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**KINGSMEAD  
COLLEGE**

There are 18 pages in this Answer Booklet (i – xviii)

Answer the questions in the spaces provided.

**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**

- [ ] Discovered the molecular structure of DNA
- [ ] Technology used in criminal forensics.
- [ ] DNA that does not provide instructions for making proteins.
- [ ] Used to identify chromosomal abnormalities.
- [ ] A physical or chemical agent that alters genetic material.
- [ ] Unit of hereditary that transmits information from one generation to another.
- [ ] Process used to make many copies of a small section of DNA.
- [ ] Type of sugar molecule found in DNA.
- [ ] Thread-like structures containing DNA.
- [ ] Monomer of nucleic acids.

**Column B**

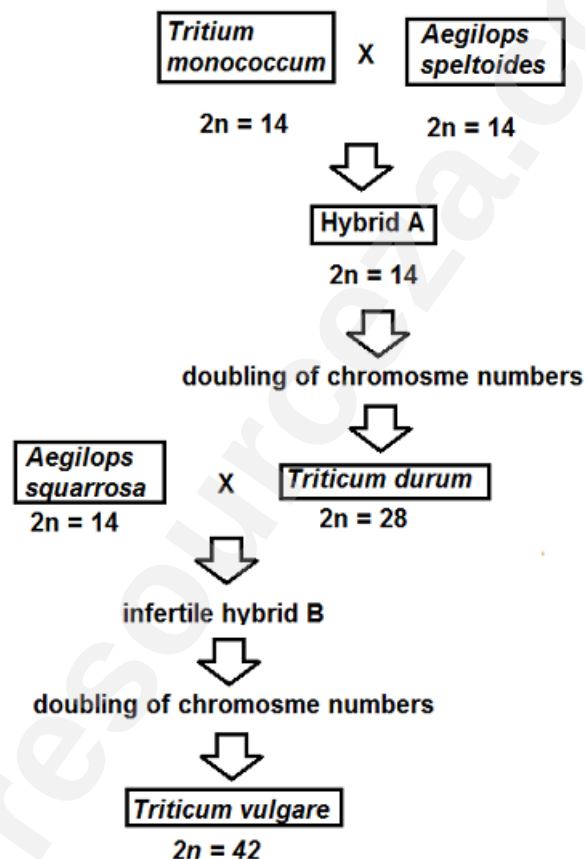
- A Karyotype
- B Mendel
- C Deoxyribose
- D Chromosomes
- E Amino acids
- F Polymerase chain reaction
- G Watson and Crick
- H DNA profiling
- I Gene
- J Noncoding DNA
- K Mutagen
- L Nucleotide

**[10]**

1.2 Various possible options are provided as answers to the following questions.  
Choose the most correct answer and write only the correct corresponding letter  
in the table below:

| 1.2.1 | 1.2.2 | 1.2.3 | 1.2.4 | 1.2.5 | 1.2.6 | 1.2.7 | 1.2.8 | 1.2.9 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       |       |       |       |       |       |       |       |       |

1.2.1 The diagram below shows stages in the evolution of a species of modern wheat (*Triticum vulgare*) through polyploidy.



Which of the following statements is true?

- A. Hybrid A is sterile because it cannot form homologous pairs
- B. The chromosome number of hybrid B is 21
- C. *Triticum vulgare* resulted from a doubling of chromosome numbers of hybrid B
- D. Hybrid A had 28 chromosomes

(1)

1.2.2 Which of the following is an example of courtship?

- A. Female moths produce species-specific pheromones that guide males towards her.
- B. Male malachite sunbird has metallic-green plumage.
- C. Springbok males make loud grunts during the annual rutting season.
- D. All of the above.

(1)

1.2.3 Which of the following is incorrect about testosterone in a human male?

- A. Stimulates the maturation of spermatozoa.
- B. Carries out the process of puberty.
- C. Maintains secondary sexual characteristics.
- D. Is produced by the cells of Sertoli.

(1)

1.2.4 The DNA profiles below were taken from evidence at a crime scene and three possible suspects. Which of the DNA profiles is likely to belong to the criminal?

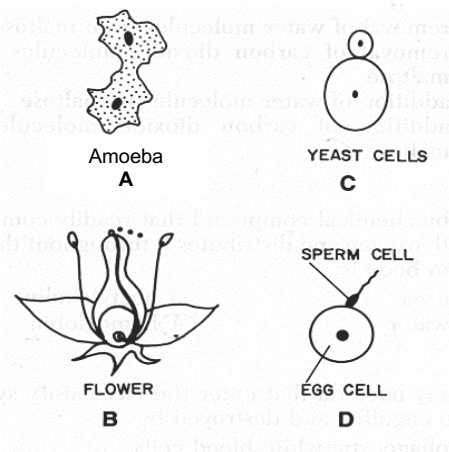


- A. Suspect 1
- B. Suspect 2
- C. Suspect 3
- D. None of the suspects were at the crime scene

(1)

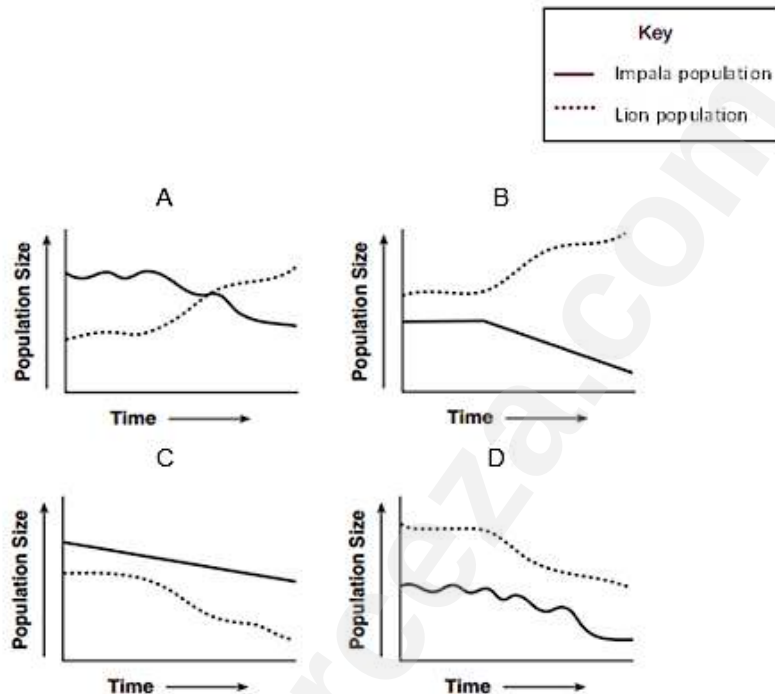
1.2.5 The diagrams alongside represent various processes associated with reproduction. Asexual reproduction is represented by...

- A. A only.
- B. B only.
- C. A and C.
- D. B and D.



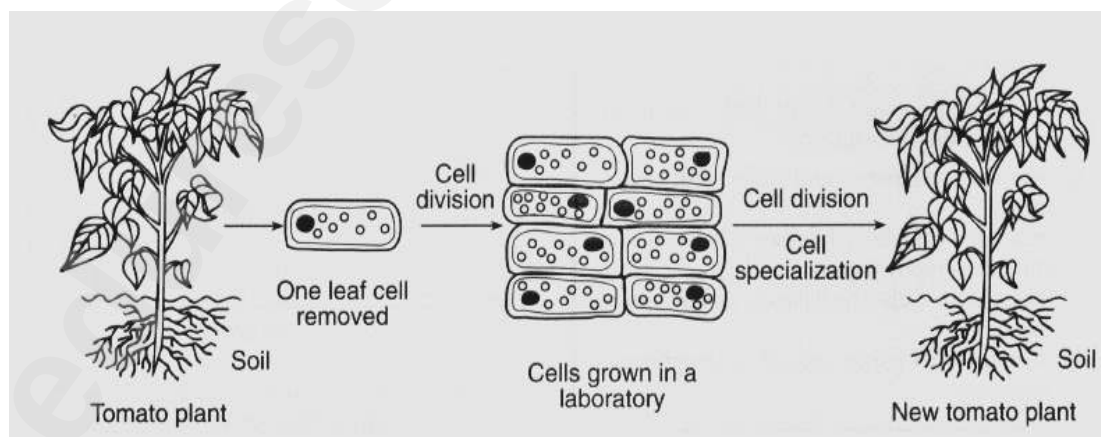
(1)

- 1.2.6 In an ecosystem, impala (buck) make up a large portion of the diet of lions. A fatal disease in the impala population begins to reduce their population over a period of months. Which graph below (A to D) best represents the expected changes in population size of the lion and the impala?



(1)

- 1.2.7 A technique used to produce new plants is represented in the diagram below. Which statement is best supported by the information in the diagram?



- A. The one leaf cell removed formed a zygote that developed into a new plant by mitotic cell division.
- B. This procedure is used to produce new tomato plants that are clones of the original tomato plant.
- C. The cell taken from the leaf produce more cells, each having half of the genetic information of the original leaf cell.
- D. The new tomato plant will not be able to reproduce sexually.

(1)

1.2.8 In which part of the male's body are the Leydig cells located?

- A. Epididymis
- B. Testes
- C. Seminiferous tubules
- D. Seminal vesicles

(1)

1.2.9 The base sequences of a short section of DNA are shown together with mRNA that has been transcribed from it and one end of the tRNA anticodons that can be used to translate the mRNA.

**DNA strand 1** A-C-G-G-C-A-T-T-A-G-C-T-A      **tRNA anticodon** U-U-A  
**DNA strand 2** T-G-C-C-G-T-A-A-T-C-G-A-T      **mRNA** U-G-C-C-G-U-A-A-U-C-G-A-U

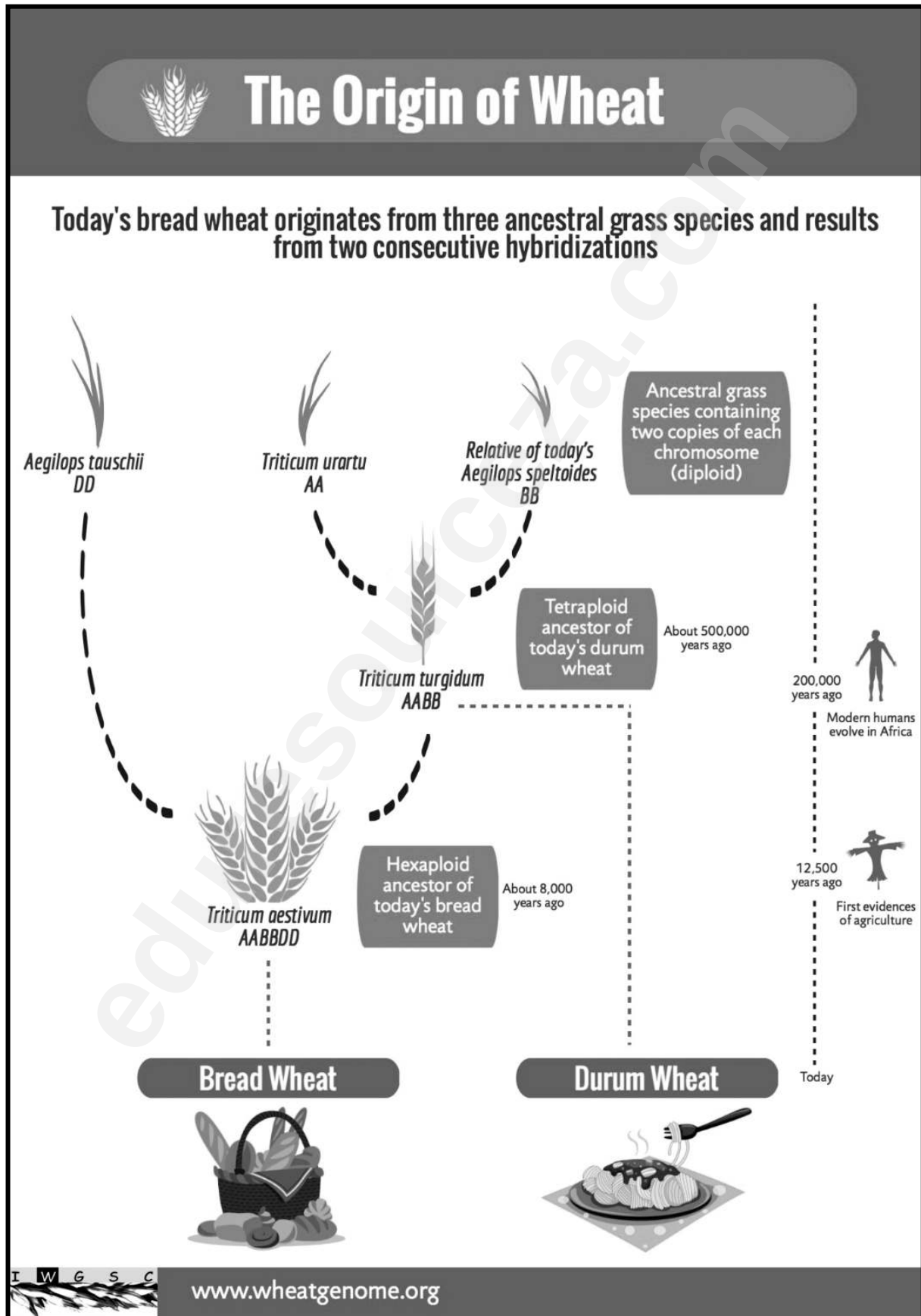
Which strand of DNA is transcribed and to which codon in the mRNA would the tRNA anticodon bind to during translation?

|    | DNA strand transcribed | mRNA codon that tRNA anticodon binds to |
|----|------------------------|-----------------------------------------|
| A. | DNA strand 1           | second                                  |
| B. | DNA strand 2           | second                                  |
| C. | DNA strand 1           | third                                   |
| D. | DNA strand 2           | third                                   |

(2)

[10]

1.3 The following infographic relates to the origin of wheat. Use the information below to answer the questions on the following page.



The five statements in the table below refer to the infographic on the previous page. For each statement, decide whether:

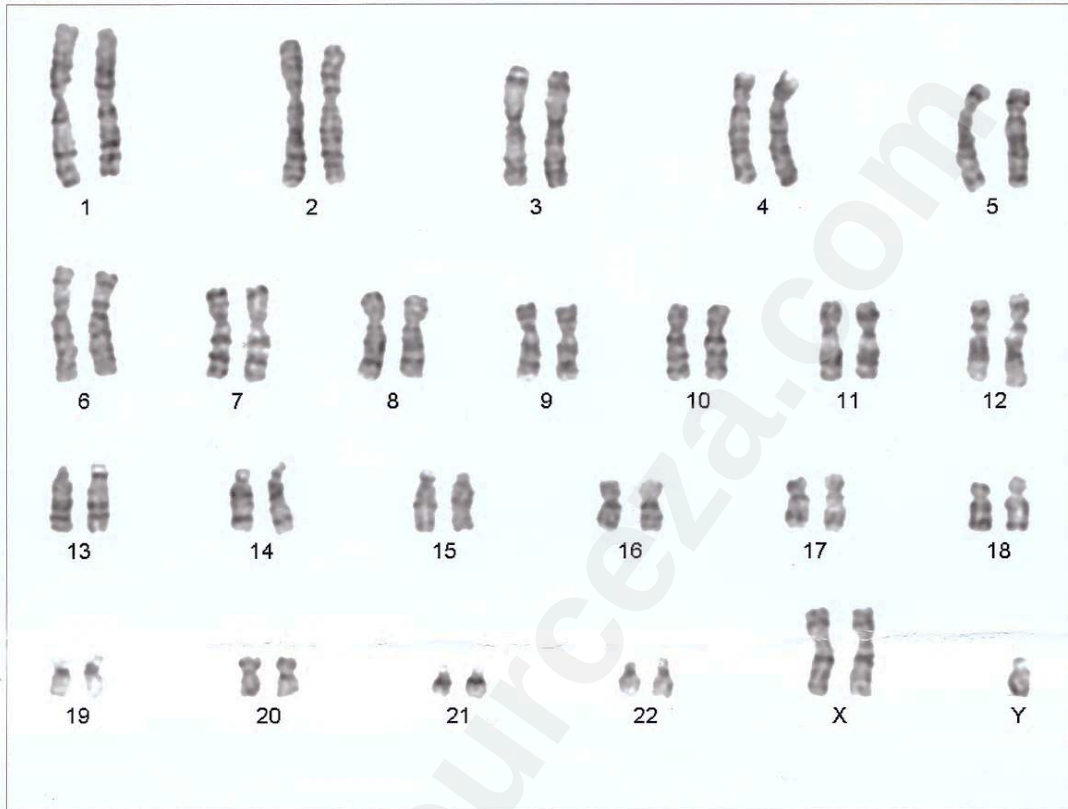
- A the statement is supported by the information in the infographic.
- B the statement is contradicted by the information in the infographic.
- C the statement is neither supported nor contradicted by the information in the infographic.

Write your answer in the space provided in the table below.

|       | Statement                                                                                              | A, B or C |
|-------|--------------------------------------------------------------------------------------------------------|-----------|
| 1.3.1 | The hexaploid ancestor of bread wheat originated before humans were involved in agriculture.           |           |
| 1.3.2 | The modern bread wheat genome is composed of 42 chromosomes.                                           |           |
| 1.3.3 | <i>Triticum turgidum</i> is a hybrid of two grass species.                                             |           |
| 1.3.4 | The ancestral grass species, <i>Aegilops tauschii</i> has two copies of each chromosome, i.e. diploid. |           |
| 1.3.5 | A hexaploid has double the chromosome number of a diploid.                                             |           |

[5]

- 1.4 Mr and Mrs Smith are in their early forties and are expecting a baby. Since they are concerned about their ages, they decide on an amniocentesis to get a sample of foetal cells. In order to get this image shown below, the chromosomes from the foetal cells are isolated, stained, and examined under the microscope.



[Source:< <https://ghr.nlm.nih.gov/condition>>]

- 1.4.1 During which stage of the cell cycle is this image likely to be taken?

\_\_\_\_\_ (1)

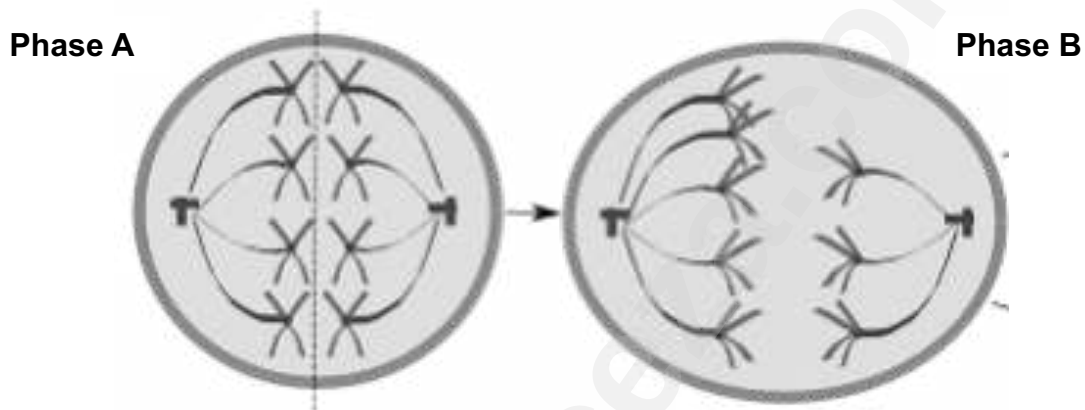
- 1.4.2 Does the foetus have the normal number of chromosomes? Explain your answer.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

- 1.4.3 If Mrs Smith's ovum had a chromosome complement of  $22 + X$ , what was the chromosome complement of her husband's sperm cell which formed this particular child's zygote?

(2)

- 1.4.4 It was confirmed that an 'error' occurred during the formation of some of Mr Smith's sperm cells (meiosis). This 'error' is shown in the diagram below.



[Source:< <https://study.com/academy/lesson>>]

- a) Is the cell shown in phase B haploid or diploid?

(1)

- b) Explain how the error shown above resulted in the formation of Mr Smith's abnormal sperm cell.

(2)

- 1.4.5 Using the cell in phase B as the parent cell, draw ONE of the daughter cells (gametes) as it would appear after Telophase II of this meiotic division. Provide a suitable heading and 2 labels ONLY. The chromosomes must be very clearly visible. Use the space provided below.



(6)

[14]

- 1.5 Cormorant and shag are two similar looking closely related species of bird belonging to the genus *Phalacrocorax*. They are both black, reptilian-like, fish eating water birds that swim low on the water with their heads tilted up towards the sky. Both are diving birds and when resting can be found sitting upright on rocks in their familiar spread-eagle pose. In Scotland, shags and cormorants both nest near each other on the same cliffs and feed in the same part of the ocean.



The table below shows the main components of each bird's diet.

| Prey       | Percentage composition of diet               |                                             |
|------------|----------------------------------------------|---------------------------------------------|
|            | Shag<br>( <i>Phalacrocorax aristotelis</i> ) | Cormorant<br>( <i>Phalacrocorax carbo</i> ) |
| sand eels  | 33                                           | 0                                           |
| sprats     | 49                                           | 1                                           |
| flatfish   | 1                                            | 26                                          |
| shrimps    | 2                                            | 33                                          |
| gobies     | 4                                            | 17                                          |
| other fish | 4                                            | 18                                          |

Adapted from <https://scottishwildlifetrust.org.uk/2016/11/cormorant-and-shag> and SQA 2016

- 1.5.1 Name the phenomenon illustrated in table 1 that reduces competition between the cormorant and shag.

\_\_\_\_\_ (1)

- 1.5.2 Do the cormorant and shag occupy the same ecological niche? Explain your answer using data from the table above.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

- 1.5.3 Scientists wanted to determine the number of cormorants just before breeding season that nested on a particularly steep cliff off the coast of Scotland. 50 cormorants were caught in the first sample and tagged with a leg ring. Three weeks later 60 cormorants were caught of which 15 had the leg ring.

Calculate the estimated population size of the cormorants on this cliff. Show all your calculations.

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(4)

- 1.5.4 Describe **one** precaution that needs to be taken for the mark-recapture method to work with some accuracy.

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(2)

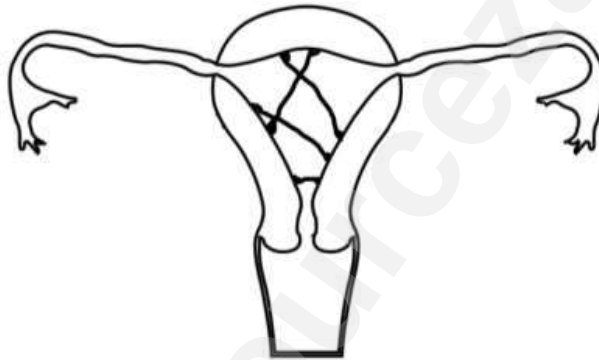
[9]

1.6. Read the article below and answer the questions that follow.

### Asherman syndrome

Asherman syndrome affects a significant number of women who have had a dilation and curettage (D&C). A D&C is a surgical procedure that involves widening the cervix and removing the tissue lining of the uterus, usually after the termination of a pregnancy or a miscarriage. Damage to the inner wall of the uterus leads to adhesions (scar tissue) that cause the tissues to stick together and this can block the cervix. It reduces menstrual flow or stops periods altogether and could cause infertility if the adhesions are not removed.

Diagram showing female reproductive organs with Asherman syndrome



Adapted: <<http://www.totalhealth.co.uk>>]

1.6.1 Label the vagina, cervix and fallopian tubes on the diagram above. (3)

1.6.2 Draw and label the ovaries on the diagram above. (2)

1.6.3 Provide the correct biological term for the lining of the uterus. (1)

\_\_\_\_\_

1.6.4. Explain ONE reason why Asherman syndrome could lead to infertility in women. (2)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1.6.5. Would a woman with Asherman syndrome still be able to ovulate? Justify your answer.

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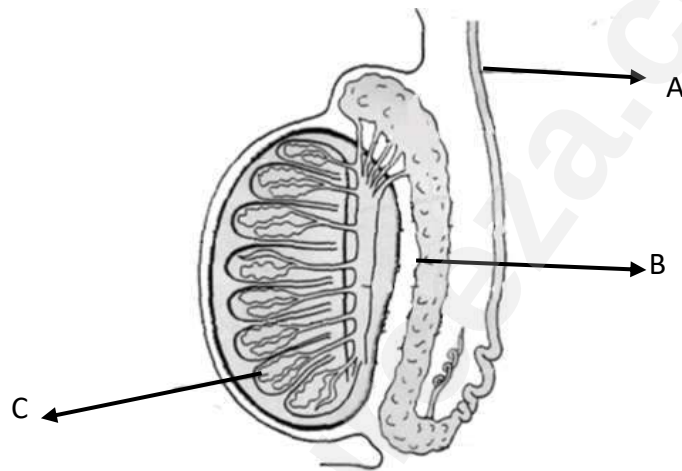


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(2)

[10]

1.7 The diagram below shows the testis of a mammal.



[Adapted: <<https://www.researchgate.net>>]

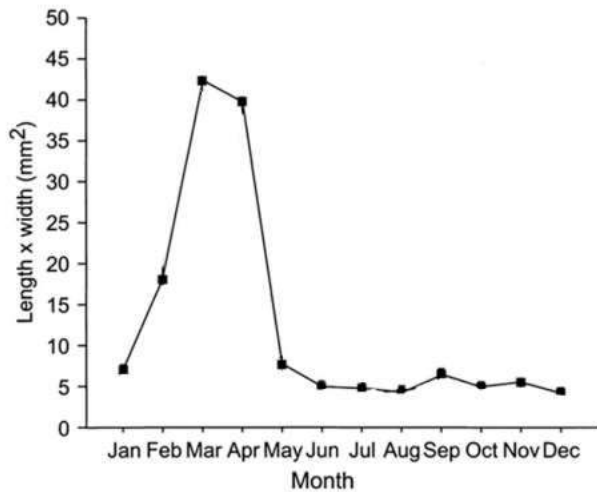
1.7.1 Complete the table below by filling in the name of structures A, B and C and the corresponding function of each structure.

|   | Name of structure | Function |
|---|-------------------|----------|
| A |                   |          |
| B |                   |          |
| C |                   |          |

(6)

- 1.7.2 The graph below shows the size of the prostate gland in a male bat over a period of a year. The function of the prostate gland is similar in both bats and humans.

**Graph showing the size of the prostate gland of a male bat over a period of one year**



[Adapted: <<https://academic.oup.com>>]

- a. What is the function of the prostate gland?

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(1)

- b. What is the size of the prostate gland during the month of October?

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(1)

- c. Use data from the graph to suggest the months when the breeding season of bats occurs.

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(2)

- d. Explain how you got to your answer in question 1.7.2 c.

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(2)

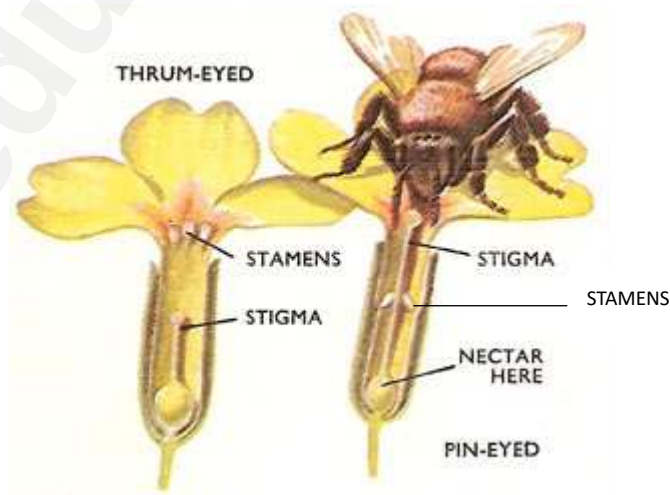
- 1.7.3 Make an **annotated** biological drawing of the gamete that is produced at the part labelled C in Diagram in question 1.7. You must include only **TWO** appropriate annotations.

(6)



[18]

- 1.8 The diagrams below show two different types of primrose flowers; thrum-eyed and pin-eyed. The flower on the right shows a flower being pollinated by an insect.



1.8.1 Name **one** feature of the flower that is likely to attract insects?

\_\_\_\_\_ (1)

1.8.2 Suggest **one** advantage of flowering plants using insects rather than wind for pollination.

\_\_\_\_\_  
\_\_\_\_\_ (1)

1.8.3 Discuss how flowering plants ensure genetic variation during pollination.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**[4]**

**Total: 80 marks**

[illegible]

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