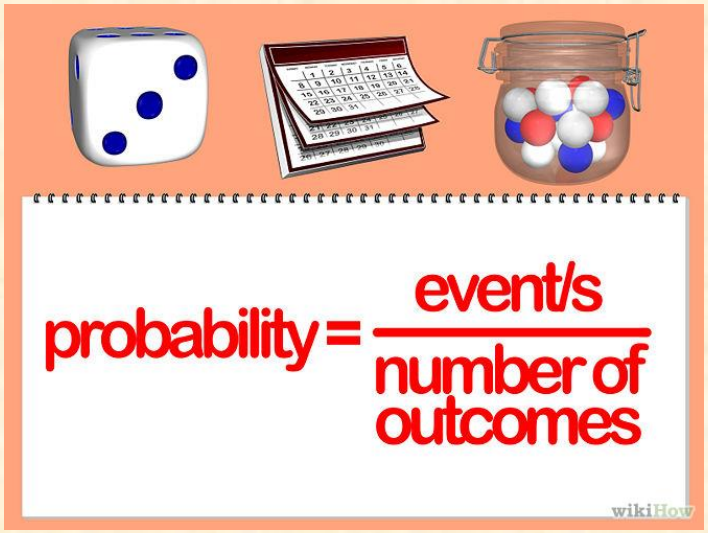
Probability Unit 6
Day 3



Warm-up: 1. If you have a standard deck of cards in how many different hands exists of: (Show work **by hand but** no need to write out **the full** factorial!)

a) 5 cards

b) 2 cards

2. Pick a team of 3 people from a group of 10

3. Choose 3 desserts from a menu of 8 desserts

4. Choose a winner and a runner up from the 40 Miss Pickle Princess contestants

5. Arrange the letters of the word FACTOR

6. Choose two jellybeans from a bag of 15?

7. Assign the part of a play to the 4 lead characters from a group of 30 who tried out

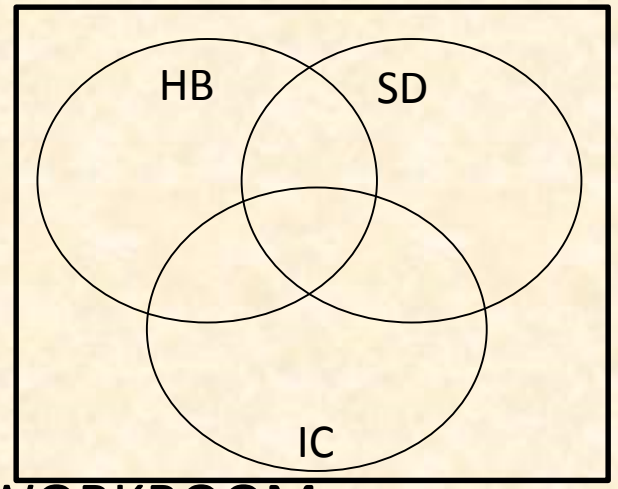
Practice – on notebook paper

1) 120 students went to a school carnival. 4 had a hamburger, soft drink and ice-cream. 26 had hamburgers. 7 had a hamburger and a soft drink. 35 had soft drinks. 12 had a soft drink and ice-cream. 40 had ice-cream. 10 had a hamburger and ice-cream.

a) Create Venn Diagram

b) How many had nothing?

c) How many had at least 2 food items?



2) Find how many ways you can rearrange WORKROOM.

3) In how many ways can you select a team of 3 math wizzes and 5 science wizzes for a Quiz Bowl game from the club of 10 math students and 8 science students?

4) How many outfits are there from 7 shirts, 3 pants, and 2 scarves in your suitcase on a vacation?

Warm-up: 1. If you have a standard deck of cards in how many different hands exists of: (Show work **by hand**!)

a) 5 cards

$$_{52}C_5 = \frac{52\cdot51\cdot50\cdot49\cdot48}{5\cdot4\cdot3\cdot2\cdot1} = 2,598,960$$

b) 2 cards

$$_{52}C_2 = \frac{52\cdot51}{2\cdot1} = 1,326$$

2. Pick a team of 3 people from a group of 10 **Combination $_{10}C_3 = 120$**

3. Choose 3 desserts from a menu of 8 desserts **Combination $_{8}C_3 = 56$**

4. Choose a winner and a runner up from the 40 Miss Pickle Princess contestants **Permutation $_{40}P_2 = 1560$**

5. Arrange the letters of the word FACTOR **Permutation $_{6}P_6 = 720$**

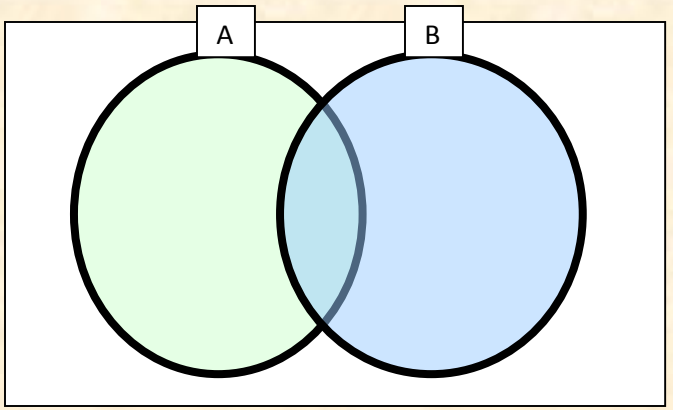
6. Choose two jellybeans from a bag of 15? **Combination $_{15}C_2 = 105$**

7. Assign the part of a play to the 4 lead characters from a group of 30 who tried out. **Permutation $_{30}P_4 = 657,720$**

Homework Answers p.3

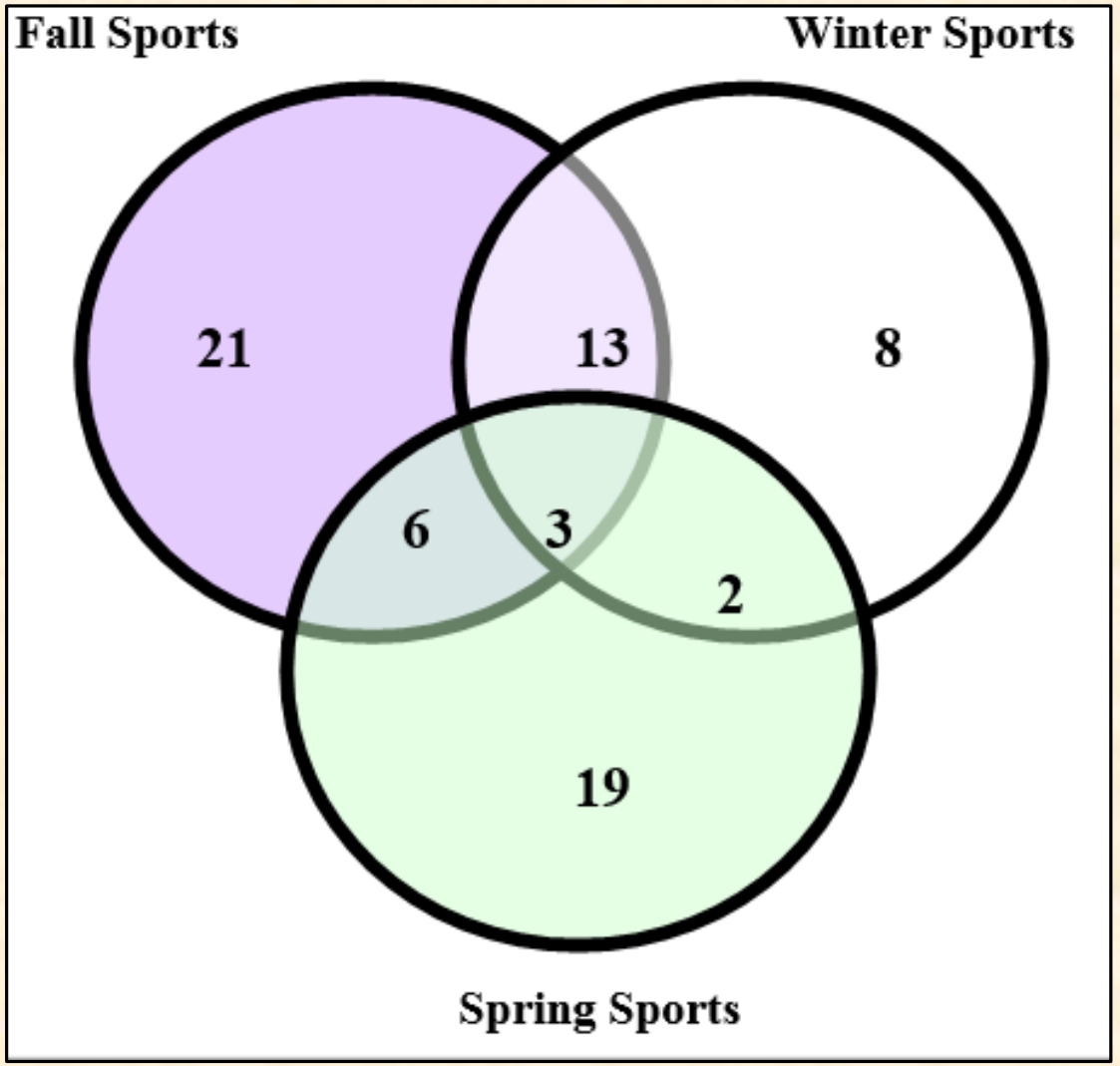
Part I: Organize the Data

1. $A \cup B = \{1,2,3,4,6,8,12,16,24,32,64\}$
2. $A \cap B = \{1,2,4,8\}$
3. $A^C = \{0,3,6,7,9,12,24,30,55\}$
4. $B^C = \{0,7,9,16,30,32,55,64\}$



Part II: Answer Questions about the diagram p. 3

1. 3
2. 9
3. 16
4. 5
5. 48
6. 24



Homework Answers p. 4

7. a.) 4/13

   b.) 1/52

8. BB, BR, BW, RR, RB, RW, WB, WR, WW

9. a.) ¼
   b.) 5/16
   c.) 11/16
   d.) 0
   e.) 9/16
   f.) 1:3
   g.) 3:1

10. Red, Blue, Yellow, Green, Purple, Orange

a.) 6x6 = 36 items

RR, RB, RY, RG, RP, RO,
BR, BB, BY, BG, BP, BO,
YR, YB, YY, YG, YP, YO,
GR, GB, GY, GG, GP, GO,
PR, PB, PY, PG, PP, PO,
OR, OB, OY, OG, OP, OO

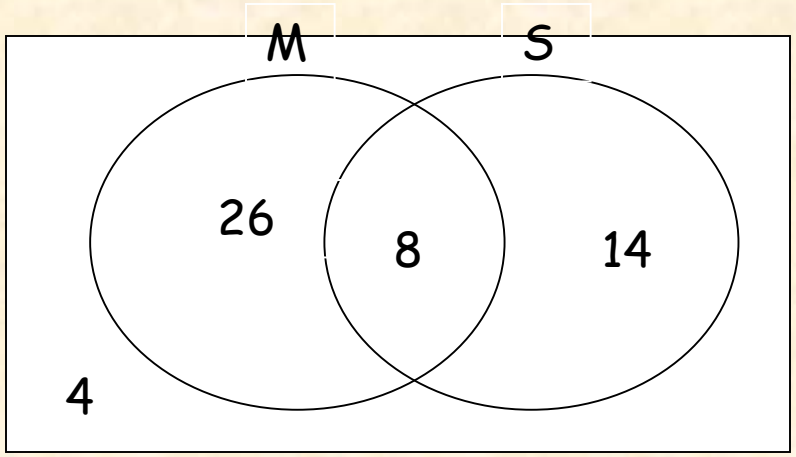
b.) 1/6

c.) 1/2

d.) 1/36

Homework Answers p. 5

11) a)



b) $M \cup S = \{48\}$

c) $M \cap S = \{ 8 \}$

d) Students taking both Math and Science

e) $M^C = \{18\}$

f) $S^C = \{30\}$

g) Students not taking Math or Science

Tonight's Homework

- Packet p. 6 and 7
- Cumulative Review Sheet #1-8
- AND Study for Quiz on Monday

Practice – on notebook paper

1) 120 students went to a school carnival. 4 had a hamburger, soft drink and ice-cream. 26 had hamburgers. 7 had a hamburger and a soft drink. 35 had soft drinks. 12 had a soft drink and ice-cream. 40 had ice-cream. 10 had a hamburger and ice-cream.

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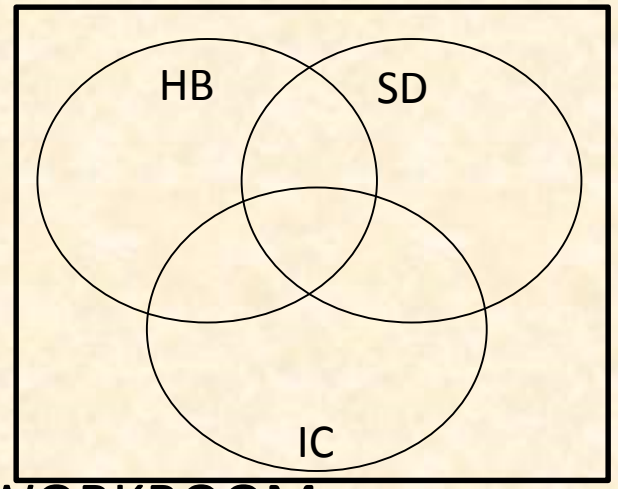
c) How many had at least 2 food items?



2) Find how many ways you can rearrange WORKROOM.

3) In how many ways can you select a team of 3 math wizzes and 5 science wizzes for a Quiz Bowl game from the club of 10 math students and 8 science students?

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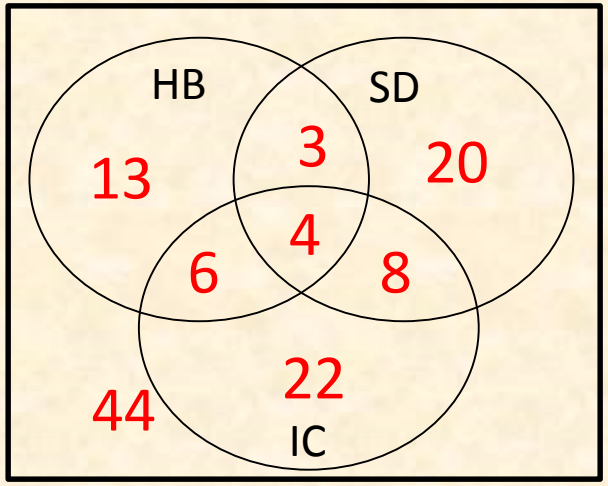
Practice – on notebook paper

1) 120 students went to a school carnival. 4 had a hamburger, soft drink and ice-cream. 26 had hamburgers. 7 had a hamburger and a soft drink. 35 had soft drinks. 12 had a soft drink and ice-cream. 40 had ice-cream. 10 had a hamburger and ice-cream.

a) Create Venn Diagram

b) How many had nothing? **44**

c) How many had at least 2 food items? **21**



2) Find how many ways you can rearrange WORKROOM. $\frac{8!}{2!*3!}$ **= 3360**

3) In how many ways can you select a team of 3 math wizzes and 5 science wizzes for a Quiz Bowl game from the club of 8 science students and 10 math students? $_{10}C_3 * {}_8C_5$ **= 6720**

4) How many outfits are there from 7 shirts, 3 pants, and 2 scarves in your suitcase on a vacation? 7 x 3 x 2 = **42**

Notes Day 3 : Probability of Independent and Dependent Events

Remember, the probability that an event E will occur is abbreviated **P(E)**.

Review:

Ex 1: If you are dealt one card from a standard 52-card deck, find the probability of getting a king.

$$\frac{4}{52} = \frac{1}{13}$$

Ex 2: Find the probability of rolling a number greater than 2 when you roll a die once.

$$\frac{4}{6} = \frac{2}{3}$$

Independent and Dependent Events

There are 7 marbles in a bag. You draw 2 marbles from the bag using the following scenarios:

Experiment 1: Draw one marble. Put it back. Draw a marble again.

Draw 2 **IS NOT** affected by draw 1.

- When the outcome of a second event **is not** affected by the outcome of the first event, then the two events are called **INDEPENDENT** events.

Independent and Dependent Events

There are 7 marbles in a bag. You draw 2 marbles from the bag using the following scenarios:

Experiment 2: Draw one marble. Then draw another without replacing the first.

Draw 2 **IS** affected by draw 1.

- When the outcome of a second event **is** affected by the outcome of the first event, then the two events are called **DEPENDENT** events.

- If A and B are **independent events**, then

$$P(A \text{ and } B) = \underline{P(A) \cdot P(B)}$$

similar to yesterday's multiplication rule

- If A and B are **dependent events**, then

$$P(A, \text{ then } B) = \underline{P(A) \cdot P(B \text{ after } A)}$$

assume success on 1st draw

Example 1

Suppose 5 marbles in the bag are yellow and 2 marbles are green. You draw 1 marble and put it back before drawing a second. Find the probability that the marble color in both draws is yellow.

P(yellow and yellow) = $\frac{5}{7} \cdot \frac{5}{7} = \frac{25}{49}$

Example 2

Suppose 5 marbles in the bag are yellow and 2 marbles are green. You draw 1 marble and then another without putting back the first marble. Find the probability that both marbles are yellow.

****assume success on 1st draw****

P(yellow then yellow) = $\frac{5}{7} \cdot \frac{4}{6} = \frac{20}{42} = \frac{10}{21}$

1 less yellow

1 less yellow

You Try: Classifying Events as Dependent or Independent

1. Pick a cookie from the party platter. Then pick another cookie from the same platter.

Dependent

2. A number from 1 to 31 is selected at random. Then a month is selected at random.

Independent

3. A grade level from K-12 is selected at random. Then one of the remaining grade levels is selected at random.

Dependent

4. Select a bag of chips at random from the pile. Change your mind and return it. Then pick another bag of chips at random.

Independent

YOU TRY: Calculating Probabilities of Independent and Dependent Events

A game board in your closet has 7 purple game pieces, 4 red game pieces, and 3 green game pieces. You randomly choose one game piece and then replace it. Then you choose a second game piece. Find each probability.

1) P(red and green)= $\frac{4}{14} \cdot \frac{3}{14} = \frac{3}{49}$

2) P(green and purple)= $\frac{3}{14} \cdot \frac{7}{14} = \frac{3}{28}$

3) P(both red)= $\frac{4}{14} \cdot \frac{4}{14} = \frac{4}{49}$

YOU TRY: Calculating Probabilities of Independent and Dependent Events

You are folding the socks from the laundry basket, which contains 6 brown socks, 2 blue socks, and 5 black socks. You pick one sock at a time and don't replace it. Find each probability.

4) P(blue, then black)= $\frac{2}{13} \cdot \frac{5}{12} = \frac{5}{78}$

5) P(brown, then blue)= $\frac{6}{13} \cdot \frac{2}{12} = \frac{1}{13}$

6) P(both black)= $\frac{5}{13} \cdot \frac{4}{12} = \frac{5}{39}$

A **COMPOUND EVENT** is an event that is the result of more than one outcome.

Example: What is the probability that you forgot to do your homework AND there will be a pop quiz in class?

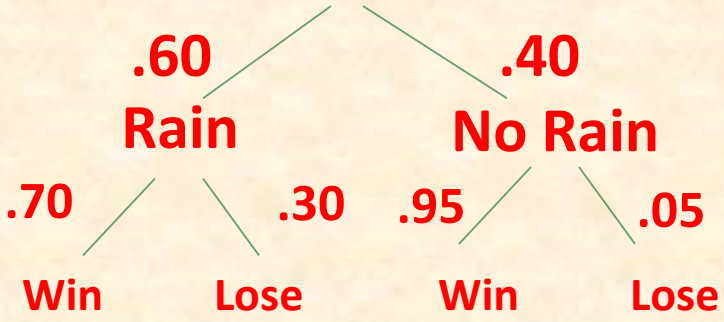
Example: If you flip a coin and roll a die, what is the probability of getting tails and an even number?

To determine probabilities of compound events, we can use **TREE DIAGRAMS**.

For tree diagrams, we place probabilities on the branches and words after the branches. Like the counting principle, you multiply to find the overall probability.

Example 2: Create a Tree Diagram for the following scenario:

There is a 60% chance of rain on Wednesday.
If it rains, the track team has a 70% chance of winning.
If it doesn't rain, there is a 95% chance that the track team will win.



To fill in the probabilities for the branches not stated in our problem, we'll need to use the "**complement**" of each probability.

To calculate probabilities using tree diagrams, we use the **MULTIPLICATION RULE** for Compound Events.

To use this rule, all of the separate outcomes that make up the compound event must be **INDEPENDENT EVENTS**, which means that the probabilities of the outcomes do not affect one another.

To calculate probability of compound events:

1st) MAKE A TREE DIAGRAM.

2nd) MULTIPLY ALONG THE BRANCHES ON THE TREE.

To fill in the probabilities for the branches not stated in our problem, we'll need to use the "**complement**" of each probability.

Ex 3) In the table below, fill in the remaining outcomes for Example 2 above. Then, calculate the probabilities for each outcome.

Outcome	Calculations	Probability
Rain and Track Team Wins	(.60)(.70) = .42	42%
Rain and Track Team Loses	(.60)(.30) = .18	18%
No Rain and Track Team Wins	(.40)(.95) = .38	38%
No Rain and Track Team Loses	(.40)(.05) = .02	2%

Ex 4 a) What is the probability that the track team wins?

42% + 38% = 80 %

b) What is the probability the team wins given that it rains = P(win | rain)? <- **This | is notation for "given"!**

70 % ("zoom in" on the branch with rain & look at probability of winning)

You Try!

Ex 5: A student in Buffalo, New York, made these observations:

Of all snowfalls, 5% are heavy (at least 6 inches).
After a heavy snowfall, schools are closed 67% of the time.
After a light (less than 6 inches) snowfall, schools are closed 3% of the time.

a) Create a tree diagram for the scenario, listing all possibilities and probabilities.

b) Find the probability that snowfall is light and schools are open.

(.95)(.97) = 92.15 %

c) Find the probability that there is snowfall and schools are open.

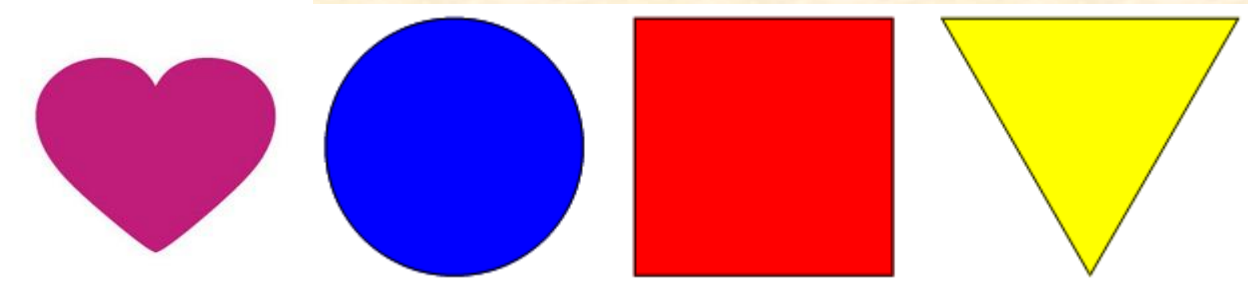
(.05)(.33) + (.95)(.97) = 93.8 %

d) Find P(schools open, given heavy snow) = P(schools open | heavy snow).

33 %

“AND” Probability Discovery with Tree Diagrams

Complete Notes p. 14

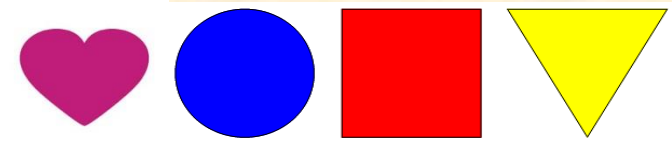


Calculate and express probabilities as %, rounding to the hundredths place.

“AND” Probability Discovery with Tree Diagrams

Ex: You have a special deck of 20 cards for a game. This deck contains cards with equal amounts of the following shapes:

heart, circle, square, and triangle



<u>Part A:</u> You choose a card, <u>put it back</u>, and then choose another card.

<u>Part B:</u> Suppose now you play with these cards again, but you choose the second card <u>without replacement</u>.

Part A: You choose a card, put it back, and then choose another card.

2) P(heart then circle)

$$(\frac{1}{4})(\frac{1}{4}) = .0625 = 6.25\%$$

3) P(not heart then circle)

$$(\frac{3}{4})(\frac{1}{4}) = .1875 = 18.75\%$$

4) P(circle on 2nd draw)

$$= P(\text{heart and circle OR not heart and circle})$$

$$= P(\text{heart and circle}) + P(\text{not heart and circle})$$

$$(\frac{1}{4})(\frac{1}{4}) + (\frac{3}{4})(\frac{1}{4}) = .25 = 25\%$$

5) P(circle | heart)

$$\frac{1}{4} = 25\%$$

6) P(not heart , not circle)

$$(.75)(.75) = .5625 = 56.25\%$$

Part B: Suppose now you play with these cards again, but you choose the second card without replacement.

2) Why does part of your tree have different probabilities than it did in Part A?

We are not replacing the cards. After the 1st draw, there are only 19 cards left.

3) P(heart then circle)

$$(\frac{1}{4})(\frac{5}{19}) = .0658 = 6.58\%$$

4) P(not heart then circle)

$$(\frac{3}{4})(\frac{5}{19}) = .1974 = 19.74\%$$

5) P(circle on 2nd draw)

$$= \text{P(heart and circle OR not heart and circle)}$$

$$= \text{P(heart and circle)} + \text{P(not heart and circle)}$$

$$(\frac{1}{4})(\frac{5}{19}) + (\frac{3}{4})(\frac{5}{19}) = .2632 = 26.32\%$$

6) P(circle | heart)

$$\frac{5}{19} = 26.32\%$$

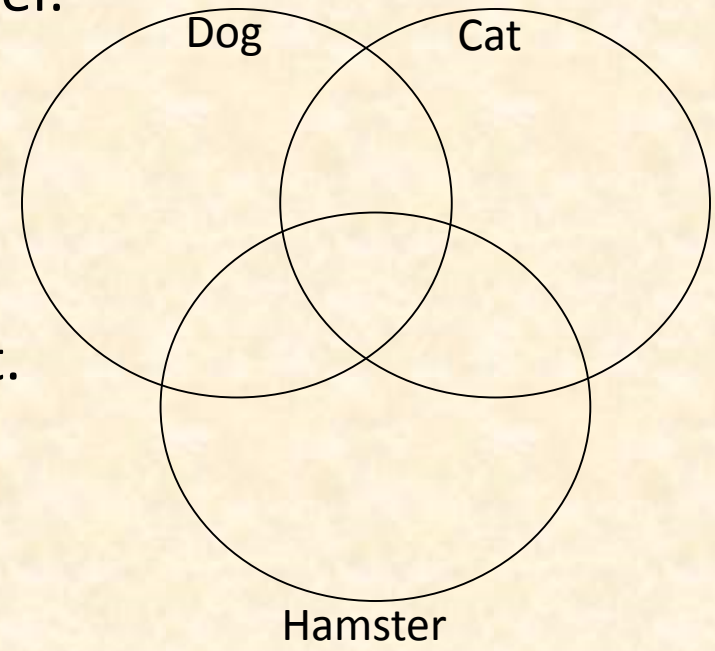
7) P(not heart , not circle)

$$(\frac{3}{4})(\frac{14}{19}) = .5526 = 55.26\%$$

Exit Ticket: on NEW notebook paper!!

There are 100 people in an office.

- *5 people have a dog, a cat, and a hamster.
- *60 people own a dog.
- *13 people own a dog and a cat.
- *17 people own a dog and a hamster.
- *0 people own ONLY a hamster and a cat.
- *20 people own hamsters
- *31 people own a cat



1. Fill in the Venn diagram.
2. How many people in this office own no cats, dogs, or hamsters?
3. In how many ways can you create a bag by picking from 5 colors, 3 straps, and 7 buckles?
4. In how many ways can you rearrange the word GEOMETRY?
5. In how many ways can you select 6 puzzles from a set of 20?

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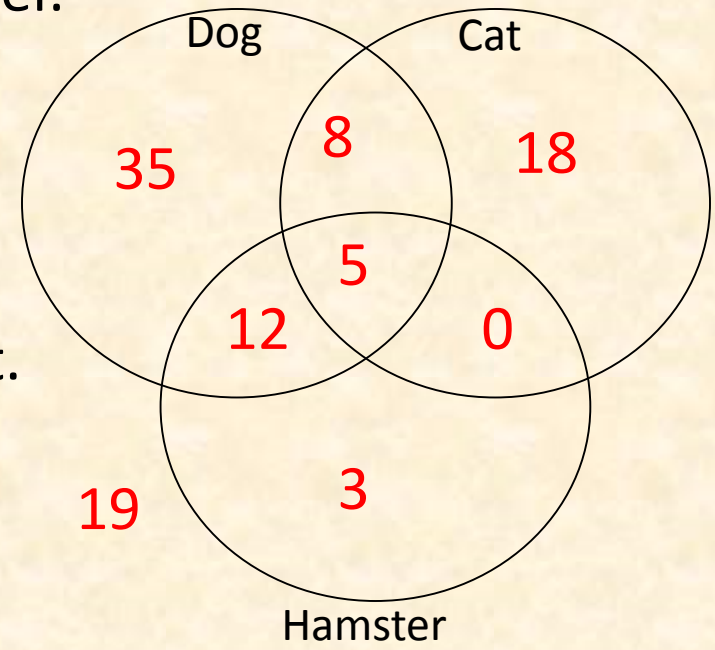

1. Fill in the Venn diagram.
2. How many people in this office own no cats, dogs, or hamsters? **19**
3. In how many ways can you create a bag by picking from 5 colors, 3 straps, and 7 buckles? $5 \times 3 \times 7 =$ **105**
4. In how many ways can you rearrange the word GEOMETRY? $\frac{8!}{2!} =$ **20160**
5. In how many ways can you select 6 puzzles from a set of 20? $_{20}C_6 =$ **38760**

Homework

- Packet p. 6 and 7