

## Sex Determination and Sex Chromosomes

1) The *Lygaeus* mode of sex determination is the \_\_\_\_\_.

- A) XY/XX scheme
- B) XX/XO scheme
- C) XO/YY scheme
- D) hermaphroditic scheme
- E) scheme based on single translocations in the X chromosome

2) The sex of birds, some insects, and other organisms is determined by a ZW chromosomal arrangement in which the males have the same sex chromosomes (ZZ) and females are ZW (similar to XY in humans). Assume that a recessive lethal allele on the Z chromosome causes death of an embryo in birds. What sex ratio would result in the offspring if a cross were made between a male heterozygous for the lethal allele and a normal female?

- A) 4:1 male to female
- B) 2:1 male to female
- C) 3:1 male to female
- D) 1:2 male to female
- E) 1:1 male to female

3) A recessive gene for red-green color blindness is located on the X chromosome in humans. Assume that a woman with normal vision (her father is color blind) marries a color-blind male. What is the likelihood that this couple's first son will be color blind?

- A) 0%
- B) 25%
- C) 50%
- D) 75%
- E) 100%

4) One form of hemophilia is caused by a sex-linked recessive gene. Assume that a man with hemophilia marries a phenotypically normal woman whose father had hemophilia. What is the probability that they will have a daughter with hemophilia?

- A) 1/16
- B) 1/8
- C) 1/4
- D) 1/2
- E) 3/4

5) Assume that a man who carries an X-linked disease allele has children. Assuming normal meiosis and random combination of gametes, the man would pass this allele to \_\_\_\_\_.

- A) half of his daughters
- B) all of his daughters
- C) all of his sons
- D) half of his sons
- E) all of his children

6) Give the sex of the following organisms assuming that the autosomes are present in the normal number.

<i>Sex Chromosome Complement</i>	<i>Humans</i>	<i>Organism Drosophila</i>
XX	_____	_____
XY	_____	_____
XO	_____	_____
XXX	_____	_____
XXY	_____	_____

## Extranuclear Inheritance

9) To which of the following does the term *heteroplasmy* refer?

- A) cells with a variable mixture of normal and abnormal mitochondrial genomes
- B) heterozygous individuals with more than one gene pair involved
- C) conditions in which the germ plasm is a mixture of dominant and recessive genes
- D) a circumstance that is homologous to incomplete dominance
- E) various stages of development of mitochondria and chloroplasts

10) Approximately one in 5000 humans either have a mitochondrial DNA disorder or are at risk for developing such a disorder. What future approach involving nuclear transplantation might be available to treat mtDNA-based human disorders?

- A) nuclear disintegration
- B) mitochondrial swapping
- C) nuclear activation
- D) mitochondrial activation
- E) mitochondrial suppression

11) Direction of shell coiling in *Lymnaea peregra* is strongly and most directly influenced by\_\_\_\_\_.

- A) the genotype of the mother
- B) the genotype of the father
- C) the phenotype of the mother
- D) the phenotype of the father
- E) the genotype of the embryo itself

12) Through the study of mitochondrial disorders, scientists have suggested a link between the decline of mitochondrial function and aging. What process appears to be involved in this suspected phenomenon?

- A) accumulation of sporadic mutations in the nuclear genome
- B) decline of mutations in the nuclear genome
- C) accumulation of mutations in the mtDNA
- D) recombination of mtDNA and nuclear DNA
- E) recombination among mtDNAs of different mitochondria

13) Researchers in the late 1950s isolated multiple antibiotic-resistant strains of the bacterium *Shigella*, which causes dysentery. Such resistance was caused by nonchromosomal R factors that originated in *E. coli*. Which of the following forms of extrachromosomal heredity would you consider most closely related to the transfer bacterial antibiotic-resistant strains?

14) How are reciprocal crosses used to identify cases of extrachromosomal inheritance? What criteria would one use to state that a particular mode of inheritance is extrachromosomal?

15) Which three classes of macromolecules are encoded by mtDNA?

## Population and Evolutionary Genetics

17) What term is given to the total genetic information carried by all members of a population?

- A) gene pool
- B) genome
- C) chromosome complement
- D) breeding unit
- E) race

18) A number of mechanisms operate to maintain genetic diversity in a population. Why is such diversity favored?

- A) Homozygosity is an evolutionary advantage.
- B) Diversity leads to inbreeding advantages.
- C) Genetic diversity may better adapt a population to inevitable changes in the environment.
- D) Greater genetic diversity increases the chances of haploidy.
- E) Genetic diversity helps populations avoid diploidy.

19) In a population of 100 individuals, 49% are of the NN blood type. What percentage is expected to be MN assuming Hardy-Weinberg equilibrium conditions?

- A) 9%
- B) 21%
- C) 42%
- D) 51%
- E) There is insufficient information to answer this question.

20) Albinism is an autosomal recessive trait in humans. Assume that there are 100 albinos ( $aa$ ) in a population of 1 million. How many individuals would be expected to be homozygous normal ( $AA$ ) under equilibrium conditions?

- A) 100
- B) 10000
- C) 19800
- D) 980100
- E) 999900

21) In small, isolated populations, gene frequencies can fluctuate considerably. The term that applies to this circumstance is \_\_\_\_\_.

- A) genetic isolation
- B) allelic separation
- C) natural selection
- D) stabilizing selection
- E) genetic drift

22) List at least five of the assumptions that pertain to a population in a Hardy-Weinberg equilibrium.

23) In a population of cattle, the following color distribution was noted: 36% red ( $RR$ ), 48% roan ( $Rr$ ), and 16% white ( $rr$ ). Is this population in a Hardy-Weinberg equilibrium? What will be the distribution of genotypes in the next generation if the Hardy-Weinberg assumptions are met?

- 24) List three factors that contribute to the phenomenon of natural selection.
- 25) Which term is given to the measure of the proportion of offspring that a particular phenotype will contribute to the next generation?
- 26) The difference between fitness of a given genotype and another genotype considered optimal is called the selection coefficient ( $s$ ). What is the selection coefficient for a genotype ( $aa$ ) that produces an average of 99 offspring when  $Aa$  individuals produce an average of 100 offspring?
- 27) Which would change allele frequencies more quickly: selection against a dominant allele or selection against a recessive allele?
- 28) What are the genetic consequences of inbreeding?
- 29) In the case of complete dominance in a population in equilibrium, we cannot tell which individuals are homozygous dominants and which are heterozygous, but by knowing the frequency of the homozygous recessives, we can estimate the frequency of homozygous dominant and heterozygous genotypes. True or false?
- 30) Given an inheritance pattern of incomplete dominance and 81 flowers that are red ( $R^1R^1$ ), 18 flowers that are pink ( $R^1R^2$ ), and 1 flower that is white ( $R^2R^2$ ), the frequency of the  $R^1$  allele is 0.9. True or false?
- 31) If a gene has three alleles in a population, their frequencies must add up to 1.5. True or false?
- 32) In *directional selection*, both phenotypic extremes are equally selected against. True or false?
- 33) Natural selection occurs when there is nonrandom elimination of genotypes from a population due to differences in viability or reproductive success. True or false?
- 34) Mutations are regarded as a strong evolutionary mechanism for changing allelic frequencies. True or false?
- 35) Genetic drift is primarily associated with relatively small breeding populations. True or false?
- 36) Inbreeding by itself can change gene frequencies. True or false?