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REDHILL HIGH SCHOOL

GRADE 12 MEIOSIS AND GENETICS TEST

LIFE SCIENCES

Examiner: Mrs Ho

Moderator: Mrs Enslin

Time: 60 minutes

60 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of 10 pages. Please check that your question paper is complete
2. QUESTION 1 must be completed on the Question Paper.
3. QUESTION 2-5 be completed on the paper provided.
4. Read the questions carefully
5. All questions are compulsory.
6. It is in your own interest to write legibly and present your work neatly.

Student Name: _____ **Class:** _____

QUESTION	MARK ALLOCATION	STUDENTS MARK
1	24	
2	9	
3	10	
4	13	
5	9	
Total	60	

QUESTION 1

- 1.1 The following table compares mitosis and meiosis. Under each heading put either a tick if the statement is correct or a cross if it is incorrect.

Feature	Mitosis	Meiosis
DNA replicates		
Involves two nuclear divisions		
Results in a haploid cell		
There is crossing over between the chromatids		
Homologous chromosomes pair up		
Sister chromatids separate		
Results during growth		
Daughter cells are identical to the parent cell		
Occurs during gamete formation		

(9)

- 1.2 MULTIPLE CHOICE: There are 10 Multiple Choice Questions. Write the letter of the most correct answer in the space provided below. (10)

Question	Answer	Question	Answer
1.2.1		1.2.6	
1.2.2		1.2.7	
1.2.3		1.2.8	
1.2.4		1.2.9	
1.2.5		1.2.10	

1.2.1. In mice, black coat colour (allele B) is dominant to brown coat colour (allele b). The offspring of a cross between a heterozygous black mouse and a brown mouse were allowed to interbreed. What percentage of their progeny would have brown coats?

- A. 25%
- B. 50%
- C. 75%
- D. 100%

1.2.2. In gerbils, brown coat **B** is dominant to grey coat, **b**. If a gerbil has the genotype **Bb**, then its parents could NOT have been.

- A. BB and Bb
- B. bb and BB
- C. BB and BB
- D. Bb and Bb

1.2.3 The data in the accompanying table which were obtained from studies of pairs of twins. Which two columns should be compared to find out if the environment has an effect when the genotype is the same?

Characteristic measured	P	Q	R	S
	50 pairs of identical twins reared together	50 pairs of non-identical twins reared together	50 pairs of identical twins reared apart	50 pairs of non-identical twins reared apart
Average difference in body mass (kg)	1.8	4.5	4.4	4.6
Average difference in width of head (mm)	2.8	4.3	2.9	4.4
Average difference in waist circumference (cm)	2.0	9.8	9.5	10.4
Average number of fillings in needed to teeth	2.3	8.7	10.6	9.9

- A. P and Q
- B. P and R
- C. R and S
- D. Q and S

1.2.4 In *Drosophila*, the allele for normal grey body colour (G) is dominant to ebony body (g). The following table summarises the results of several crosses.

Cross	result
strain 1 x gg	all grey
strain 2 x gg	1 grey: 1 ebony
strain 3 x gg	all ebony
strain 4 x Gg	3 grey : 1 ebony

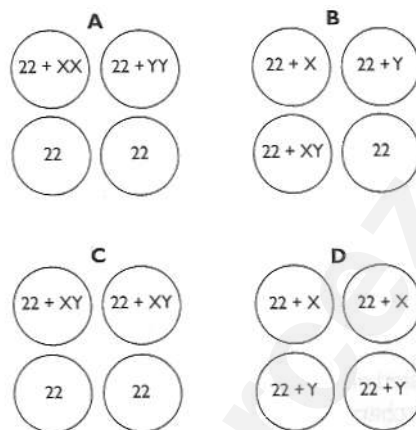
Which strains both have the genotype Gg?

- A. 1 and 3
- B. 1 and 4
- C. 2 and 3
- D. 2 and 4

1.2.5 Klinefelter's syndrome results from the fusion of

- A. an XX egg and a Y sperm
- B. an XY egg and an X sperm
- C. an X egg and a YY sperm
- D. an XX egg and a YY sperm

1.2.6. If a gamete mother cell of chromosome complement $44 + XY$ suffers a non-disjunction at the first meiotic division, which of the following sets of gametes could result?



Questions 1.2.7 AND 1.2.8 refer to the following possible answers.

- A. $44 + XO$
- B. $44 + XXY$
- C. $45 + XX$
- D. $45 + XY$

1.2.7 Which chromosome complement is possessed by a female sufferer of Down's syndrome?

1.2.8 Which chromosome complement is possessed by a sufferer of Turner's syndrome?

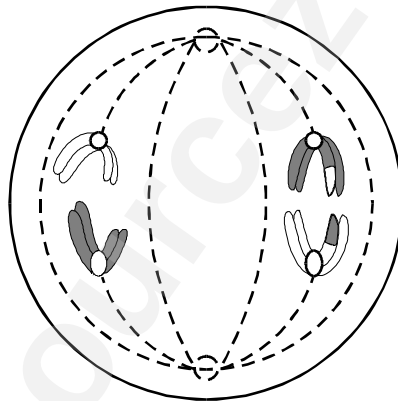
1.2.9 Which of the following concepts is not attributable to Mendel?

- A. one allele may be dominant to another allele at the same locus
- B. chromosomes are the carriers of the genes
- C. chromosomes assort randomly in metaphase I of meiosis
- D. the pair of alleles at a locus separate from each other during gamete formation

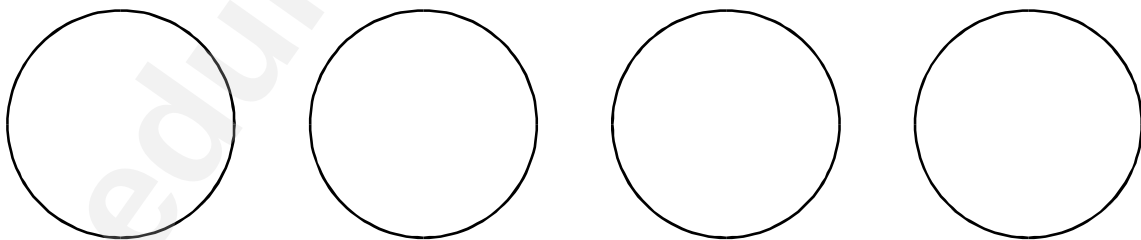
1.2.10 Which of the following mutations would have the most widespread effects on an individual?

- A. Trisomy 13
- B. Trisomy 21
- C. Deletion
- D. Substitution

1.3 The diagram shows a cell during the first division of meiosis.



1.3.1 Complete the diagram below to show the appearance of the chromosomes in each of the four daughter cells formed at the end of the second division of meiosis.



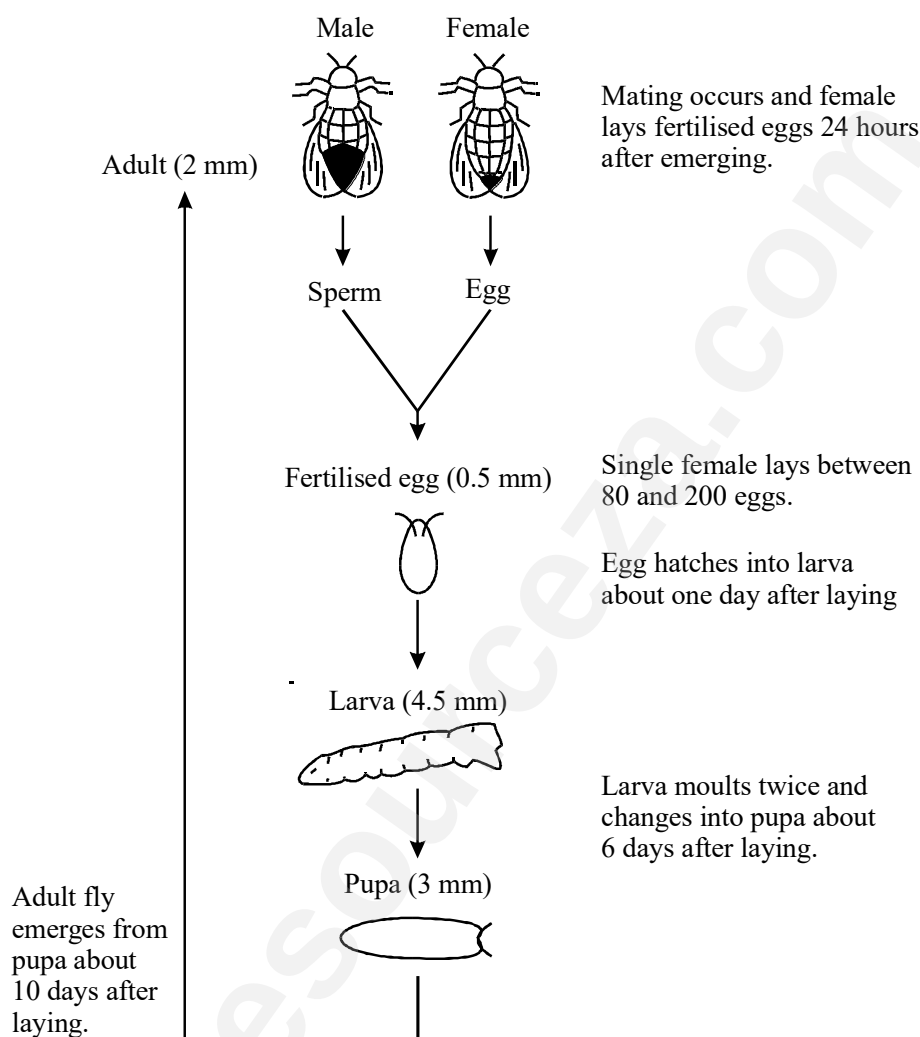
(4)

1.3.2 In an insect, 16 chromatids were visible in a cell at the start of the first division of meiosis. How many chromosomes would there be in a normal body cell from this insect?

(1)

QUESTION 2

The fruit fly is a useful animal for studying genetic crosses. The diagram shows the life cycle of the fruit fly.



2.1 Using information from the diagram explain **three** ways in which the fruit fly is a useful animal for studying genetic crosses. (3)

2.2 In fruit flies the allele for normal wings, **N**, is dominant to the allele for vestigial wings, **n**. A cross between normal-winged fly and a vestigial-winged fly resulted in the following offspring.

49 normal-winged flies
53 vestigial-winged flies

2.2.1 Give the genotype of the normal-winged parent. (1)

2.2.2 Draw a genetic diagram to show the above cross (5)
[9]

QUESTION 3

Read the following information and use it and your own knowledge to answer the questions that follow.

Crigler-Najjar (C-N) syndrome is a rare genetic disorder controlled by a recessive allele. The normal gene for UDP-glucuronosyltransferase (the enzyme that breaks down bilirubin) is found on the short arm of chromosome 2. Due to a mutation, the gene is non-functional in C-N sufferers.

Individuals with the disorder are unable to break down bilirubin, a toxic waste product formed when the liver destroys old red blood cells. Children with this syndrome must sleep under special blue lights which destroy bilirubin. If this treatment fails a liver transplant is required.

Although rare in the general population, C-N syndrome is common in one particular community. This community is described as closed as marriage occurs only between its members.

Adapted from *The learning Factory* and *Wikipedia*

- 3.1 Describe what is meant by an allele. (2)
- 3.2 Discuss Gregor Mendel's role in the discovery of the patterns of inheritance. (3)
- 3.3 What would the genotypes of the parents be if they are both non sufferers but they have a child with C-N syndrome? (1)
- 3.4 Which organ does not function properly in people who suffer with C-N syndrome? (1)
- 3.5 What is the locus of the gene that codes for the enzyme that breaks down bilirubin? (1)
- 3.6 Suggest how C-N syndrome could become common in a closed community. (2)

[10]

QUESTION 4

Figure 1 and **Figure 2** show the chromosomes from a single cell at different stages of meiosis.

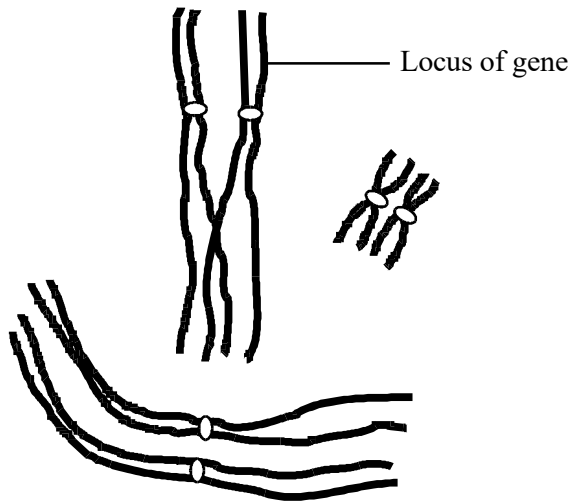


Figure 1

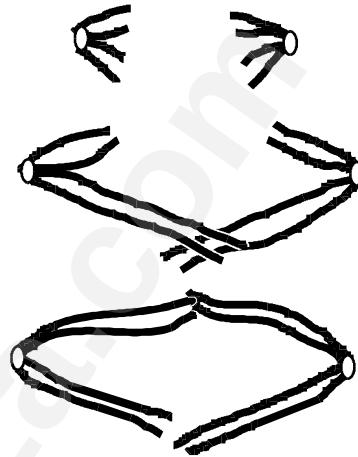


Figure 2

- 4.1 What is the diploid number of chromosomes in the organism from which this cell was taken? (1)
- 4.2 Describe what is happening to the chromosomes at the stage shown in
 - 4.2.1 Figure 1 (2)
 - 4.2.2 Figure 2 (2)
- 4.3 Two pairs of alleles A and a, and B and b are found on one pair of homologous chromosomes. A person has the genotype AaBb. Figure 3 shows the chromosomes at an early stage of meiosis. The position of two of the alleles is shown.

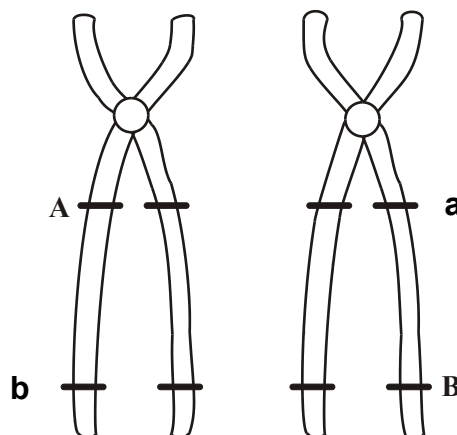


Figure 3

Crossing over occurs as shown in Figure 4.

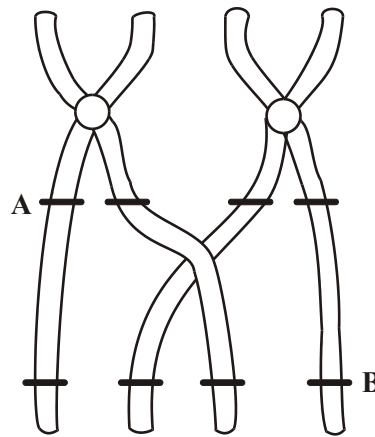


Figure 4

- 4.3.1 Name the point where crossing over occurs. (1)
- 4.3.2 What term is used to describe the pair of homologous chromosomes shown in Figure 4? (1)
- 4.3.3 From Figure 4, give the genotypes of the gametes produced containing the chromatids
- a) that have not crossed over (1)
 - b) that have crossed over. (1)
- 4.3.4 Give two processes, other than crossing over, which result in genetic variation. Describe how each process contributes to genetic variation. (4)

[13]

QUESTION 5

A florist has discovered a new variety of plant in the Drakensberg. This plant either has red flowers or yellow flowers. He is interested in breeding these plants to sell at his flower market but needs to know which allele is dominant and which is recessive in order to breed them to get more of the red variety than the yellow as he knows red flowers sell better than yellow ones.

Design an experiment that will determine which allele is dominant and which is recessive so the florist can use the information to produce the plants with the flower colour he wants.

Set up the experiment under the following headings:

Hypothesis

Method

[9]