Genetics (Biology 3416) Sample Problems

1. The cross *AaBb* x *AaBb* is called a

a. dihybrid cross; **b**. backcross; **c**. reciprocal cross; **d**. testcross; **e**. monohybrid cross

2. Assuming codominance for both genes, what is the phenotypic ratio of the offspring of the cross *AaBb x AaBb*?

a. 1:2:1:2:4:2:1:2:1; **b**. 9:4:1; **c**. 9:3:3:1; **d**. 3:6:3:1:2:1; **e**. 1:2:1

3. The cross *AaBb* x *aabb* is called a

a. dihybrid cross; **b**. backcross; **c**. reciprocal cross; **d**. testcross; **e**. monohybrid cross

4. Assuming complete dominance, what is the phenotypic ratio of the offspring of the cross *AaBb* x *aabb*?

a. 1:1; **b**. 3:1; **c**. 1:1:1:1; **d**. 9:3:3:1; **e**. 1:2:1

5. Corn has a color gene and a height gene with the following phenotypes: *CC* and *Cc*, purple; *cc*, white; *TT*, tall; *Tt*, medium; *tt*, dwarf. If a dihybrid is self-fertilized, what is the resulting phenotypic ratio?

a. 1:2:1:2:4:2:1:2:1; **b**. 2:3:6:3:2; **c**. 3:3:3:3:3:1; **d**. 3:6:3:1:2:1; **e**. 3:1

6. Mendel's work on the rules of inherited traits was not appreciated until it was rediscovered in 1900 because

a. his work lacked scientific controls;
b. he never published his work.
c. there was no known physical basis for Mendel's "gene" concept at the time.
d. it was found that Mendel cheated.
e. none of these choices

7. Full pod shape (*F*) is dominant to constricted pod shape (*f*), and yellow pod color (*Y*) is dominant to green pod color (*y*) in pea plants. A pure-breeding green plant with full pods is crossed with a pure-breeding yellow plant with constricted pods. The offspring are then testcrossed. What is the expected phenotypic ratio of the offspring?

a. 1:2:1; **b**. 3:1; **c**. 1:1:1:1; **d**. 9:3:3:1; **e**. 9:7

8. Full pod shape (*F*) is dominant to constricted pod shape (*f*), and yellow pod color (*Y*) is dominant to green pod color (*y*) in pea plants. What is the genotype of a yellow plant with a constricted pod?

a. *FFYY;* **b**. *ffYY;* **c**. *Ffyy;* **d**. *ffyy;* **e**. two of these choices

9. How many different phenotypes can be expressed in a character controlled solely by a one gene, two-allele system, in which the alleles are codominant?

a. one; **b**. two; **c**. three; **d**. five; **e**. ten

10. A woman of blood type O has a type O child. A man of which blood type could have been the father?

a. A; **b**. B; **c**. AB; **d**. O; **e**. more than one of these

11. Which of the following could be the blood type of a father of a type A child with an AB mother?

a. A; **b**. B; **c**. O; **d**. two of these choices; **e**. all of these choices

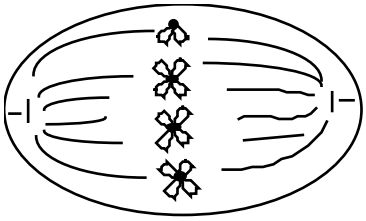
12. How many tetrads are there in metaphase I of meiosis in human beings?

a. 2; **b**. 22; **c**. 23; **d**. 46; **e**. 92

13. Segregation and independent assortment (as defined by Mendel) occur during

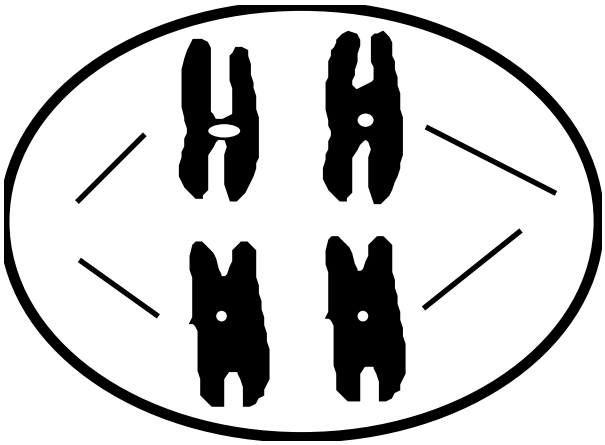
a. metaphase of mitosis; **b**. metaphase of meiosis I; **c**. anaphase of meiosis I;
d. anaphase of meiosis II; **d**. metaphase of meiosis II.

14. Identify the stage of cell division and the diploid number of the cell in figure below.



a. metaphase of mitosis, $2n = 4$; **b**. metaphase I of meiosis, $2n = 4$
c. metaphase I of meiosis, $2n=8$; **d**. metaphase II of meiosis, $2n=4$
e. none of these choices

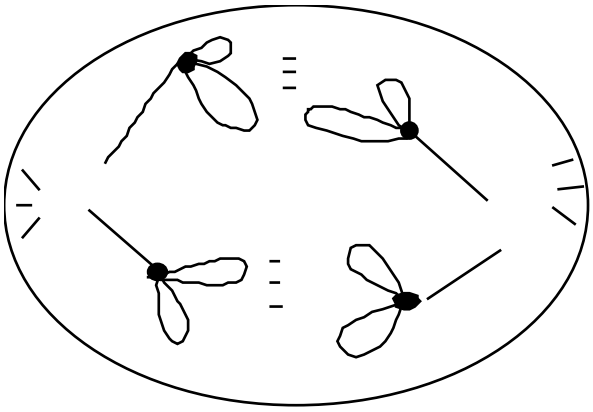
15. Identify the stage of cell division and the diploid number of the cell in figure below.



a. metaphase of mitosis, $2n = 4$
b. metaphase I of meiosis, $2n = 2$

c. metaphase I of meiosis, 2*n* = 4
d. metaphase II of meiosis, 2*n* = 4
e. none of these choices

16. What process and what ploidy number of the parent organism are shown in the cell in below?



a. mitosis, 2*n* = 4; **b**. mitosis, 2*n* = 8; **c**. meiosis I, 2*n* = 2; **d**. meiosis I, 2*n* = 4;
e. meiosis II, 2*n* = 4

17. How many chromosomes (as opposed to chromatids) are there in metaphase II of meiosis in human beings?
a. two; **b**. twenty-two; **c**. twenty-three; **d**. forty-six; **e**. ninety-two

18. The stage between mitoses in eukaryotic cells is called
a. prophase; **b**. interphase; **c**. telophase; **d**. cytophase; **e**. none of these choices

19. A dihybrid plant was crossed; the F2 generation consisted of: 860 tall plants with purple flowers; 285 dwarf, purple plants; 340 tall, pink plants; and 115 dwarf, pink plants. The data remind you of a 9:3:3:1 ratio. What is the chi-square value in the test of this hypothesis?
a. 0.377; **b**. 7.5; **c**. 10.11; **d**. 11.08; **e**. 15.78

20. A dihybrid plant was crossed; the F2 generation consisted of: 860 tall plants with purple flowers; 285 dwarf, purple plants; 340 tall, pink plants; and 115 dwarf, pink plants. The data remind you of a 9:3:3:1 ratio. How many degrees of freedom apply to the test of this hypothesis?
a. zero; **b**. one; **c**. three; **d**. four; **e**. 15

21. A dihybrid plant was crossed; the F2 generation consisted of: 860 tall plants with purple flowers; 285 dwarf, purple plants; 340 tall, pink plants; and 115 dwarf, pink plants. The data remind you of a 9:3:3:1 ratio. The critical chi-square for two degrees of freedom (*d.f.*) = 5.991; three *d.f.* = 7.815; four *d.f.* = 9.488; nine *d.f.* = 16.919. Therefore, you should
a. reject your hypothesis; **b**. accept your hypothesis;
c. perform a backcross; **d**. fudge your data;
e. use a lower critical chi-square value

22. A dihybrid (*AaBb*) lab mouse is testcrossed. What is the probability that the first three offspring are dihybrid females?

a. 3(1/8) = 0.375; **b**. $(1/4)^3 = 0.016$; **c**. $(1/8)^3 = 0.002$
d. 3(1/4) = 0.75; **e**. 3(1/2) = 1.50

23. What is the probability that a gamete formed in a female in a *Drosophila* species with $2n = 10$ will have only paternal centromeres?

a. $(1/2)^{10} = 0.001$; **b**. $(1/2)^5 = 0.031$; **c**. $(1/2)^2 = 0.25$; **d**. (1/2) = 0.5; **e**. $(1/4)^5 = 0.001$

24. A male fruit fly and a female fruit fly are heterozygous for detached wings (*det*). What is the probability that of their first ten offspring, any five will be females with detached wings?

a. $(1/4)^5(3/4)^5$; **b**. $(1/8)^5\ (3/8)^5$; **c**. $(10!/5!5!)(1/8)^5(3/8)^5$
d. $(10!/5!5!)(1/8)^5\ (7/8)^5$; **e**. none of these choices

25. A trihybrid plant, exhibiting independent assortment at all three loci, is self-fertilized. What is the probability that an offspring will have the dominant phenotype at all three loci?

a. 1/2; **b**. 1/8; **c**. 9/16; **d**. 1/64; **e**. 27/64

26. An organism is diploid with an XYY sex chromosome complement. It would be a

a. male fly, male human being;
b. male fly, female human being
c. female fly, male human being;
d. female fly, female human being
e. intersex fly, male human being

27. An organism is diploid with an XXY sex chromosome complement. It would be a

a. male fly, male human being;
b. male fly, female human being
c. female fly, male human being;
d. female fly, female human being
e. intersex fly, male human being

28. How many Barr bodies are found in the nuclei of an XYY human male?

a. zero; **b**. one; **c**. two; **d**. three; **e**. unpredictable

29. How many Barr bodies would a cell from an XXYY human being have?

a. none; it's male; **b**. none; it's female; **c**. one; **d**. two; **e**. three

30. If a fruit fly is a normal diploid for its autosomes but has one X and no Y chromosomes, what sex is it?

a. male; **b**. female; **c**. intersex; **d**. metafemale; **e**. none of these choices

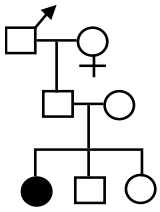
31. A woman whose husband worked at the Chernobyl nuclear reactor gives birth to a hemophilic son.

a. She should blame the reactor accident because the radiation might have caused the hemophilia.
b. She should not blame the accident because she carried the hemophilia allele.
c. Her husband should sue for divorce because it can't be his child.
d. Further genetic tests should be done to determine who is at fault.
e. Hemophilia is environmentally induced, not genetic.

32. If the father and all his daughters but none of his sons have a genetic disease, how is the trait most likely inherited?

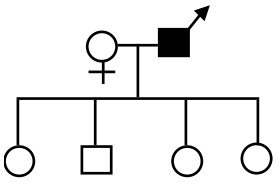
a. autosomal dominant; **b**. autosomal recessive; **c**. X-linked dominant;
d. X-linked recessive; **e**. holandric

33. Barring new mutation, and assuming complete penetrance and single-locus inheritance, what are possible modes of inheritance of the trait shown in figure below?



a. autosomal recessive; **b**. autosomal dominant;
c. X-linked recessive; **d**. X-linked dominant;
e. more than one of these.

34. Barring new mutation, and assuming complete penetrance and single-locus inheritance, what are possible modes of inheritance of the trait shown in figure below?



a. autosomal recessive; **b**. autosomal dominant;
c. X-linked recessive; **d**. X-linked dominant;
e. more than one of these.

35. A plant of genotype *CCdd* is crossed to *ccDD* and an F1 testcrossed to *ccdd*. If the genes are linked, and 20 cM apart, the percentage of *ccdd* recombinants will be

a. 10. **b**. 20. **c**. 25. **d**. 50. **e**. 75.

36. In *Drosophila*, the two genes *w* and *sn* are X-linked and 25 map units apart. A female fly of genotype $w^+ sn^+/w\ sn$ is crossed to a male from a wild-type line. What percent of male progeny will be $w^+\ sn$?

a. 0; **b**. 12.5; **c**. 25; **d**. 37.5; **e**. 50.

37. In maize, two plants that are heterozygous for the recessive alleles *a* and *b* are crossed, what frequency of double-mutant progeny will appear if *a* and *b* are 7.2 map units apart, and both parents carry *a* and *b* in trans (configuration)?

a. 0.036; **b**. 0.0625; **c**. 0.001296 **d**. 0.005184; **e**. 0.072.

38. In a four-point testcross the number of phenotypic classes of progeny expected is

a. 16; **b**. 8; **c**. 81; **d**. 4; **e**. cannot be determined.

39. The following recessive alleles are found in corn: *g*, glossy leaf and *r*, red aleurone. A hybrid of unknown origin is testcrossed, with the following 1,000 progeny resulting: red, 127; glossy, 153; wild-type, 352; and glossy + red, 368. Which of the following could have been a parent of the dihybrid, assuming the parents were homozygous?

a. glossy, red; **b**. glossy; **c**. red; **d**. more than one of these; **e**. none of these choices

40. The following recessive alleles are found in corn: *g*, glossy leaf and *r*, red aleurone. A hybrid of unknown origin is testcrossed, with the following 1,000 progeny resulting: red, 127; glossy, 153; wild-type, 352; and glossy + red, 368. What is your best estimate of the map distance between glossy and red, in map units?

a. 12.7; **b**. 15.3; **c**. 28.0; **d**. 36.8; **e**. 56.0

41. Genes *a* and *b* are 10 map units apart, *b* and *c* are 20 map units apart, and *a* and *c* are 30 map units apart. If a triple heterozygote is testcrossed, among 1,000 progeny, how many are expected to result from double crossovers if there is no interference?

a. 10; **b**. 20; **c**. 30; **d**. 60; **e**. can't be determined

42. Genes *a* and *b* are 10 map units apart, *b* and *c* are 20 map units apart, and *a* and *c* are 30 map units apart. If a triple heterozygote is testcrossed, among 1,000 progeny, how many are expected to result from double crossovers if interference = 0.5?

a. 10; **b**. 20; **c**. 30; **d**. 60; **e**. can't be determined

43. Genes *a* and *b* are 10 map units apart, *b* and *c* are 20 map units apart, and *a* and *c* are 30 map units apart. If a triple heterozygote is testcrossed, among 1,000 progeny, how many are expected to result from single crossovers between *a* and *b* if there is no interference?

a. 20; **b**. 40; **c**. 60; **d**. 80; **e**. none of the above

44. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F1 that was testcrossed, the phenotypes in figure 5 below were observed. What is the linkage arrangement of these three loci?

259 hairless	268 anthocyaninless, jointless, hairless
40 jointless, hairless	941 anthocyaninless, hairless
931 jointless	32 anthocyaninless
260 normal	269 anthocyaninless, jointless

a. *h-a-j*. **b**. *a-h-j*. **c**. *a-j-h*. **d**. *j-h-a*. **e**. two of these choices.

45. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F1 that was testcrossed, the phenotypes in figure 5 above were observed. If the parentals (P1) were homozygous, which of the following could have been a parental?

a. anthocyaninless. **b**. jointless. **c**. anthocyaninless, jointless.
d. hairless, jointless. **e**. hairless.

46. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F1 that was testcrossed, the phenotypes in figure 5 above were observed. What is your best estimate of the anthocyaninless-hairless distance?

a. 20.0. **b**. 35.2. **c**. 37.6. **d**. 40.0. **e**. 60.0.

47. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F1 that was testcrossed, the phenotypes in figure 5 above were observed. What is your best estimate of the anthocyaninless-jointless distance?

a. 20.0. **b**. 35.2. **c**. 37.6. **d**. 40.0. **e**. 60.0.

48. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F_1 that was testcrossed, the phenotypes in figure 5 were observed. What is your best estimate of the hairless-jointless distance?

a. 20.0. **b**. 35.2. **c**. 37.6. **d**. 40.0. **e**. 60.0.

49. Three recessive genes in the tomato plant produce an absence of anthocyanin pigment (*a*), hairless plants (*h*), and jointless fruit stems (*j*). Among 3,000 progeny from a trihybrid F_1 that was testcrossed, the phenotypes in figure 5 were observed. Approximately what is the coefficient of coincidence?

a. 0.4 **b**. 0.5 **c**. 0.6 **d**. 1.8 **e**. irrelevant

50. A bacterial strain that requires an organic form of carbon is named
a. autotrophic; **b**. auxotrophic; **c**. heterotrophic; **d**. prototrophic; **e**. pseudotrophic.

51. A bacterial strain that has a nutritional requirement is named
a. autotrophic; **b**. auxotrophic; **c**. heterotrophic; **d**. prototrophic; **e**. pseudotrophic.

52. If the phenotype of a bacterial strain is Met^-, it
a. requires methionine for growth; **b**. cannot grow in the presence of methionine
c. is resistant to excessive quantities of methionine; **d**. does not like opera
e. none of these choices

53. The sexual process by which a phage transfers bacterial DNA between bacteria is named
a. transformation; **b**. conjugation; **c**. transduction
d. sexduction; **e**. viral recombination

54. A bacterial cell with the phenotype F^+
a. is an *Hfr* cell; **b**. can donate the *F* factor during conjugation
c. can receive the *F* factor during conjugation; **d**. does not need fluorine for growth
e. two of these choices

55. A bacterial cell with the phenotype *Hfr*
a. can donate the *F* factor during conjugation
b. can receive the *F* factor during conjugation
c. can donate the host chromosome during conjugation
d. can receive the host chromosome during conjugation
e. two of these choices

56. In an interrupted mating experiment, gene *a* first appears at 12 minutes, gene *b* first appears at 7 minutes, and gene *c* first appears at 5 minutes. What is the order of transfer?
a. *a b c;* **b**. *c b a;* **c**. *c a b;* **d**. *b a c;* **e**. *b c a*

57. The Hershey and Chase experiment with P^{32} and S^{35} demonstrated that
a. proteins contain sulfur; **b**. DNA contains phosphorus;
c. phage DNA enters the host cell; **d**. phage protein enters the host cell;
e. two of these choices

58. Which of the following is a purine?
a. guanine; **b**. uracil; **c**. adenine; **d**. two of these choices; **e**. all of these choices.

59. Antiparallel means that
a. DNA strands run in opposite directions; **b**. DNA strands are not straight;
c. DNA strands are not parallel; **d**. there is no uracil in DNA;
d. there is no thymine in RNA

60. The melting temperature of DNA increases as the
a. A + T content increases; **b**. antiparallelism increases; **c**. complementarity increases; **d**. polarity increases; **e**. G + C content increases

61. DNA replication is
a. conservative; **b**. semiconservative; **c**. dispersive; **d**. two of these choices; **e**. all of these choices

62. If DNA polymerase III could add bases in the 3' -> 5' direction in *E. coli*, there would be no need for
a. DNA ligase; **b**. Okazaki fragments; **c**. helicase; **d**. gyrase (topoisomerase); **e**. two of these choices

63. Okazaki fragment primers are created by
a. RNA polymerase; **b**. RNA primase; **c**. DNA polymerase I; **d**. DNA polymerase III; **e**. two of these choices

64. Primer removal and gap filling in the completion of an Okazaki fragment is done primarily by
a. RNA polymerase; **b**. RNA primase; **c**. DNA polymerase I; **d**. DNA polymerase III; **e**. two of these choices

65. The final covalent bond made in the completion of an Okazaki fragment, including primer removal and gap filling, is made by
a. RNA polymerase; **b**. RNA primase; **c**. DNA polymerase I; **d**. DNA polymerase III; **e**. DNA ligase

66. If a double-stranded DNA molecule is 28% G, what percent of the bases is A?
a. 22%; **b**. 28%; **c**. 56%; **d**. 72%

67. Histones interact with DNA to form
a. scaffold; **b**. nucleosomes; **c**. nonhistone protein; **d**. Balbiani rings; **e**. polytene chromosomes

68. How many molecules of histones H1, H2A, H2B, H3, and H4, respectively, make up a nucleosome?
a. one each; **b**. two each; **c**. three each; **d**. 0, 2, 2, 2, 2; **e**. 2, 2, 2, 2, 0

69. The width of a nucleosome, in A, is approximately
a. 1; **b**. 11; **c**. 110; **d**. 300; **e**. 2,000.

70. The second-order (highest-order) fiber of a eukaryotic chromosome, the second solenoid like coiling of the nucleosomed DNA, is approximately how wide, in A?
a. 1; **b**. 11; **c**. 110; **d**. 300; **e**. 2,400.

71. Chromosome puffs occur in
a. all eukaryotic chromosomes; **b**. polytene chromosomes; **c**. satellite DNA;
d. scaffolding; **e**. lampbrush chromosomes

72. Transcribed DNA generally is
a. euchromatic; **b**. in G bands; **c**. centromeric; **d**. constitutive; **e**. two of these

73. A forbidden transfer of information in the central dogma is
a. RNA -> DNA; **b**. RNA -> RNA; **c**. protein -> RNA;
d. two of these choices; **e**. all of these choices

74. If the G + C content of the RNA of an *E. coli* cell is 30%, it is reasonable to assume that the DNA of the cell will have a G + C content of
a. 15%; **b**. 30%; **c**. 50%; **d**. 60%; **e**. 70%

75. The transcribing enzyme is primarily
a. RNA polymerase; **b**. RNA primase; **c**. polynucleotide phosphorylase.
d. DNA polymerase; **e**. reverse transcriptase

76. The fidelity of the initiation of transcription in prokaryotes is determined by
a. AUG (methionine codon); **b**. RNA polymerase core enzyme;
c. sigma factor; **d**. rho factor; **e**. CAP protein

77. The primary function of a promoter is
a. ribosomal recognition; **b**. stem-loop formation; **c**. RNA core polymerase recognition;
d. sigma factor recognition; **e**. rho factor recognition

78. The eukaryotic equivalent of the prokaryotic Pribnow box is the
a. Goldstein-Hogness (TATA) box; **b**. CAAT box; **c**. enhancer;
d. intron; **e**. None; the Pribnow box is eukaryotic

79. The coding strand of DNA is complementary to the
a. template strand; **b**. mRNA; **c**. neither of these; **d**. both of these

80. Prokaryotes and eukaryotes have how many ribosomal RNA segments, respectively, in their ribosomes?
a. one, one; **b**. two, two; **c**. three, three; **d**. three, four; **e**. four, four

81. Posttranscriptional modification of eukaryotic mRNAs includes a
a. 5' cap; **b**. 3' cap; **c**. poly-T tail; **d**. two of these choices; **e**. all of these choices

82. In self-splicing, RNA is acting like
a. a replisome; **b**. a ribosome; **c**. a ribozyme; **d**. an enhancer; **e**. a rho protein

83. An RNA molecule had the sequence 5' GCAAUGCAA 3'. What is the sequence of the DNA strand that was transcribed?
a. 5'-GCAATGCAA-3'; **b**. 5'-AACGTAACG-3'; **c**. 5'-GGTTACGTT-3';
d. 5'-TTGCATTGC-3'; **e**. 5'-GCTTAGCTT-3'.

84. During RNA editing
a. extra Us are added; **b**. many bases are changed; **c**. the cap is modified
d. introns are removed; **e**. the poly-A tail is added

85. The sequence of amino acids in a protein is referred to as the
a. primary structure; **b**. secondary structure; **c**. tertiary structure;
d. quaternary structure; **e**. all of these choices

86. The approximate number of aminoacyl-tRNA synthetases in a cell is
a. one; **b**. 20; **c**. 50; **d**. 61; **e**. 62.

87. The first amino acid synthesized is at which end of the protein?
a. 5'; **b**. 3'; **c**. carboxyl; **d**. amino; **e**. R-group

88. The first amino acid incorporated into *E. coli* proteins is
a. methionine; **b**. N-formyl methionine; **c**. C-formyl methionine;
d. any of three**;** **e**. any of 20

89. The enzyme that creates peptide bonds at the ribosome is called peptidyl
a. polymerase; **b**. synthetase; **c**. transferase; **d**. ligase; **e**. preposterase

90. Termination of translation requires
a. AUG; **b**. rho (often but not exclusively); **c**. an initiation factor;
d. a release factor; **e**. two of these

91. Eukaryotic polysomes (polyribosomes)
a. do not exist; **b**. exist only in lower eukaryotes; **c**. are monocistronic;
d. are polycistronic some, but not necessarily all, of the time;
e. would exist if not for membrane signal sequences (signal hypothesis)

92. The fact that a given amino acid may have more than one codon is called
a. degeneracy; **b**. ambiguity; **c**. redundancy; **d**. family mixing; **e**. wobble.

93. An RNA molecule has 48 nucleotides. The maximum number of amino acids it can encode is
a. 12; **b**. 16; **c**. 48; **d**. 144; **e**. can't be determined

94. Molecular chaperones
a. are elongation factors; **b**. are termination factors; **c**. recognize signal sequences
d. attach amino acids to tRNA; **e**. help proteins fold properly

95. What is the minimum number of nucleotides necessary to synthesize a protein of 50 amino acids?
a. 16; **b**. 48; **c**. 50; **d**. 100; **e**. 150

96. The product of the regulator gene of the *lac* operon is
a. operator; **b**. I protein; **c**. repressor; **d**. corepressor; **e**. inducer.

97. In the *lac* operon of *E. coli*, lactose (or allolactose) is the
a. operator; **b**. I protein; **c**. repressor; **d**. corepressor; **e**. inducer.

98. A *lac* operon merozygote with two different alleles of the z locus (z_1, z_2) present has the following genotype: $i^+p^+o^+z_1/i^-p^+o^+\mathbf{Z}_2$. If no lactose is present in the environment
a. neither z_1 nor z_2 will be transcribed; **b**. both z_1 and z_2 will be transcribed;
c. only z_1 will be transcribed; **d**. only z_2 will be transcribed

99. A *lac* operon merozygote with two different alleles of the z locus (z_1, z_2) present has the following genotype: $i^+p^+o^+z_1/i^-p^+o^+\mathbf{Z}_2$. If lactose is present in the environment
a. neither z_1 nor z_2 will be transcribed; **b**. both z_1 and z_2 will be transcribed;
c. only z_1 will be transcribed; **d**. only z_2 will be transcribed

100. An o^c mutation in the *lac* operon is
a. operator constitutive; **b**. *cis-dominant;* **c**. *trans-acting;*
d. two of these choices; **e**. all of these choices

101. Catabolite repression
a. involves cyclic-AMP levels; **b**. requires the 5'-cap on the mRNA
c. causes lactose to be preferentially metabolized in *E. coli.*
d. two of these choices; **e**. all of these choices

102. Which of the following sequences is/are probably recognizable, in the double-stranded form to a type II restriction endonuclease?
a. GAATTC; **b**. GGATCC; **c**. GGGTTT; **d**. two of these choices; **e**. all of these choices

103. A plasmid containing a foreign insert is known as a
a. chimeric plasmid; **b**. hybrid vector; **c**. lambda phage;
d. two of these choices; **e**. all of these choices

104. A commonly used locus for selecting hybrid vectors is
a. *Eco EI;* **b**. amp^r; **c**. ter^r; **d**. two of these choices; e. all of these choices

105. DNA cloning can be carried out on blunt-ended DNA with
a. linkers; **b**. blunt-end ligation; **c**. poly-dA/poly-dT technique;
c. two of these choices; **e**. all of these choices

106. The key enzyme for blunt-end ligation is
a. T4 DNA ligase; **b**. deoxynucleoside transferase; **c**. *amp*^{r};
d. *Eco RI;* **e**. more than one of these

107. The form of DNA called cDNA refers to
a. another form of DNA like A-DNA and B-DNA; **b**. cosmid DNA;
c. complementary DNA; **d**. cohesive DNA; **e**. DNA from Col plasmids.

108. A laboratory method of transferring electrophoresed DNA is known as
a. northern blotting; **b**. western blotting; **c**. southern blotting;
d. eastern blotting; **e**. N by NW blotting.

109. Plasmids that allow the transcription and translation of their cloned genes are called
a. cosmids; **b**. Charon phages; **c**. translation vectors;
d. expression vectors; **e**. dot vectors.

110. The technique of studying an extended length of DNA by way of overlapping clones is called
a. dot blotting; **b**. footprinting; **c**. blunt-end ligation;
d. chromosome walking; **e**. heteroduplex analysis

111. For a prokaryotic plasmid to grow successfully in yeast, it must contain
a. *amp*^{r}; **b**. *oriC;* **c**. *CEN;* **d**. two of these choices; **e**. all of these choices

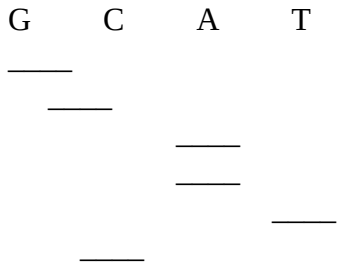
112. A 650 bp piece of DNA is cut with a single restriction enzyme. Fragments of 150*, 200*, and 300 bp are found. (Asterisks denote radioactively labeled end pieces.) How many restriction sites are there?
a. 1; **b**. 2; **c**. 3; **d**. 4; **e**. can't be determined

113. A 650 bp piece of DNA is cut with a single restriction enzyme. Fragments of 150*, 200*, and 300 bp are found. (Asterisks denote radioactively labeled end pieces.) Which order(s) is (are) consistent with the results?
a. 150, 200, 300; **b**. 150, 300, 200; **c**. 300, 150, 200; **d**. two of these; **e**. none of these

114. An amplification technique for DNA lying between known sequences is
a. RFLP; **b**. VNTR; **c**. PCR; **d**. DNA fingerprinting; **e**. DNA footprinting.

115. Dideoxy bases do not function as primers during DNA sequencing because they lack the following configuration:
a. 1'-OH; **b**. 2'-OH; **c**. 3'-OH; **d**. 4'-OH; **e**. 5'-OH.

116. Below are the results of a dideoxyg sequencing gel. What is the sequence of the newly synthesized strand?



a. 5'-GCAATC-3'; **b**. 5'-CTAACG-3'; **c**. 5'-GATTGC-3';
d. 5'-CGTTAG-3'; **e**. 5'-TCAAGC-3'

117. RNA, complementary to messenger RNA, that can prevent translation of that messenger is called
a. idling RNA; **b**. stringent RNA; **c**. preference RNA; **d**. relaxed RNA; **e**. antisense RNA

118. Feedback inhibition
a. is a transcriptional control mechanism; **b**. is a translational control mechanism;
c. is a posttranslational control mechanism; **d**. requires the stringent factor;
d. two of these choices

119. As the length of unique DNA in a sample increases, cot values
a. increase; **b**. decrease; **c**. stay the same; **d**. cannot be predicted

120. Seymour Benzer coined words for the gene, the minimal mutable site, and the smallest unit of recombination. These terms are, respectively,
a. cistron, recon, muton. **b**. cistron, muton, recon. **c**. cistron, muton, exon.
d. cistron, intron, recon. **e**. cistron, nucleotide, crossover.

121. If the addition of one base restores the reading frame of a deletion mutation, we can conclude that the original deletion might have been of
a. one base. **b**. two bases. **c**. three bases. **d**. four bases. **e**. two of these choices.

122. What type of mutation is AGAGCCGAGGA -> AGAGCCAGGA?
a. deletion. **b**. inversion. **c**. frameshift. **d**. insertion. **e**. two of these choices.

123. What type of mutation is AGAGCCGAGGA -> AGAGAGCCGGA?
a. deletion. **b**. inversion. **c**. frameshift. **d**. insertion. **e**. two of these choices.

124. The restoration of function by a second mutation at a different site in the same gene is called
a. back mutation. **b**. conditional lethality. **c**. intragenic suppression.

d. intergenic suppression. **e**. tautomeric shift.

125. The restoration of function by a second mutation at a different gene is called
a. back mutation. **b**. conditional mutation. **c**. intragenic suppression.
d. intergenic suppression. **e**. tautomeric shift.

126. A mutation of A-T to T-A can come about by
a. tautomeric shift. **b**. tautomeric shift plus anti -> syn shift. **c**. misalignment.
d. treatment with an alkylating agent. **e**. two of these.

127. Acridine orange induces mutations by
a. removing bases from DNA. **b**. inducing tautomeric shifts.
c. inducing anti -> syn transitions. **d**. intercalating into the DNA.
e. inactivating repair enzymes.

128. Ethyl methane sulfonate induces mutations by
a. removing bases from DNA. **b**. inducing tautomeric shifts.
c. inducing anti -> syn transitions. **d**. intercalating into the DNA.
e. inactivating repair enzymes.

129. 5-bromouracil induces mutations by
a. removing bases from DNA. **b**. inducing tautomeric shifts.
c. inducing anti -> syn transitions. **d**. intercalating into the DNA.
e. inactivating repair enzymes.

130. If the DNA for a codon is G A T, which of the following sequences represents a transversion?
a. G A C. **b**. G G T. **c**. A G T. **d**. C A T. **e**. G G C.

131. The occurrence in the phenotype of a recessive trait, although only one copy of the recessive allele is present, is named
a. pleiotropy; **b**. epistasis; **c**. pseudodominance; **d**. acentricity; **e**. trisomy.

132. A chromosome with two centromeres is named
a. disomic; **b**. dicentric; **c**. acentric; **d**. trisomic; **e**. variegated.

133. Two breaks in the same chromosome can lead immediately to
a. inversion; **b**. deletion; **c**. duplication; **d**. two of these choices; **e**. all of these choices

134. What structure might be visible in a reciprocal translocation heterozygote during meiosis?
a. stem-loop; **b**. cross-shaped figure; **c**. inversion loop
d. breakage-fusion bridge; **e**. none of these

135. The failure of chromosomes to separate properly in meiosis or mitosis, leading to aneuploidy (in which all chromosomes are included in one nucleus or another), is called

a. nondisjunction; **b**. chromosome lagging; **c**. centromeric fusion;
d. Robertsonian fusion; **e**. unequal crossing over

136. The *Drosophila* maternal-effect gene *bicoid* is involved in determining
a. the sex ratio of *Drosophila*. **b**. anterior portion of *Drosophila*.
c. posterior portion of *Drosophila*. **d**. dorso-ventral polarity of *Drosophila*. **e**. nothing.

137. Segment genes in *Drosophila* are turned on by
a. α factors. **b**. homeotic genes. **c**. morphogens. **d**. egg genes. **e**. medium.

138. Homeotic genes in *Drosophila* turned on directly by
a. β factors. **b**. segment genes. **c**. morphogens. **d**. aggressive genes. **e**. gas genes.

139. Programmed cell death in animals are probably
a. necessary. **b**. not necessary. **c**. genetically determined. **d**. bad for animals.
e. two of these choices.

140. When several loci control a phenotype and each locus has an allele that contributes an equivalent small increment to that phenotype, we call the inheritance pattern
a. narrow sense. **b**. broad sense. **c**. realized. **d**. true. **e**. additive.

141. Traits exhibiting quantitative inheritance are called
a. continuous. **b**. metrical. **c**. quantitative. **d**. two of these choices.
e. all of these choices.

142. Polygenes appear to be located
a. on polytene chromosomes. **b**. usually on only one or two chromosomes.
c. on all chromosomes. **d**. on long chromosomes only.
e. usually on short chromosomes.

143. Three genotypes occur in the following proportions: $f(AA) = U$, $f(Aa) = V$, $f(aa) = W$. Therefore, $f(A)$ is
a. square root of U. **b**. (U + V)/2. **c**. U + (V/2). **d**. $1 - W^2$. **e**. two of these choices

144. One-hundred persons in Albuquerque were tested for their blood type: type A, 20; type B, 48; type AB, 16; type O, 16. Approximately what is the frequency of the *A* allele?
a. 0.1. **b**. 0.2. **c**. 0.4. **d**. 0.45. **e**. 0.69.

145. Lysogeny in phage λ
a. requires the product of the *cro* gene; **b**. requires the product of the *cI* gene;
c. requires the presence of POP' and BOB'; **d**. two of these choices;
e. all of these choices

146. In phage λ
a. *cI* and *cro* proteins act like repressors; **b**. *cI* and *cro* proteins act antagonistically;

c. *cI* and *cro* are transcribed from the same promoter; **d**. two of these choices
e. all of these choices

147. The mature DNA of phage λ, in the form in which it will be packaged into phage heads, is
a. a circle; **b**. linear, ending in POP' and BOB'; **c**. linear, ending in *cos* sites;
d. linear, ending at *att;* **e**. linear, ending at the *cI/cro* border.

148. The *N* gene product of phage λ
a. is a terminator protein; **b**. binds at the *nutL* and *nutR* sites;
c. is needed for readthrough of rho-dependent terminators
d. two of these choices; **e**. all of these choices

149. Protease inhibitors are being used for treating AIDS patients because
a. the drugs are not toxic to human beings. **b**. the drugs are cheap.
c. the drugs stop HIV RNA replication. **d**. the drugs prevent HIV protein maturation.
e. strengthen AIDS patients' health.

150. Snail coiling is a maternal effect, with dextral coiling dominant to sinistral coiling. Which of the following can be genotypes of a sinistral snail?
a. *DD.* **b**. *Dd.* **c**. *dd.* **d**. two of these choices. **e**. all of these choices.

151. Moth pigmentation can be maternally inherited. Two moths mate and produce pigmented larvae of which half remain pigmented as adults. If a^+ is the allele for pigmentation, then the mother's genotype was
a. *a/a.* **b**. a^+/a. **c**. a^+/a^+. ***d***. all of these choices. **e**. none of these choices.

152. The human mitochondria have as genetic material
a. no DNA. **b**. small linear DNA molecules.
c. large linear DNA molecules (chromosomes).
d. small circular DNA molecules. **e**. small circular RNA molecules.

153. A petite yeast is crossed with the wild-type. After meiosis, petites and wild-types appear in a 1:1 ratio. The petite is
a. segregational. **b**. neutral. **c**. suppressive. **d**. could be any of these; **e**. none of these.

154. Inheritance of variegation in corn is cytoplasmic because
a. pollen grains do not carry chloroplasts. **b**. ovules do not carry chloroplasts.
c. neither pollen grains nor ovules carry chloroplasts.
d. both pollen grains and ovules carry chloroplasts. **e**. of spiral cleavage.

Answers to Sample Problems

1. a; 2. a; 3. d; 4. c; 5. d; 6. c; 7. c; 8. b; 9. c; 10. e; 11. e; 12. c;
13. c; 14. a; 15. c; 16. e; 17. c; 18. b; 19. c; 20. c; 21. a; 22. c; 23. b; 24. d;
25. e; 26. a; 27. c; 28. a; 29. c; 30. a; 31. b; 32. c; 33. a; 34. e; 35. a; 36. b;
37. c; 38. a; 39. a; 40. c; 41. b; 42. a; 43. e; 44. e; 45. b; 46. a; 47. d; 48. a;
49. C.

50. c; 51. b; 52. a; 53. c; 54. b; 55. c; 56. b; 57. c; 58. d; 59. a; 60. e; 61. b;
62. b; 63. b; 64. c; 65. e; 66. a; 67. b; 68. d; 69. c; 70. e; 71. b; 72. a; 73. c;
74. b; 75. a; 76. c; 77. d; 78. a; 79. a; 80. d; 81. a; 82. c; 83. d; 84. a;
85. a; 86. b; 87. d; 88. b; 89. c; 90. d; 91. c; 92. a; 93. b; 94. e; 95. e; 96. c;
97. e; 98. a; 99. b; 100. d; 101. a; 102. d; 103. d; 104. d; 105. e; 106. a; 107. c; 108. c;
109. d; 110. d; 111. c; 112. b; 113. b; 114. c; 115. c; 116.b; 117. e; 118. c; 119. A.

120. b; 121. e; 122. e; 123. b; 124. c; 125. d; 126. e; 127. d; 128. a; 129. b; 130. d; 131. c;
132. b; 133. d; 134. b; 135. a; 136. b; 137. c; 138. b; 139. e; 140. e; 141. e; 142. c; 143.c;
144. b; 145. d; 146. d; 147. c; 148. d; 149. d; 150. d; 151. b; 152. d; 153. a; 154. a.