

Name: _____

7.03 Exam One -- 2005

Name: _____

Exam starts at 11:05 am and ends at 11:55 am.

There are 7 pages including this cover page.

Please write your name on each page.

Only writing on the **FRONT** of every page will be graded.
(You may use the backs, but only as scratch paper.)

Question 1 **24 pts** _____

Question 2 **30 pts** _____

Question 3 **30 pts** _____

Question 4 **16 pts** _____

TOTAL **out of 100** _____

Name: _____

1. (24 pts) You are studying two recessive mutations in the fruit fly *Drosophila melanogaster*. The hb^- mutation causes flies to have hairy backs (wild-type flies have hairless backs). The tl^- mutation causes flies to have thick legs (wild-type flies have thin legs). You mate females from a true-breeding strain with hairy backs and normal legs to males from a true-breeding strain with normal backs and thick legs. F1 females are then mated to males that have hairy backs and thick legs to produce F2 progeny. If you analyzed 500 **MALE** progeny in the F2 generation, how many flies of each possible phenotypic class would you expect, given that:

(a, 8pts) The two traits are determined by two unlinked autosomal genes

hairy thick:

hairy thin:

hairless thick:

hairless thin:

(b, 8pts) The two traits are determined by two completely linked genes on the X chromosome

hairy thick:

hairy thin:

hairless thick:

hairless thin:

(c, 8pts) The two traits are determined by two autosomal genes that are 20 cM apart

hairy thick:

hairy thin:

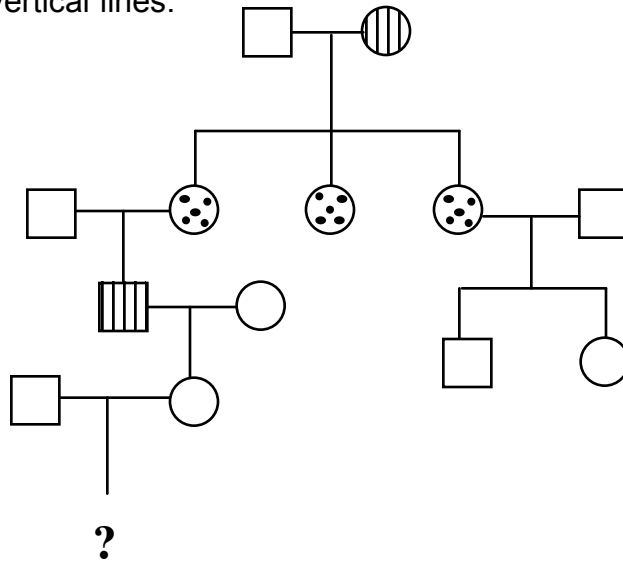
hairless thick:

hairless thin:

Name: _____

2. (30 pts) The following pedigree shows the inheritance two different **rare** traits. Each trait is determined by a different gene. The presence of Trait 1 is indicated by dots, and the presence of Trait 2 is indicated by vertical lines.

(Note that no single individual displays both traits.)



(a, 6pts) What mode(s) of inheritance is/are consistent with each of the traits segregating in this pedigree? (Your choices are: autosomal recessive, autosomal dominant, X-linked dominant, X-linked recessive.) Assume no new mutations and complete penetrance.

Trait 1 (dots):

Trait 2 (vertical lines):

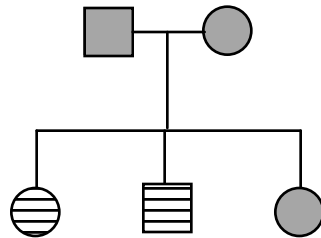
(b, 6pts) State whether the two traits in the pedigree are **linked** or **not linked**, or if it is inconclusive given these data.

(c, 6pts) What is the probability that the child indicated with a question-mark will show at least one of the two traits? Show your work.

Name: _____

Consider this new pedigree, which shows the inheritance of two different rare traits. Each trait is determined by a different gene. The presence of Trait 3 is indicated by horizontal lines, and the presence of Trait 4 is indicated by shading.

(Note that no single individual displays both traits.)



(d, 6pts) What mode(s) of inheritance is/are consistent with each of the traits segregating in this pedigree? (Your choices are: autosomal recessive, autosomal dominant, X-linked dominant, X-linked recessive.) Assume no new mutations and complete penetrance.

Trait 3 (horizontal lines):

Trait 4 (shading):

(e, 6pts) State whether the two traits in the pedigree are **linked** or **not linked**, or if it is inconclusive given these data.

Name: _____

3. (30 pts) You are studying three mutations in yeast. The first mutation causes the Ser⁻ phenotype of being unable to grow without serine in the medium. The second mutation causes the His⁻ phenotype of being unable to grow without histidine in the medium. The third mutation causes a small colony phenotype. Wild-type yeast are Ser⁺ His⁺ and big. You mate a Ser⁻ haploid mutant yeast to a His⁻ small haploid mutant yeast. You induce sporulation of the resulting diploid, and obtain the following tetrad types. (The number of tetrads of each type that you get (out of a total of 100) are shown after the tetrad type.)

Tetrad Type A)
Ser⁻ His⁺ big
Ser⁻ His⁺ small
Ser⁺ His⁻ big
Ser⁺ His⁻ small)
9 tetrads of this type

Tetrad Type B)
Ser⁻ His⁺ big
Ser⁻ His⁺ big
Ser⁺ His⁻ small
Ser⁺ His⁻ small)
90 tetrads of this type

Tetrad Type C)
Ser⁺ His⁻ big
Ser⁻ His⁺ small
Ser⁻ His⁻ big
Ser⁺ His⁺ small)
1 tetrad of this type

(a, 4pts) Which Tetrad Types are TTs, NPDs, and PDs with respect to the His and size genes?

TT:

NPD:

PD:

(b, 4pts) Are the His and size loci linked? If so, what is the genetic distance between them?

Name: _____

(c, 4pts) Which Tetrad Types are TTs, NPDs, and PDs with respect to the Ser and size genes?

TT:

NPD:

PD:

(d, 4pts) Are the Ser and size loci linked? If so, what is the genetic distance between them?

(e, 4pts) Which Tetrad Types are TTs, NPDs, and PDs with respect to the Ser and His genes?

TT:

NPD:

PD:

(f, 4pts) Are the Ser and His loci linked? If so, what is the genetic distance between them?

(g, 6pts) Draw a genetic map showing the correct relative order of the Ser, His, and size loci. If one of the loci is unlinked from the other two, draw it on a separate chromosome.

Name: _____

4. (16 pts) You are studying a recessive trait in a diploid rodent species in which XX organisms are female and XY organisms are male. This trait is determined by a single gene, but you have no idea where in the genome this gene is located. This rodent has 20,000 distinct genes in its genome, 400 of which are found on the X chromosome.

(a, 4pts) Given this information, give your best estimate of the probability that the trait you are studying is X-linked.

(b, 12pts) You mate a female rodent displaying the trait to a wild-type male. You then mate an F1 female to a wild-type male to produce F2 offspring, and analyze only the F2 males. The first three F2 male offspring display the wild-type phenotype.

Given that the first three male F2 offspring show the wild-type phenotype, determine the probability that the trait you are studying is X-linked. Show **all** steps of your work, using clear labels.