INHERITANCE & VARIATION REVISION Qns

1. (a) State Mendel's **first law of inheritance** and explain what it means.
(b) (i) State the stages of meiosis that illustrate this law.
(ii) Explain what takes place in the stages you have named in a (ii) above.
(c) Suggest **three** reasons for the choice of the following organisms in genetic experiments.
(i) Garden pea, *Pisum sativa*.
(ii) Fruit fly. *Drosophila melanogaster*.

2. (a) Using the law of Independent assortment, explain the 3:1 ratio in the F1 generation of a monohybrid inheritance when one parent is homozygous dominant and the other homozygous recessive for a trait.
(b) Chickens with shortened wings and legs are Creepers. When Creepers were mated with normal chicken, they produce Creepers and normal birds with equal frequency. When Creepers are mated with Creepers, they produce two Creepers and one normal chicken. Crosses between normal birds produce only normal birds. Using suitable genetic symbols, show the 2:1 ratio of progeny can be obtained.
(c) Give other situations where the law of independent assortment may not apply.

3. (a) Distinguish between the following genetic terms.
(i) **Phenotype** and **genotype**
(ii) **Sex linked** and **sex limited** traits
(b) A male housefly homozygous for brown-coloured body and normal antennae was crossed with a female homozygous mutant fly which had a black body and forked antennae. All the offsprings obtained possessed brown bodies and normal antennae. The F1 males with mated with females having the same genetic make-up as the mother and they produced the following offsprings.
230 flies with brown bodies and normal antennae
20 flies with brown bodies and forked antennae
18 flies with black coloured bodies and normal antennae
236 flies with black bodies and forked antennae.
(i) Using suitable symbols to represent the alleles of the genes involved in the experiment, explain the genotypes and phenotypes of the flies in;
- the F1 generation.
- Offspring of the final mating

(ii) Determine the cross over value for body colour and antenna characteristics. Comment on your answer.

4. In drosophila, the genes for broad abdomen and long wings are dominant over the genes for narrow abdomen and vestigial wing. Pure breeding strains of the double dominant variety were crossed with a double recessive variety and a test cross was carried out on the F1 generation.
(a) Using suitable genetic symbols, work out the expected phenotypic ratio of the test cross of the F1 generation, if the genes for abdomen width and length of wing are linked.
(b) It was however observed that when the test cross of the F1 generation was carried out, the following results were obtained.
Broad abdomen, long wing 380

Narrow abdomen, vestigial wing 396
Broad abdomen, vestigial wing 14
Narrow abdomen, long wing 10
Calculate distance in units between the genes for abdomen width and wing length.

5. In an oil seed plant, the allele for tallness is dominant over that for dwarfness. Mean while, the allele for chlorophyll production and non-chlorophyll show incomplete dominance. The heterozygote plants are variegated.
(a) Using suitable symbols, carry out a cross between a tall plant with green leaves and a dwarf plant with variegated leaves, to show the genotypes and phenotypes of the offsprings.
(b) Explain why 25% of the offsprings of the cross in (a) would fail to survive.

6. In an animal species, individuals that are homozygous for gene **A** or its allele dies. An another independent gene **B** in the homozygous state, blocks this lethal effect, otherwise gene **B** has no other effect on the organism.
(a) Work out the expected phenotypic ratio of viable offsprings in a cross of individuals of **AaBb** and **AaBB** respectively.
(b) State the type of gene interaction in (a) above.

7. In cats, short hair is dominant over long hair. The gene involved is autosomal. Another gene which is sex linked produces hair colour. Its alleles produce black or white coat colour and the heterozygote combination produces tortoise shell coat colour.
(a) If a long-haired black male is mated with tortoise shelled female homozygous for short hair. What kind of offsprings will be produced in F1?
(b) (i) If the F1 cats are allowed to interbreed freely among themselves, what are the chances of obtaining long haired males?
(ii) Apart from being sex linked, what else can you say about the inheritance of the gene for coat color?
(c) Using suitable examples, describe the common effects of mutations.

8. (a) What is meant by the term ***epistasis***?
(b) A walnut comb rooster was mated with three hens. Hen **A**, which is pea combed, produced offsprings in a ratio of 3 walnuts: 3 pea combs: 1 rose comb: 1 single comb. Hen **B**, which is walnut combed produced offspring in the ratio of 3 walnut combs: 1 rose comb. Hen **C**, which is walnut-combed has only walnut combed offspring. Determine the genotype of the three hens, **A**, **B** and **C** and that of the walnut-combed rooster. Show your working.

9. Both hemophilia and colour blindness are transmitted the same way.
(a) State the effects of each disease.
(b) Describe the transmission of the diseases.
(c) Explain why there are more colour blind individuals than hemophiliacs among the human population inspite of the similar way of transmission.

10. In cats, males are **XY** and females are **XX**. A gene on X chromosome controls fur colour in cats. The allele **G** codes for ginger fur while allele **B** codes for black fur. These alleles are codominant. Heterozygous females have ginger and black patches of fur and their phenotype is described as tortoise shell.
(a) Explain;

(i) What is meant by ***codominant*** alleles?
(ii) Why male cats with tortoise shell do not usually occur.

(b) A tortoise shelled female was crossed with a black male. Use a genetic diagram to show all the possible genotypes and the expected offspring phenotype ratio from this cross.

11. (a) Distinguish between **aneuploidy** and **polyploidy**.
(b) How does polyploidy lead to
(i) variation in species?
(ii) sterility in species?
(c) Why is polyploidy more common in plants than animals?

12. (a) Distinguish between **gene mutation** and **genetic disorders.**
(b) Explain why;
(i) some mutations persist in human population through generations and yet they are harmful when expressed while others are not transmitted to the next generation.
(ii) incidences of antibiotic resistance have increased in pathogenic bacteria.
(c) Explain the significance of mutations in agriculture.

13. (a) Describe how abnormal haemoglobin arises in the human population.
(b) Explain the;
(i) effects of the gene for abnormal haemoglobin in humans
(ii) prevalence of sickle cell trait in tropics.

14. (a) What is meant by the term **variation**?
(b) With suitable examples, describe the different types of genetic variation.
(c) Explain how each of the following causes variation in sexually reproducing organisms.
(i) Crossing over during meiosis
(ii) Independent assortment of chromosomes during meiosis
(iii) Mutation
(d) In what way may variation resulting from gene reshuffling differ from that caused by mutation.
(e) (i) Why do commercial crop varieties have a relatively uniform genotype?
(ii) How disadvantageous is the growing of a crop with relatively uniform genotype?

15. In poultry, feather colour is controlled by two sets of alleles W (white) dominant over w(coloured) and B(black) dominant over b (brown). A fowl heterozygous for both alleles(WwBb) is white.
(a) Explain why the genetic constitution of WwBb is white.
(b) Work out to show the phenotypic ratio of crossing a white cock (WwBb) with a brown hen.
(c) State the possible genotypes of a black fowl.

16. (a) How is sex determined in humans?
(b) A woman has four sons, one of whom is a hemophiliac and the other three are normal
(i) What are the possible genotypes of the woman and her husband?
(ii) Is it possible for the couple to have a hemophilic daughter, Explain your answer?

(c) Why are sex linked traits most common in males among humans?

17. (a) State the ***Hardy-Weinberg equilibrium*** principle.

(b) Derive the **Hardy-Weinberg** equation from first principles.

(c) (i) Explain how the gene frequency of a population may be altered.

(ii) The frequency of cystic fibrosis in the human population is approximately I birth in 2000. Cystic fibrosis is caused by a recessive allele.
Using Hardy-Weinberg formula, determine the percentage of the population who are;

- Heterozygous for the dominant allele.
- Homozygous for the dominant allele.

18. (a) What is meant by the following terms.

(i) Deme
(ii) Gene pool
(iii) Genetic drift

(b) Brown eyes in human population is caused by a dominant allele. If in a population 84% of the people have brown eyes, using Hardy Weinberg formula, determine the percentage of the population who are

(i) heterozygous for eye colour. Show your working.
(ii) homozygous dominant for eye colour. Show your working

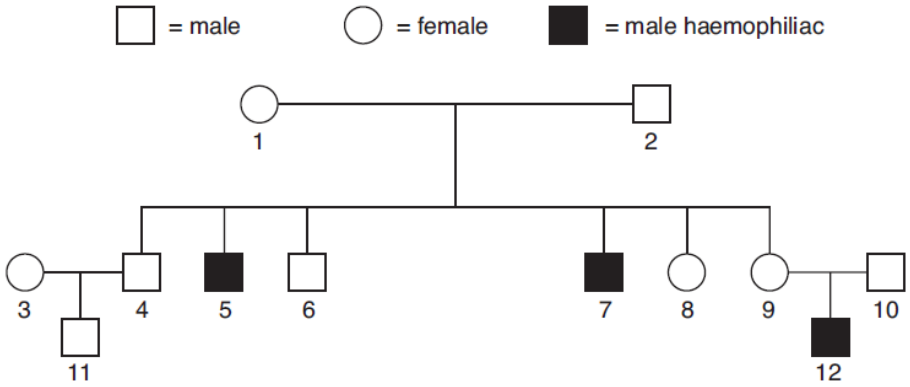
(d) How can the genetic equilibrium of population be upset?

(e) Explain why it is difficult to eliminate recessive alleles from a population.

19. (a) Explain how each of the following may alter the gene frequency.

(i) Closeness of population
(ii) Small population size
(iii) Non-random mating

(b) Figure below shows occurrence of haemophilia in one family.



(i) State the genotypes of individuals 1,2 ,5, 6 and 9.

(ii) What is the probability that individual 8 is a carrier of haemophilia?

(iii) Work out the possible genotypes of offsprings produced when individual 6 marries a carrier female.

(iv) Explain the difference in the existence of haemophilia in males and females.

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