Genetics Problems #4: Sex Linked Inheritance Problems

1. Duchene's muscular dystrophy is a sex-linked (X-linked) recessive disease. A woman who is a carrier for the muscular dystrophy allele marries a man who is phenotypically normal. Predict the likelihood (as a percentage) of one of their sons developing muscular dystrophy.

   (X^M = dominant (no muscle degeneration); X^m = recessive (muscular dystrophy))

2. Hemophilia is a disease in which the person's blood will not clot properly when the person is cut. Normal blood clotting is dominant over hemophilia, and the alleles for this gene are carried only on the X chromosome. A man with hemophilia marries a homozygous woman with normal blood clotting. Showing all work, explain why none of their sons will be hemophiliacs.

   (X^N = dominant (normal blood clotting); X^n = recessive (hemophilia))

3. Red-green colour blindness is X-linked recessive. A red-green colour-blind man marries a woman with normal vision (she is heterozygous).
   a) Predict the genotypes and phenotypes of their children.
   b) In general, what must occur to produce a colour-blind son? A colour-blind daughter?

   (X^C = dominant (normal colour vision); X^c = recessive (colour-blind)

4. Eye colour in fruit flies is X-linked recessive. Red eyes are X-linked dominant and white eyes are X-linked recessive. A red-eyed female fruit fly of unknown genotype was crossed with a white-eyed male fly. Half of the male and half of the female offspring were red-eyed, and half of the male and half of the female offspring were white-eyed. What was the genotype of the female fly? Use a Punnett square to defend your answer.

5. Premature baldness is X-linked recessive. A normal male marries a female who carries the allele for premature baldness.
   a) Will the woman (the mother) become prematurely bald? Explain why or why not.
   b) What percentage of their children will be bald?

1. Genotypes: $1X^MX^M : 1X^MY : 1X^MX^m : 1X^mY$ There is a 50% chance that a son will have muscular dystrophy ($1X^mY$)
2. Genotypes: $1X^NX^n : 1X^NY : 1X^NX^n : 1X^NY$ The sons get their X from their mother who is X^NX^N so they can not get the disease (X^nY)
3. Genotypes: $1X^CX^c : 1X^CY : 1X^cX^c : 1X^mY$ Pheno: 1 ♀carrier : 1 ♂ not colour blind : 1 ♀ colour blind : 1 ♂ colour blind

b) In general, a colour blind son needs one recessive X^c gene while a colour blind daughter needs two recessive X^cX^c alleles, one from each parent

4. Genotypes: $1X^RX^r : 1X^RY : 1X^rX^r : 1X^rY$ Female was heterozygous (X^RX^r) because half of female are red-eyed.
5. Genotypes: $1X^NX^N : 1X^NY : 1X^NX^n : 1X^nY$ The mother will not go bald because she has a dominant normal (N) gene.

b) One son (X^nY) out of 4 ***children*** will have premature balding, so chance of prematurely bald ***child*** is 25% (chance of prematurely bald ***son*** is 50%)