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 contains 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^H | X chromosome with normal dominant allele (no hemophilia) |
| X^h | X chromosome with recessive hemophilia allele |
| Y   | Y chromosome (does not contain comparable gene) |
| X^B | X chromosome with normal dominant allele (not colorblind) |
| X^b | 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 color blindness.
   a. normal male _______X^BY_______
   b. normal female carrying no colorblind alleles (Homozygous) _______X^BX^B_______
   c. colorblind male ___________X^bY_________________
   d. normal female carrying the colorblind allele (Heterozygous) _____X^BX^b_______
   e. colorblind female _______X^bX^b_____________
2. $X^B X^B \times X^b Y$
   
   a. What proportion/percent of the male children are colorblind? ____0%______
   
   b. What proportion/percent of the female children are colorblind? ____0%______

3. $X^B X^b \times X^B Y$
   
   a. What proportion of the male children are colorblind? ______50%______
   
   b. What proportion of the female children are colorblind? ______0%______

4. What is the probability that a colorblind woman who marries a man with normal vision will have a colorblind child? ______50%______

5. A normal-sighted woman (whose father was colorblind) marries a colorblind man. $X^b X^b \times X^B Y$
   
   a. What is the probability that they will have a son who is colorblind? ______50%______
   
   b. What is the probability that they will have a colorblind daughter? ______50%______
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? ________25%___________

7. A woman who is a carrier for hemophilia marries a hemophiliac man.

\( X^H X^h \times X^h Y \)

a. What proportion of the male children are hemophiliacs? ________50%___________

b. What proportion of the female children are hemophiliacs? ________50%___________

8. A phenotypically normal man marries a homozygous normal woman.

\( X^H X^H \times X^H Y \)

a. What is the probability that any of their children will be hemophiliacs? ________0%___________
9. A phenotypically normal woman has phenotypically normal parents. However, she has a hemophiliac brother. 

<table>
<thead>
<tr>
<th>(Mom is carrier)</th>
<th>(Dad)</th>
<th>Brother</th>
</tr>
</thead>
<tbody>
<tr>
<td>X^H X^h</td>
<td>X</td>
<td>X^H Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X^h Y  (got X^h from Mom)</td>
</tr>
</tbody>
</table>

a. What are her chances of being a carrier for hemophilia? **50%**

10. What is a sex-linked trait?

*Those traits whose genes are found on the X chromosome but NOT on the Y chromosome*

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

*Because their mother gives them their X chromosome.*

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

*Because the trait is recessive and since they only have one allele, there is no Other allele expressed. So what they have on their one X chromosome is what is expressed. Females can have one recessive allele but it is masked by the Dominant normal allele.*