Mid Sem Examination - Genetics [BT204]

Date: 25 Sep 2021 Exam Duration: 75 min Total Marks: 30
Name: Roll No:

Key Instructions: Read the instructions carefully

- Start of the Exam is 10.00 AM and is till 11.15 AM.
- Answers to be hand written in sheet of paper.
- Write your Name and Roll No and sign on each sheet.
- All questions are compulsory and answers to be given clearly and to the point.
- All questions are self-explanatory and carries appropriate marks.
- Answer to question should follow in the order of question.
- Numerical question answer should be rounded off and marks allotted for steps.
- Genetic crosses should be made clearly with correct labelling.
- Strikethrough should be made if not part of the answer. Scribbling/ cutting to be avoided.
- After the end of exam, scan the document and attach the pdf labelled with your Roll No.
- PDf file to be attached to MS Teams with a copy to the instructor (LRANGAN@IITG.AC.IN) before to 11.25 AM. No consideration will be given if not able to upload during the set time.

1. A man produces the following kinds of sperm in equal proportions *SB*, *Sb*, *sB*, and *sb*. What is his genotype with reference to the genes specified? = ***SsBb*** **[1]**

2. Mark the **true** statements with (**+**) and the false with a zero (**0**) **[2]**

(a) Skin cells and gametes of the same animal contain the same number of chromosomes = 0
(b) Any chromosomes may pair with any other chromosome in the same cell in meiosis = 0
(c) Of the 10 chromosomes in a mature sperm cell, 5 are always maternal = 0
(d) The gametes of an animal may contain more maternal chromosomes than its body cell contains = +

3. How does meiosis differ from mitosis? Consider differences in mechanisms as well as end results. **[2]**
Meiosis includes a pairing (synapsis) of corresponding maternal and paternal chromosomes. In the cell division that follows, the chromosomes that have previously paired separate. This results in a reduction of chromosome number from *2n* (diploid) to *n* (haploid)

4. A woman of blood group AB presented a baby of group O. which she claimed as her baby. What bearing might the blood-type information have on the case? **[2]**
It is extremely unlikely that the baby with O-type blood was the daughter of the woman with AB- type blood.

5. How many different kinds of F1 gametes, F2 genotypes, and F2 phenotypes would be expected from **[4]**
   (a) *PP* X *pp*
   (b) *PPQQ* X *ppqq*
   (c) *PPQQRR* X *ppqqrr*
   (d) What general formula can be applied for F1 gametes, F2 genotypes, and F2 phenotypes?

P Cross	***PP* X *pp***	***PPQQ* X *ppqq***	***PPQQRR* X *ppqqrr***	**General Formula**
(e) F1 gametes	2	4	8	2^{n*}
(f) F2 genotypes	3	9	27	3^{n}
(g) F2 phenotypes#	2	4	8	2^{n}

Where n*= number of segregating pairs of alleles.
Under complete dominance of *P*, *Q* and *R*

6. Solve and explain as has been asked **[5]**
   (a) If the haploid human genome contains 3 x 10^9 nucleotide-pairs and the average molecular weight of a nucleotide-pair is 600, how many copies of human genome are present, on average in 1 µg of human DNA?
   (b) What is the mass of one copy of the human genome?
   (c) Of what importance are calculations of the type above to geneticists?

   a. One µg of human DNA will contain, on average 3.04 x 10^5 copies of the genome. Using an average molecular weight per nucleotide-pair of 600, the "molecular" weight of entire genome is 1.98 x 10^{12} (3 x 10^9 x 660). Thus 1.98 x 10^{12} g (1 "mole=number of grams equivalent to the "molecular weight) of human

DNA will contain, on average 6.02 x 10^{25} molecules (Avogardo' number= number of molecules). One gram will contain on average 3.04 x 10^{13} (6.02 x 10^{25}/1.98 x 10^{12}) copies of the genome, thus 1 µg will contain on average 3.04 x 10^{5} copies of the human genome

b. One copy of the human genome weighs approximately 3.3 x 10^{-12} g (1.98 x 10^{12} g per "mole"/6.02 x 10^{25} molecules per "mole") or 3.3 x 10^{-6} µg.

c. In carrying out molecular analysis of the structures of genomes, geneticists frequently need to know how many copies of a genome are present, on average in a given quantity of DNA.

7. Phenylketonuria in humans is caused by a recessive allele *k*. If both partners are known to be carriers (*Kk*) what is the chance in the following combinations with 5 children that **[6]**

   All are normal=243/1024

   Four are normal and one is affected=405/1024

   Three are normal and two are affected=270/1024

   Two are normal and three are affected=90/1024

   One is normal and four are affected= 15/1024

   All are affected?= 1/1024

8. The shape and the colour of radishes are controlled by two independent pairs of alleles that show no dominance; each genotype is distinguishable phenotypically. The colour may be yellow (*YY*), purple (*R′ R*), or white (*R′ R′*) and the shape may be long (*LL*), oval (*L′ L*), or round (*L′ L′*). using the Punnett square method, diagram a cross between red, long (*RRLL*) and white, round (*R′ R′ L′ L′*) radishes and summarize the F2 results under the headings phenotypes, genotypes, genotypic frequency, and phenotype ratio. **[8]**

Crosses I have not put

F2 Results

Phenotypes	**Genotypes**	**Genotypic Frequency**	**Phenotypic Ratio**
Red long	*RRLL*	1	1
Red oval	*RRLL′*	2	2
Red round	*RRL′L′*	1	1
Purple long	*RR′LL*	2	2
Purple oval	*RR′LL′*	4	4
Purple round	*RR′L′L′*	2	2
White long	*R′R′LL*	1	1
White oval	*R′R′L′L*	2	2
White round	*R′R′L′L′*	1	1