Genetics Concept Questions

1. Explain why it is fair to say that serendipity played a big part in Mendel's choice of the garden pea.   (They were available to him and are easy to grow. They are large and easy to see and had traits that showed simple inheritance)

2. Explain how the dominant phenotype can have more than one genotype. (A dominant phenotype would result if a person were heterozygous or homozygous dominant.)

3. A mother has two alleles for a given trait. State the number of alleles for the trait she would give to an offspring. Identify the principle of genetics that describes this.   (She gives only 1 because alleles are separated according to the law of segregation.)

4. Plants grown by vegetative propagation (*i.e.*, by cuttings) have exactly the same traits as the parent plants. Plants grown from seeds may vary from the parent plants in many ways. Explain these two observations.   (Vegetative propagation is asexual.)

5. Describe the relationship between genes, proteins and heritable traits.   (A gene is the section of DNA that provides the instructions for making one protein. Genes are passed from one generation to the next as the units of heredity.)

6. Identify the principle of genetics that states the inheritance of one characteristic does not affect the inheritance of another.   (independent assortment)

7. A student claims the height of a pea plant affects the color of its flowers. Provide reasoning to support or refute this claim.   (The law of independent assortment states that traits are inherited separately unless they are on the same chromosome.)

8. A student claims an individual can be heterozygous for a trait and show the recessive phenotype. Provide reasoning to support or refute this claim.   (This is not possible. The dominant allele results in the dominant phenotype.)

9. Of all the chromosomes in one of your cells, half came from each of your parents. Identify the fraction that came from each of your grandparents.   (1/4) Identify the fraction that came from each of your great-grandparents.   (1/8)

10. In a cross between a homozygous dominant and a homozygous recessive parent, there are 32 offspring in the F_2 generation. Predict the number of offspring you would expect to show the recessive trait.   (8)

11. a) Describe a test cross and why it would be used.   (A cross between an unknown genotype and a homozygous recessive is called a test cross and it reveals the genotype of the unknown individual.)
    b) Explain the two possible outcomes and what it tells you.   (If all offspring show the dominant phenotype, the unknown parent is homozygous. If some offspring show the recessive phenotype, the unknown parent must be heterozygous.)

12. In sheep, white coat is dominant. Black is recessive. Occasionally, a black sheep appears in a flock. Black wool is worthless. Describe how a farmer could eliminate the genes for black coat from the flock.   (The farmer should eliminate from the flock both parents and all offspring whenever a black sheep appears.)

13. In a certain animal, one variety always has a hairy tail while another always has a naked tail. Explain how you would determine which trait is dominant. (Cross the two breeds. The trait that is most common in the resulting offspring is the dominant trait.)

14. A couple has three sons and one daughter. Calculate the probability that a fifth child will be female. Provide reasoning for your response. (1/2; these are independent events)

15. Explain how probability can be used in genetic counseling. (It can be used to predict the outcome of crosses and to give advice to parents.)

16. Explain why a large sample is more statistically reliable than a small sample. (Irregularities are not as significant in a large sample.)

17. A white cow and a red bull mate and produce a roan calf.
    a) State the genotype of the roan calf. (The roan is heterozygous.)
    b) Predict whether a roan cow and roan bull can mate and produce all roan calves. Provide reasoning for your prediction. (Two roan parents can produce all roan offspring if they produced all heterozygous offspring. The expected ratio, however, would be 1:2:1.)

18. A flower grower is looking for new varieties of petunias. He crosses a yellow flower plant with a blue one and gets green flowered plants. Explain how this is possible. (The inheritance must be incomplete dominance.)

19. Mary has blood type A and she marries John, whose blood type is B. They have three children: Joan, James and Pete. Joan has blood type O, James has blood type A, and Pete has blood type B. Explain how this is possible. (Mary and John are both heterozygous.)

20. A man with type O blood marries a woman who is heterozygous for type B blood.
    a) Predict the probability of them having a child with type B blood. (1/2)
    b) Predict the probability of them having a child with type O blood. (1/2)

21. Mr. and Mrs. Doe had a child named Flo at the same time Mr. and Mrs. Roe had their son Joe. The Roes took Joe home, and after looking at him they claimed that Joe was not their child. They were going to sue the Hospital for the mix up. The Hospital took the blood types of all six individuals to try and prove there was no mix up. The results of the tests were as follows: Mr. Roe had A blood type; Mrs. Roe had A blood type; Joe had O blood type; Mr. Doe had O blood type; Mrs. Doe had AB blood type and Flo had A blood type. Provide reasoning to support or refute the Roes' claim that Joe was not their child. (Mrs. Doe could not have a child with type O blood because she must always donate either A or B.)

22. Huntington's chorea is a dominant neurological disorder that usually appears when a person is between 35 and 45 years of age. Many people with Huntington's chorea, however, do not show symptoms until they are well into their sixties. Explain how the slow development of the disease explains why it has not been eliminated by natural selection. (If the disease does not affect you until after you have reproduced then it is too late - it has already been passed to offspring.)

23. Provide a reason for the importance of identifying the alleles which cause genetic disorders. (This allows us to study the gene/allele for treatment or prevention and to provide predictions and counseling to couples who may carry it.)

24. In most cultures, it is unacceptable to marry your immediate relatives. Using the principles of genetics, explain why inbreeding in humans is discouraged.   (The presence of recessive alleles in heterozygous individuals is masked by the presence of dominant alleles. In matings between close relatives (who may carry the same recessive alleles) the chance of producing homozygous recessive offspring increases.)

25. a) Explain what is meant by saying that genes are linked.   (It means they are inherited together.)
    b) Identify the law of inheritance that linked genes violate.   (This seems to defy the law of independent assortment.)

26. Describe the cause of incomplete linkage.   (During crossing over, pieces of chromosomes switch places meaning alleles can be separated.)

27. Propose a reason for the observation that there are more males with sex-linked genetic disorders than females.   (Males have only one X chromosome so if they have a recessive allele they will show the phenotype.)

28. For humans, identify which parent determines the sex of the offspring. Provide reasoning for your response.   (The male because the female can only donate X.)

29. While examining a population of fruit flies, you notice that a certain trait never appears in males. Provide reasoning to explain this observation.   (The phenotype could be caused by sex-linked alleles in the heterozygous condition which is not possible in males (*e.g.*, Calico color in cats). It could be a sex-linked trait with the recessive allele being lethal but the heterozygotes being less severely affected (*e.g.*, sickle cell anemia (though it is not sex-linked)).)