## Multiplication Rule

1. Jane is given the following probability problem and her work is displayed. She has done something wrong. What did she do wrong and why is it wrong?

Problem: A bag of marbles has 3 green, 2 blue and 5 red marble. What is the probability of getting a red and then a green marble without replacement?

$$
P(R \text { and } G)=\left(\frac{5}{10}\right)\left(\frac{3}{10}\right)=\frac{15}{100}
$$

2. Given a jar of cookies with 5 chocolate chip, 3 oatmeal, and 2 peanut butter cookies in it, determine the following probabilities.
a) Getting an oatmeal cookie and then a chocolate chip cookie without replacement.
b) Getting two chocolate chip cookies without replacement.
c) Getting a peanut butter cookie and then an oatmeal cookie without replacement.
$\mathrm{P}(\mathrm{O}$ and CC$)=$ $\qquad$
$P(C C$ and $C C)=$ $\qquad$
$P(P B$ and $O)=$ $\qquad$
3. Given two bags of marbles, bag \#1 with 2 green, 3 red and 7 orange, and bag \#2 with 5 green, 1 red and 4 orange. Determine the following probabilities.
a) Getting an orange from bag \#1 and
b) Getting a red from bag \#1 and
c) Getting a green from bag \#1 and then getting a green from bag \#2.
then getting a red from bag \#1 without replacement.
$\qquad$
$P(O 1$ and $G 2)=$
d) Getting a red from bag \#1 and then getting an orange from bag \#1 with replacement.
$P(R 1$ and $R 1)=$ $\qquad$
e) Getting a red from bag \#2 and then getting an orange from bag \#2 with replacement.
$P(G 1$ and $G 2)=$ $\qquad$
f) Getting a green from bag \#1 and then getting an red from bag \#2.
$P(R 1$ and 01$)=$ $\qquad$
$P(R 2$ and $O 2)=$ $\qquad$
$P(G 1$ and $R 2)=$ $\qquad$
4. Using the marble bags in question \#3, what would P(Green and Green) be if the person picked from bag \#1 and then placed that marble into bag \#2 and then picked from bag \#2?

## 5. Given a standard deck of cards. Determine the probabilities.

a) Getting a red card and then a red card without replacement.
$P($ Red and Red $)=$ $\qquad$
d) Getting a 2 and then a 2 without replacement.
$P(2$ and 2$)=$ $\qquad$
b) Getting a face card and then a 5 without replacement.
$P($ Face and 5$)=$ $\qquad$
e) Getting two black face cards without replacement.
$P(B$ Face and $B$ Face $)=$ $\qquad$
c) Getting a numerical card less than 5 and then a king with replacement.
$P(\#<5$ and King $)=$ $\qquad$
f) Getting any pair without replacement.
$P($ Pair $)=$ $\qquad$
6. Complete the tree diagram by writing in the probabilities for each branch and then calculating the probabilities for each possible outcome.
a) Bag \#1 has 2 white and 3 red marbles and bag \#2 has 4 purple, 2 green and 1 orange. Pick from bag \#1 keep it and then pick from bag \#2.

b) A bag of marbles has 15 red and 5 green. Two picks are made from the same bag without replacement.

7. A Jar of cookies have 12 chocolate chip cookies, 13 peanut butter cookies, and 5 walnut cookies. Beside the jar is a cookie sheet of $\mathbf{2 0}$ chocolate chip cookies.

Some unique replacement rules exist as you pick from the jar:
-- if you pick a chocolate chip cookie from the jar you eat it and then replace it with 2 chocolate chip cookies from the cookie sheet.
-- if you pick a peanut butter cookie you eat it
-- if you pick a walnut cookie, you put it back.
a) $P(C C \mid P)=$ $\qquad$
b) $P(P \mid W)=$ $\qquad$
c) $P(W \mid C C)=$ $\qquad$ d) $P(C C$ and then $W)=$ $\qquad$
e) $P(C C$ and $C C)=$ $\qquad$ f) $P(W$ and then $W)=$ $\qquad$
g) $P(P B$ and then $C C)=$ $\qquad$
h) Which has a greater chance of happening? $\mathrm{P}(\mathrm{PB}$ and then a W$)$ or $\mathrm{P}(\mathrm{W}$ and then a CC$)$ ?
8. Box \#1 has 7 white marbles and 3 black marbles and Box \#2 has 6 black marbles and 4 white marbles. You pick a marble from box \#1 (not looking at it) and then place it into box \#2.

a) on the second pick from Box \#2, $\mathrm{P}(\mathrm{W} \mid \mathrm{B})=$ $\qquad$
b) on the second pick form Box $\# 2, \mathrm{P}(\mathrm{B} \mid \mathrm{B})=$ $\qquad$
c) $P(W$ and $W)=$ $\qquad$
d) $P(B$ and then $W)=$ $\qquad$ e) $P(B$ and then $B)=$ $\qquad$

