Practice with Sex Linkage and Other Cool Stuff

1. In fruit flies, eye color is sex-linked. What are the expected sexes and eye colors from the following crosses?
a) red-eyed (homozygous) female x white-eyed male
b) carrier female x white-eyed male
c) white-eyed female x red-eyed male
d) female carrier x red-eye male

2. A recessive sex-linked gene (h) located on the X chromosome increases blood-clotting time. This causes the genetic disease, hemophilia.
a) Explain how a hemophilic offspring can be born to two normal parents.
b) Would any of the female offspring have hemophilia?

3. A mutant sex-linked trait called "notched" (N) is deadly in Drosophila when homozygous in females. Males who have a single N allele will also die. The heterozygous condition (Nn) causes small notches on the wing. The normal condition in both male and females is represented by the allele n.
a) Indicate the phenotypes of the F_1 generation from the following cross: X^NX^n x X^nY
b) Explain why dead females are never found in the F_1 generation no matter which parents are crossed.
c) Explain why the mating of female X^NX^n and a male X^Ny is unlikely.

4. In Drosophila, eye color is determined by two different genes located on different chromosomes. A recessive gene b, found on chromosome 2 (an autosome), produces brown eye color. A recessive sex-linked gene v causes vermilion eye color to be produced. The presence of the dominant genes b+ and v+ results in a wild-type color. The presence of both the brown and vermilion allele, in the homozygous condition result in an individual with white eyes. Indicate the genotypes and phenotypes produced from the following crosses:
a) $b+b+X^{v+}X^{v+}$ (wild-type female) x bbX^vy(white-eyed male)
b) $b+bX^{v+}X^v$ (wild-type female) x $b+bX^{v+}y$ (wild-type male)
c) $bbX^{v+}X^{v+}$ (brown-eyed female) x $b+bX^vy$ (vermilion-eyed male)

5. Larry has hemophilia (a recessive, X-linked condition) but his daughter, Lauren, has a normal phenotype. She marries Jake who is normal for the trait.
a) What is the probability that Lauren and Jake have a daughter with hemophilia?
b) What are the chances of having a son with the disorder?
c) What are the chances of their daughters being a carrier?
d) If the couple has four sons, what is the probability that all four will be hemophiliac?
e) If Jill's father had hemophilia, what are the chances that she is normal for the trait? Explain.
f) If we learn that her mother was a carrier, what are the chances that she is normal? A carrier?

6. Red-green colorblindness is caused by a sex-linked recessive allele. A color blind man marries a woman with normal vision whose father was color blind. What is the probability that they will have a color blind daughter? What is the probability that their first son will be color blind? (Notice that these questions are worded slightly differently)

7. Paul is colorblind and he marries Linda, whose father was colorblind.
a) What are the chances they have a normal boy?
b) What are the chances that their sons will be colorblind?
c) What are their chances of having a normal girl?
d) What are the chances that their daughters will be carriers?

8. One of the genes for cat color is sex linked with two alleles - yellow and black. The heterozygous condition results in a mixed coat color referred to as calico. A calico cat is mated to a black cat.
a) What are the chances of them producing calico females?
b) What are the chances of them producing calico males?

9. The cross-over percentage between linked genes A and B is 40%, between B and C is 20%, between C and D is 10%; between A and C is 20%; between B and D is 10%. What is the sequence of genes on the chromosome?

10. In 1911, Thomas Morgan collected the following crossover gene frequencies while studying Drosophila. The four genes, bar-shaped eyes (B), carnation eyes (C), fused veins (F) and scalloped wings (S) are located on the same chromosome.

Gene	Frequencies of recombination
F/B	2.5%
F/C	3.0
B/C	5.5
B/S	5.5
F/S	8.0
C/S	11.0

Use the crossover frequencies to make a gene map.