarystephan.pbworks.com/>]</p>	<p>The live bearing strategy involves the female/male bearing live young (e.g. seahorses). Before breeding, the seahorses may "court" for several days, then when they are ready to breed, they will swim aside each other with their tails linked and will spin around in unison. Then the male will pump water through his pouch to catch the female's attention, and to show her that the pouch is empty. The female will then deposit her eggs into the male's pouch (up to 1 500) and then swim away. Seahorses give birth during the night and their young are independent from birth, the male does not look after the brood or protect them in any way.</p>  <p>[<http://reefkeeping.com/>]</p>
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[Information adapted from: <<http://fishbreedingstrategies.weebly.com/live-bearing.html>>]

- 3.1.1 What is meant by the term "reproductive strategies"? (2)
- 3.1.2 Explain why it is necessary for seahorses to produce up to 1 500 babies while the mouth brooders only produce 20–50. (4)
- 3.1.3 Name two other reproductive strategies referred to in the above texts. (2)

3.1.4 Identify the courtship behaviour described in each of the three groups above. (3)

3.2 Consider the reproductive strategies shown below:



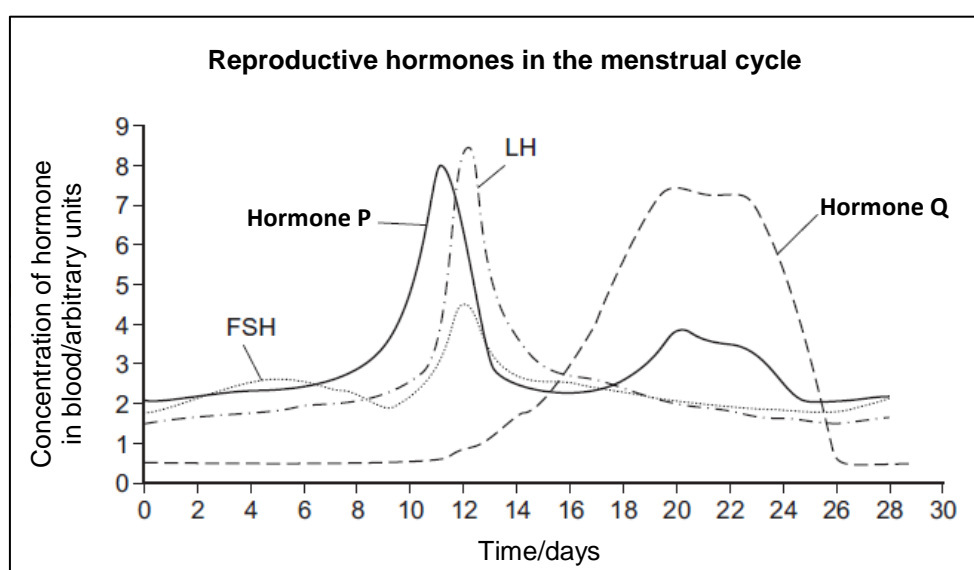
[Source: <<http://www.doctortee.com>>]

3.2.1 Which of these organisms (A or B) has a survival strategy similar to humans? Explain. (2)

3.2.2 Why is it beneficial for species A to be an r-strategist? (2)

3.2.3 What TWO features of the seeds of species A assist with its survival strategy? (2)

3.3 Study the graph below of the reproductive hormones as measured in Woman A, and answer the questions that follow:



[Adapted from: GCE Advanced Level Examination Unit 5 Biol5 June 2012]

3.3.1 Which gland secretes the hormones FSH and LH? (1)

3.3.2 Identify ovarian hormones P and Q. (2)

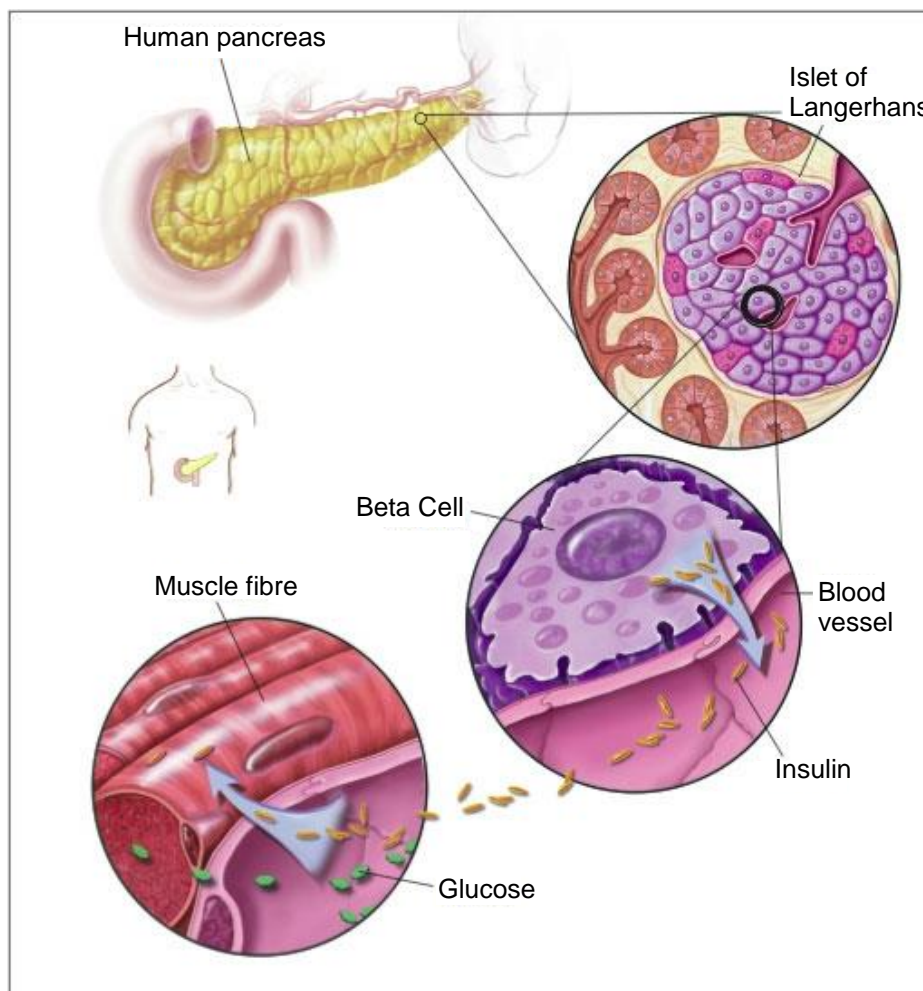
3.3.3 Which gland is responsible for the production of hormone Q in ...

(a) Woman A during the month that her hormone levels were measured? (1)

(b) a 6-month pregnant female? (1)

3.3.4 Is the woman, whose hormones are being measured in the above graph, pregnant? Explain your reasoning. (3)

3.4 Study the diagram below and answer the questions that follow:



[Source: <<http://www.precisionnutrition.com/all-about-insulin>>]

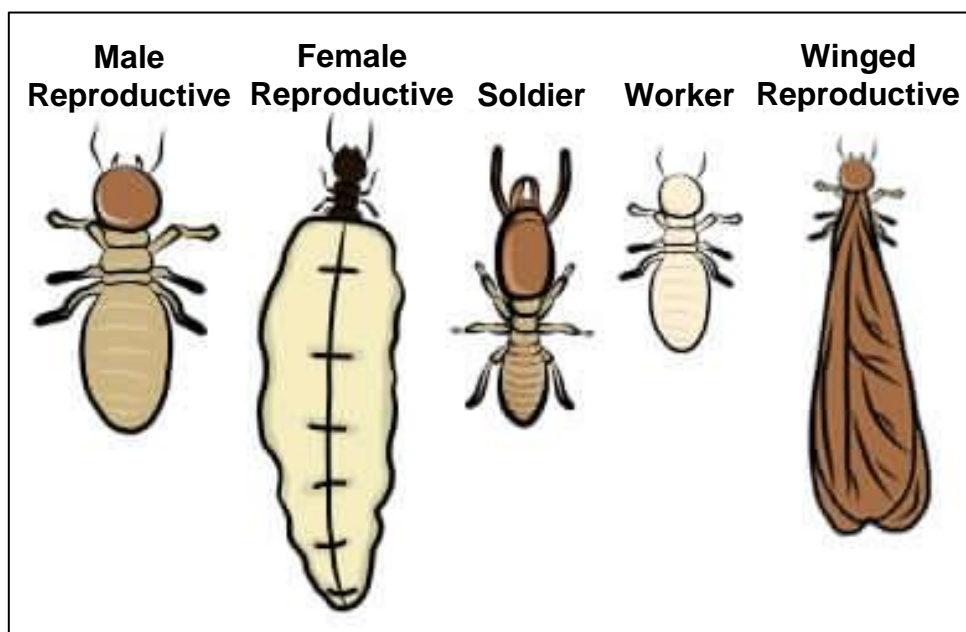
3.4.1 Discuss how homeostasis of blood sugar level is achieved after a sugary drink is consumed, from the time it enters the blood stream until the normal blood sugar level is restored, as illustrated in the diagram. (7)

3.4.2 The Banting Diet is a low-carbohydrate and high-fat diet popularised in recent years by Professor Tim Noakes. Prof Noakes claims that if Diabetes Type 2 patients follow the Banting Diet, it is possible for them to reduce or even reverse their diabetes. Two students decided to test this, so they designed an experiment in which they selected 10 Type 2 diabetics and divided them into two groups. To one group they gave a diet plan which followed the Banting principles (low carbohydrate) while to the other group they gave a diet plan which was for a normal healthy balanced diet. After 3 months they tested all ten individuals to check their insulin resistance.

- (a) What was their hypothesis? (3)
 - (b) Identify THREE fixed variables. (3)
 - (c) List TWO ways in which they could have made their experiment more scientifically valid. (2)
- [40]**

QUESTION 4

4.1 Study the diagram of termites below and answer the questions that follow:



[Source: <<http://termitedroppings.org/what-do-termites-look-like/>>]

- 4.1.1 List one function performed by each of the castes above. (5)
- 4.1.2 Discuss the advantages of social organisation to the termite. (2)

4.2 Read the article below about the African Wild Dog and answer the questions that follow:

Once abundant in most parts of the continent, the species has been largely exterminated in north and west Africa, with the majority surviving in southern and eastern Africa. Because of the low densities at which wild dogs live and their need for large home ranges, they remain vulnerable to extinction because of the fragmentation of their former living spaces, human persecution and disease.

In South Africa, the only remaining viable population of wild dogs is in the Kruger National Park, which has a population of less than 200 dogs. As a result, wild dog experts have been trying to introduce new populations into smaller reserves.

This approach to wild dog conservation involves establishing new packs and moving individual animals between 10 smaller reserves from time to time to create new packs and avoid genetic inbreeding.

On Friday, a new pack of six dogs was released into the Zululand Rhino Reserve near Mkhuze.

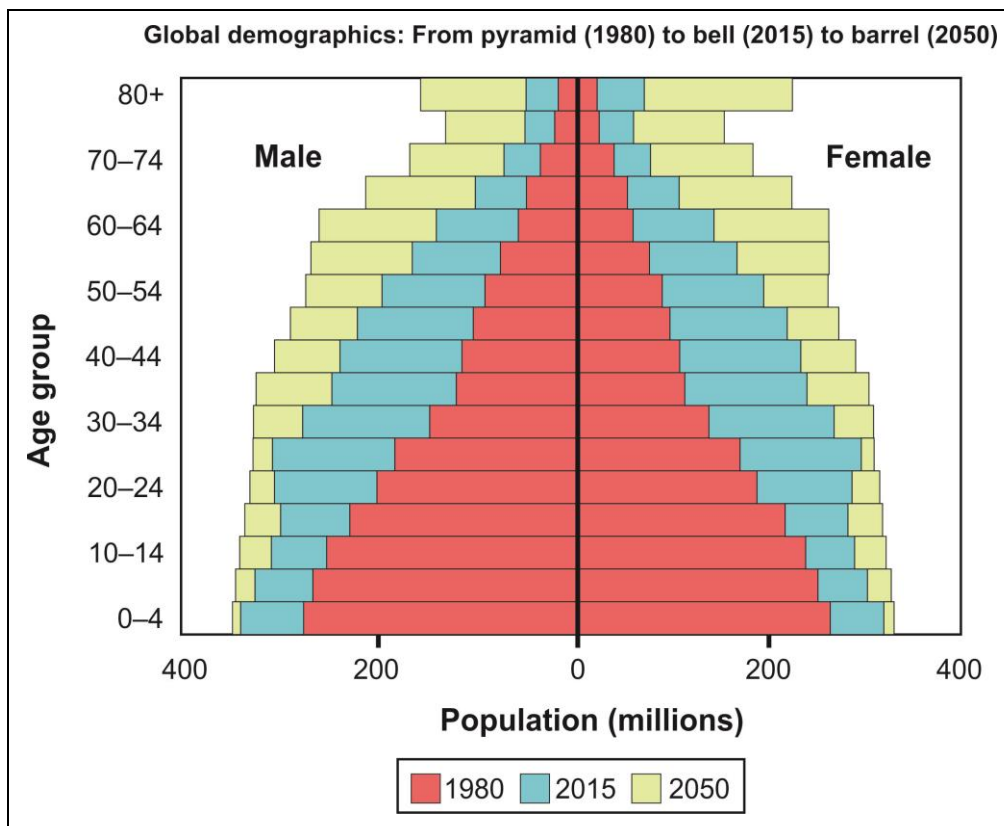
The Mercury, 11 May 2015



[Source: <<http://www.africanwildlifeconservationfund.org>>]

- 4.2.1 Wild dogs are social animals that live and hunt in packs. Discuss THREE ways in which this makes them highly effective hunters. (6)
- 4.2.2 In the article, reference is made to wild dog habitats becoming fragmented by man. This prevents migratory males from joining new packs and the packs are forced to remain together in isolated groups. This has resulted in "genetic inbreeding" and a loss of hybrid vigour.
- (a) Explain the term "hybrid vigour". (3)
 - (b) Why is the loss of hybrid vigour a real concern for the wild dog populations in Africa? (3)
 - (c) Suggest TWO management strategies to prevent the African Wild Dog from becoming extinct. (4)

- 4.3 The following population pyramid shows projections for world human population figures up to the year 2050. Study the pyramid and answer the questions that follow:



[Adapted from: <<http://blogs.worldbank.org>>]

- 4.3.1 "Today's rapid population growth is driven by longevity, and no longer by high fertility. This is why we can experience both declining fertility and rapid population growth at the same time." Wolfgang Fengler: Economist from World Bank.

- (a) Longevity means "living for a long time". Discuss TWO factors that have contributed to increased longevity in the world population. (2)
- (b) Why do you think fertility (the number of offspring produced per individual) is declining? Discuss TWO reasons. (2)

- 4.3.2 Analyse the population pyramid and read the following figures off the pyramid:

- (a) The number of males in the 40–44 years category in 1980. (1)
- (b) The number of females in the 0–4 years category in 2015. (1)
- (c) The total number of individuals in the 70–74 years category in 2050. (1)

- 4.3.3 (a) Explain why we say that the global population pyramid has become a bell shape in 2015 and will become a barrel shape in 2050? (4)
- (b) What problems do you foresee with this changing population pyramid shape? (2)
- (c) Discuss TWO strategies that a government could put in place to cope with the changing population demographics. (4)
- [40]**

Total: 200 marks