

**Problem Set 3 Answers**  
**Genetics 371**  
**Winter 2010**

1. A husband and wife are both carriers of the recessive gene for the metabolic disorder galactosemia. They plan to have two children. Calculate the probability that:

- (a) The first child will be galactosemic.  $1/4$
- (b) Both children will be galactosemic.  $1/4 * 1/4$
- (c) The first child will be galactosemic and the second will not.  $1/4 * 3/4$
- (d) Only one child will be galactosemic.  $1/4 * 3/4 + 3/4 * 1/4$

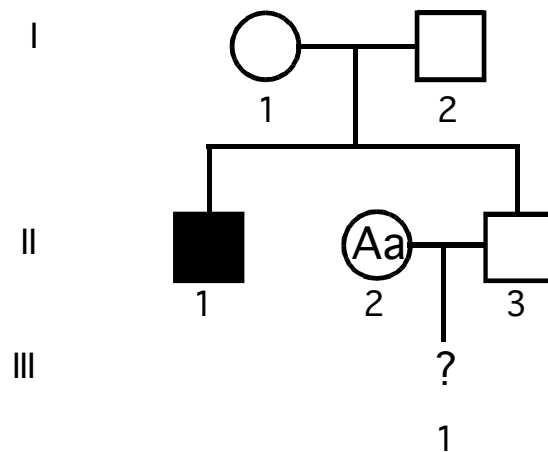
2. Phenylketonuria (PKU) is a serious metabolic defect occurring in individuals who are homozygous for a recessive gene. Two unaffected parents have a daughter with the disease and an unaffected son.

- (a) What is the probability that the son is a carrier (heterozygous) of the PKU allele?  $2/3$
- (b) Suppose the unaffected son marries an unaffected woman whose father has PKU. What is the probability that their first-born child is affected with the disease?  $2/3 * 1/4$
- (c) Suppose the unaffected son marries an unaffected woman whose parents are also unaffected, but whose sister suffers from PKU. What is the probability that their first-born child is affected with the disease?  $2/3 * 2/3 * 1/4$

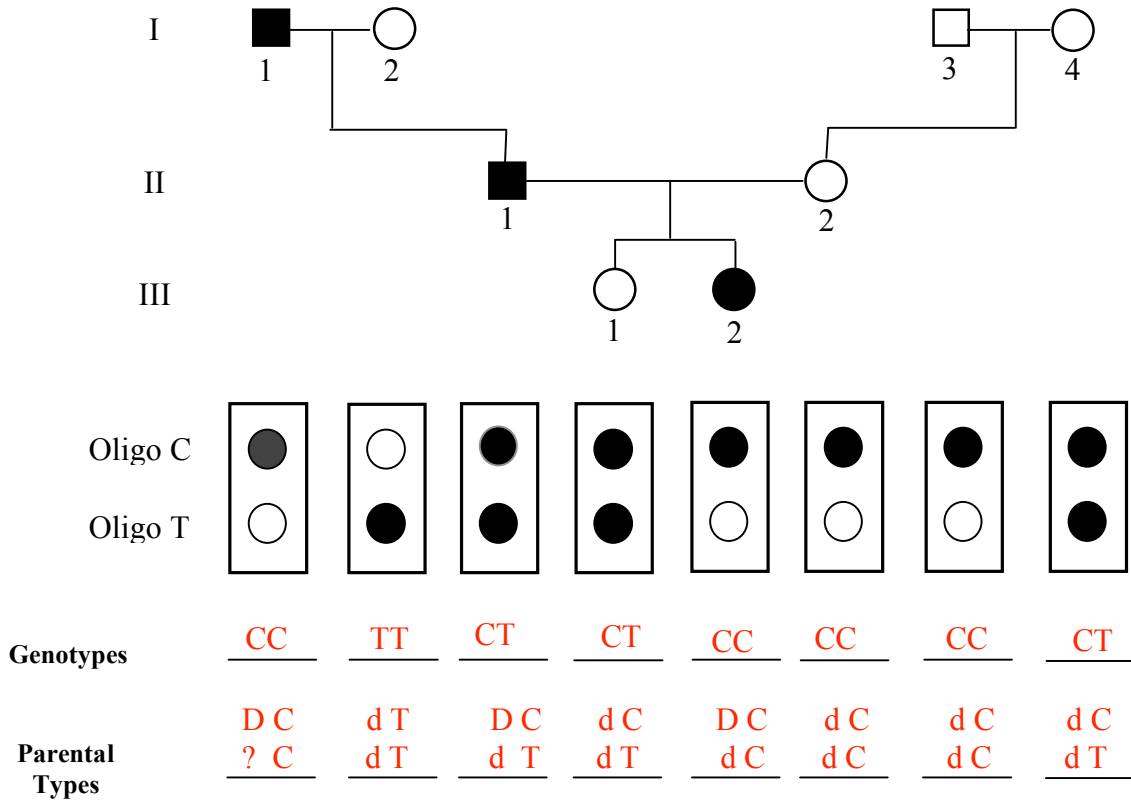
3. Below is the pedigree that we discussed in lecture, which is segregating the albinism phenotype (a recessive disease). Let's denote the wild type allele as A and the recessive allele as a.

a. What is the probability that III-1 is:

- (a) A carrier of the albinism allele?  $1/3 * 1/2 + 2/3 * 1/2$
- (b) A male carrier of the albinism allele?  $1/2 * [1/3 * 1/2 + 2/3 * 1/2]$
- (c) A female carrier of the albinism allele?  $1/2 * [1/3 * 1/2 + 2/3 * 1/2]$



4. The pedigree below is segregating a very rare autosomal dominant form of deafness ( $D$  = deafness,  $d$  = wild type). As a first step towards mapping the deafness gene, you have determined SNP genotypes for thousands of markers by hybridizing genomic DNA to glass slides that contain allele specific oligonucleotides. The hybridization pattern for one particular marker, SNP1, is shown for each person (black circle = hybridization, unfilled circle = no hybridization).



Fill in the genotypes and parental types of the deafness gene and SNP1 for each individual in the spaces provided above. For example, you should specify genotypes and parental types as

DDTT and  $\frac{D}{D} \frac{T}{T}$  (use ? for alleles that you cannot determine).

5. In tomatoes, red fruit (A-) is dominant to yellow (aa), and a tall stem (B-) is dominant to dwarf stems (bb). A series of matings between dihybrid tomato plants yields the following offspring:

557 tall, red-fruited plants

187 tall, yellow-fruited plants

192 dwarf, red-fruited plants

64 dwarf, yellow-fruited plants.

Are the fruit-color and stem length genes independently assorting? Perform a chi-square test to support your argument, and clearly state the degrees of freedom and interpretation of the p-value you obtain.

We are testing the null hypothesis that the data conform to a 9:3:3:1 ratio expected for independently assorting genes. Therefore, the  $df = 4 - 1 = 3$ . The chi-square value is 0.199. Looking this value up in the table provided gives a p-value between 0.975 and 0.995. We therefore do not reject the null hypothesis of independent assortment.