

**ANSWERS TO Exam Questions from Exam 1 – Basic Genetic Tests, Setting up and Analyzing Crosses, and Genetic Mapping**

**1.** You are studying three autosomal recessive mutations in the fruit fly *Drosophila melanogaster*

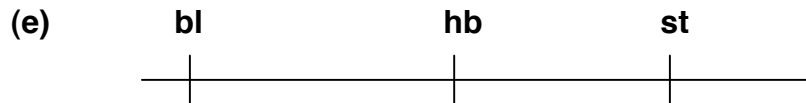
(a) Genotype of one parental strain:  $hb^- \ bl^- \ st^+$  on each chromosome

Genotype of the other parental strain:  $hb^+ \ bl^+ \ st^-$  on each chromosome

(b) 22 flies

(c) 5.5 cM

(d) 9.9 cM

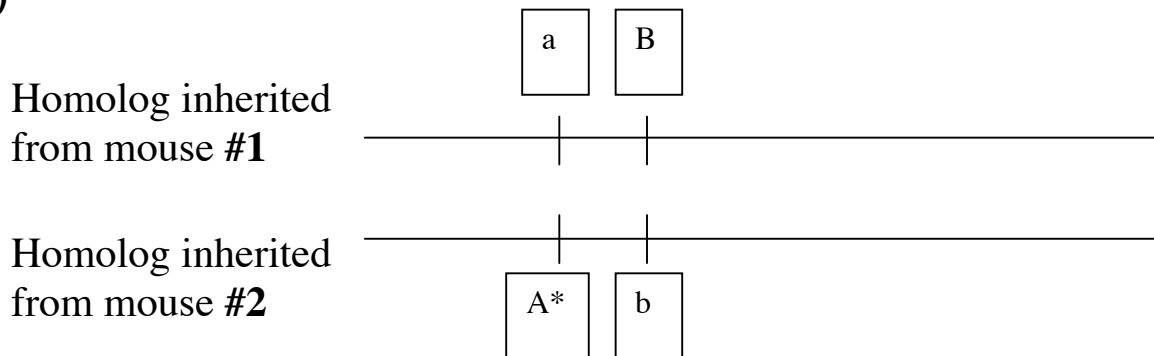


**2.** The following mouse pedigree shows the segregation of two different mutant traits.

(a)

	Number of "A*" alleles	Number of "a" alleles	Number of "B" alleles	Number of "b" alleles
Mouse #1	0	2	1	1
Mouse #2	1	1	0	2
Mouse #3	0	2	0	2
Mouse #4	1	1	1	1

(b)



(c) 47%

(d)

	X-linked		autosomal	
	Number of "A*" alleles	Number of "a" alleles	Number of "B" alleles	Number of "b" alleles
Mouse #1	0	1	1	1
Mouse #2	1	1	0	2
Mouse #3	0	1	0	2
Mouse #4	1	1	1	1

(e) 25%

**3.** You are working with a mutant strain of yeast that is dark tan (wild-type yeast are white).

(a) Type One is NPD, Type Two is PD, Type Three is TT

(b) yes, at 33 cM

(c) yes, the diploids would be white

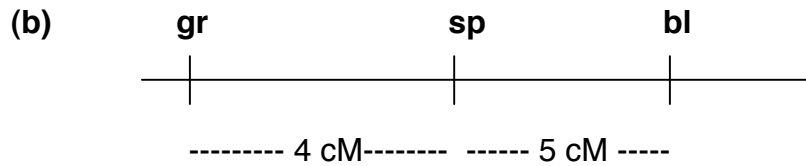
(d)

	# of spores that can grow on medium lacking leucine	color of each spore that can grow on medium lacking leucine
Type A tetrad	2	both are light tan
Type B tetrad	2	One light tan One white

(e) Genotype of one light tan spore:  $leu1^+$  and  $drk1^-$   
 Genotype of the other light tan spore:  $leu1^+$  and  $drk1^-$

**4.** Wild-type humbugs have brown bodies and brown eyes, and are not spotted.

(a) one parent is  $sp^+ bl^+ gr^-$  on each chromosome  
 the other parent is  $sp^- bl^- gr^+$  on each chromosome



(c) 20 cM

**5.** Consider two different antigen molecules produced on the surface of blood cells of wild-type mice, according to the biosynthetic pathway below.

(a) One parent is  $aaBBCC$  and the other parent is  $AAbbcc$

(b)

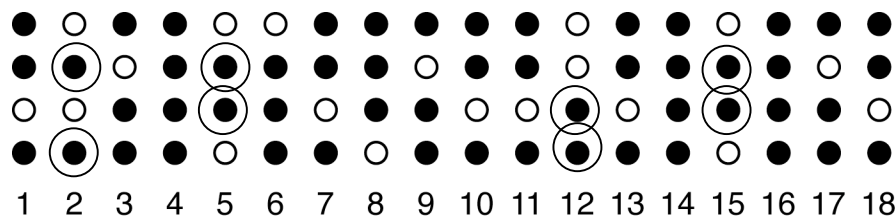
	<u>Fraction of F<sub>2</sub></u>
antigen 1 <sup>+</sup> , antigen 2 <sup>+</sup>	0.42
antigen 1 <sup>+</sup> , antigen 2 <sup>-</sup>	0.14
antigen 1 <sup>-</sup> , antigen 2 <sup>-</sup>	0.30
antigen 1 <sup>-</sup> , antigen 2 <sup>+</sup>	0.14

(c) You would cross to an  $aaBBCC$  mouse. If the F<sub>2</sub> mouse was defective in production of enzyme A, then you would never see a mouse born from this cross that had either antigen. However, if the F<sub>2</sub> mouse could make enzyme A, then you would see some progeny mice that had both antigens.

**6.** Some yeast mutants with defects in enzymes in the pathway for adenine biosynthesis form red colonies because of the accumulation of an intermediate in the pathway, which is a red pigment.

- (a) the *ade1* and *ade2* mutations are in the same gene and both give recessive phenotypes
- (b) they are linked at 2.7 cM
- (c) the *ade3* mutation gives a dominant phenotype so you cannot conclude whether or not it is in the same gene as the *ade1* mutation
- (d) 3 PDs, 4 NPDs, 11 TTs
- (e) they are unlinked and thus cannot be in the same gene

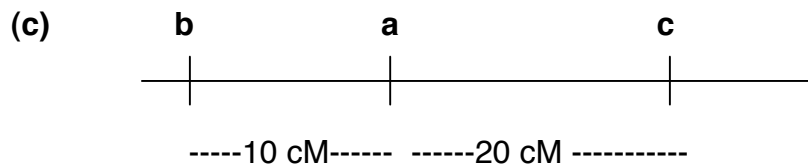
(f)



(g) 12 TTs

**7.** You are studying the genetics of a new insect species and have identified three different autosomal recessive traits -- apricot eyes, black body, and curly wings.

- (a) one parent is  $a^+ b^- c^+$  on each chromosome  
the other parent is  $a^- b^+ c^-$  on each chromosome
- (b) you analyzed too few flies to see the double crossovers



(d) 0.16%

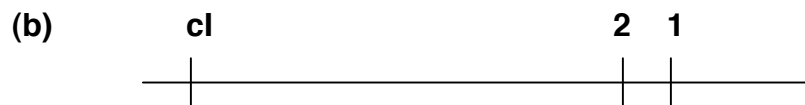
**8.** The following mouse pedigree shows the segregation of both a dominant and a recessive trait.

(a)  $X^{DR} X^{dr}$

- (b) zero
- (c) 15%
- (d) DdRr
- (e) 7.5%

**9.** You have isolated two different mutants of phage  $\lambda$  that make fuzzy plaques, which you name **fz-1<sup>-</sup>** and **fz-2<sup>-</sup>**.

(a) 3 m.u.

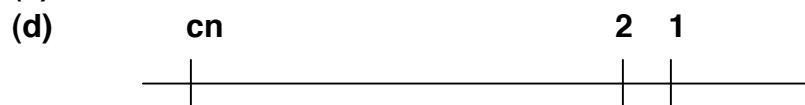


**10.** You have obtained a strain of *Drosophila*, which is homozygous for the **cn<sup>-</sup>** mutation (and thus has cinnabar colored eyes) and is homozygous for the **shi-1<sup>-</sup>** mutation (and thus becomes paralyzed at high temperature).

(a) 15 cM

(b) paralyzed with red eyes

(c) 0.2 cM



**11.** You have isolated a new **His<sup>-</sup>** yeast mutant.

(a) it gives a recessive phenotype

(b) the original strain had two mutations, which were linked at 30 cM

(c)  $2 * (40/240) * (40/239) = (1/18)$

**12.** In the following human pedigree, individuals exhibiting a **common** inherited allergy to milk are shown by shaded-in symbols, and unaffected individuals are shown by unshaded symbols.

(a) autosomal recessive

(b)

	<u>Genotype</u>		<u>Genotype</u>
II-1	+ m	III-2	+ m
II-2	m m	III-5	m m
II-3	+ m OR ++		

(c) = (1/6)

**13.** Wild-type yeast form white colonies.

(a) both mutations give a recessive phenotype and are in different genes

(b) Type I are PDs, Type II are TTs, Type III are NPDs

(c) yes, at 40 cM

(d) Clone A: red3<sup>+</sup> and red4<sup>+</sup>

Clone B: red3<sup>-</sup> and red4<sup>+</sup>

Clone C: red3<sup>-</sup> and red4<sup>-</sup>

Clone D: red3<sup>+</sup> and red4<sup>-</sup>

**14.** Consider the following family pedigree where two first cousins have a son.

(a)

male #4 = 100%

female #5 = 0%

female #7 = 0%

male #8 = 50%

male #9 = 50%

(b) male #4 = 100%

male #8 = 45%

male #9 = 5%

male #9 = 45%

male #9 = 45%

**15.** Consider two autosomal recessive *Drosophila* mutant phenotypes -- curly-wings (caused by the **cr** allele) and humpback (caused by the **hb-1** allele).

(a) 21 cM

(b) wild-type (straight wings, straight back)

(c) 2 cM

(d)



**16.** A true-breeding mouse strain exhibits two different rare traits.

(a) X-linked dominant

(b) 40%

(c) 20 cM

**17.** You have isolated a yeast mutant that makes small colonies.

(a) it gives a recessive phenotype

(b) the mutant contains only one mutation

(c) two are small and two are big

(d) the two mutations both give recessive phenotypes and are in different genes

(e) 36 cM

(f) 8 tetrads from DCOs

**18.** You have isolated two different mutants of phage lambda in the repressor gene

(cl); these mutations cause clear plaques rather than the normal turbid plaques.

(a) 4 m.u.

(b)

Phenotype	# of Plaques in this class	Genotype(s) of Plaques in this class
Clear, large	484	$mi^+$ , and $1^-2^+$ OR $1+2^-$ OR $1^-2^-$
Clear, small	496	$mi^-$ , and $1^-2^+$ OR $1+2^-$ OR $1^-2^-$
Turbid, large	16	$mi^+$ and $1+2^+$
Turbid, small	4	$mi^-$ and $1+2^+$

**19.** The genes for two rare human autosomal dominant traits are 10 cM apart (as determined by meiosis in females).

(a)

Probability

Dominant trait 1 only                      25%

Dominant trait 2 only                      25%

Both dominant trait 1 and trait 2                      25%

(b)

Probability

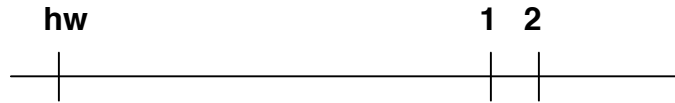
Dominant trait 1 only                      45%

Dominant trait 2 only                      45%

Both dominant trait 1 and trait 2                      5%

**20.** Mutations in the **w** gene on the X chromosome of *Drosophila* give white eyes instead of the normal red.

- (a) white eyes
- (b) red eyes
- (c) half
- (d) 0.02 cM
- (e)



**21.** Wild-type yeast make white colonies.

(a) How many tetrads of each type are there?

<u>PD</u>	<u>NPD</u>	<u>TT</u>
5	1	6

- (b) yes, at 50 cM
- (c) all tetrads will have 2 red spores and 2 white spores
- (d)

Spore clone	X	wild-type	→	resulting diploid – STATE PHENOTYPE:
○		○		white
●		○		red
●		○		red
○		○		white

**22.** Wild-type *Drosophila* have red eyes, and white eyes is an X-linked recessive phenotype caused by a single mutation.

- (a) same gene

- (b) 1.2 cM
- (c) on the X
- (d) different genes
- (e)



**23.** The following mouse pedigree shows the segregation of two different autosomal recessive traits.

- (a) AaBb
- (b) (9/16)
- (c) 51%
- (d) 50%

**24.** You have isolated a new mutation of phage  $\lambda$  that makes plaques with rough edges.

- (a) 10 m.u.
- (b) 2 m.u.
- (c)

