

Name _____

Check One: Section 1 Section 2
 Section 3 Section 4

GENETICS

Exam #2

100 pts + 10 extra credit points

1. (5) In *Drosophila* the gene for white eyes (*w*) is X-linked and the gene for black body (*b*) is autosomal. In both genes, the wild type is dominant to the mutant. Use **BRANCHING** to determine the F2 **PHENOTYPIC** ratios in the cross below. (Note: you are being tested on your ability to do branching. Any other method will not receive credit).

male black body x female white eyes

Give the **genotypes** for the P1 generation of the **reciprocal cross** _____ X _____

2. (5) In *Drosophila* the gene for Curly Wing (*CY*), singed bristles (*s*) and black body (*b*) are all autosomal and unlinked. Mutations in *s* and *b* are recessive to the wild type allele but a mutation in *CY* is dominant to the wild type allele. Use **BINOMIAL EXPANSION** to determine the F2 **PHENOTYPIC** ratios in the cross below. (Note: you are being tested on your ability to do binomial expansion. Any other method will not receive credit).

male black body, singed x female Curly Wing

3. (15) Complete the table and fill in the blanks:

What is the function of the Y chromosome in humans? How do non-disjunction syndromes prove this?

What is the function of the Y chromosome in fruit flies? How do non-disjunction strains prove this?

What is the embryonic tissue that differentiates into ovaries and testes?

Why does each sex possess residual secondary sexual characteristics of the opposite sex?

What is the difference between "homogametic" and "heterogametic" sex? (note: I am **not** asking which sex is heterogametic or homogametic)

4. (10) Briefly describe the three general types of data that are used to demonstrate that in females, one X chromosome is inactivated.

5 (5) What is the TDF gene? Where is it believed to be located? How may X-inactivation be involved in sex determination?

6. (20) In *Drosophila* the genes fuzzy hair (*f*), vestigial wings (*v*), and black body (*b*) are autosomally linked. The mutant alleles are recessive to wild type in all cases. Fill in the blanks to indicate how you would do a cross to map the genes and use the data to determine the map. The initial cross is:

fuzzy, vestigial x black

<u>F2 Phenotypes</u>			<u>Numbers</u>
B	<i>f</i>	<i>v</i>	1380
<i>b</i>	F	V	1384
B	F	<i>v</i>	70
<i>b</i>	<i>f</i>	V	76
B	<i>f</i>	V	41
<i>b</i>	F	<i>v</i>	45
<i>b</i>	<i>f</i>	<i>v</i>	1
B	F	V	3
Total			3000

give the genotypes of the P1 parents

give the genotype of the F1

give the phenotype of the F1

give the genotype of the strain with which the F1's will be crossed

give the name of this type of cross

Draw the map of the genes:



Calculate the coefficient of coincidence

Calculate the interference:

Is this positive or negative interference?

Does positive interference increase or decrease as the distance between the markers grows longer? Why?

7. (10) In *Drosophila* the genes A B and D are autosomally linked according to the map:



In each case, the mutant allele is recessive to the dominant. You propose to cross **ab x d**. Determine the resulting F₂ phenotypes and numbers assuming that you recover 1500 flies from the cross and assuming that the coefficient of coincidence is **0.76**. You must show the reciprocal phenotypes for each recombinant/nonrecombinant but you can combine the numbers for each pair.

Event	Phenotype	Expected Number
No Recombination		
Single recombination A-B		
Single Recombination B-D		
Double Recombination		
Total		1500

8. (10) You cross a strain of flies with brown eyes with a strain of flies whose body color is black instead of the usual yellow. Use the Chi-square test to determine whether the genes for eye color and body color are unlinked. You may use the table below to compute your results, but there may be more squares than you need.

Phenotype	Number						
Normal Eyes Normal Body	120						
Normal Eyes Black Body	58						
Brown Eyes Normal Body	42						
Brown Eyes Black Body	20						

Null Hypothesis = _____

Degrees of Freedom = _____

Probability Level = _____

X² = _____

Critical X² = _____

Accept H₀

Reject H₀

Professor was on the level

Professor is a cheating SOB

Table of Chi Square Values

Degrees of Freedom	P=.99	P=0.95	P=0.8	P=0.5	P=0.2	P=0.05	P=0.01
1	0.000157	0.00393	0.0642	0.455	1.642	3.841	6.635
2	0.020	0.103	0.446	1.386	3.219	5.991	9.210
3	0.115	0.352	1.005	2.366	4.642	7.815	11.345
4	0.297	0.711	1.649	3.357	5.989	9.488	13.277
5	0.554	1.145	2.343	4.351	7.289	11.071	15.086
6	0.872	1.635	3.070	5.348	8.558	12.592	16.812
7	1.239	2.167	3.822	6.346	9.803	14.067	18.475
8	1.646	2.733	4.594	7.344	11.030	15.507	20.090
9	2.088	3.325	5.380	8.343	12.242	16.919	21.666
10	2.558	3.940	6.179	9.342	13.442	18.307	23.209

9. (6) From the population information below, calculate the frequency of I^A , I^B , and i alleles.

<u>Blood Type</u>	<u>Number</u>	<u>Final Answers</u>
A	240	$I^A =$ _____
B	292	$I^B =$ _____
AB	201	$i =$ _____
O	<u>67</u>	
Total	800	

10. (8) The allele frequencies for I^A , I^B , and i alleles are $I^A = 0.25$, $I^B = 0.19$, and $i = 0.56$. Assuming a population size of 650, determine the number of individuals with each blood type.

<u>Blood Type</u>	<u>Number</u>
A	_____
B	_____
AB	_____
O	_____
Total	650

11. (5) Gene **A** is sex-linked in *Drosophila*. When two strains are mixed, the allele frequency for **A** in males is 0.45 and in females it is 0.38. Determine the allele frequencies of **A** in males and females for the next three generations. What will the allele frequencies of **A** and **a** be when the population finally reaches equilibrium?

Generation	males	females
0	0.64	0.55
1		
2		
3		
A at equilibrium		
a at equilibrium		

12. (11) Short Answers

- a. _____ is a term that describes a static population
- b. _____ and _____ are two characteristics of the population described in "a"
- c. _____ is the term that describes a population whose allele frequencies remain the same from generation to generation
- d. _____ is the name of the theory that best describes our current understanding of the appearance and disappearance of species from the fossil record
- e. _____ is term that means that speciation occurs in small populations isolated from the main population
- f. _____ is the term opposite to "e", which means that speciation occurs within a large population
- g. _____ is the difference between the large cactus finch on Espanola Island and the large cactus finch on Genovesa Island in the Galapagos
- h. _____ is believed to be the cause of the difference in "g"
- i. _____ is the term that describes changes in allele frequency within a population, but not so great an amount as to lead to speciation
- j. _____ is the term that describes changes in a population that leads to the formation of a new species