

Name: \_\_\_\_\_

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Biol 3301

Midterm 1

Spring 2012

Multiple Choice. Circle the single best answer. (4 pts each)

1. Which of the following changes in the DNA sequence of a gene will produce a new allele?

- a) base pair change    b) deletion of three bases    c) insertion of three bases  
d) all of the above    e) none of the above

2. Which of the following does not occur in mitosis?

- a) replicated diploid nucleus    b) attachment of chromosomes to spindle    c) centromere division  
d) dissolution of the nuclear membrane    e) independent assortment

3. You inherit 100 bristly hamsters from an eccentric aunt. All the hamsters have the same parents, and these are all the known offspring of the parental pair. If a single gene is responsible for the bristly coat trait, which of the following cannot represent the genotypes of the parent hamsters?

- a) b/b x b/b    b) B/b x B/b    c) B/B x B/b    d) B/B x b/b  
e) any of the above pairs could represent the parental genotypes

4. Which of the following statements is not true?

- a) If a phenotype is due to a dominant allele, affected offspring always have affected parents.  
b) If a phenotype is due to a recessive allele, affected offspring may not have affected parents.  
c) If you make a cross between homozygous parents with different phenotypes, and all the offspring have the phenotype of one parent, then that trait is dominant.  
d) If a single copy of the wild type allele is sufficient to produce a functional phenotype, then the gene is haploinsufficient.  
e) The "wild type" allele may produce a dominant or a recessive phenotype.

5. Mitochondrial genomes

- a) replicate in synchrony with the nuclear genome  
b) contain both dominant and recessive alleles  
c) can vary within an individual  
d) exist as a single copy per cell  
e) have many sex-linked genes

6. In the marbled murrelet, plumage color may be black, gray or white. Color is due to three alleles:  $c^b$ ;  $c^g$ ;  $c^w$ . Regardless of what crosses you make between coat color phenotypes, you never obtain female progeny with black feathers. What must be true?

- a) Black is recessive in females and dominant in males.  
b) Black is a lethal recessive on an autosome.  
c) Black is a lethal recessive on the X-chromosome.  
d) Expression of black is limited to males.  
e) The described results are impossible.

7. In a cross between two individuals heterozygous for three autosomal, independently assorting loci (i.e., A/a; B/b; E/e), what is the probability of getting an offspring whose phenotype differs from both parents?

- a)  $(1/4)^3$     b)  $(3/4)^3$     c)  $1 - (3/4)^3$     d)  $[(3/4)^3 + (1/4)^3]$     e)  $1 - [(3/4)^3 + (1/4)^3]$

8. If two mice of genotype F/f; G/g; H/h; I/i; J/j are repeatedly mated, how many different phenotype will be found in the progeny if the genes are assorting independently?

- a) two    b) five    c) fifteen    d) sixteen    e) thirty-two

9. In swine, individuals with sandy-colored hair have leaner meat, which makes them desirable. When sandy individuals are mated to each other, the outcome is 50% sandy, 25% red, and 25% white. If you wanted to mass produce sandy hogs for sale, which type would be best to use as a breeding pair?

- a) sandy male x sandy female
- b) red male x white female
- c) red male x red female
- d) sandy male x white female
- e) red male x sandy female

10. A strain of *E. coli* that is  $lys^+$

- a) cannot grow without lysine
- b) is resistant to lysine
- c) can utilize lysine as a carbon source
- d) cannot utilize lysine as a carbon source
- e) can make its own lysine

11. When a chi-square test is significant,

- a) the null hypothesis is rejected
- b) the p-value is less than 0.5
- c) the genes are linked
- d) there are insufficient degrees of freedom
- e) you must redo the experiment

12. Which of the following indicates paternal transmission (leakage) in a trait that is otherwise inherited maternally?

- a) 5% of offspring display their father's phenotype
- b) 5% of male offspring display their father's phenotype
- c) male offspring resemble their fathers; female offspring resemble their mothers
- d) most offspring inherit their mother's phenotype, but an occasional offspring resembles their father
- e) in most families, offspring inherit their mother's phenotype, but in an occasional family, all offspring resemble their father

13. Normal mitosis takes place in a diploid cell of genotype A/A; B/b. Which of the following genotypes represents a possible daughter cell?

- a) A/A; B/b      b) A/a; b/b      c) A/a; B/B      d) A/a; B/b      e) a/a; b/b

14. If a  $met^- thr^- Hfr$  strain is mated with an  $F^-$  strain of genotype  $leu^- thi^-$ ,  $thi^+$  recombinants can be detected by plating the mixture on

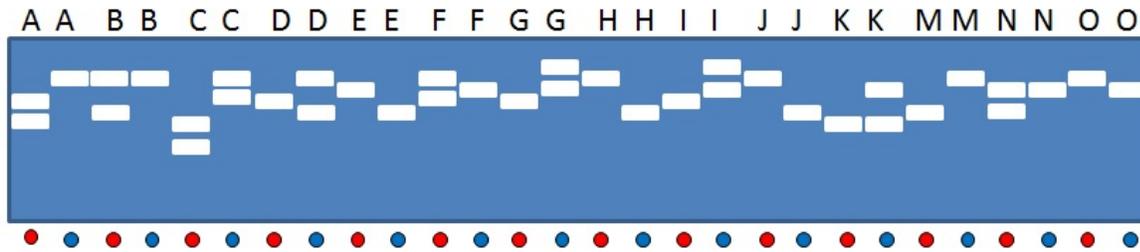
- a) leucine
- b) threonine
- c) thiamine
- d) methionine
- e) minimal medium

15. A female *Drosophila* that is heterozygous for the recessive, sex-linked traits of forked bristles (f), sable body (s) and garnet eyes (g) is mated to a male that is homozygous recessive for all three traits. The phenotypic distribution of 1000 male testcross progeny is shown below: 74 wild type; 70 forked sable garnet; 44 forked; 50 sable garnet; 2 forked sable; 4 garnet; 368 sable; 388 forked garnet. What is the gene order?

- a) f---s---g
- b) g---f---s
- c) s---g---f
- d) only f and g are linked
- e) there's not enough information to tell

16. The figure below shows a series of SNP loci (A-O) loci for two strains of mice (Houston in black, Dallas in gray). Which locus would not be useful in mapping novel mutations?

- a) G      b) H      c) I      d) J      e) K



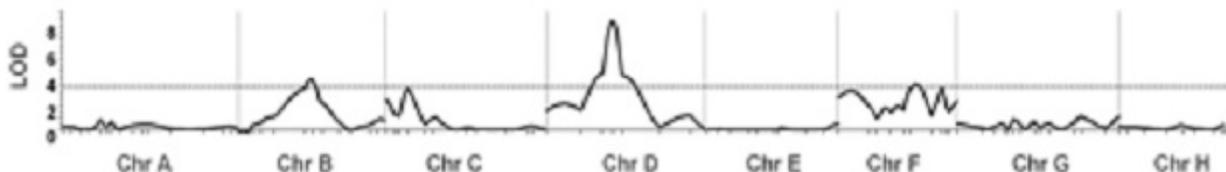
Short answer. For each of the questions give a brief answer. If you feel that the answer requires a mathematical expression it is only necessary to put numbers in the proper places, you do not have to calculate the answer.

17. You make a cross using an Hfr strain of *E. coli* that is  $azi^R lys^+ pen^R$  and an  $F^-$  strain that is  $azi^S lys^- pen^S$ . Interrupted mating studies show that  $pen^R$  enters the recipient last. In an interrupted mating between the same two strains, you select  $pen^R$  recombinants and test by replica plating for the presence of the  $lys^+$  and  $azi^R$  alleles. You score 300 individuals, and find the following genotype distribution: 259  $azi^R lys^+ pen^R$ ; 1  $azi^S lys^+ pen^R$ ; 11  $azi^R lys^- pen^R$ ; 29  $azi^S lys^- pen^R$ . What is the gene order (give as first to enter...second...last)?

18. The allelic series for an autosomal gene affecting guinea pig coat color is:  
 $c^B > c^S > c^R = c^C > c^A$  where  $c^B$  is black,  $c^S$  is sepia,  $c^R$  is russet,  $c^C$  is cream and  $c^A$  is albino. If you cross individuals of the genotype:  $c^S c^R \times c^C c^A$ , what phenotypic distribution do you expect in the offspring?

19. In order to map the *Drosophila* genes Bar eye (**B**), miniature wings (*m*) and singed bristles (*sn*), you would make a cross between a female heterozygous for all three traits and a male of what genotype? NB: use proper genetic notation.

20. You are trying to identify the location of a gene for herbivore resistance in rice. After screening a population of 513 plants with 722 microsatellite loci, and conducting a maximum likelihood analysis, you generate the LOD score plot shown below.



On which chromosome or chromosomes, could a gene contributing to the phenotype of herbivore resistance be located?

Word Problems. For each question, give both an answer and an explanation of your reasoning for why this is the correct answer. (8 pts each)

21. You are a xenogeneticist studying dragons. You are particularly interested in the color of flames (red or yellow) and hoarding behavior (dragons hoard either gems or gold). You make the following reciprocal crosses between two homozygous lines.

Cross A

P<sub>0</sub> red, gold ♂ x yellow, gems ♀

F<sub>1</sub> red, gems ♂ ♂; red, gems ♀ ♀

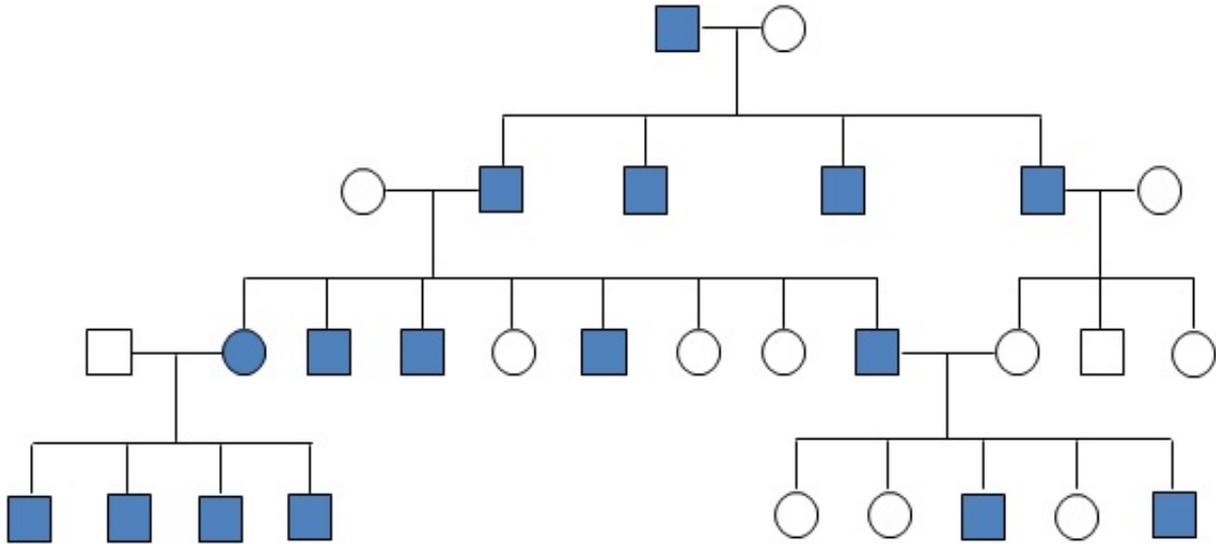
Cross B

yellow, gems ♂ x red, gold ♀

red, gold ♂ ♂; yellow, gold ♀ ♀

What is the genetic basis (autosomal, sex-linked or mitochondrial; dominant or recessive) of each phenotype? Explain your answer.

22. The pedigree below is for a rare hereditary disease of the liver in chimpanzees. What is the most likely genetic basis (autosomal, sex-linked or mitochondrial; dominant or recessive) of the trait? Explain your answer.



23. In pheasants, there are three feather color variants—light, buff, and ring. The table below gives the results of several crosses between parents of unknown genotype.

Cross	Parents		Offspring
	female	male	
1	light	light	all light
2	light	buff	$\frac{1}{2}$ light, $\frac{1}{2}$ buff
3	buff	light	$\frac{1}{2}$ light, $\frac{1}{2}$ buff
4	light	ring	all buff
5	buff	buff	$\frac{1}{2}$ buff, $\frac{1}{4}$ light, $\frac{1}{4}$ ring
6	buff	ring	$\frac{1}{2}$ buff, $\frac{1}{2}$ ring
7	ring	buff	$\frac{1}{2}$ buff, $\frac{1}{2}$ ring
8	ring	ring	all ring

On the basis of these data, what phenotypic distribution of offspring would you expect if you crossed the female parent from Cross 7 to the male parent from Cross 3. Explain your answer.