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Biol A201
Genetics
Spring 1999
Exam 2

Circle the letter next to the BEST answer for each of the following 12 ques. (3 pt)

1. A wife is a hemophiliac (a sex-linked recessive disorder). Her husband is phenotypically normal although his father was a hemophiliac. What is the probability that they will have a child with hemophilia?

a. 1/4 b. 1/2 c. 3/4 d. 0 e. not possible to estimate

2. If the following cross is made AaB^1B^2CcDd x AaB^1B^2CcDd, what is the probability that an offspring will be AAB^1B^2Ccdd assuming all gene loci are independently assorting?

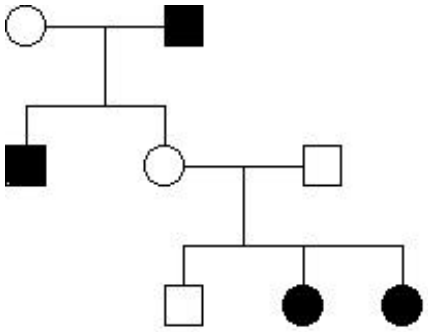
a. 0 b. 1/8 c. 1/16 d. 1/32 e. 1/64 f. 1/128

3. Epistasis can be defined as

a. condition where the dominant alleles of two genes are linked on the same chromosome
b. condition where the dominant allele of one gene is linked on the same chromosome to the recessive allele of another gene
c. condition where a particular gene affects two or more different traits
d. condition where two genes interact to control the expression of a particular trait
e. condition of total confusion

4. The human pedigree below is following a genetic disorder. Which of the following best assesses the possible inheritance patterns exhibited by this pedigree?

a. autosomal dominant disorder
b. autosomal recessive disorder
c. sex-linked recessive disorder
d. a or b
e. b or c
f. a, b or c



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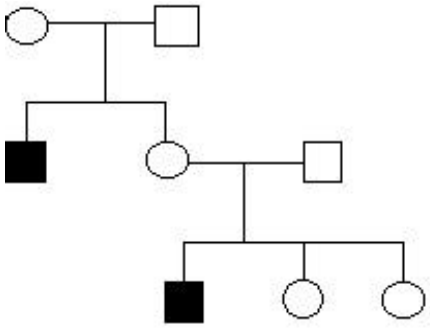

6. In corn, colored aleurone in the kernels is due to the dominant allele R. The recessive allele r, when homozygous produces colorless aleurone. The plant color (not the kernel color) is controlled by the gene pair Y and y. The dominant Y gene results in green color, whereas the homozygous presence of the recessive y gene causes the plant to appear yellow. A cross is made between a colorless aleurone, yellow plant and a homozygous colored aleurone, homozygous green plant. The offspring are testcrossed resulting in the following testcross progeny: 85 colored, green; 15 colored, yellow; 7 colorless, green; 93 colorless, yellow. Assuming the two genes are linked, what would be the calculated the map distance (in map units) given this data?

a. 11 b. 22 c. 32 d. 40 e. 90

7. In the previous problem, the F_1 in testcrossed. What is the phenotype of the individual that the F_1 is testcrossed to?

a. colored, green b. colored, yellow c. colorless, green d. colorless, yellow

8. All the following are possible epistatic ratios as discussed in class except

a. 3:1 b. 13:3 c. 9:7 d. 9:3:4 e. 12:3:1

9. In the experiment by Hershey and Chase, they labeled bacteriophages with radioactive labels ^{32}P and ^{35}S. They were able to conclude from this study that

a. protein is the genetic material
b. the "transforming principle" is an, as yet, unidentified chemical
c. the genetic material is DNA
d. DNA has a certain periodicity and helical structure

10. Thanks to the work by Taylor and his co-workersl on *Vicia faba* chromosomes, they were able to provide strong evidence that led to the conclusion that

a. DNA has a helical structure
b. DNA consists of the three main components: deoxyribose, phosphate and nitrogenous bases
c. The ratio of adenine to thymine (and guanine to cytosine) is 1:1 in the molecule
d. DNA is a triple helix
e. Replication of DNA is semiconservative

11. Which of the following statements regarding the DNA structure is <u>not</u> true?

a. Each nucleotide subunit of the DNA consists of a sugar, a phosphate and a nitrogenous base
b. The orientation of the two strands of a DNA molecule point in the same, parallel direction
c. The nucleotides of each individual strand are linked together by covalent bonds
d. Hydrogen bonds hold the two strands of the double helix together
e. Guanine undergoes complementary base pairing with cytosinee, and adenine base pairs with thymine

12. The enzyme that is responsible in DNA replication for conducting most of the DNA synthesis on both the lagging strand and leading strand is

a. DNA ligase
b. RNA polymerase
c. DNA polymerase I
d. DNA polymerase III

13. In fruit flies, smooth eyes (R) is dominant to rough (r) while straight wings (C) is dominant to curled (c). Fruit flies heterozygous for both traits were testcrossed resulting in the following observed progeny: 27 smooth, straight; 22 smooth, curled; 20 rough, straight; 31 rough, curled.

a. In performing a test to determine whether the two genes are independently assorting, what are your EXPECTED numbers of progeny of the four testcross phenotypes. (4 pt)

b. Perform a chi-square test and report your calculated chi-square value (6 pt)

c. Using the chi-square table below, what is your chi-square probability (p) base on your results? Do you REJECT or do you FAIL TO REJECT your hypothesis? (4 pt)

	Probabilities (p)					
df	0.90	0.50	0.20	0.05	0.01	0.001
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
3	0.58	2.37	4.64	7.82	11.35	16.27
4	1.06	3.36	5.99	9.49	13.28	13.47
5	1.61	4.35	7.29	11.07	15.09	20.52

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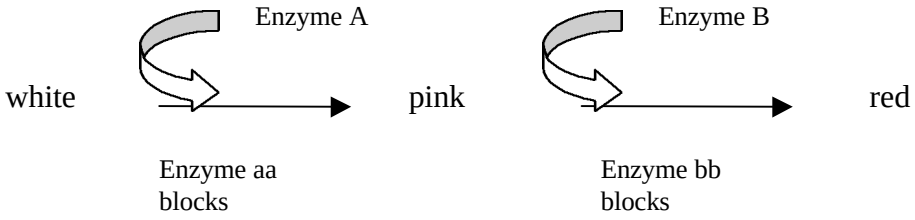
14. If you were told that the biochemical process below illustrates epistasis involving two, independently assorting gene loci (A/a and B/b) and their effect on eye color in fruit flies, which epistatic F_2 ratio discussed in class best fits this example? Show or explain <u>why</u> your ratio is correct (6 pt)



15. Chargaff's and Franklin/Wilkins' works were significant in helping Watson and Cricks develop and ultimate publish the structure of DNA. Briefly explain what were Chargaff's and Franklin/Wilkins' contributions. (5 pt)

16. Meselson and Stahl tested three hypotheses on how DNA replication occurred. They grew *E. coli* cells for several generations in media containing heavy nitrogen (^{15}N). They replaced the media with light nitrogen (^{14}N) media and after allowing the bacteria to grow for one generation, analyzed the DNA. What did they find after one generation (in the density-gradient centrifuge tube) that made it possible for them to <u>reject</u> the hypothesis of conservative replication? Explain. (6 pt)

17. Draw a schematic diagram of a DNA replication fork and be sure to label**: lagging strand, leading strand, 5' ends, 3' ends, DNA polymerase I, DNA polymerase III, DNA ligase, continuous replication, discontinuous replication**. (10 pt)

18. Given the following **template** strand of DNA: 5'-ACGTTGAATCCG-3'
    a. give the sequence of the **partner** strand (include 5' and 3' ends) (3 pt)

    b. Give the sequence of the RNA strand produced from this DNA sequence (include 5' and 3' ends) (3 pt)