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LIFE SCIENCES: PAPER I

EXAMINATION NUMBER

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ANSWER BOOKLET

QUESTION 1

- 1.1 Select the term in Column B which best matches the description in Column A. Write the letter of the matching term in the appropriate space provided between the brackets. Each letter may only be used once.

COLUMN A

COLUMN B

- | | | |
|-------|--|----------------------|
| [H] | The genetic makeup of an organism | A. Phenotype |
| [F] | When the number of chromosomes in all body cells of a human occur in pairs. | B. Homozygous |
| [G] | The scientist/s who was/were awarded a Nobel prize for discovering the structure of DNA. | C. Gene |
| [A] | The observable characteristics of an organism. | D. Heterozygous |
| [I] | The crossing over points of chromosomes during meiosis. | E. Homologous |
| [D] | Possessing unlike alleles for a particular trait. | F. Diploid |
| [C] | A unit of heredity composed of DNA. | G. Watson and Crick |
| [K] | A structure joining two chromatids of a chromosome after DNA replication. | H. Genotype |
| [E] | Pairs of chromosomes at the start of meiosis. | I. Chiasmata |
| [L] | One of the two longitudinal sub-units of duplicated chromosome | J. Rosalind Franklin |
| | | K. Centromere |
| | | L. Chromatid |
| | | M. Haploid |

(10)

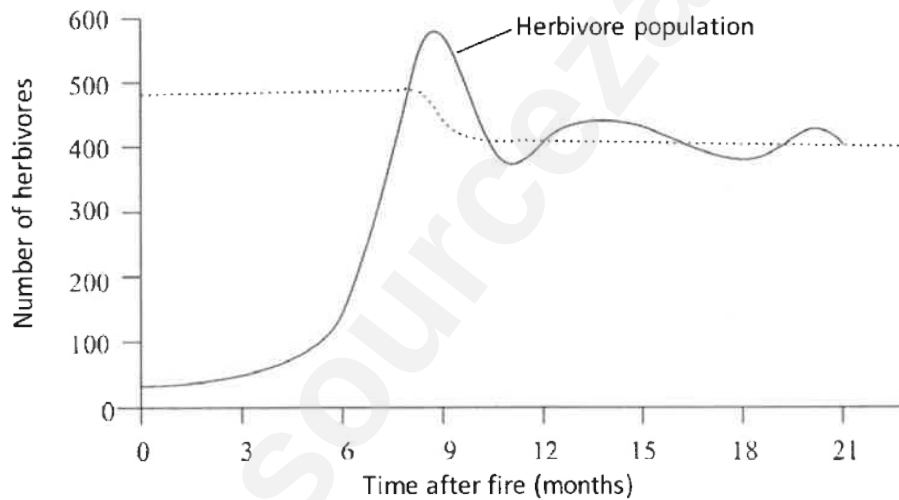
- 1.2 Ten multiple choice questions are given below. Choose the most correct alternative in each question and write only the letter of the most correct answer in the space provided in the table.

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	1.2.10
C	B	A	D	C	C	A	B	C	C

- 1.2.1 A population is defined as ...

- 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

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

- 1.2.3 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.

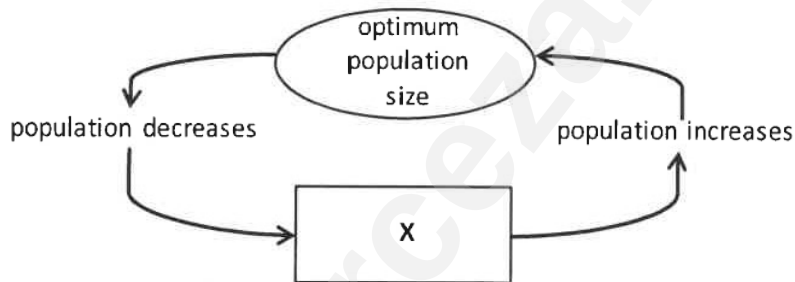
1.2.4 A density-independent factor which could affect the size of the herbivore population is ...

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

1.2.5 What does the dotted line on the graph represent?

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

1.2.6 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

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.

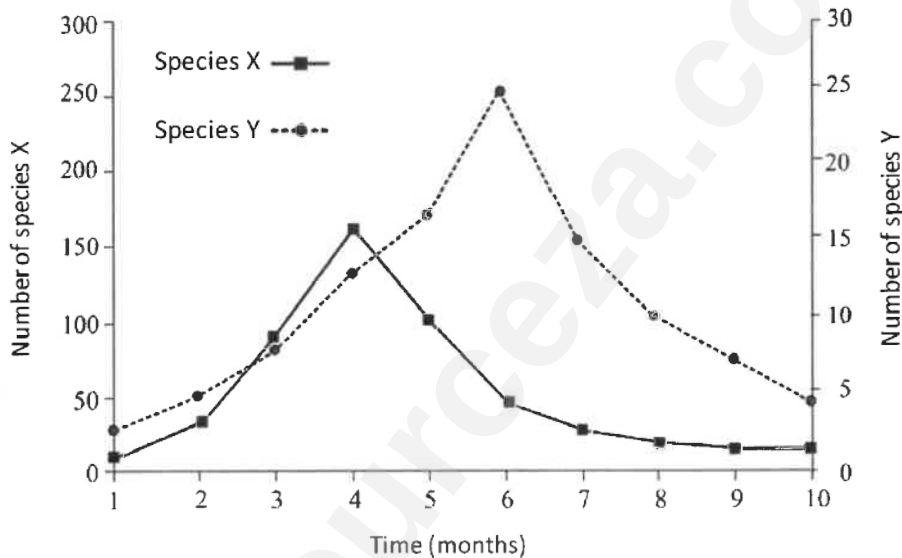
1.2.7 What was the estimated size of the beetle population?

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

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.

1.2.9 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.

1.2.10 Assuming that the emigration 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

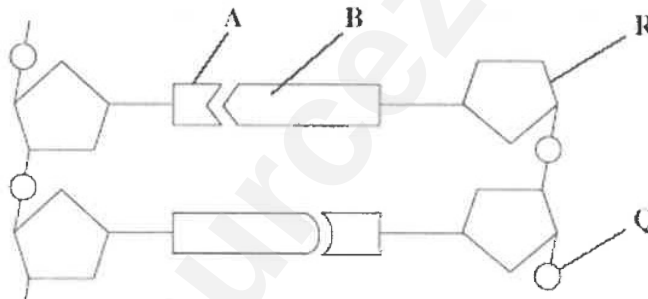
(10)

- 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	T ✓		
Proteins are synthesised from amino acids in association with the mitochondria of cells.	F ✓	mitochondria ✓	ribosomes ✓
RNA differs from DNA in that uracil replaces the base adenine.	F ✓	adenine ✓	thymine ✓
Translation is the process by which DNA makes mRNA	F ✓	translation ✓	transcription ✓

(10)

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

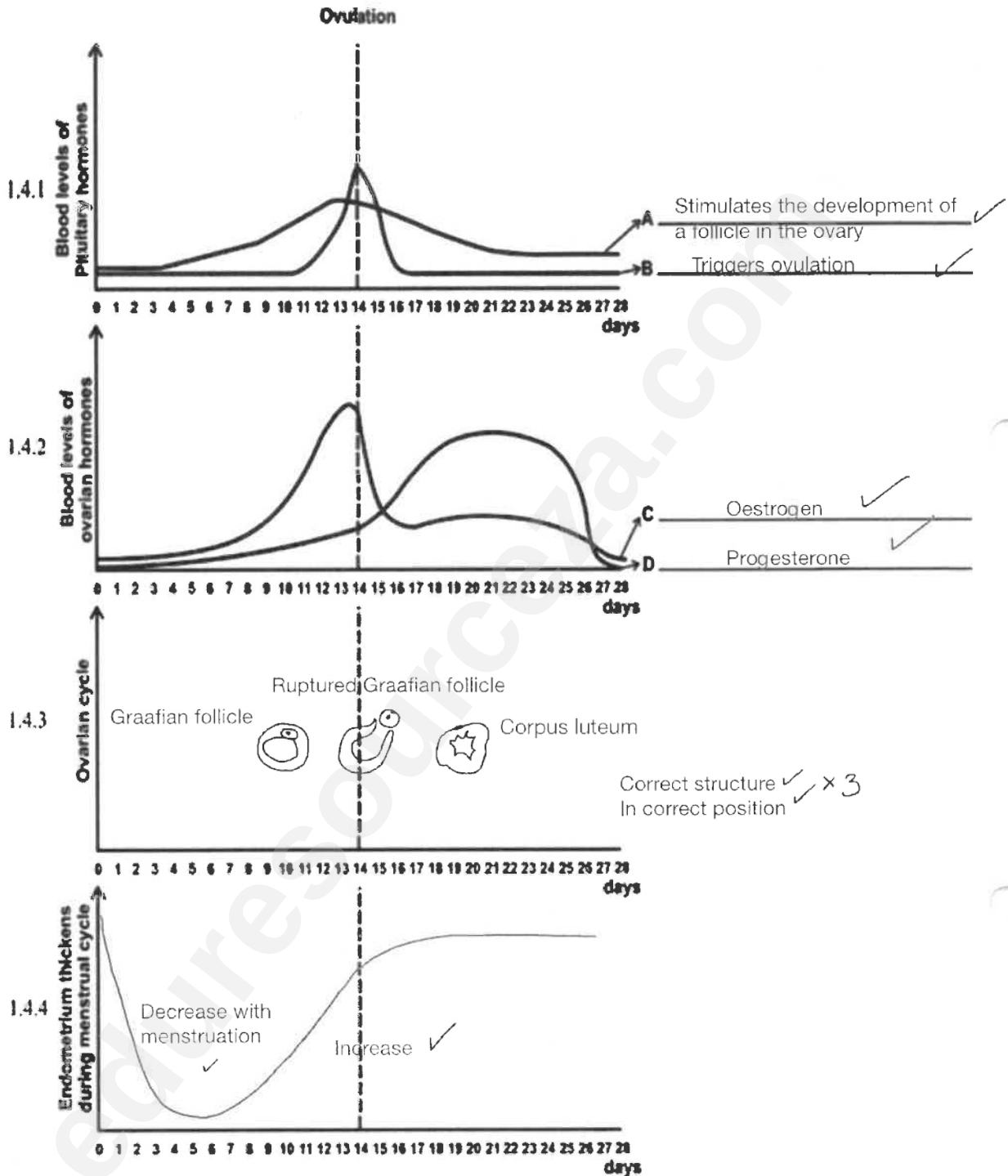


- a) Name parts R: Deoxyribose sugar ✓
and Q: Phosphate ✓ (2)
- b) Name the bonds that join A and B. Hydrogen ✓ (1)

- 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 a 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)

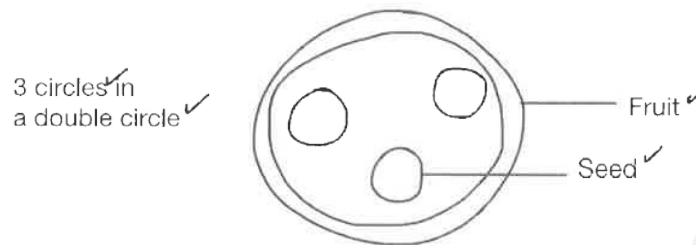


1.4.5 Define menstruation:

Periodic shedding of the endometrium through the vagina

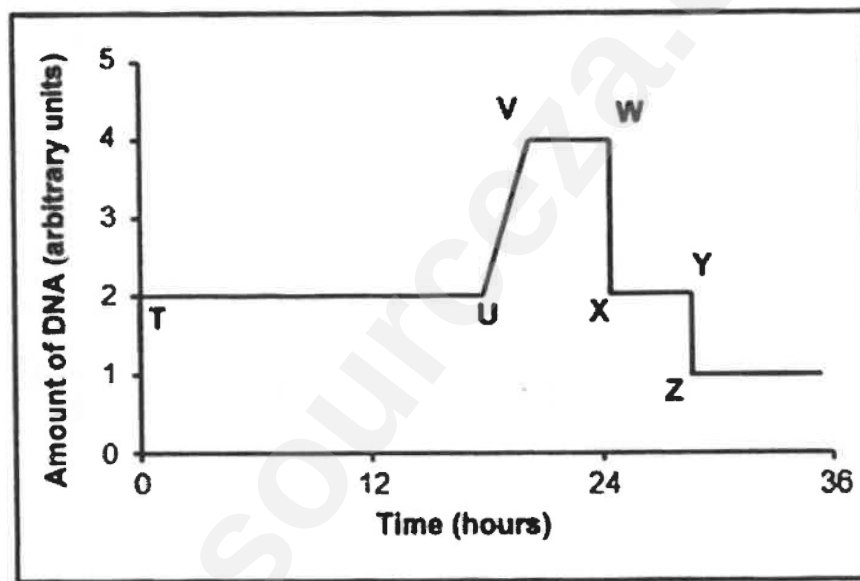
(2)

- 1.6.2 Do a simple sketch to show the appearance of the structure labelled as Q on the previous page as it would appear in cross section at plane Y to Z. 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: Interphase

(1)

- 1.7.2 Explain the reason for the shape of the graph between the letters U and V.

DNA is replicating / being copied

(1)

- 1.7.2 Between which two letters on the graph will the

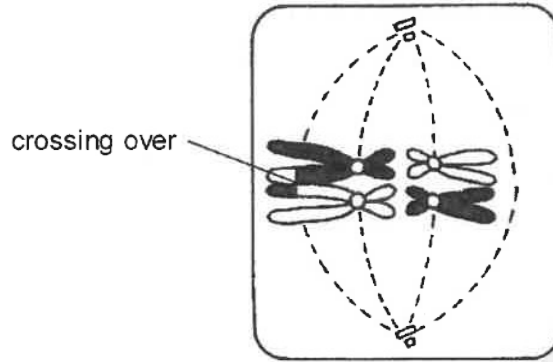
a) chromosomes be arranged in homologous pairs? V to W

(1)

b) chromatids be separating and moving to opposite poles? Y to Z

(1)

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

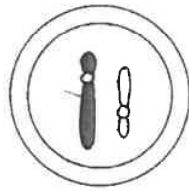


- a) Name the stage of meiosis shown in the diagram above.

Metaphase I ✓

(4)
(2)

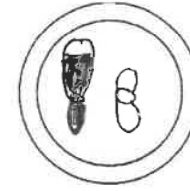
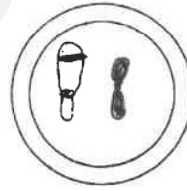
- b) The diagram below shows the appearance of one of the gametes formed at the end of meiosis in this cell. Complete the remaining diagrams to show the appearance of the other possible gametes formed.



One long light and
one short shaded
chromosome



Long light with dark tip
chromosome paired with
short shaded chromosome



(6)

[80]

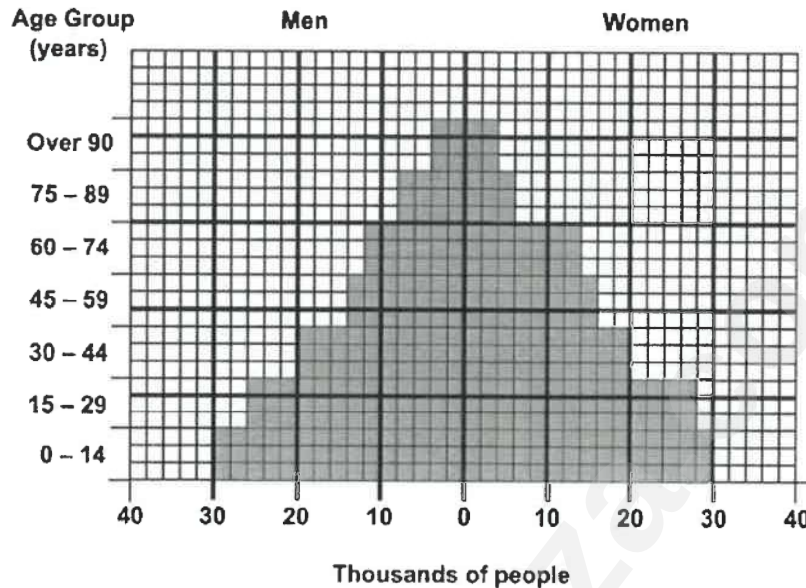
Long dark chromosome
with light tip and
light short chromosome

2 chromatids per daughter cell ✓

One short one long ✓

Shading in each daughter cell correct ✓✓✓

- 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)

Census ✓

- 1.5.2 How many of the population are aged ^{14 years or younger} ~~75 years or older~~? 60 000 ✓ (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.

Grow rapidly ✓ due to large numbers / proportion of people reaching reproductive age ✓

- 1.5.4 Explain TWO ways in which the population pyramid of a developed first-world country might differ from the pyramid shown above. (2)

Fewer individuals in lower age categories ✓

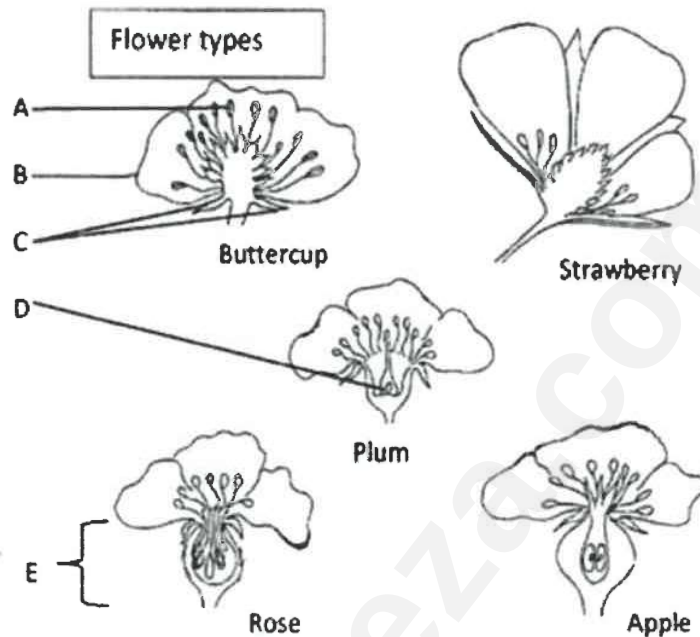
as people choose to have fewer children due to better education / access to family planning ✓

More people in older categories due to longer life expectancy ✓

as a result of better medical care ✓

+ shape becomes more rectangular

1.6 The diagrams below show different flower types.

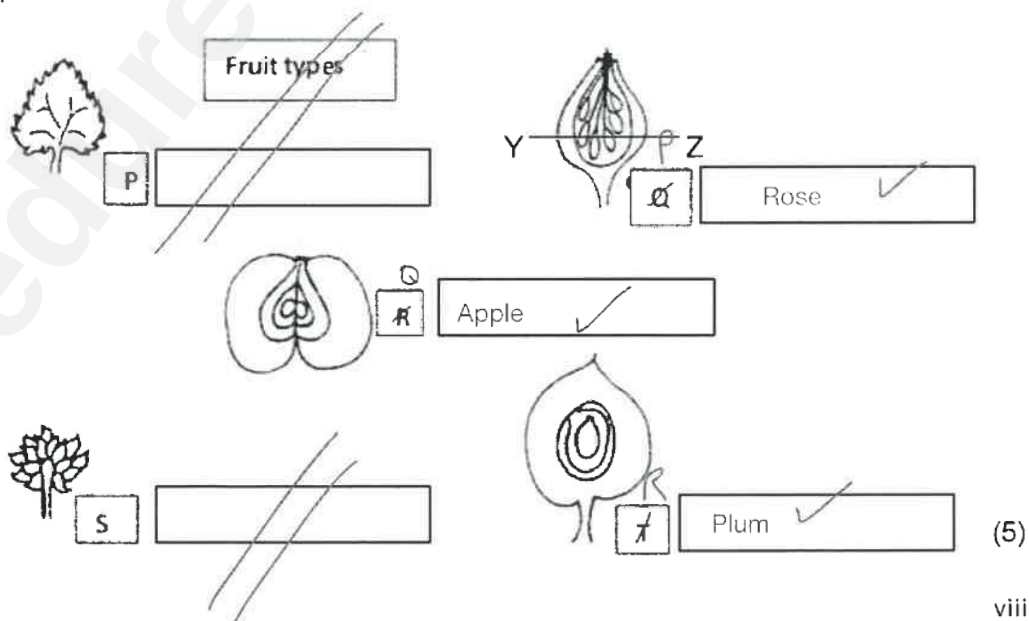


1.6.1 Provide labels for the letters A – E

A: Anther ✓
 C: Sepals ✓
 E: Ovary ✓

B: Petal ✓
 D: Ovule / egg ✓ / ovary ✓ / ovum ✓
 (5)

1.6.2 The diagrams below show five fruits produced from the flowers shown above. Match the letters to the names of the flowers to indicate which flower produces which fruit.



LIFE SCIENCES PAPER I
PRELIM
MEMO

QUESTION 2

- ③ 2.1 a) endemic✓ *indigenous, native*
b) monogamous✓
c) predation / predator-prey✓
- ④ 2.2 they produce nutrient-rich guano ✓ which stimulates algal growth✓, which in turn provides food for limpets, increasing the population ✓ which are food for oyster catchers
they control the population of their prey✓, reducing population of invasive mussel species and allowing native mussel population to increase✓ (max 4)
- ① 2.3.1 a) courtship: strengthens pair bond✓ (also accept more general purpose of courtship behaviour e.g. selection of fittest mate / ensures species specific mate / ensure sexual readiness of mate *cannot just say find a "suitable" mate – what is a suitable mate?*
b) territoriality: ensures they get the best breeding sites✓ / exclusive use of resources such as food for rearing young.
NB territoriality relates to intraspecific competition and is NOT for protection against predators
- ③ 2.3.2 incubate the eggs,✓ protect eggs and chicks from predators, ✓ feed the young✓
laying camouflaged eggs is a reproductive strategy but NOT an example of parental care – parental care refers to behaviours that improve survival of offspring
- ① 2.3.3 C✓
- ② 2.4 by gathering in large groups it can confuse the predator, making it hard to single out an individual to attack, ✓ also reduces each individual's chance of being eaten ✓ and there are more eyes to spot and to warn of predators✓ (max 2) *Many pupils simply repeated the question, stating that birds flock together in groups of up to 200 to protect against predators without explaining how flocking protects against predators.*
- ① 2.5.1 "Near threatened"✓
- ③ 2.5.2 urban development destroys breeding habitat
pollution
vehicles on beaches
introduction of predators (any 3)
Cannot just say habitat destruction – must list factors that result in habitat destruction
- ② 2.5.3 Yes: must protect African Black Oystercatcher as it is a threatened species/ could become extinct if breeding sites are not protected ✓ / species important in coastal ecology ✓ OR
No: population is stable✓ it is not practical to ban people from all beaches along such a long coastal stretch ✓ it is not the actual presence of humans that cause the problems but associated activities✓
Some pupils answered "NO" and then listed alternatives rather than addressing why people should not be banned.
- ② 2.5.4 educate public ✓ about importance of oystercatcher leaving nests/breeding sites alone✓
implement regulations ✓ around how the beach is used, e.g. banning vehicles and dogs✓

- ② 2.6.1 interspecific✓ competition✓
- ② 2.6.2 so that sample is representative ✓ in case distribution is not even ✓
- ④ 2.6.3 Total 6 quadrats = $5 + 2 + 3 + 4 + 8 + 1 = 23$ ✓
 Ave per quadrat = $23 \div 6 = 3,83$ ✓
 Multiplied by total area = $3,83 \times 100$ ✓
 = 383✓
 Do not round off until final answer
- ② 2.6.4 large number of quadrats ✓ sampled and averaged✓ same quadrant size used
- ①② 2.6.5 ecological niche✓ not resource partitioning unless you can specify what resource is being partitioned and how. Resource use in one aspect of an organism's niche.
- ① 2.7.1 2.8.1 *Ulva lactuca*✓
- ① 2.7.2 2.8.2 Algae would normally grow on rock, concrete may have different texture, is flat or any feature referred to explain that this would not mimic algae's natural growth ✓ not natural
- ④ 2.7.3 2.8.3 Pioneer species / *Ulva* establishes itself and increases ✓
 Principle of a species changing the conditions / a species makes the conditions less hostile; ✓/
 description of how it changes conditions e.g. creates suitable substrate for other species to grow
 New / named species better competitor increases ✓
 previous / named / pioneer species outcompeted; ✓ declines

[40]

QUESTION 3

- ① 3.1.1 22✓
- ② 3.1.2 Odd number of chromosomes / 33 chromosomes (in leaf cell); Chromosomes cannot pair ✓ cannot undergo meiosis / cannot form haploid✓
- ① 3.1.3 a) Faster fruit growth / produces crop fast✓
 ① b) Leaves less likely to break / higher breaking strength;✓
- ③ 3.1.4 a) Low genetic diversity / no genetic variation✓ because they are produced by mitosis; ✓ will all have the same DNA / genes / alleles / will be genetically identical / will be clones; ✓
 ② b) Because they are all clones, all plants will be equally susceptible to pest / disease✓ therefore farmer could lose entire crop ✓
- 3.2.1 To increase amount of DNA / only small amount present in faeces✓
- 3.2.2 Taking samples from animals causes stress / injury to animal; ✓
 Difficult to find animals; ✓ Pandas are dangerous / threat to human ✓ (max 2)
- 3.2.3 All bands in cub which don't come from mother; ✓
 Must be in father's DNA fingerprint; ✓
- 3.2.4 Select pandas with dissimilar DNA fingerprints to breed✓
- ② 3.1.5 • capable of dividing and renewing for long periods
 • give rise to specialized cells
 • they are unspecialized.

3.3.1 Will replace themselves / keep dividing / replicate ✓
Undifferentiated / can differentiate / develop into any type of cells ✓

③ 3.1.6 ~~3.3.2~~ Uses RNA as a template to create DNA strand (DNA from RNA ✓; concept of template or base-pairing ✓)

③ 3.1.7 ~~3.3.3~~ Alters base / nucleotide sequence / causes frame shift; ✓
Different sequence of amino acids in polypeptide / protein ✓
alters the protein structure require for it to function ✓

① 3.1.8 ~~3.3.4~~ disrupts DNA in such a way that cells divide uncontrollably ✓

→ non functional protein
malignant growth

3.3.5 Yes:

③ 3.1.9 a) ~~3.3.6~~ SCID patients unlikely to survive / quality of life poor unless treated; ✓
Cancer that develops is treatable ✓
only affects 25% / five children; ✓

No:

Risk of developing cancer is high / 25%; ✓

Cancer may recur / may not be treated successfully in future ✓

only short time scale so more may develop cancer; ✓

No mark for yes or no. Marks are for supporting argument based on biological reasoning.

Accept any points

① ③ 3.1.9 b) ~~3.3.6~~ Allows gene to be inserted at very specific location ✓ in genome accurate

④ 3.1.10 ~~3.3.7~~ a) only males are affected ✓
b) males (5,11,13) are affected even though neither parent / mother is affected ✓

= small percentage

~~3.3.8~~ 5: X^nY ✓

3.1.11 6: X^nY ✓

⑧ 7: X^nX^n ✓ or X^nX^N ✓

8: $X^N X^n$ ✓

3.1.12

25% X^nY

22% affected male

3.1.12 ~~3.3.9~~ 25% ✓

⑤ Parental genotypes correct ✓ ✓

Cross / punnett square correctly shown ✓ ✓

[40]

QUESTION 4

② 4.1.1 Table to show the effectiveness ✓ of various of contraceptive methods ✓

① 4.1.2 Method / type of contraception ✓

② 4.1.3 Bar graph ✓ the independent variable is discontinuous / values not numbers ✓

④ 4.1.4 Age of participants ✓ as fertility varies with age ✓
Education of participants ✓ effects ability to use methods of contraception appropriately ✓
Life styles factors eg smoking or obesity ✓ which affect fertility negatively ✓ must be excluded
Include instance of miscarriage / abortion in statistics / any other sensible factor + explanation

(2 X 2 = 4)

① 4.1.5 vaginal sponge ✓

- ② 4.1.6 e.g. hormonal implant / IUD ✓ because it is in the body, you cannot forget to use it or not have it with you ✓ or any other suitable example
- ② 4.1.7 condoms prevent exchange of body fluids / act as a barrier ✓
therefore can also prevent the spread of HIV / STDs ✓
cheap ✓ (max 2)
- ① 4.2.1 oviduct / fallopian tube ✓
- ④ 4.2.2 a) mitochondria ✓ provide energy for sperm to swim ✓
b) nucleus ✓ carries haploid chromosome contribution / genetic characteristics from male ✓
- ③ 4.2.3 T releases enzymes ✓ *acrosome*
Which break down zona pellucida / jelly coat ✓
To allow entry of sperm nucleus ✓
- ① 4.2.4 pollen grain ✓ *not anther or stamen*
- ② 4.3.1 a) levels of HCG still quite low ✓ may not be enough hormone molecules in the urine to bind to coloured granules and create the second stripe / to give a positive result ✓
b) a missed period ✓ / swollen tender breasts
- ①
- ② 4.3.2 9 weeks (accept 8-10) ✓
HCG levels are at their highest ✓
- ⑥ 4.3.3 it has a thumb grip ✓ so that it can be held in the urine stream without slipping ✓
It has a protective cover ✓ to prevent contact with urine once used ✓
It has a band ✓ to show that test has run correctly ✓
Quick result (3-5min) and can be done at home – no blood test or doctors visit required (any 3 sensible well explained features)
- ③ 4.4.1 B – vagina ✓ *birth canal*
D – umbilical cord ✓
F – amniotic fluid ✓
- ③ 4.4.2 brings baby's blood in close contact with mother's blood ✓
For easy diffusion of nutrients and oxygen to baby ✓
And removal of waste products from baby's blood ✓
Prevents transfer of diseases ✓ (max 3)