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Date: May 9, 2022

NOTE: Total Marks: 40

➤ Read the questions carefully. All questions are compulsory.
➤ Write your answers as brief as brief as possible, should not exceed one page but all points covered in bullet points.
➤ Explain through the crosses, wherever required.
➤ For numerical questions, all steps are to be mentioned resulting into the final answers.

Q 1: Predict the results obtained from a cross of a triploid (3A + XXX) ♀ fly and a diploid ♂ (2A + XY) fly in *Drosophila*. **[Marks 3]**

Q 2: In a cross between a white-eyed female and a red-eyed male, why are a few white-eyed females and red-eyed males produced? Explain with the help of appropriate cross(es). *Drosophila eor* **[Marks 3]**

Q 3: Red-green color blindness in humans is due to an X-linked recessive gene. Both John and Cathy have normal color vision. After 10 years of marriage to John, Cathy gave birth to a color-blind daughter. John filed for divorce, claiming that he is not the father of the child. Is John justified in his claim of nonpaternity? Explain why. If Cathy had given birth to a color blind son, would John be justified in claiming nonpaternity? **[Marks 3]**

Q 4: Red-green color blindness is a human X-linked recessive disorder. Jill has normal color vision, but her father is color blind. Jill marries Tom, who also has normal color vision. Jill and Tom have a daughter who has Turner syndrome and is color blind: **[Marks 3]**
(a) How did the daughter inherit color blindness?
(b) Did the daughter inherit her X chromosome from mother Jill or from father Tom?

Q 5: A series of two-point crosses were carried out among seven loci (a, b, c, d, e, f and g), producing the following recombination frequencies. Using these recombination frequencies, map the seven loci, showing their linkage groups, the order of the loci in each linkage group, and the distances between the loci of each group: **[Marks 3]**

Loci	Recombination frequency (%)	Loci	Recombination frequency (%)	Loci	Recombination frequency (%)	Loci	Recombination frequency (%)
a and b	10	b and c	50	c and d	50	d and f	50
a and c	50	b and d	4	c and e	8	d and g	50
a and d	14	b and e	50	d and f	50	e and f	50
a and e	50	b and f	50	c and g	12	e and g	18
a and f	50	b and g	50	d and e	50	f and g	50
a and g	50						

Q 6. Determine the type of sex expression in higher plants against the flowers of different types as mentioned in the table below: **[Marks 0.5×8= 4]**

S.No.	Flowers of different types	S.No.	Flowers of different types
1.	All perfect bisexual flowers	5.	Perfect bisexual and female flowers on the same plant
2.	Separate male and female flowers, but on the same plant	6.	Perfect bisexual, female and male flowers on the same plant
3.	Separate male and female flowers, but on the different plant	7.	Perfect bisexual and male flowers on separate plant
4.	Perfect bisexual and male flowers on the same plant	8.	Perfect bisexual and female flowers on separate plant

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Q7: The heights of mothers and daughters are given in the following table: [Marks 4]

Height of mother (in)	Height of daughters (in)
64	66
65	66
66	68
64	65
63	65
63	62
59	62
62	64
61	63
60	62

$(x_i - \bar{x})$

-5.6
-4.6
-3.6
-5.6
-6.6
-6.6
-10.6
-7.6
-8.6
-9.6

$(y_i - \bar{y})$

-5.44
-5.44
-3.44
-6.44
-6.44
-9.44
-9.44
-7.44
-8.44
-9.44

from the data above, determine,

(a) The mean, variance, and standard deviation of the heights
(b) The correlation coefficient for the heights of mothers and daughters.
(c) Using regression, predict the expected height of a daughter whose mother is 67 inches tall?

Q 8: Assume that plant weight is determined by a pair of alleles at each of the two independently assorting loci (A and a, B and b) that are additive in their effects. Further assume that each allele represented by an uppercase letter contributes 4 g to weight and that each allele represented by a lowercase letter contributes 1 g to weight: [Marks 5]

(a) If a plant with genotype *AA BB* is crossed with a plant with genotype *aa bb*, what weights are expected in F_1 progeny of this cross?
(b) If the F1 plants are intercrossed, what are the distribution of expected weights and proportions of the F_2 Plants?

Q 9. A wild-type chromosome has the following segments, where ● represents the centromere: [Marks 6]

A B ● C D E F G H I

An individual is heterozygous for the following chromosome mutations. For each mutation,
[A] Sketch how the wild-type and mutated chromosomes would pair in **Prophase-I** of meiosis.
[B] What type of Chromosomal Mutations are occurring in each one of them.

(i)	A B ● C D E F. G E F G H I
(ii)	A B ● C D H I
(iii)	A B ● C D G F E E F G H I
(iv)	A E D C ● B F G H I

G F E E

Q 10: A young couple is planning to have children. Knowing that there have been a substantial number of miscarriages and fertility problems on the husband's side of the family, they see a genetic counsellor. A chromosome analysis revealed that, whereas the women has a normal karyotype, the man possesses only 45 chromosomes and is carrier of Robertsonian translocation between chromosome 22 and 13. [Marks 3+3]

(a) List all the different types of gametes that might be produced by the man.
(b) What types of zygotes will develop when each of gametes produced by the man fuses with a normal gamete produced by the women?