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Time: 50 minutes

Marks: 50

**MEMO****Instructions:**

Write your name in the space provided on the question paper.

Answer all questions in the spaces provided.

Please check that there are 7 printed pages.

Question 1:

- 1.1 Match the terms in Column X with the descriptions in Column Y. Write only the correct letter in the Answer column.

Answer	Column X	Column Y
D✓	Autosomes	A. An organism with more than two sets of chromosomes in each cell.
E✓	Mutation	B. The genetic crossing of two organisms in which one pair of contrasting characteristics is studied.
A✓	Polyploid	C. Either of the two daughter strands of a replicated chromosome.
F✓	Genetics	D. Thread-like structures found in the nucleus of a cell but not involved in sex determination.
B✓	Monohybrid inheritance	E. Change in genotype that may result in a new expression of a characteristic.
G✓	Semi-conservative	F. The science of inheritance.
		G. Accepted hypothesis for DNA Replication.

(6)

- 1.2 Distinguish between the terms "gene" and "allele".

(2)

A gene is a piece of DNA in a chromosome that carries information or that will determine a particular trait✓. An allele is a different form of the same gene at a particular locus on a pair of homologous chromosomes✓.

- 1.3 Distinguish between the terms "genotype" and "phenotype".

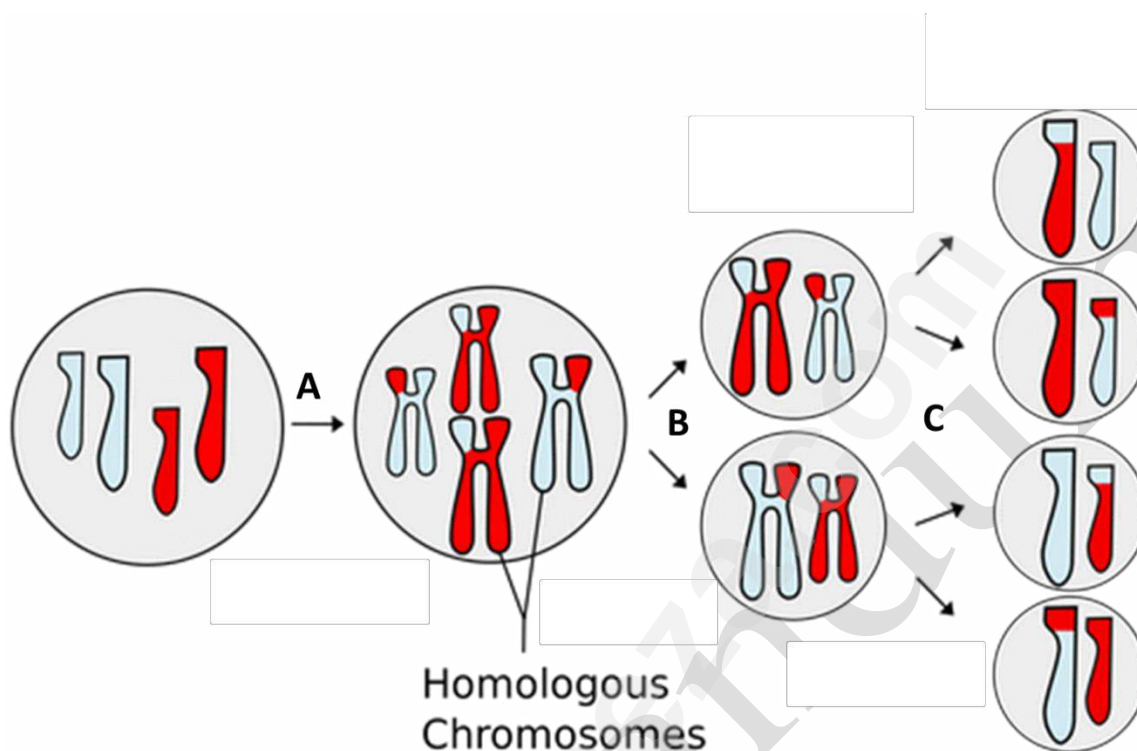
(2)

Genotype is the genetic (unseen) characteristics of an organism (genetic code)✓ whereas phenotype is the physical (seen/displayed) characteristic (visible/expressed trait)✓.

[10]

QUESTION 2

Study the figure below and then answer the questions that follow.



2.1 What do the stages A and C represent?

A: **Interphase OR DNA replication**✓

C: **Meiosis II (also accept Telophase II)**✓

(2)

2.2 In the paragraph below, underline the correct word in brackets.

(4)

Before meiosis, the chromosome number is [**haploid** / **diploid**]. After meiosis, the chromosome number is [**halved** / **doubled**]. One could say that in this cell, [**$2n = 4$** / **$2n = 2$**] while [**$n = 4$** / **$n = 2$**]

2.3 Other than crossing over, describe one other way that variation can be introduced into gametes during meiosis.

(3)

Random/independent assortment✓ occurs during **Metaphase I**✓; pairs of homologous chromosomes line up randomly at the equator ✓ (maternal/paternal) which introduces variation

Do not accept fertilisation (as this is not during meiosis/gamete production)

[9]

Question 3

3.1 Read the passage below and answer the questions that follow.

The Royal Society for the Prevention and Cruelty to Animals (RSPCA) has alerted the public to potential problems in the breeding of pure domestic breeds of dog. Some of the major concerns raised include:

1. The fates of "rejected" dogs from a *test cross* in the determination of pure breeds.
2. Many breeds have high rates of heritable disorders or diseases.
3. Dogs are regularly bred whose heads are too large to birth naturally.
4. Pure-bred dogs often have a lower life expectancy than cross-bred dogs.
5. Unscrupulous breeders sell heterozygous dogs as pure bred pedigrees and profit from this.

The RSPCA says that all members of society, and in particular all those who benefit from pedigree dogs, have a moral and ethical obligation to ensure every action is taken to attempt to overcome the current problems and to increase the health and welfare of future generations of pedigree dogs.

Adapted from Rooney & Sargan (2009)

<http://www.rspca.org.uk>

3.1.1 What is meant by a *test cross*?

(2)

A test cross is an intentional crossing of an unknown Genotype✓ with a homozygous recessive version✓ to determine whether the Genotype of the parent is Heterozygous or Homozygous dominant.

3.1.2 Show, by means of two Punnett squares, how one could perform a test cross to determine if a dog is pure bred.

(4)

	B	B
b	Bb	Bb
b	Bb	Bb

No recessive trait displayed
in offspring
= pure bred parent

	B	b
b	Bb	bb
b	Bb	bb

Half of offspring display
recessive trait
= Heterozygous parent

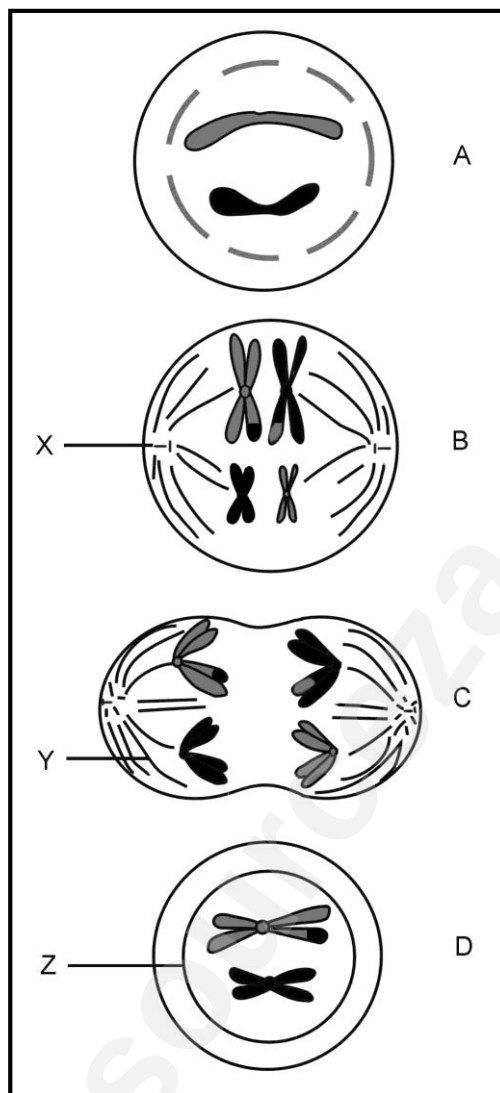
3.1.3 Why would it be considered unethical to use test crosses to determine the pedigree of a dog?

(2)

Have unwanted puppies that display recessive trait✓; puppies could then be abandoned/euthanized etc; any reasonable response✓.

[8]

- 3.2 The diagrams of animal cells show different stages of cell division. Study them carefully and answer the questions that follow.



- 3.2.1 Write down the letters in the correct sequence of the phases that occur in Meiosis I. (4)

B✓ C✓ D✓ A✓

- 3.2.2 Provide labels for structures Y and Z. (2)

Y: Spindle fibres✓

Z: Nuclear envelope/membrane✓

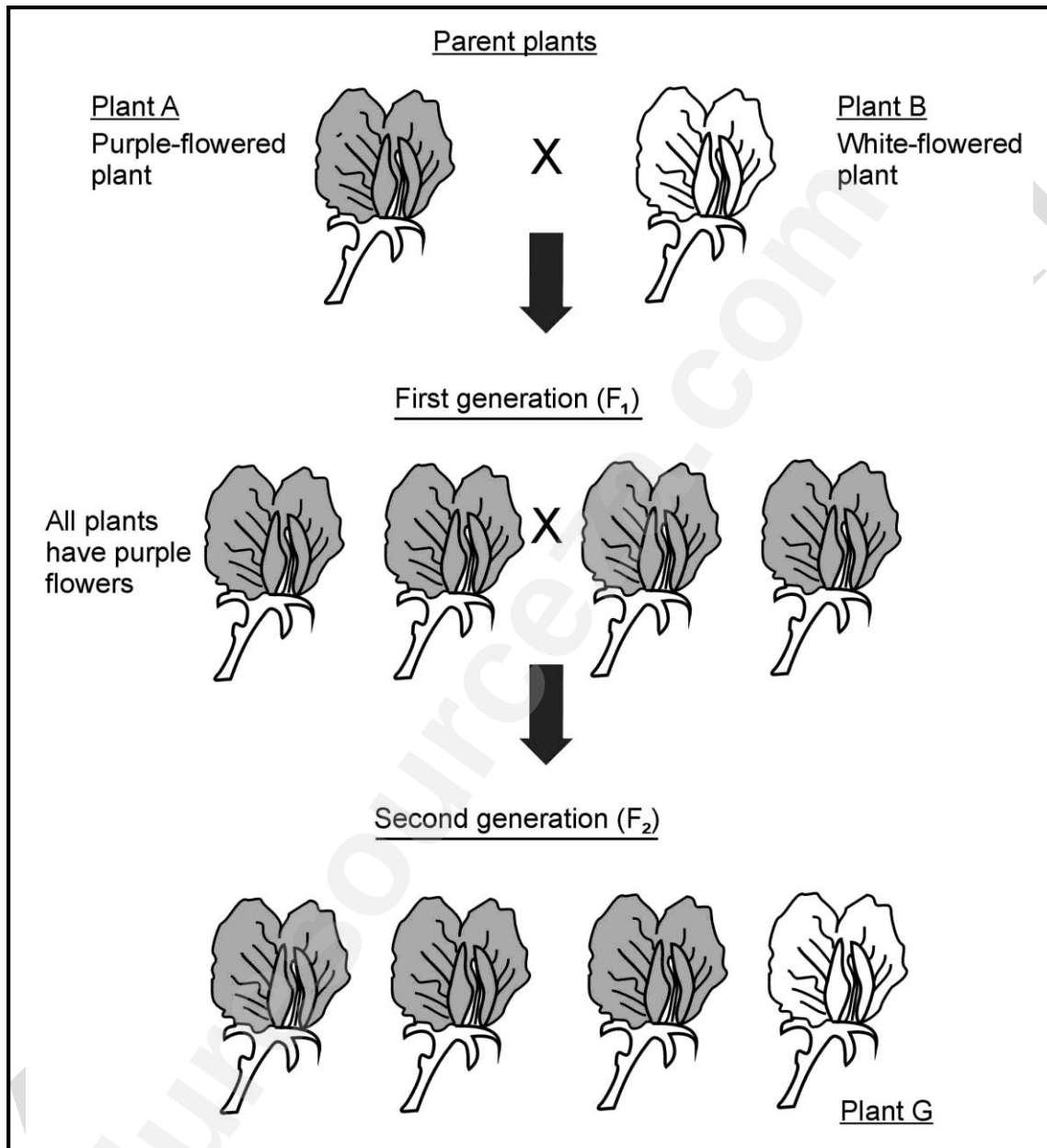
- 3.2.3 Name **ONE** place in sexually mature humans where meiosis occurs. (1)

Ovaries or testes✓

[7]

Question 4

Andrew is conducting an investigation in the Life Sciences laboratory. He crosses two pure breeding garden pea plants. Plant A has purple flowers and Plant B has white flowers. The diagram shows the results he obtained for two generations of pea plants.



- 4.1 Use the symbol P to represent the gene for purple flowers. Give the genotype of the original breeding pair of plants. (2)

Plant A = PP✓

Plant B = pp✓

- 4.2 Is the F₁ generation homozygous or heterozygous? Explain your answer. (2)
Heterozygous✓ If 2 pure breeding (homozygous) individuals are bred, all their offspring will be heterozygous Pp✓

4.3 Show, using a formal genetic diagram, the possible phenotypes and genotypes for flower colour of the F_2 generation. (8)

Allele for purple flowers

P

Allele for white flowers

p

✓

Parental (P) phenotypes

Purple

Purple

Parental genotypes

Pp

Pp

Meiosis

✓

Gametes

P

p

P

p

Possible fertilisation

F_2 generation

PP

Pp

Pp

pp

Ratio genotypes

25% PP (homozygous dominant), 50% Pp (heterozygous) and 25% pp (homozygous recessive) ✓

Ratio phenotypes

75% Purple Flowers, 25% White Flowers (3:1) ✓

Instead of Lines for possible fertilisation above, Punnett Square may be used.

	P	p
P	PP	Pp
p	Pp	pp

Question 5

Choose the most correct alternative in each question and write its letter in the space provided in the table below.

Question	5.1 (1 mark)	5.2 (1 mark)	5.3 (1 mark)	5.4 (1 mark)
Answer	C✓	B✓	D✓	C✓

[4]

- 5.1 A person carries the gene alleles C and c, D and D, f and F, and G and G on homologous chromosomes. The alleles in one of her gametes could be:
- A Cc DD fF GG
 - B C d F g
 - C c D f G
 - D C D F g
- 5.2 The cross that will result in the phenotypic ratio of 1:1 is ...
- A BB × BB
 - B Bb × bb
 - C bb × bb
 - D Bb × Bb
- 5.3 Which of the following represents the chromosome number of a normal human male?
- A 23 + Y
 - B 21 + XY
 - C 22 + XX
 - D 22 + XY
- 5.4 Which of the following can be passed onto offspring?
- A a mutation in a somatic cell
 - B a cancerous growth
 - C a mutation in a gamete or sex cell
 - D long hair and nails