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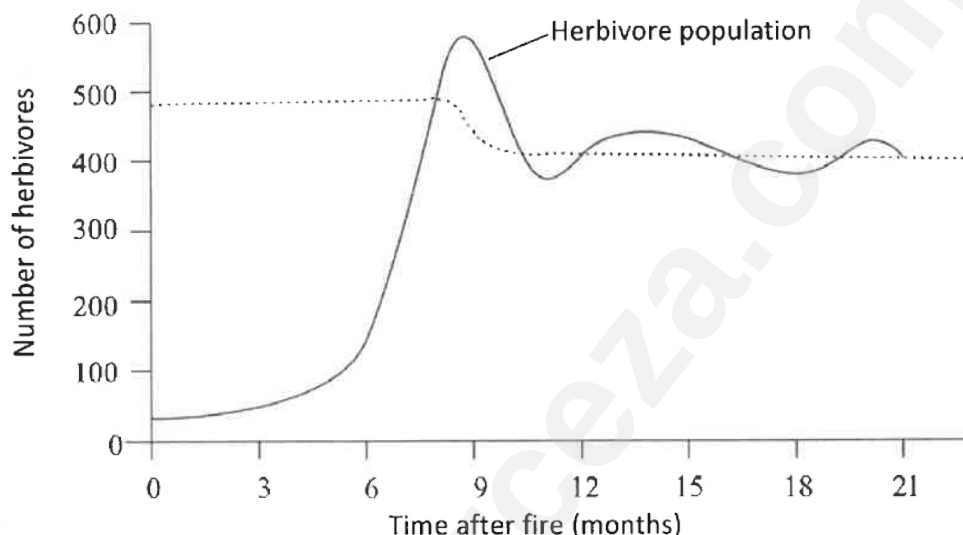
[illegible]

1.2.1 A population is defined as ...

- where will they write answers?
- A all the organisms in an area
 - B the number of organisms per unit area
 - C all the members of a species in a defined area
 - D the number of different species in an area

(1)

Questions 1.2.2 to 1.2.5 refer to the graph below which shows the changes in the population of a small herbivore in a fenced park for 21 months after a grass fire.



1.2.2 During which period was there the greatest rate of growth of the herbivore population?

- A 12 and 21 months
- B 6 and 9 months
- C 3 and 6 months
- D 0 and 3 months

(1)

1.2.3 Which one of the following statements about the population of herbivores is best supported by the information in the graph?

- A At 3 months there was a shortage of reproducing animals.
- B At 9 months the birth rate was zero.
- C At 12 months the death rate was zero
- D At 21 months the population had used all its resources and will decline sharply.

(1)

1.2.4 A density-independent factor which could affect the size of the herbivore population is ...

- A biomass of the grass
- B population of carnivores
- C viral disease
- D grass fire

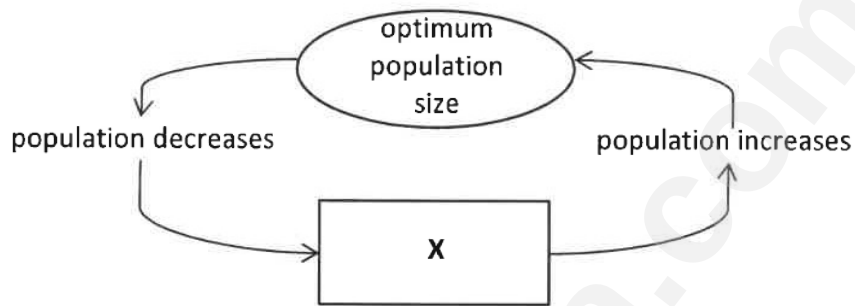
(1)

1.2.5 What does the dotted line on the graph represent?

- A Maximum number of herbivores
- B Environmental resistance
- C Carrying capacity
- D Territoriality

(1)

1.2.6 The diagram below represents an aspect of the control of population size.



What could **X** represent?

- A Increasing effect of density-dependent factors
- B Increasing effect of density-independent factors
- C Decreasing effect of density-dependent factors
- D Decreasing effect of density-independent factors

(1)

Questions 1.2.7 and 1.2.8 refer to the following data:

A biologist caught 70 beetles, marked and released them. A week later, a second sample was captured. Of these, 20 beetles had been marked and 80 had no marking.

1.2.7 What was the estimated size of the beetle population?

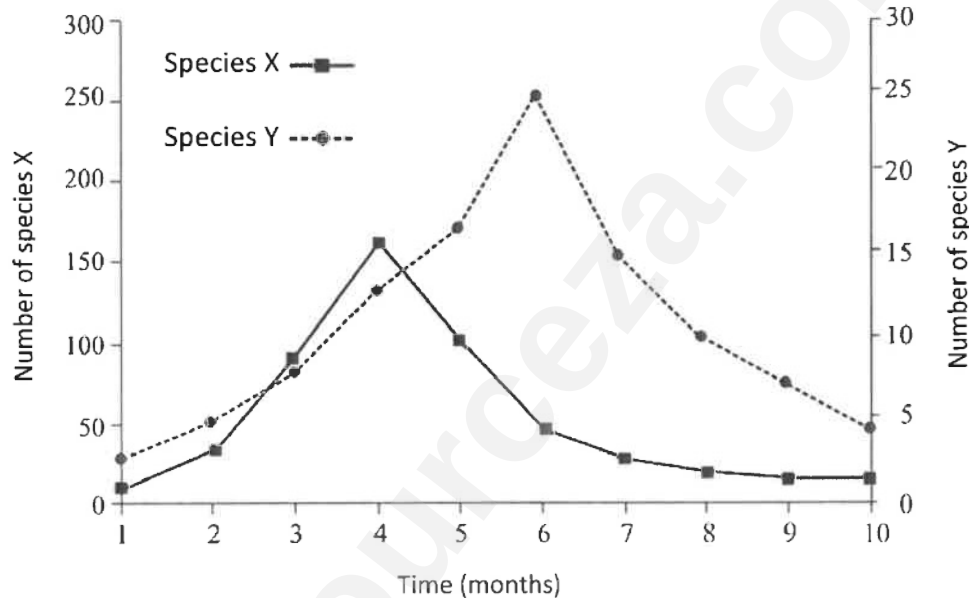
- A 350
- B 280
- C 170
- D 23

(2)

1.2.8 Which one of the following assumptions would result in an **inaccurate** estimation of the size of the beetle population using the mark-recapture method?

- A There was little movement of the beetles into or out of the population.
- B Marking the beetles made them clearly visible to the biologist and to their predators.
- C The probability of capturing a marked beetle depended on the proportion of marked beetles in the population.
- D The marked beetle mixed randomly with the rest of the population. (1)

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



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

- A Species **X** is the predator and **Y** is its prey.
- B Species **X** and species **Y** are competing for the same resources.
- C Species **Y** is the predator and species **X** is its prey.
- D An increase in species **X** causes a decrease in species **Y**. (2)

1.2.10 Assuming that the immigration rate equals the emigration rate, which continent has the highest population growth rate?

	Continent	Birth rate per 1 000	Death rate per 1 000
A	Africa	46	20
B	Europe	17	9
C	South America	39	10
D	North America	18	9

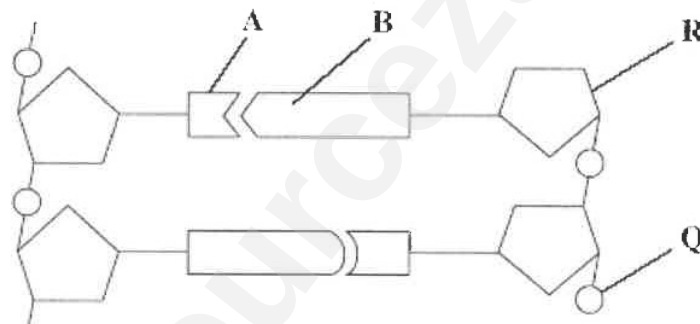
(1)

- 1.3.1 For each of the following, decide if the statement is TRUE (T) or FALSE (F). If the statement is false, it can be corrected by changing one word. Write the incorrect word down in the appropriate column and then the correct word in the column next to it.

Statement	T / F	Incorrect word	Correct word
DNA and RNA nucleotides are made up of a sugar, a phosphate and a nitrogenous base.			
Proteins are synthesised from amino acids in association with the mitochondria of cells.			
RNA differs from DNA in that uracil replaces the base adenine.			
Translation is the process by which DNA makes mRNA.			

(10)

- 1.3.2 The diagram below shows a short section of a DNA molecule.

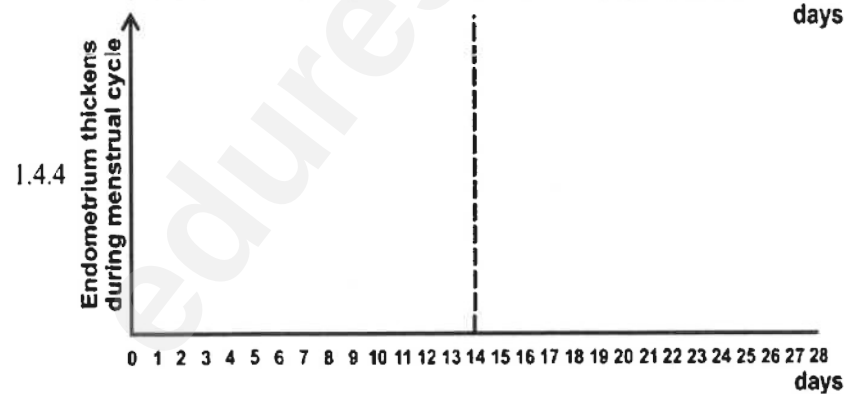
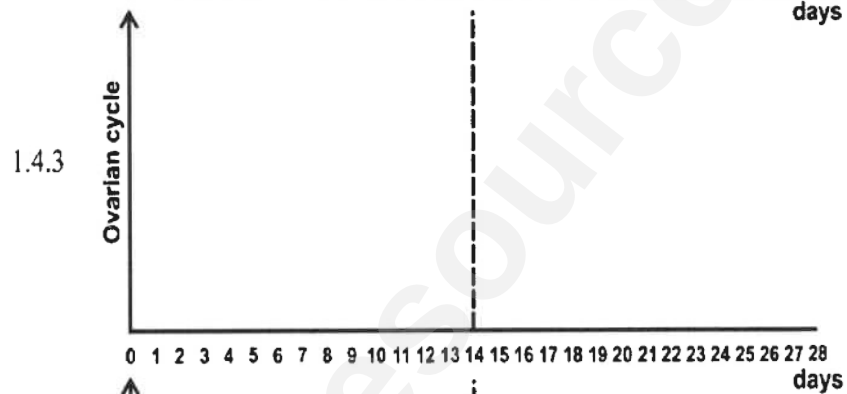
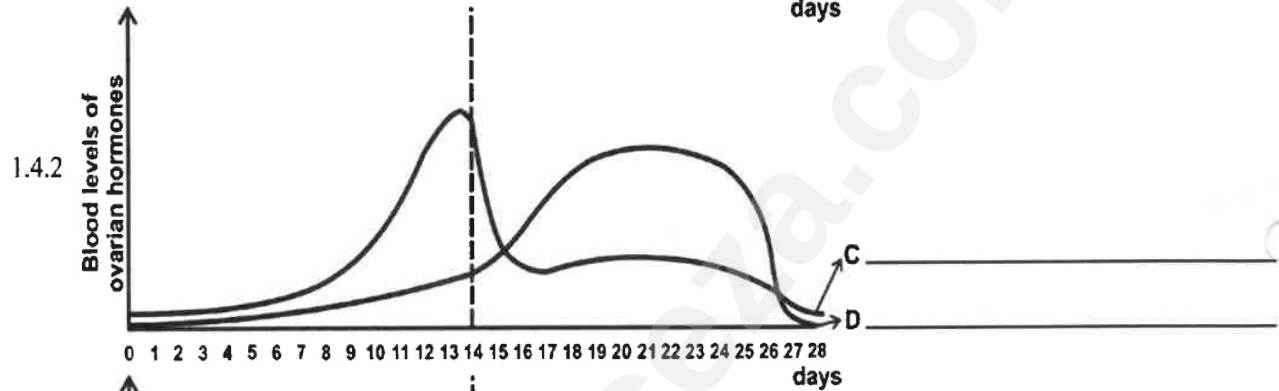
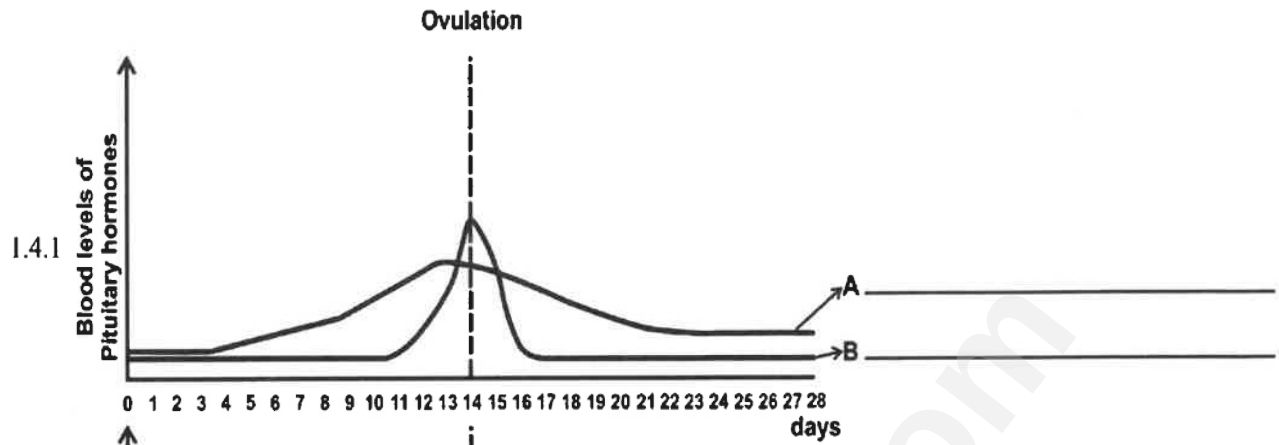


- a) Name parts **R**: _____
and **Q**: _____ (2)
- b) Name the bonds that join **A** and **B**. _____ (1)

- 1.4 An incomplete set of graphs illustrating human hormones, the ovarian cycle and endometrium thickness have been drawn on the following page.

Complete the graphs by adding the following information in the spaces provided on the graphs.

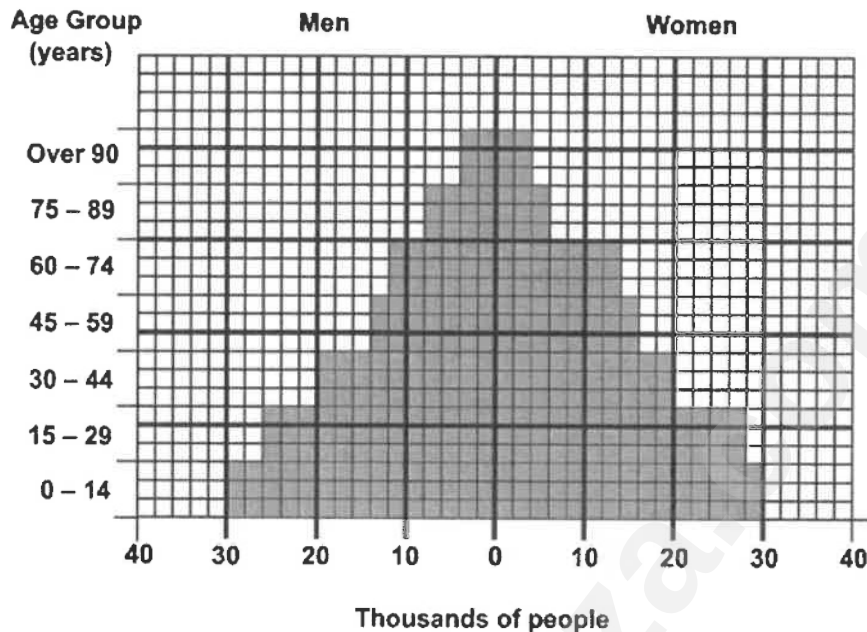
- 1.4.1 Give the **functions** of the hormones A and B. (2)
- 1.4.2 Label the hormones C and D. (2)
- 1.4.3 Draw a diagram of a Graafian follicle; a ruptured Graafian follicle; and a corpus luteum at the correct position on the day line of the ovarian cycle. Name each diagram. (6)
- 1.4.4 Draw in the thickness of the endometrium to show the menstrual cycle. (2)



1.4.5 Define menstruation:

(2)

1.5 The diagram below shows a population pyramid for a small country.



[Givens, P. & Reiss, M. (2002). *Human biology and health studies*]

1.5.1 What is the most likely method used to obtain this population data?

_____ (1)

1.5.2 How many of the population are aged 14 years or younger? _____ (1)

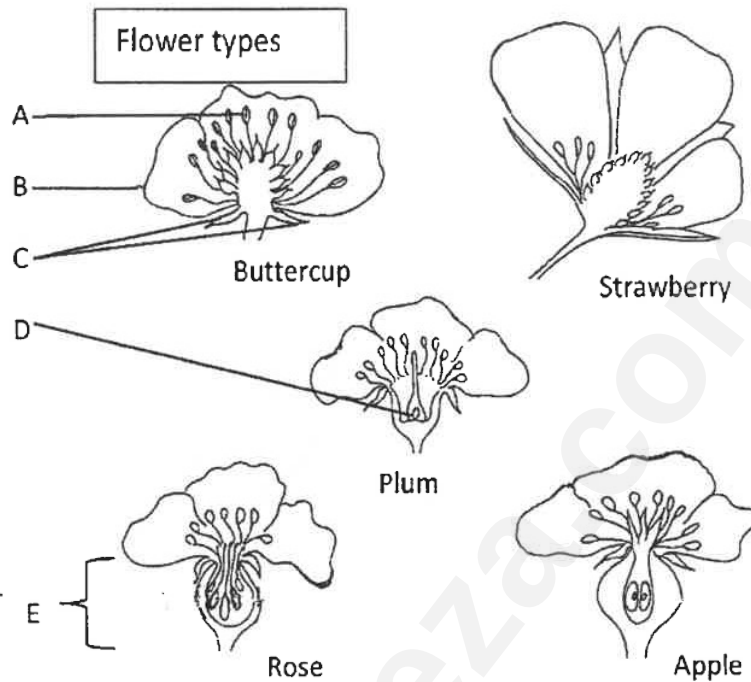
1.5.3 Predict what will happen to the population of the small country over the next 20 years. Use information from the population pyramid to explain the reason for your answer.

_____ (2)

1.5.4 Explain TWO ways in which the population pyramid of a developed first-world country might differ from the pyramid shown above.

_____ (4)

1.6 The diagrams below show different flower types.



1.6.1 Provide labels for the letters A – E

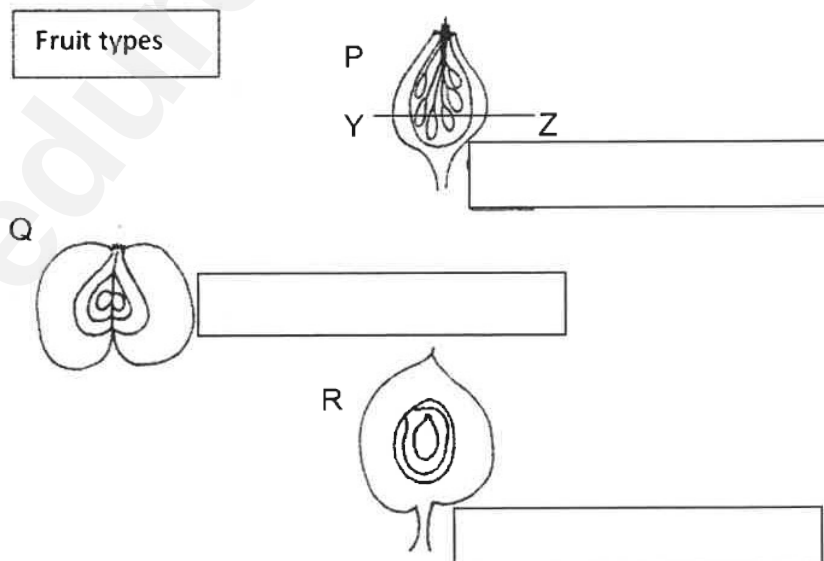
A: _____ B: _____

C: _____ D: _____

E: _____

(5)

1.6.2 The diagrams below show three fruits produced from some of the flowers shown above. Write the names of the flowers in the blocks to indicate which flower produces which fruit.

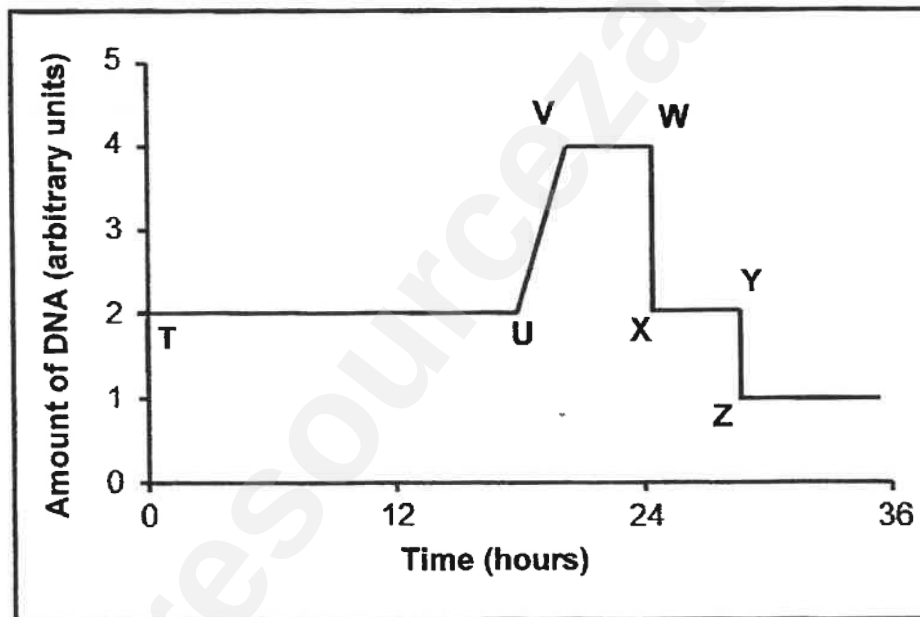


(3)

- 1.6.3 Do a simple sketch to show the appearance of the fruit labelled as Q on the previous page as it would appear if it had been cut in cross section at plane Y to Z rather than in longitudinal section as shown. No heading or scale is necessary. Provide two labels.

(4)

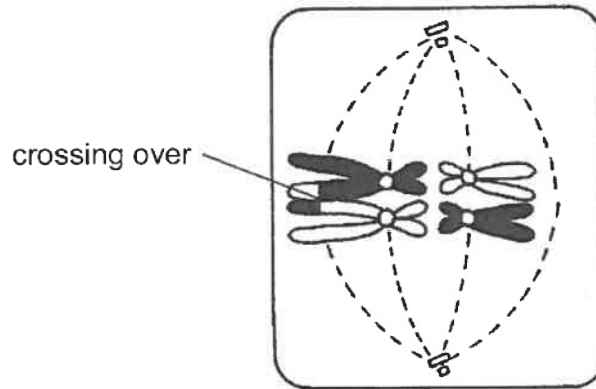
- 1.7 The graph below shows changes in the amount of DNA present in a cell over a period of 36 hours.



[Adapted from www.slideshare.net]

- 1.7.1 Name the stage in the cell cycle represented by the part of the graph labelled T to V: _____ (1)
- 1.7.2 Explain the reason for the shape of the graph between the letters U and V. _____ (1)
- 1.7.2 Between which two letters on the graph will the
- chromosomes be arranged in homologous pairs? _____ (1)
 - chromatids be separating and moving to opposite poles? _____ (1)

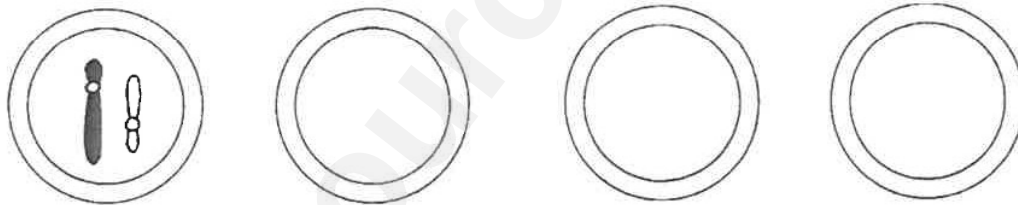
- 1.7.3 In the accompanying diagram of a cell undergoing meiosis, assume that crossing over occurs only as indicated.



- a) Name the stage of meiosis shown in the diagram above.

(1)

- b) The diagram below shows the appearance of one of the gametes formed at the end of meiosis in this cell. Complete the remaining diagrams to show the appearance of the other possible gametes formed.



(6)

[80]



QUESTION 2

Read the information on a coastal bird, the African Black Oystercatcher, and answer the questions that follow.

The African Black Oystercatcher is a black bird with pink legs and feet, a bright orange-red beak and red eyes surrounded by an orange eye ring. The African Black Oystercatcher is near endemic to the coast of southern Africa. It is found along the coast from Angola to Mozambique with breeding places from Namibia to KwaZulu-Natal, South Africa.

An African Black Oystercatcher



[Source: <https://en.wikipedia.org/wiki/African_oystercatcher>]

Their main diet consists of marine organisms, e.g. mussels, limpets, whelks and crustaceans. Rocky coasts have a great variety of food for the birds. They forage exclusively during low tide in the intertidal zones.

Mussels growing on rocks



[Source: <<http://www.open.edu>>]

These birds are monogamous slow breeders. They are territorial during the breeding season which takes place from October to April. Birds will perform 'piping' displays to establish and defend territories and 'butterfly' flights may be used during courtship. Females will lay 1–2 well-camouflaged eggs in sand or rock depressions. Both parents incubate eggs for about 32 days before hatching. The chicks hatch simultaneously and are dependent on the parents for food and shelter. Adults are known to live for 18 years.

These birds roost in flocks of up to 200 individuals during non-breeding season. These large numbers protect them from predators. The African Black Oystercatcher is subject to predation from feral cats, house rats, kelp gulls, genets, foxes, jackals and snakes. Uncontrolled domestic dogs also prey on young chicks. These birds excrete nutrient-rich guano (faeces), which may land in the sea. Algae growing along the shore absorb this nutrient-rich guano. The algae therefore grow and reproduce faster and are consumed by limpets. The limpets also grow and reproduce faster increasing the food available for the African Black Oystercatcher. The role of the African Black Oystercatcher is to control the population of its prey within the marine ecosystem.

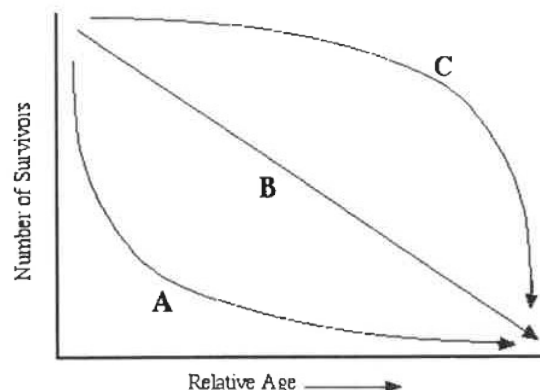
Threats to African Black Oystercatcher populations include human disturbances in the form of recreational cars on beaches, introducing predators at the breeding sites, degradation and destruction of breeding areas through urban developments, coastal diamond mining and pollution.

The global population of the African Black Oystercatcher is 6 670. Due to the small population size of less than 10 000 individuals, the International Union for Conservation of Nature regards the African Black Oystercatcher as "Near Threatened".

The African Black Oystercatcher population is currently stabilising due to improved management plans that were put in place to protect these birds as well as the additional food source in the form of the alien Mediterranean Mussel. This bird has played a vital role in reducing and controlling the population of the alien invasive Mediterranean Mussel within the marine ecosystem, thus reducing competition between the native and alien mussels and increasing the population of native mussels along the coast of South Africa.

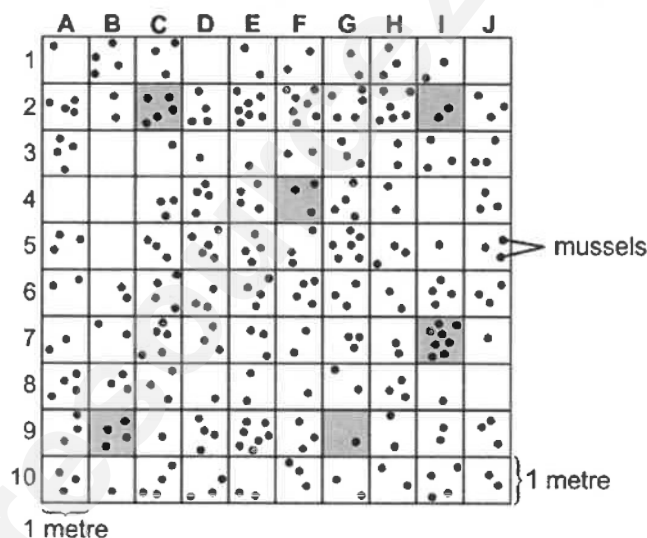
The Oystercatcher Conservation Programme was established to increase the conservation of this species, raise public awareness and get local communities involved in the conservation of these birds. In 2000, a national ban of recreational vehicles along the beaches of South Africa was put in place. This ban reduced the level of disturbance along South Africa's coasts, thus increasing the bird's breeding success and populations along the coastal areas.

- 2.1 Use the text to provide the correct biological term for each of the following descriptions:
- a) an organism unique to a specific region (1)
 - b) having a single sexual partner (1)
 - c) the relationship between domestic dogs and Oystercatcher chicks (1)
- 2.2 Explain why the African Black Oystercatcher is regarded as playing an important role in the ecosystem. (4)
- 2.3.1 Explain the value of each of the following behaviours as a reproductive strategy in the African Black Oystercatcher:
- a) courtship (1)
 - b) territoriality (1)
- 2.3.2 Describe how parental care in these birds increases the chances of survival of the young. (3)
- 2.3.3 Which of the following graphs, A, B or C, would best represent the survivorship curve of the African Black Oystercatcher? (1)



- 2.4 Explain how the roosting behaviour of the African Black Oystercatcher during the non-breeding season can work as a survival strategy. (2)
- 2.5.1 What is the conservation status of the African Black Oystercatcher? (1)
- 2.5.2 List THREE threats posed by humans that influence the survival of the African Black Oystercatcher. (3)
- 2.5.3 Beaches are there to be enjoyed by all for recreation. In your opinion, is it correct to ban humans from beaches where African Black Oystercatcher are found? Give a well-explained reason for your answer. (2)
- 2.5.4 Suggest and explain an alternative way to protect the African Black Oystercatcher other than banning people from breeding sites. (2)
- 2.6 Ecologists wanted to gain an idea of how many invasive alien mussels were growing on the rocks at a breeding site. They marked out an area as seen below and counted the mussels in a number of random samples.

Grid of Invasive Mediterranean Mussel Sampling Area

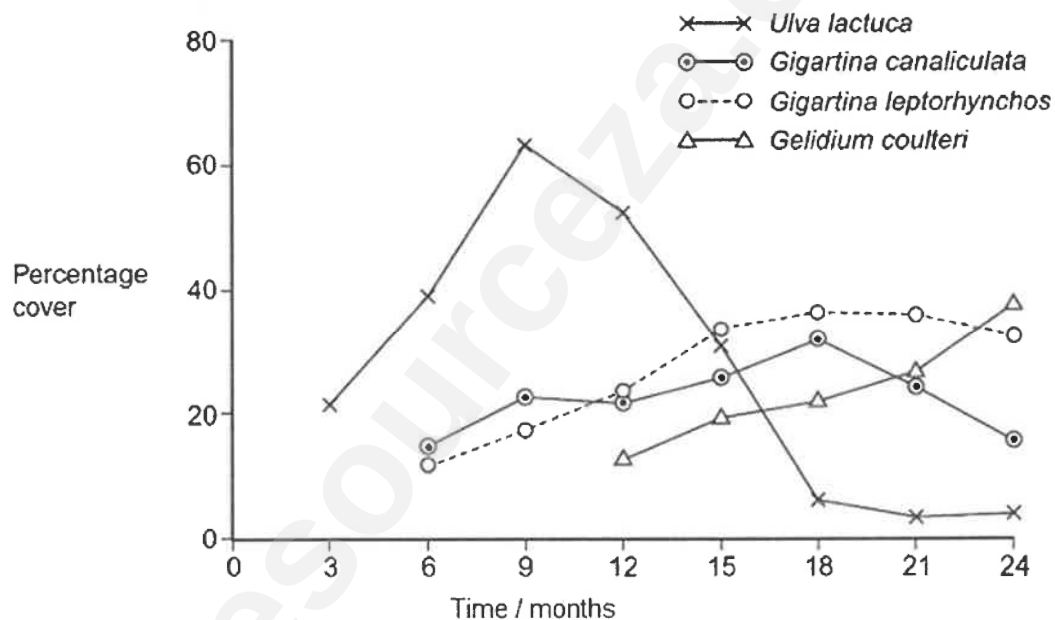


- 2.6.1 Name the type of relationship between the native and the invasive alien mussel species. (2)
- 2.6.2 Why is it important to take random samples in the given area? (2)
- 2.6.3 Areas where quadrats were placed are shaded on the diagram above. Use these quadrats to estimate the number of mussels in the marked-out area. Show all working. (4)
- 2.6.4 Describe ONE other precaution (besides random placement of the quadrats) that was taken to ensure the accuracy of estimating the size of the population. (2)

- 2.6.5 Invasive mussels tend to attach themselves less strongly than the indigenous species. Invasive mussels might suffer a higher mortality rate in sites where it is harder to cling on, for instance where the waves and current are stronger. Already a divide is emerging between the sites where the invasive and native mussels are found. This is caused by both post and pre-settlement factors as well as different growing seasons for the two species.

What ecological concept is illustrated in the example of the two species of mussels that are able to co-exist? (1)

- 2.7 Algae are photosynthesising organisms. Some algae grow on rocky shores. A scientist investigated succession involving different species of algae. He placed concrete blocks on a rocky shore. At regular intervals over 2 years, he recorded the percentage cover of algal species on the blocks. His results are shown in the graph.



- 2.7.1 Name the pioneer species. (1)
- 2.7.2 Some scientists reviewing this investigation were concerned about the validity of the results because of the use of concrete blocks. Suggest **one** reason why these scientists were concerned about using concrete blocks for the growth of algae. (1)
- 2.7.3 Use the results of this investigation to describe and explain the process of succession. (4)

[40]

QUESTION 3

3.1 The table shows some differences between three varieties of banana plant.

	Variety A	Variety B	Variety C
Number of chromosomes in a leaf cell	22	33	44
Growth rate of fruit / cm ³ week ⁻¹	2.9	6.9	7.2
Breaking strength of leaf / arbitrary units	10.8	9.4	7.8

- 3.1.1 How many chromosomes are there in a male gamete from variety C? (1)
- 3.1.2 Variety B cannot produce fertile gametes. Use information in the table to explain why. (2)
- 3.1.3 In some countries very strong winds may occur. Banana growers in these countries choose to grow variety B.
- a) Use the data in the table to explain why banana growers in these countries choose to grow variety B rather than variety A. (1)
- b) Use the data in the table to explain why banana growers in these countries choose to grow variety B rather than variety C. (1)
- 3.1.4 Banana growers can only grow new variety B plants from suckers. Suckers grow from cells at the base of the stem of the parent plant.
- a) Use your knowledge of cell division to explain how growing variety B on a large scale will affect the genetic diversity of bananas. (3)
- b) Young plants produced in this manner can grow very quickly. However there are disadvantages to this method of reproduction as well. Describe one disadvantage and its possible impact on the farmers. (2)

m Q numbers

SCID is a severe inherited disease. People who are affected have no immunity. Doctors carried out a trial using gene therapy to treat children with SCID. The doctors who carried out the trial obtained stem cells from each child's umbilical cord.

Give **two** characteristic features of stem cells. (2)

The doctors mixed the stem cells with viruses. The viruses had been genetically modified to contain alleles of a gene producing full immunity. The doctors then injected this mixture into the child's bone marrow. The viruses that the doctors used had RNA as their genetic material. When these viruses infect cells, they pass their RNA and two viral enzymes into the host cells.

One of the viral enzymes is called *reverse transcriptase*. Use your knowledge of transcription to suggest what the function of this enzyme is.

The other viral enzyme is called integrase. Integrase inserts the DNA copy anywhere in

the DNA of the host cell. It may even insert the DNA copy in one of the host cell's genes.

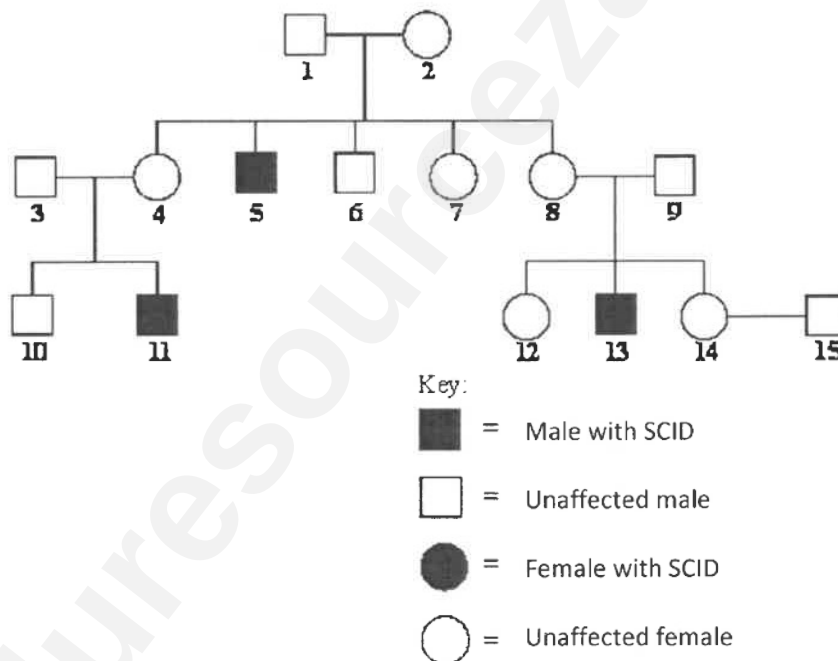
The insertion of the DNA copy in one of the host cell's genes may cause the cell to make a non-functional protein. Explain how. (3)

Some of the children in the trial developed cancer. How might the insertion of the DNA have caused cancer? (1)

Five out of the 20 children in the trial developed cancer. Although the cancer was treated successfully, the doctors decided to stop the trial in its early stages. They then reviewed the situation and decided to continue. Do you agree with their decision to continue? Explain your answer. (3)

A new genome editing tool known as CRISPR/Cas9 has been developed. How is this method of inserting genes superior to using a virus as a vector? (1)

The most common type of SCID is inherited in an X-linked recessive manner. The diagram shows the inheritance of SCID in one family.



- Give evidence from the diagram which suggests that SCID is
- a) sex-linked (1)
 - b) caused by a recessive allele (2)

Using the following symbols,

X^N = an X chromosome carrying the normal allele

X^n = an X chromosome carrying the allele for SCID

Y = a Y chromosome

give **all** the possible genotypes of each of persons 5, 6, 7 & 8 (5)

A blood test shows that person 14 is a carrier of SCID. Person 15 has recently married person 14 but as yet they have had no children. What is the probability that their first child will be a male who has SCID? Show your

working.

(2)

[30]

QUESTION 4

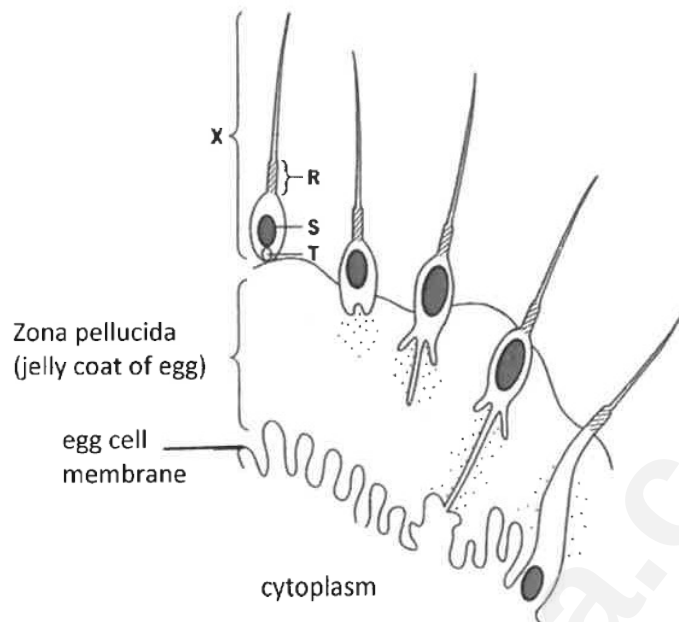
- 4.1 The data below resulted from a study conducted in the USA. Use the data and your knowledge of Life Sciences to answer the questions that follow.

Method of contraception	Effectiveness of method (pregnancies/ 1000 users/ year)
Male sterilisation	3.5
Female sterilisation	6.0
Hormone implant	3.0
Injectable hormones	10.0
Intra-uterine device	3.0
The pill	5.0
The mini-pill	7.0
Condoms	9.0
A diaphragm	15.0
Vaginal spermicides	17.0
Periodic abstinence	20.0
Vaginal sponge	22.0

[Source: *The Economist*]

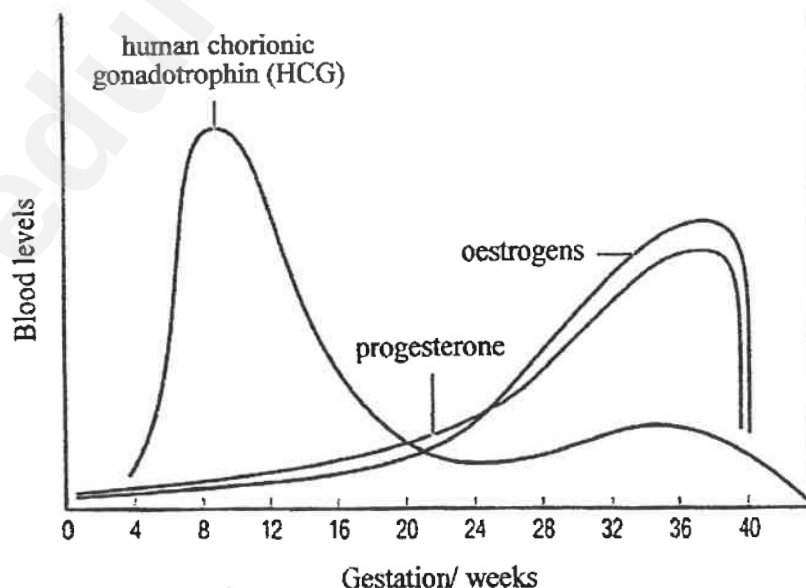
- 4.1.1 Give a heading for the table. (2)
- 4.1.2 What was the independent variable in this study? (1)
- 4.1.3 What type of graph would you draw to make the results easier to read? Give a reason for your answer. (2)
- 4.1.4 Suggest two other variables (factors) that should have been taken into consideration in this study to improve its accuracy. Provide a reason for each of your suggestions. (4)
- 4.1.5 Which was the least effective method of contraception? (1)
- 4.1.6 Choose one of the most successful methods of contraception and explain why you think it was effective. (2)
- 4.1.7 Condoms are not rated as very effective in this study, yet their use is being promoted by the Department of Health in South Africa. Why? (2)

- 4.2 The diagram shows the sequence of events which take place when the nucleus of a sperm enters the cytoplasm of an egg.



- 4.2.1 Name the part of the reproductive tract in which these events take place. (1)
- 4.2.2 Name the organelle found in each of the following structures **and** give the function of these organelles:
- a) **R**
- b) **S** (4)
- 4.2.3 Use the information in the diagram to explain the role of **T** in the process. (3)
- 4.2.4 Name the part of a plant which has the same function as the structure labelled **X** in the diagram. (1)

4.3 The following graph shows the levels of certain hormones in the blood of a human female during pregnancy. Human chorionic gonadotrophin is initially secreted by the cells of a developing embryo. It is also released in the urine of a pregnant mother in significant quantities and can be used as an indicator of pregnancy.

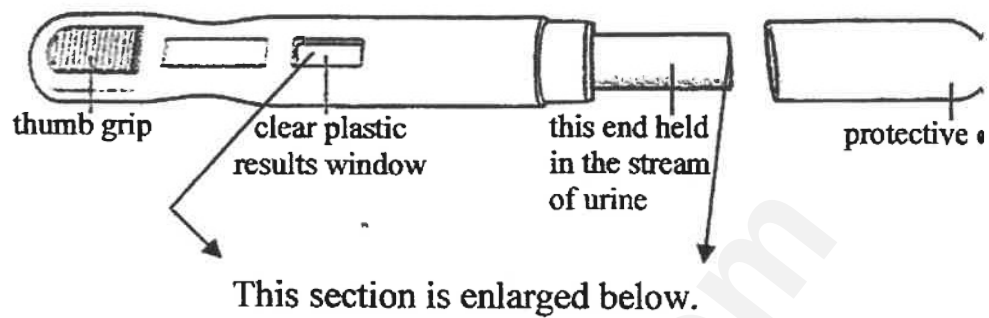


Study the diagrams below showing how a home pregnancy kit is used and answer the questions.

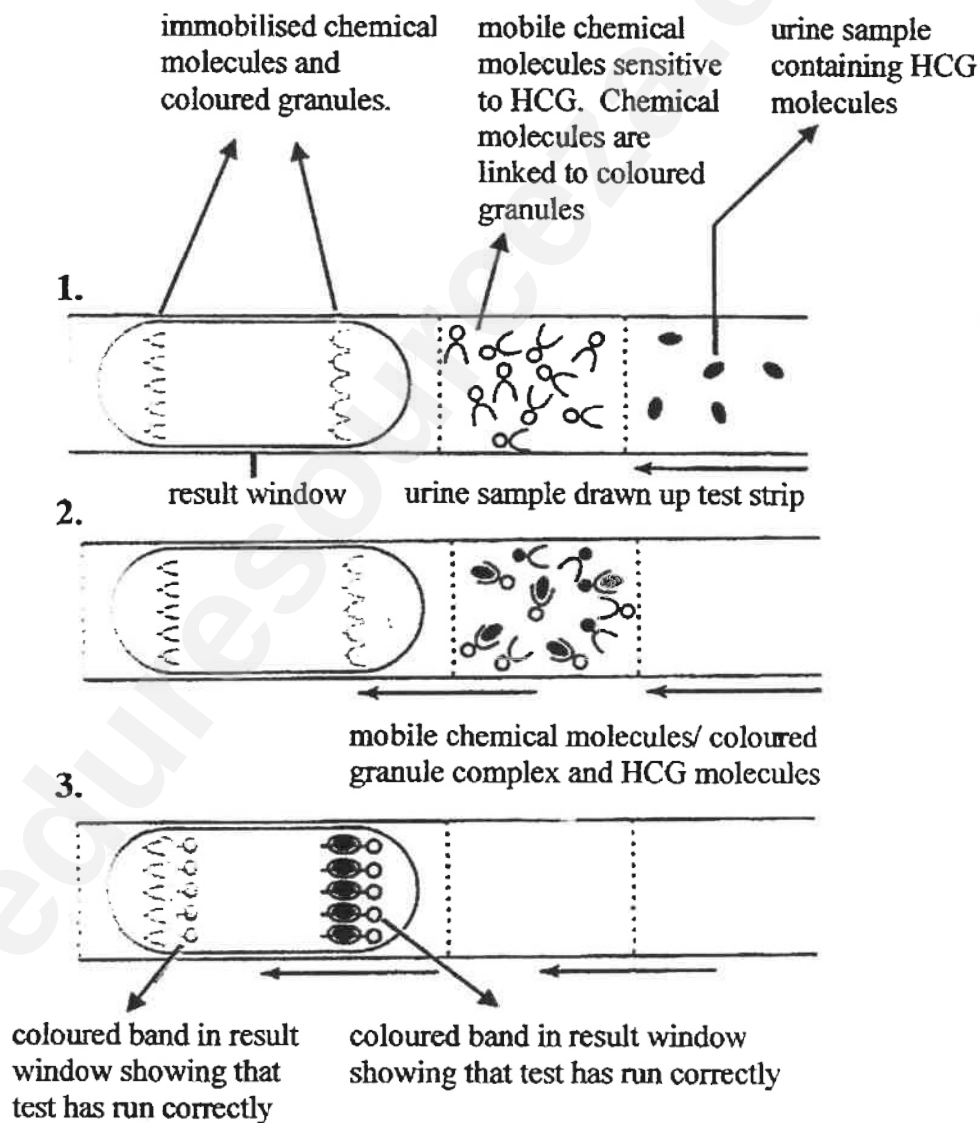
This kit works in the following way. It contains a test strip with tiny coloured granules attached to chemicals that are sensitive to Human chorionic gonadotrophic hormone (HCG). The granules and chemicals can move up this strip. Further up the strip are other chemicals, also sensitive to HCG but immobile. This serves as a check that the kit is active.

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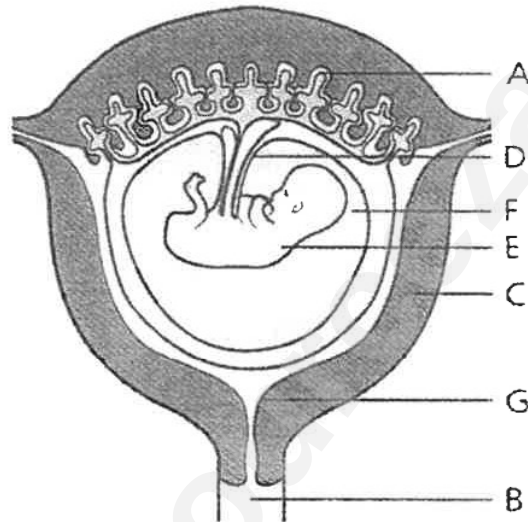
Home pregnancy kit



(A) Urine sample containing HCG hormone molecules



- 4.3.1 a) A six week pregnancy cannot be very accurately confirmed using the test kit. Why? (2)
b) What would be another indicator of pregnancy at this stage? (1)
- 4.3.2 During which week of pregnancy would this test kit give the most accurate results? Explain your answer. (2)
- 4.3.3 This 'home pregnancy test kit' has several features which make it effective to use. Explain three of these. (6)
- 4.4 The diagram below shows a foetus developing in the uterus.



- 4.4.1 Provide labels for B, D and F (3)
- 4.4.2 Describe the significance of structure A in pregnancy (3)

[40]

✓

4.4.3
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What is circumcision? (2)

2.3.2 Assume you are the parent of a newborn baby boy. Your doctor recommends circumcision soon after birth while your isiXhosa culture recommends this is delayed until puberty. Whose advice would you follow? Give a reason for your decision.

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