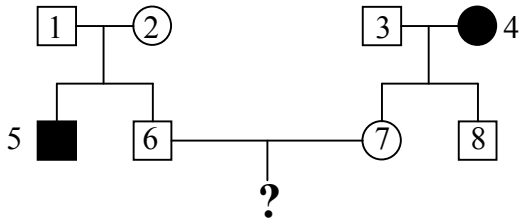
Solution key - 7.012 Recitation 5 - 2010

Questions:

1. In the box below, write the most likely mode of inheritance of the following pedigree?

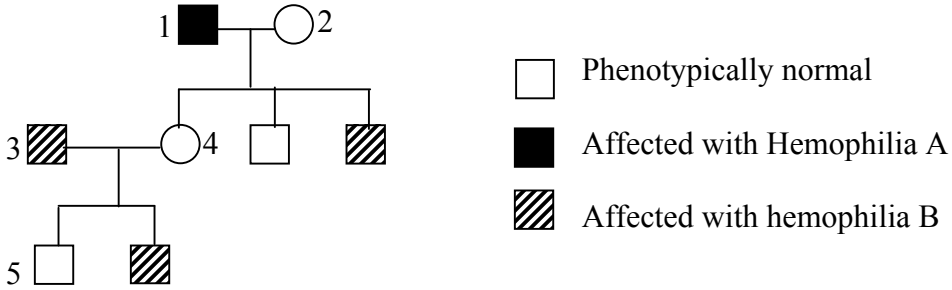


autosomal recessive inheritance

Given each consistent mode of inheritance, if the couple in question decides to have a child, what is the probability of that child being affected? *(Note: Use the uppercase or lowercase A to represent the alleles for the dominant and recessive traits).*

If Individual#5 has the disease than both his parents are carriers i.e. #1 and #2 both have the Aa genotype. Therefore the probability that Individual #6 will be a carrier is 2/3rd. In comparison Individual #7 is most certainly a carrier since one of his parents (individual #4 who has the genotype aa) has the disease. Therefore the probability that the child of individuals #6 and #7 will have the disease is 1/4th. Combining all the probabilities together, the probability that the child will have the disease is 2/3 X 1/4 = 1/6th.

2. Consider the pedigree below showing the inheritance of two X-linked diseases, hemophilia A and hemophilia B . Hemophilia A is due to a lack of one clotting factor, and hemophilia B is due to a lack of a different clotting factor. These two clotting factors are encoded by two different genes, located at different positions on the X chromosome. Note that no individual shown in this pedigree is affected with both hemophilia A and hemophila B.



i. Write the genotypes for the following individuals at both the hemophilia A and hemophilia B disease loci. Clearly define your genotype symbols.

Individual	Genotype
1	$X^{aB}Y$
2	$X^{aB}X^{AB}$
3	$X^{Ab}Y$
4	$X^{aB}X^{Ab}$ or $X^{aB}X^{AB}$
5	$X^{AB}Y$

ii. How do you account for individual 5 not being affected with either hemophilia A or hemophilia B? *He originated owing to a crossing over event during meiosis –I between the hemophilia A and hemophilia B genes on the X chromosomes of Individual #4.*

3. Name an organism that may exist

i. In a haploid state: *Yeast*
ii. In a diploid state: *Yeast*
iii. Can adopt either state: *Yeast*
iv. If you were mutagenizing the last organism and looking for a resulting recessive mutant phenotype, would you mutagenize the haploid or diploid form?

You would use haploid since heterozygous diploid will not show the recessive phenotype.

4. You are studying a biochemical pathway results in the synthesis of compound F in yeasts. Compounds A through E are intermediates in this biochemical pathway. You have isolated 5 different haploid mutant yeast strains, each of which are defective in a single gene that encodes an enzyme that acts in this pathway. The table shows whether each mutant can (+) or cannot (–) synthesize compound F (and thus can grow on minimal medium) when provided with each of the compounds shown along the top of the chart in their growth medium.

Compound Mutant	A	B	C	D	E	F
1	-	-	-	+	-	+
2	-	+	-	+	-	+
3	-	-	-	-	-	+
4	-	+	+	+	-	+
5	+	+	+	+	-	+

Given the chart, draw the biochemical pathway that produces compound F. Indicate the correct order of the steps, and which enzyme (out of enzymes #1-5) catalyzes each reaction.

E5 E4 E2 E1 E3

E → A → C → B → D → F

5. You discover a series of fruit flies that all display a recessive "mini-fly" phenotype. Each mutant fly is homozygotic for the mutation causing the mini fly phenotype. You cross each mutant fly with the other flies in the series and score the phenotype of the resulting F1 progeny as follows.

	a/a	b/b	c/c	d/d	e/e	f/f
a/a	X	mini	normal	normal	normal	mini
b/b	mini	X	normal	normal	normal	mini
c/c	normal	normal	X	normal	mini	normal
d/d	normal	normal	normal	X	normal	normal
e/e	normal	normal	mini	normal	X	normal
f/f	mini	mini	normal	normal	normal	X

i. Place the six mutations into complementation groups.

They can be divided into three complementation groups: Group 1 (a/a, b/b, f/f), group II (c/c and e/e) and group III (d/d).

ii. Are mutations *b* and *c* in the same gene or in different genes?

The mutations are in two different genes since they complement each other and are therefore in two different complementation groups.

iii. You cross a homozygous "*g/g"* mutant animal to *a/a* and *b/b* animals. Both crosses yield mini-flies. What is your conclusion?

This means that the two mutants cannot complement each other and are therefore in the same complementation group.