Sex-Linked Traits Worksheet

Background Information:
Sex-linked traits are those whose genes are found on the X chromosome but not on the Y chromosome. In humans, the X chromosomes are much larger than the Y chromosome and contain thousands of more genes than the Y chromosome. For each of the genes that are exclusively on the X chromosomes, females, who are XX, would obviously have two alleles. Males, who are XY, would have only one allele. Thus females with one recessive allele and one dominant allele, for a gene that is unique to the X chromosome, will always display the dominant phenotype. However, a male with a recessive allele for a gene unique to the X chromosome will always exhibit that recessive trait because there is no other corresponding allele on the Y chromosome.

In humans, each of two different sex-linked genes has a defective recessive allele that causes a disease. The diseases are hemophilia and colorblindness. In hemophilia, the defective allele prevents the synthesis of a factor needed for blood clotting. In colorblindness, the defective allele prevents a person from seeing certain colors.

Use the information below to answer the following questions.

X<sup>H</sup>- X chromosome with normal dominant allele (no hemophilia)
X<sup<h> - X chromosome with recessive hemophilia allele
Y - Y chromosome (does not contain comparable gene)
X<sup>B</sup> - X chromosome with normal dominant allele (not colorblind)
X<sup>b</sup> - X chromosome with recessive colorblind allele
Y - Y chromosome (does not contain comparable gene)

1. Write the genotypes for the following phenotypes of red-green colorblindness.

   a. normal male _____________
   b. normal female carrying no colorblind alleles (Homozygous) _____________
   c. colorblind male _____________
   d. normal female carrying the colorblind allele (Heterozygous) _____________
   e. colorblind female _____________
2. $X^B X^B \times X^b Y$

   a. What proportion/percent of the male children are colorblind? ___________

   b. What proportion/percent of the female children are colorblind? ___________

3. $X^B X^b \times X^B Y$

   a. What proportion of the male children are colorblind? ___________

   b. What proportion of the female children are colorblind? ___________

4. What is the probability that a colorblind woman who marries a man with normal vision will have a colorblind child? ___________

   ___________ X ___________

5. A normal-sighted woman (whose father was colorblind) marries a colorblind man. ___________ X ___________

   a. What is the probability that they will have a **son** who is colorblind? ___________

   b. What is the probability that they will have a colorblind **daughter**? ___________
For the following Sex-Linked Punnett Squares:

H= normal blood clotting
h=hemophilia

6. $X^H X^h \times X^h Y$
   
   a. What is the probability that any of their offspring will have hemophilia? ____________

7. A woman who is a carrier for hemophilia marries a hemophiliac man.
   
   a. What proportion of the male children are hemophiliacs? ____________
   
   b. What proportion of the female children are hemophiliacs? ____________

8. A phenotypically normal man marries a homozygous normal woman.
   
   ____________ X ____________
   
   a. What is the probability that any of their children will be hemophiliacs? ____________
9. A phenotypically normal woman has phenotypically normal parents. However, she has a hemophiliac brother. (Mom is carrier) (Dad) Brother

_____________  _____________  ___________

a. What are her chances of being a carrier for hemophilia? ______________

ANSWER THE FOLLOWING QUESTIONS USING YOUR KNOWLEDGE OF SEX-LINKED TRAITS, THE BACKGROUND INFORMATION AND YOUR NOTES.

10. What is a sex-linked trait?

11. Why must males inherit colorblindness or hemophilia from their mothers?

12. Why is colorblindness or hemophilia more common in males than in females?