

Select the letter of the most appropriate answer.

1. An organism that has a grandfather but no father is the
  - A. echidna.
  - B. drone honeybee.
  - C. oyster.
  - D. spinach.
  - E. tortoise-shell cat.
  
2. With 3 X chromosomes and 2 of each pair of the autosomes in *Drosophila*, the fly would be
  - A. a male.
  - B. a metafemale.
  - C. female.
  - D. triploid metamale.
  - E. an intersex.
  
3. Jimpy is a sex-linked recessive in the mouse, *Mus musculus*, characterized by muscular incoordination resulting in death at 3-4 weeks of age. Crosses between heterozygous females and normal males should produce progeny in which
  - A. half the females are jimpy.
  - B. half the males are jimpy.
  - C. all the males are jimpy.
  - D. half of each sex are jimpy.
  - E. none are jimpy.
  
4. Both sexes in Suffolk sheep lack horns. In Dorset sheep both sexes are horned. The F<sub>1</sub> rams in reciprocal crosses of these breeds have horns but the F<sub>1</sub> ewes lack horns. Therefore, the inheritance is:
  - A. holandric.
  - B. sex-linked.
  - C. sex-influenced.
  - D. sex-limited.
  - E. partially sex-linked.
  
5. The domestic pigeon, *Columba livia*, has three sex-linked alleles, BA (ash red), B+ (blue), and b (brown) in order of decreasing dominance. An ash red cock heterozygous for brown crossed with a blue hen would yield progeny including
  - A. 1/2 of the sons blue.
  - B. 1/2 of the daughters blue.
  - C. all daughters brown.
  - D. all sons ash red.
  - E. all three colors for sons as well as for daughters.

6. In the square-circle representation of human pedigrees a simple dominant is characterized by
- never skipping a generation.
  - being transmitted through any sex to any sex.
  - "criss-cross" inheritance.
  - breeding true when two individuals with the character have offspring.
  - both A and B are correct.
7. Reversion to the wild type (atavism) may occur in the  $F_1$  if
- single recessive mutant non-allelic stocks are crossed.
  - single dominant mutant non-allelic stocks are crossed.
  - recessive allelic stocks are crossed.
  - dominant allelic stocks are crossed.
  - any mutant stock is crossed with normal.
8. In pedigree analysis
- one of the  $P_1$  phenotypes always appears in the  $F_1$ .
  - the dihybrid  $F_2$  may include a new phenotype not encountered in the  $P_1$  or  $F_1$ .
  - each  $3/16$  frequency class of a dihybrid  $F_2$  always includes one mutant phenotype.
  - three gene pairs segregating and assorting independently as testcross results among the progeny, results in frequencies dealing in 64th.
  - the absence of wild type (normal or standard) does not interfere with conclusions.
9. Pick the false statement
- If mutant by mutant yields all normal  $F_1$ , any and all mutants involved are recessive and non-allelic.
  - If normal does not appear in a Mendelian  $F_2$ , then the mutants could be allelic.
  - If normal does not appear in a Mendelian  $F_2$  then the  $P_1$  stocks could be homozygous for a mutant held in common.
  - If normal does not appear in a Mendelian  $F_2$ , one may still determine the number of mutants from the frequencies.
  - Purebred stock, which does not breed true for that characteristic phenotype, most likely is heterozygous for a codominant.
10. Two genetically independent mutants in wheat, Triticum vulgare, act quantitatively to produce necrosis, but each is dependent on interaction with the other mutant to get any necrosis. The phenotypic  $F_2$  ratio is
- 15:1.
  - 11:5.
  - 9:6:1.
  - 9:3:4.
  - 1:4:4:7.

11. In purebred carnations, Dianthus armeria, there are 20-30 white spots per petal. D. deltoides similarly has 8-12 white spots per petal. F<sub>1</sub> from a species cross produced an F<sub>2</sub> with a range of 0-37 white spots per petal. This is an example of
- introgression.
  - quantitative inheritance.
  - transgressive variation.
  - variable expressivity.
  - all of these, if back crosses are included.
12. Suppose that in daffodils the F<sub>2</sub> distribution of trumpet length from a cross of Golden Triumph with Spring Delight varieties yielded 1/256 overlapping one parental type and 1/256 overlapping the other. By how many gene pairs would the two varieties differ for length of trumpet?
- 2
  - 4
  - 16
  - 64
  - 256
13. Color in Bengal tigers, Felis tigris, may be described as black stripes on a yellow background. A recessive "chinchilla" mutant has black stripes on a white background. From heterozygous parents, what is the probability that in a litter of four cubs two will be normal and two chinchilla?
- 81/256
  - 27/128
  - 41/2048
  - 1/256
  - none of these.
14. In the tiger problem, what is the probability that at least 3 offspring will be normal?
- 13/256
  - 81/256
  - 26/64
  - 189/256
  - 3/64
15. The most basic consequence of inbreeding is to
- make the progeny more homozygous than usual.
  - increase the occurrence of detrimental traits.
  - produce superior stock.
  - increase yield in production traits.
  - change the gene frequency.

16. A prairie flower, Liatris cylindracea, is self incompatible. The corms may live to over 44 years and can be "aged" by annual pigment rings. The surviving older plants are more heterozygous for 12 allozyme systems than younger plants. Among 2 year olds, those that flower in season are more heterozygous than non-flowering ones (Schaal & Levin, 1976, Amer. Nat. 110: 191-206). This is a good example in a natural population of
- founder effect.
  - genetic drift.
  - heterozygote advantage.
  - inbreeding.
  - Hardy-Weinberg population equilibrium.
17. The Hardy-Weinberg formula  $p^2 + 2pq + q^2 = 1$  fits (conforms to)
- phenotypic frequencies in the hemizygotic sex.
  - phenotypic frequencies in haploids.
  - genotypic frequencies in diploids.
  - gametic frequencies.
  - gene frequencies.
18. The white face pattern in Hereford cattle is considered a simple dominant to the normal solid or self color. In a random mating range herd, 16 animals are self colored out of a total of 400. How many cattle in this herd would be expected to be heterozygous for the gene for white face?
- 64
  - 80
  - 128
  - 256
  - 320
19. Horses exhibit two major types (A and B) of serum albumin in gel electrophoresis. They are controlled by codominant alleles. The Salernitana breed sampled (Italy) had 14 type A, 70 type AB and 63 type B. The frequency of the gene controlling type A is
- 10%
  - 33%
  - 48%
  - 67%
  - not calculable since the square root method cannot be used in codominance.
20. Albino fox squirrels, Sciurus niger, occur as a recessive mutant. During a period of predator absence the albino frequency in an island population reached 1/64. The hawks, pine martins etc. returned and took all the albinos before reproduction. How many albinos occurred the next generation?
- 1/8
  - 1/9
  - 1/64
  - 1/72
  - 1/81

21. Choose the correct statement.
- Linkage speeds up recombinations.
  - 2-point crossover values always exceed 50%.
  - Crossovers are unaffected by others on the same chromosome.
  - Only odd number of crossovers can be detected between 2 points (2 loci) on the same chromosome.
  - Crossing over occurs in the 2-strand stage of meiosis.
22. If one class from a dihybrid testcross of linked genes constitutes 32% of the progeny, then both crossover classes constitute about
- 100%
  - 64%
  - 36%
  - 32%
  - perhaps none of these, since one cannot predict 3 more classes from just one class.
23. Two linked dominant mutants in the silkworm, Bombyx mori, are striped larva and rusty cocoon. From the testcross data below what is the percent of crossing over?
- |        |                |    |
|--------|----------------|----|
| A. 74% | normal         | 22 |
| B. 39% | striped        | 51 |
| C. 26% | rusty          | 60 |
| D. 12% | striped, rusty | 17 |
- none of these
24. From the silkworm problem above the linkage phase of the F1 is
- $\frac{R \ S}{+ \ +}$
  - $\frac{+ \ S}{R \ +}$
  - $\frac{R \ +}{S \ +}$
  - $\frac{RS \ +}{+ \ +}$
  - $\frac{R \ S}{R \ S}$
25. In the sweet pea, Lathyrus odoratus, the testcross corrected two-point crossing-over values for cretin flower, light leaf axil, maroon flower, and sterile anthers are as below (Crane and Lawrence, 1938, Genetics of Garden Plants). The gene order is
- c-l-m-sa                      sa- 1    5%
  - l-m-sa-c                      sa- m   17%
  - l-c-m-sa                      m - 1   22%
  - c-m-l-sa                      l - c   26%
  - c-l-sa-m                      sa- c   31%

26. Given a trihybrid testcross of linked genes with alphabetical gene order and one double cross over class represented by a + +, then a parental or non-cross over class would be represented by
- A. a b +
  - B. a + c
  - C. + b c
  - D. a b c
  - E. + b +
27. The cytological picture of chromosomes is expected to show a synaptic loop in a heterozygous
- A. aneuploid.
  - B. deletion from the middle of a chromosome.
  - C. inversion.
  - D. position effect.
  - E. both B and C.
28. Pick the sex chromosome aneuploid condition in humans giving 2 Barr bodies.
- A. XO
  - B. XXX
  - C. XXY
  - D. XXYY
  - E. XYY
29. Polyploids are expected to
- A. be smaller than normal diploids.
  - B. be hexaploid in all food species.
  - C. give non-standard monohybrid ratios compared to diploid Mendelian results.
  - D. be sterile and seedless.
  - E. have normal disjunction if odd numbered sets of chromosomes are involved (e.g. 3n, 5n, 7n).
30. Aneuploids are represented by
- A. triploids.
  - B. domestic wheat.
  - C. colchicine doubled chromosomes.
  - D. trisomics.
  - E. supernumerary chromosomes.