B.Sc. 5th Semester (Hons.) Examination, 2020 (CBCS)

Subject: Zoology

Paper: CC-12 (Genetics)

Full Marks: 40 **Time: 2 Hrs**

Candidates are required to give the answers in their own words as far as practicable.

*Answer any **eight** questions of the following:* 5×8 = 40

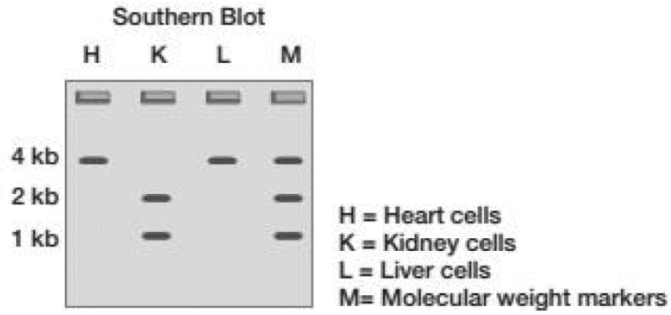
1. In a certain species of animals, two independently assorting genes, A and B, interact in a complementary manner to produce horns. Animals that are homozygous recessive for one or both genes (aaB–, A–bb, or aabb) lack horns. What genotypic and phenotypic ratios would be expected from this mating: AaBb × AaBB? Can two hornless animals produce offspring with horns? If so, how?

2. In an organism, fire production (f) is recessive to inability to produce fire, green color (g) is recessive to yellow, and presence of horns (h) is recessive to absence of horns. The three loci are linked on an autosome as shown in the following map:

   f----------5 mu----------g----------20 mu----------h

   A triple heterozygote female whose father was a true-breeding yellow, fire producer with horns is mated to a male, homozygous recessive for all three traits they produce 1000 offspring. Assuming interference is 0.4 and 0.0, determinethe expected number of offspring that are fire-producing, green, with horns and fire-producing, yellow, with horns?

3. A scientist is studying the expression of gene *T* in three different tissues. He isolates DNA from the tissues and treats it with a low concentration of DNase I. He then removes the histone proteins from DNA and subjects it to restriction endonuclease digestion, followed by electrophoresis and Southern blot hydridization using a genomic fragment containing gene T as a probe. The results are shown in the following figure:



   In which tissue is gene T actively expressed? Provide a detailed explanation.

4. A new IS element was discovered in bacteria. Which of the following pairs of DNA sequences could be found at its two ends? Justify it.

   a. 5' GAGACTCTAC 3' and 5' GAGACTCTAC 3'
   b. 5' GAGACTCTAC 3' and 5' CATCTCAGAG 3'
   c. 5' GAGACTCTAC 3' and 5' CTCTGAGATG 3'
   d. 5' GAGACTCTAC 3' and 5' GTAGAGTCTC 3'

5. **Observation 1**: Human female (46, XX) bears one Barr body which is completely heterochromatinized when seen under microscope as concentric body.

   Observation 2: Human female with Turner's syndrome (45, X0) with one active X chromosome does not express female secondary sex characters and is sterile.

   From these two observations, explain the fact that the sex chromatin must have some roles in feminine character development.

6. A wild-type chromosome has the following segments: A B C • D E F G H I; The dot (●) represents the centromere. Researchers have found individuals that are heterozygous for each of the following chromosome mutations. For eachmutation, sketch how the wild-type and mutated chromosomes would pair in prophase I of meiosis, showing allchromosome strands.
   a. A B C • D E F D E F G H I
   b. A B C • D H I
   c. A B C • D G F E H I
   d. A B E D • C F G H I

7. In *Paramoecium*, short duration conjugation with nuclear exchange but without cytoplasmic exchange results in both killer and sensitive strains. The killer strain, when undergoes autogamy produces 50% killer and 50% sensitive paramoecia. Explain the result with suitable illustration.

8. Researchers discovered recently that the sole function of the SRY protein is to activate an autosomal gene called Sox9 in the bipotential gonad. Explain what would be the sex of an individual homozygous for non-functional mutant allele sox9-. Why is SRY, rather than Sox9, considered as male determining factor?

9. Several kinds of sexual mosaicism are well documented in humans. Suggest how each of the following examples may have arisen by non-disjunction at *mitosis:*
   a. XX/XO (that is, there are two cell types in the body, XX and XO)
   b. XX/XXYY
   c. XO/XXX
   d. XX/XY
   e. XO/XX/XXX

10. Several auxotrophic point mutants in *Neurospora* are treated with various agents to see if reversion will take place. The following results were obtained (a plus sign indicates reversion; HA causes only G • C →A • T transitions).

Mutant	5-BU	HA	Proflavin	Spontaneous reversion
1	–	–	–	–
2	–	–	+	+
3	+	–	–	+
4	–	–	–	+
5	+	+	–	+

For each of the five mutants, describe the nature of the original mutation event (not the reversion) at the molecular level.