

**Biol 3301  
Genetics  
Exam #1  
September 19, 2001**

This exam consists of 25 questions worth a total of 100 points. The point total for each question is shown in parenthesis. Partial credit can be earned, so show your work. Good luck.

Name KEY SS# \_\_\_\_\_

1. (3) If an A/a plant is self crossed, the genotypic ratio of the progeny will be: answer - b  
 a) 1:1            b) 1:2:1            c) 1:1:1:1            d) 9:3:3:1            e) 3:1

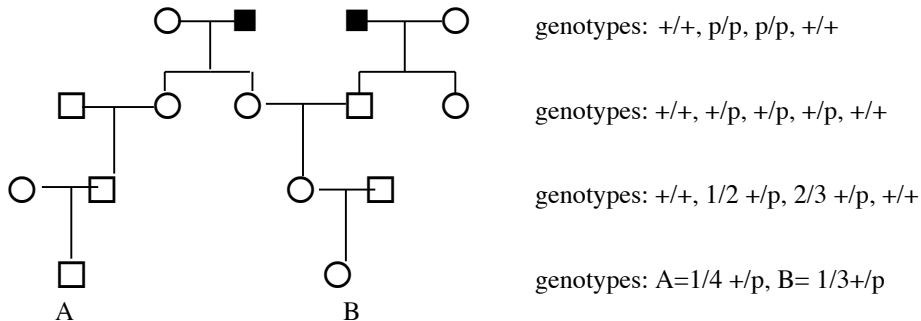
2. (10) Based on his experiments with peas, what five deductions did Mendel make concerning the inheritance of traits?

- 1) The existence of genes
- 1) Genes are in pairs (dominant/recessive)(alleles)
- 1) The principal of segregation (separate equally and move into gametes)
- 1) Gametic content of one member of a gene pair (only one allele is carried by each gamete)(independent assortment)
- 1) Random fertilization

3. (3) A mutation arises in a gene that renders its protein completely inactive. This mutation would be: answer - c  
 a) dominant    b) incompletely dominant    c) recessive    d) codominant  
 (note: this answers assumes haplosufficiency, which is almost always the case)

4. (6) PKU is an autosomal recessive disorder. In the pedigree below, the couple marked A & B are planning to have a baby but are worried that it might have PKU. Assume that people marrying into the pedigree are not carriers unless there is evidence to the contrary.

What is the probability that their first child will have PKU? +=wild type; p=PKU



Child of A+B having PKU= (1/4)(1/3)(1/4)=1/48

5. (3) A man with arachniphobia disease marries a normal woman. They have 8 children (4 boys and 4 girls). All of the girls have the disease, but none of the boys. How is this disease inherited?  
 answer - d  
 a) Autosomal recessive                      b) Y linked                      c) Autosomal dominant  
 d) X-linked dominant                      e) X-linked recessive
6. (3) A process that occurs in meiosis, but not mitosis, is:                      answer - e  
 a) Chromatid formation    b) Cell division    c) Separation of homologous centromeres to opposite poles  
 d) Chromosome condensation              e) Pairing of homologous chromosomes
7. (3) In humans, sex is determined by:                      answer - c  
 a) the X:Y ratio    b) the number of X chromosomes    c) the presence of a Y chromosome
8. (3) A cross was made in which a white eyed *Drosophila* female ( $w/w$ ) is crossed to a red eyed male ( $w^+/Y$ ). In addition to the expected red eyed female and white eyed male progeny one occasionally observes a white eyed female due to nondisjunction of X chromosomes (in females) during meiosis.
9. (3) Which of the following is the correct order of increasing levels of chromosome packing (smallest to largest)?  
 answer - e  
 a) Nucleosomes-loops-solenoids-supercoils  
 a) Solenoid-nucleosomes-loops supercoils  
 a) Nucleosomes-solenoid-supercoils-loops  
 a) Solenoid-loops-nucleosomes-supercoils  
 a) Nucleosomes-solenoids-loops-supercoils
10. (6) *Drosophila* eyes are normally red. Several purple-eyed strains have been isolated as spontaneous mutants, and the purple phenotype has been shown to be inherited as a Mendelian autosomal recessive in each case. To investigate allelism between these different purple mutations, a complementation test was done by crossing two purple-eyed strains. The progeny from this cross were all red eyed, indicating that these two purple mutants were in (circle one) a: the same gene    OR    b: different genes. answer - b
11. (3) In chickens, the dominant allele  $Cr$  produces the creeper phenotype (having extremely short legs). However, the creeper allele is lethal in homozygous condition. If two creepers are mated, what proportion of the living progeny will be creepers?  
 answer - e  
 a) 1/4                      b) 1/2                      c) 3/4                      d) 1/3                      e) 2/3

12. (4) In a certain breed of dog, the alleles B and b determine black and brown coats, respectively. However, the allele q of a gene on a separate chromosome is epistatic to the B and b color alleles and results in a gray coat (Q has no effect on color). If animals of genotype B/b; Q/q are intercrossed, what phenotypic ratio is expected of the progeny?

9	B/-;Q/-	Black
3	B/-;q/q	gray
3	b/b;Q/-	brown
1	b/b;q/q	gray

answer – 9 black: 4 gray: 3 brown

13. (4) Two agouti mice of genotype A/a; B/b are crossed and yield progeny having a phenotypic ratio of 9 agouti: 3 cinnamon: 3 black: 1 brown. Are the A and B genes in the same or different pathways?

Any time there is a 9:3:3:1 phenotypic ratio, the genes must be functioning in different pathways

14. (3) In *Drosophila*, the curly (Cy) allele leads to a curling of the wings. You look at 20 Cy/+ individuals and see that they all have the curly phenotype, but the phenotype ranges from slight curling to severe curling. Your observation suggests that the expressivity of Cy differs in these individuals.

15. (6) Two pure lines of plants are crossed, one with yellow petals and one with red. The F<sub>1</sub> are all orange. When the F<sub>1</sub> are selfed, the resulting F<sub>2</sub> are: 285 orange, 80 yellow and 115 red. You form a hypothesis that this ratio can be accounted for by recessive epistasis of r (red) on Y (orange) and y (yellow). Thus:

(yellow) y/y; R/R x Y/Y; r/r (red)

F1	Y/y; R/r (orange)				Observed	Expected
F2	9/16	Y/-; R/-	(orange)	orange	285	270
	3/16	y/y; R/-	(yellow)	yellow	80	90
	3/16	Y/-; r/r	(red)	red	115	120
	1/16	y/y;r/r	(red)	total	480	

Determine if your hypothesis is correct using  $\chi^2$  analysis. Show your work for complete credit.

(o-e) <sup>2</sup>	(o-e) <sup>2</sup> /e		
225	0.83		
100	1.11		
25	<u>0.21</u>		
$\chi^2$	2.15	df= 3-1=2	$\chi^2 > 0.1$ , so the hypothesis is accepted.



21. (3) In *Neurospora*, if a diploid of genotype  $a^+b^+ / a^-b^-$  goes through meiosis to produce spores, give an example of asci that are: parental ditype (PD), non-parental ditype (NPD) and tetratype (T).

	PD	NPD	T
spores 1&2:	$a^+b^+$	$a^+b^-$	$a^+b^+$
spores 3&4:	$a^+b^+$	$a^+b^-$	$a^+b^-$
spores 5&6:	$a^-b^-$	$a^-b^+$	$a^-b^+$
spores 7&8:	$a^-b^-$	$a^-b^+$	$a^-b^-$

22. (3) What process must occur during the first meiotic division to produce an  $M_{II}$  segregation pattern?

Crossing over or recombination or chiasmata

23. (12) In *Neurospora*, a strain that was mutant for a gene required to make thiamine (mutant allele  $t$ ) was crossed to a strain mutant for a gene required to make methionine (mutant allele  $m$ ). Linear asci were isolated and classified into the following groups:

$t^+m^+$  strain crossed to a  $t^-m^-$  strain ( $t^+m^+/t^-m^-$ ) and sporulated.

spore pair	ascus types					
1 and 2	$t^+m^+$	$t^+m^+$	$t^+m^-$	$t^+m^-$	$t^-m^-$	$t^-m^-$
3 and 4	$t^+m^+$	$t^-m^-$	$t^+m^-$	$t^-m^-$	$t^-m^-$	$t^+m^+$
5 and 6	$t^-m^-$	$t^+m^+$	$t^+m^-$	$t^-m^-$	$t^+m^+$	$t^+m^+$
7 and 8	$t^-m^-$	$t^-m^-$	$t^+m^-$	$t^+m^-$	$t^+m^+$	$t^-m^-$
Number	260	76	4	54	1	5
Ascus types	PD	T	PD	T	NPD	T
Segregation pattern for $t$	$M_I$	$M_I$	$M_{II}$	$M_{II}$	$M_I$	$M_{II}$
Segregation pattern for $m$	$M_I$	$M_{II}$	$M_{II}$	$M_I$	$M_I$	$M_{II}$

- a) Determine the distance between the centromere and  $t$ .  $1/2(M_{II})/total = \text{distance to centromere}$

$$1/2(4 + 54 + 5) = 31.5 \text{ (this answer is acceptable)}$$

$$31.5/400 = 0.79 \text{ or } 7.9\text{m.u. (1 bonus point for this answer)}$$

- b) Determine the distance between the centromere and  $m$ .

$$1/2(76 + 4 + 5) = 42.4 \text{ (this answer is acceptable)}$$

$$42.4/400 = 0.106 \text{ or } 10.6\text{m.u. (1 bonus point for this answer)}$$

- c) Determine the distance between  $t$  and  $m$ .

$$RF = 1/2(t) + NPD/total$$

$$1/2(76 + 54 + 5) + 1 = 68 \text{ (this answer is acceptable)}$$

$$68/400 = 0.170 \text{ or } 17\text{m.u. (1 bonus point for this answer)}$$

- d) Are  $t$  and  $m$  on the same side of the centromere?

This question was not graded. The actual answer is that  $t$  and  $m$  are on opposite sides of the centromere.