QUESTION BANK PART II BIOLOGY

Chapter 22

Short questions:

1. What is Bombay phenotype? (LB-2016, 2017)

Bombay Phenotype: Some persons may be genotypically of blood type A, B or AB but phenotypically of blood type, O. Such a phenotype is called Bombay Phenotype. These persons lack a glycoprotein which helps A and B antigen to adhere on RBCs

2. What is MODY? (LB-2008, 2015, 2016)

MODY: It stands for Maturity Onset Diabetes of the Young. It is an autosomal dominant trait. It is caused by mutation in gene for glucokinase enzyme, which converts glucose to glucose-6-phosphate, in pancreas.

3. What is SRY gene? How it is transferred? (LB-2011)

SRY Gene: In human beings, SRY is the male determining gene. It is located at the tip of short arm of Y chromosome. Its name SRY stands for Sex determining Regions of Y. It is male sex switch which triggers the developmental process towards maleness after 6 week pregnancy.

4. What are the genes and alleles? (LB-2016)

Gene: gene is the basic unit of biological information. It is a particular sequence of DNA nucleotides on a chromosome that encodes a protein, tRNA to rRNA molecules.
Allele: The partners of a gene pair are called alleles. They occupy same gene locus. Both alleles may be identical or different from each other.

5. What is a nullo gamete?

A gamete without any sex chromosome is called nullo gamete.

6. What do you know about hypophosphatemic rickets?

X-linked dominant inheritance: X. linked dominant traits are more common in female than in males. All the daughters of an affected father, but none of his sons are affected. Any heterozygous affected mother will pass the trait equally to half of her sons and half of her daughters. Example, Hypophosphatemic rickets

7. What is testicular feminization syndrome?

Testicular Feminization Syndrome: It is a rare x-linked recessive trait. Individuals have XY chromosomes but tfm gene on their X-chromosome develops them physically into females. They have breast, female genitalia, a blind vagina but no uterus. They are happily married as females but are sterile.

8. What are pseudoautosomal genes?

Pseudo autosomal traits: Genes of some traits are present on both X and Y chromosomes. These are called X- and Y-linked genes. These are also called pseudo autosomal genes / traits because their pattern of inheritance is like autosomal genes/traits.

9. What is haemophilia?

Haemophilia is a mostly inherited genetic disorder that impairs the body's ability to make blood clots, a process needed to stop bleeding.

10. What is the role of blood groups in establishing parentage? (LB-2010)

The blood groups are controlled by genes and these genes start their expression at early embryonic stage and keep on expressing themselves till death. Therefore the blood group phenotype of a person never changes.

11. What is meant by universal blood donor and universal recipient?

Universal Blood Donors: A person with blood group O can donate blood to persons with blood group O. But phenotype O can also be used as donor for small transfusion to A, B and AB recipients, because donor's antibodies are quickly absorbed by other tissues or greatly diluted in recipient's blood stream. As they can donate to all groups (A,B,AB,O), so are called universal donors. While AB+ is universal recipient.

12. What are X-linked and Y-linked genes? Give one example of both.

X- linked A trait whose gene is present on X-chromosome only is called X-linked or sex-linked trait. X-linked traits pass in a criss-cross fashion from maternal grandfather through his daughter to the grandson e.g. hemophilia, color-blindness.

Y-linked traits: Y-chromosome also carries few genes which have no counterpart on X-chromosome. Such genes are called Y-linked genes and their traits are called Y-linked traits. These traits directly pass through Y-chromosome from father to son only e.g. SRY gene for maleness.

13. What is crossing over? What is its importance? (LB-2013)

Crossing over: is an exchange of segments between non-sister chromatids of homologous chromosomes during meiosis. Crossing over produces genetic variations among offspring and provides raw material for evolution.

14. What is bean-bag genetics? (OR) What is a gene pool? (OR) Differentiate between gene and gene pool. (LB-2014)

Gene pool: All the gene/Alleles found in a breeding population at a given time are collectively called the gene pool. It is the total genetic information encoded in the total genes in a breeding population existing at a given time.

15. What is meant by erythroblastosis foetalis? (OR) Why erythroblastosis foetalis is called so? (OR) How does ABO incompatibility protect the developing baby against Rh-incompatibility? (LB-2011, 2012)

Protection of baby against Rh-incompatibility:

- The blood of such babies should be immediately replaced by Rh-ve blood free of Anti-Rh antibodies.
- To avoid Rh-incompatibility for the next foetus, mother is given an injection of Rh-antiserum immediately after birth and during early pregnancy.

16. What is meant by linkage, linked genes and linkage groups? (OR) What is a linkage group? (OR) Define linkage group by giving example. (OR) What are linkage groups? Give their number in human beings. (OR) Define gene linkage and gene linkage groups (LB-2018, 2021)

Gene Linkage: All the genes located on the same chromosome are linked to each other. This phenomenon of staying together all the genes of a chromosome is called gene linkage. e.g. man has 23 linkage groups. Linked genes do not obey the law of independent assortment.

17. What is test cross? Why did Mendel suggest this cross? (OR) Give the significance of test cross. (OR)
What is test cross? Give its uses. (LB-2011, 2012, 2013, 2018)

Test cross: It is a mating in which an individual showing a dominant phenotype is crossed with an individual showing its recessive phenotype. The test- cross finds out the homozygous or heterozygous nature of the genotype.

18. What is the difference between heterogametic and homogametic individuals? (OR) What is heterogametic individual? Give example. (LB-2018)

Homogametic: Individuals which produce only one type of gametes are called homogametic e.g. in human, and birds females are homogametic because they produce only one type of eggs all carrying X-chromosome along with autosomes.

Heterogametic: Individuals which produce two types of gametes are called heterogametic e.g. In humans, males are heterogametic as they produce two types of sperms half with X-chromosome and half carrying Y-chromosome along with autosomes.

19. What are compound sex chromosomes and their example? (LB-2013)

Sex-Chromosome: Chromosomes which are different in males and females of a species with reference to number of chromosomes or morphology of chromosome are called sex-chromosome e.g. in humans, females have XX and males have XY.

20. Compare monohybrids with dihybrids. (LB-2021, 2015)

Monohybrid: A cross between the individuals of the same species, considering one pair of contrasting trait is called monohybrid cross. e.g. cross between a tall and short pea plant.

Dihybrid: A cross between the individuals of the same species considering two pairs of contrasting traits is called a dihybrid cross. e.g. cross between a Round Yellow seeded and wrinkled green seeded pea plants.

21. Define laws of Mendel. (OR) Define Mendel's law of segregation (law of purity of gametes). (OR) Define law of segregation. (LB-2015, 2018)

Law of Segregation: According to this law, the two co-existing alleles of each trait in an individual segregate from each other at meiosis, so that each gamete receives only one of

the two alleles. Alleles unite again at random fertilization of gametes when zygote is formed.

22. Differentiate between phenotype and genotype. (OR) What is the difference between phenotype and genotype? (LB-2014)

Phenotype: The physical appearance of an individual for a trait is called phenotype e.g. tallness, seed color of pea plants.

Genotype: The genetic complement or genes in an individual for a particular trait e.g. TT or Tt for pea plant height.

23. Differentiate between incomplete dominance and co-dominance. (LB-2012)

Incomplete Dominance: When the phenotype of the heterozygote is intermediate between the phenotype of the two homozygotes, it is called incomplete dominance e.g. in 4,O, clock plants when red (R1R1) and white (R2R2) are crossed, an intermediate pink flower (R1R2) is produced.

Co-Dominance: Co-dominance occurs when both the alleles express independently in heterozygote and form the respective products. e.g. in ABO blood group system Allele IA and IB are co-dominant.

24. Differentiate between autosomes and sex-chromosomes. (LB-2019)

Autosomes: Any eukaryotic chromosome other than sex chromosome is called autosomes. Autosomes are present in the same number and kind in both males and females of the species e.g. human have 44 autosomes in 22 pairs.

Sex-Chromosome: Chromosomes which are different in males and females of a species with reference to number of chromosomes or morphology of chromosome are called sex-chromosome e.g. in humans, females have XX and males have XY.

25. Differentiate between gene and genome.

Gene: gene is the basic unit of biological information. It is a particular sequence of DNA nucleotides on a chromosome that encodes a protein, tRNA to rRNA molecules.

Genome: The genetic material of an organism is called genome.

26. Differentiate between homozygous and hemizygous.

Homozygous /True Breeding: The individual having two identical alleles of the same gene e.g. for a locus W the genotype W/W or w/w is a homozygous condition.

Hemizygous: Individuals carrying only one allele for a trait are called hemizygous. e.g. allele for hemophilia in human is located on X-chromosome. Males have only one X-chromosome thus have only one allele. So human males are hemizygous for hemophilia.

27. Differentiate between homozygous and heterozygous. (LB-2011, 2014, 2016)

Homozygous /True Breeding: The individual having two identical alleles of the same gene e.g. for a locus W the genotype W/W or w/w is a homozygous condition.

Heterozygous: The individual having two different alleles of the same gene e.g. for a locus W, the genotype W/w is a heterozygous condition.

28. Differentiate between dominant trait and recessive trait.

Dominant Trait/Allele: An allele that is expressed both in heterozygous and homozygous condition, is called dominant allele. e,g Pea plant height.

Recessive allele: An allele that is expressed only in homozygous form, but in heterozygous form it is masked by the other allele and does not express itself is called recessive allele e.g dwarfness in pea plant.

29. Differentiate between X-linked and Y-linked traits.

X- linked / sex-linked traits: A trait whose gene is present on X-chromosome only is called X-linked or sex-linked trait. X-linked traits pass in a criss-cross fashion from maternal grandfather through his daughter to the grandson e.g. hemophilia, color-blindness

Y-linked traits: Y-chromosome also carries few genes which have no counterpart on X-chromosome. Such genes are called Y-linked genes and their traits are called Y-linked traits. These traits directly pass through Y-chromosome from father to son only e.g. SRY gene for maleness.

30. Differentiate between X-linked dominant and X-linked recessive traits. (LHR- 2021)

X-linked dominant inheritance: X. linked dominant traits are more common in female than in males. All the daughters of an affected father, but none of his sons are affected. Any heterozygous affected mother will pass the trait equally to half of her sons and half of her daughters. Example, Hypophosphatemic rickets

Hemophilia is an X-linked recessive trait. These are always more common in males than in females.

31. Differentiate between IDDM and NIDDM.

IDDM: It stands for Insulin Dependent Diabetes Mellitus. It is diabetes type I disease. It is a multifactorial disease in which body`s own immune system destroy Beta-cells of pancreas. So pancreas does not produce insulin. Diabetics of type I must receive exogenous insulin. It is also called juvenile diabetes as it onsets before 40.

NIDDM: It stands for Non-Insulin Dependent Diabetes Mellitus. It is also called Diabetes type II. These produce endogenous insulin but their body cells do not respond to insulin, and do not take up glucose from blood. It mostly occurs over the age of 40 but some may get before 25 as in case of MODY.

32. Differentiate between multifactorial and polygenic traits.

Multi factorial Trait: Such traits which are controlled by polygenes and also show environmental influences on its expression e.g. blood pressure, diabetes, etc.

A polygenic trait is one whose phenotype is influenced by more than one gene.

33. Differentiate between probability and product rule. (LB-2008)

Probability: is the chance of an event to occur. e.g. in Mendel's monohybrid cross, the chance of Round seed in F2 was ¾ and that of wrinkled seed was 1/4.

Product Rule: When two independent events are occurring simultaneously like in dihybrid cross, the ratio of each joint phenotypic can be obtained by multiplying the probabilities of individual phenotypes. It is called the product rule.

e.g	Round	Yellow	Round Yellow
	3/4	3 / 4	(3/4 x 3/4) = 9/16

34. Differentiate between protanopia, deuteranopia and tritanopia.

Protanopia is a deficiency in colour vision in which those affected are insensitive to red light and confuse red, yellow, and green colours.

deuteranopia is a form of color blindness in which the retina is deficient in or lacks cone cells containing opsins that respond to the color green, resulting in an inability to distinguish red from green.

tritanopia in contrary to red-green color blindness tritan defects are autosomal and encoded on chromosome 7.

35. Differentiate between allele and multiple alleles? (OR) What are multiple alleles? Give example. (LB- 2014)

Allele: The partners of a gene pair are called alleles. They occupy same gene locus. Both alleles may be identical or different from each other.

Multiple alleles: When there exists more than two alternate forms of a gene, it is called multiple alleles. Such forms arise by gene mutations.

36. Differentiate between dominance and epistasis. (OR) What is epistasis? How it differs from dominance? (LB-2010, 2012, 2018)

Dominance: Dominance is physiological effect of an allele over its partner allele on the same gene locus. e.g gene for round seed shape is dominant over wrinkled seed shape.

Epistasis: (LHR-2010). When an effect caused by a gene or gene pair at one locus interferes with or hides the effect caused by another gene or gene pair at another locus, such a phenomenon of gene interaction is called epistasis. e,g Bombay phenotype

37. Differentiate between sex-limited and sex-influenced traits. (OR) What are sex-limited traits? (OR) What are sex-influenced traits? (OR) What is the sex-limited traits? Give an example. (LB-2008, 2009, 2013, 2017, 2018)

Sex limited trait: A sex limited trait is limited to only one sex due to anatomical differences either in males or in females e.g. milk yield in dairy cows, beard growth in men. (RWP-2008)

Sex influenced trait: Sex influenced trait occurs in both males and females but it is more common in one sex. It is controlled by an allele which is dominant in one sex and recessive in other due to hormonal differences. e.g. pattern baldness in humans.

38. Distinguish between polygenes and pleiotropy. (OR) Define pleiotropy. (OR) What is pleiotropy and its example? (LB-2013)

Pleiotropy: When a single gene affects two or more traits, the phenomenon is called pleiotropy e.g. genes that affect growth rate in human also influence both weight and height.

39. Give the concept of fixed allele. (LB-2012)

A fixed allele is an allele that is the only variant that exists for that gene in all the population. A fixed allele is homozygous for all members of the population. The term allele normally refers to one variant gene out of several possible for a particular locus in the DNA.

40. The value of parental combination of two linked gene AB and ab is 40, 40 and of recombinant gene Ab and aB is 10, 10 respectively. Find recombination frequency. (LB-2010)

It is the proportion of recombinant types between two gene pairs as compared to the sum of all combinations

$$\text{Recombination Frequency} = \frac{\text{Recombination types}}{\text{Sum of all combinations}} \times 100$$

$$\text{Recombination Frequency} = \frac{10+10}{(40+40+10+10)} \times 100$$

$$= 20\%$$

41. How is blood pressure as a multifactorial trait? (LB-2019)

Blood pressure is a multifactorial trait.

There is a correlation between systolic and diastolic blood pressure of parents and their children. This correlation is due to genes common in them. .

Environmental factors like diet, stress and tension also influence the blood pressure. That's why blood pressure a multifactorial trait.

42. Write formula to calculate recombination frequency. (LB-2019)

Cross Over or Recombination Frequency:

The proportion of recombinant types between two gene pairs as compared the sum of all combinations is called cross over or recombination frequency: