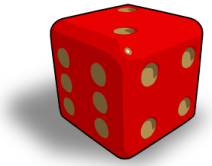
Unit 6 Probability
Day 9

Experimental and Theoretical Probability

Warm-up

1. A standard six-sided dice is rolled. Find the probability:
   a. Of rolling a number greater than or equal to one.

   b. Of rolling a number greater than six.



2. Calculate the following values.
   a. For club presentations, in how many ways can you schedule 4 speakers out of 12 people to speak?

   b. You pick 4 club members out of 35 to take on a trip. How many different groups are possible?

   c. A wing place 15 flavors at 5 heat levels of boneless and regular wings. How many options do they offer?

Warm-Up Continued ->>

Warm-up

3. A customer can pick from the following mix-ins at a frozen yogurt stand: chocolate chips, strawberries, crushed cookies, chopped nuts, sprinkles, & cookie dough. How many ways are there to make a yogurt with no more than three condiments?

4. The counselors at a summer camp are juniors and seniors, with 55% of them male. Of the females, 60% are juniors. Of the males, 56% are seniors.
   a. Create a tree diagram for the scenario, labeling all probabilities and possibilities.
   b. Find P(junior)
   c. If the counselor is a female, find the probability that she is a senior.
   d. Find P(male | junior)

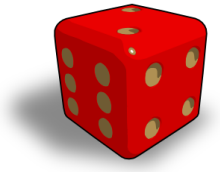
Warm-up — ANSWERS!

1. A standard six-sided dice is rolled. Find the probability:
   a. Of rolling a number greater than or equal to one.

      1

   b. Of rolling a number greater than six.

      0



2. Calculate the following values.
   a. For club presentations, in how many ways can you schedule 4 speakers out of 12 people to speak?

      $_{12}P_4 = 11{,}880$

   b. You pick 4 club members out of 35 to take on a trip. How many different groups are possible?

      $_{35}C_4 = 52{,}360$

   c. A wing place 15 flavors at 5 heat levels of boneless and regular wings. How many options do they offer?

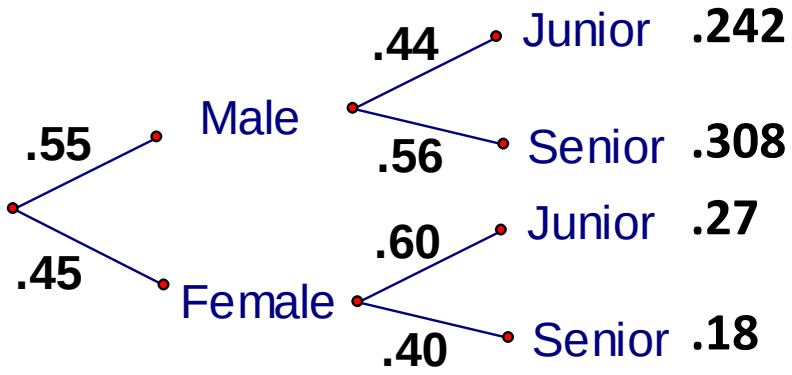
      $15 \cdot 5 \cdot 2 = 150$

Warm-Up Continued ->>

Warm-up — ANSWERS!

3. A customer can pick from the following mix-ins at a frozen yogurt stand: chocolate chips, strawberries, crushed cookies, chopped nuts, sprinkles, & cookie dough. How many ways are there to make a yogurt with no more than three condiments? $_6C_3 + {}_6C_2 + {}_6C_1 + {}_6C_0 = 42$

4. The counselors at a summer camp are juniors and seniors, with 55% of them male. Of the females, 60% are juniors. Of the males, 56% are seniors.



   a. Create a tree diagram for the scenario, labeling all probabilities and possibilities.
   a. Find P(junior) **51.2%**
   b. Find the probability that the counselor is a senior, given that she is female. **40%**
   c. Find P(male | junior)

47.27% (must use formula)

Homework Solutions

Packet Page 14

1. $\frac{8}{20} \bullet \frac{9}{20} = \frac{9}{50}$ OR 18%

2. $\frac{18}{40} = \frac{9}{20}$ OR 45%

3. 1x3x2 = 6 options

4. $\frac{1}{28} \bullet \frac{1}{32} = \frac{1}{896}$ OR 0.11%

5. 6! = 720 arrangements

6. ${}_9C_4$ = 126 options

7.

A. $\frac{17}{125}$ OR 13.6%

B. $\frac{119}{125}$ OR 95.2%

C. $\frac{88}{201}$ OR 43.78%

D. $\frac{5}{125} = \frac{1}{25}$ OR 4%

Homework Solutions

Packet Page 15

8. 0.3/0.75 = 40 %

9. 0.28/0.65 = 43.08%

10.

	Likes Coffee	Doesn't Like Coffee	Total
Age 14 - 18	**4**	**16**	**20**
Age 19 - 23	**22**	**8**	**30**
Total	**26**	**24**	**50**

B. $\frac{13}{25}$ OR 52 %

C. $\frac{2}{3}$ OR 66.7%

D. $\frac{2}{5}$ OR 40%

E. $\frac{11}{15}$ OR 73.3%

Homework Solutions

Packet Page 15 Continued…

11.

A. $\frac{36}{91}$ OR 39.56%

$$\left(\frac{9}{14}\right)\left(\frac{8}{13}\right)=\frac{36}{91}$$

B. $\frac{81}{91}$ OR 89.01%

$$\left(\frac{9}{14}\right)\left(\frac{8}{13}\right)+\left(\frac{9}{14}\right)\left(\frac{5}{13}\right)+\left(\frac{5}{14}\right)\left(\frac{9}{13}\right)=\frac{81}{91}$$

C. $\frac{45}{91}$ OR 49.45%

$$\left(\frac{9}{14}\right)\left(\frac{5}{13}\right)+\left(\frac{5}{14}\right)\left(\frac{9}{13}\right)=\frac{45}{91}$$

D. $\frac{10}{91}$ OR 10.99%

$$\left(\frac{5}{14}\right)\left(\frac{4}{13}\right)=\frac{10}{91}$$

Tonight's Homework - Update your outline!!

Packet p. 16 and 17

AND

Mastery Review Packet p. 1 and 2

Notes Day 9
Theoretical vs. Experimental Probability !

Students names in the bag.

-write all the students names on a piece of paper and put them in a bag.

1. Calculate the theoretical probability you pick a boy out of the class.
2. Calculate the theoretical probability you pick a girl out of the class.
3. Then have the class keep a tally and draw names out of the bag.

Discovery: Theoretical vs. Experimental Probability

Notes p. 28-29

When you get to Part B, bring your answers from part A to be checked AND get a die from your teacher.

Before Part C, return the die and give your teacher your Part B data.

Done early? Do Packet p. 12 #1 and 2

Discussion of Theoretical vs. Experimental Probability !

Highlight the key items in your notes!

Part A: Theoretical Probability

Probability is the chance or likelihood of an event occurring. We will study two types of probability, theoretical and experimental

Theoretical Probability: the ratio of the number of favorable outcomes to the total possible outcomes. Probability based on what ***should*** happen, in theory.

$$P(\text{Event}) = \frac{\text{\# of favorable outcomes}}{\text{Total possible outcomes}} = \frac{\text{desired}}{\text{total}}$$

Part A: Theoretical Probability

Sample Space: The set of all possible outcomes.

Example: The sample space for tossing a coin is { heads , tails }

Theoretical probability is based on the set of all possible outcomes, or the sample space.

Let's review what we found:

List the sample space for rolling a six-sided die (remember you are listing a set, so you should use brackets { }):

{1,2,3,4,5,6}

Find the following probabilities:

P(2) 1/6 P(3 or 6) 1/3 P(odd) 1/2 P(not a 4) 5/6

P(1,2,3,4,5, or 6) 1 P(8) 0

Did you get the same answers as those around you on this part? Why or why not?

Yes! Theoretical probability is based on a sample space, so all should get the same answers.

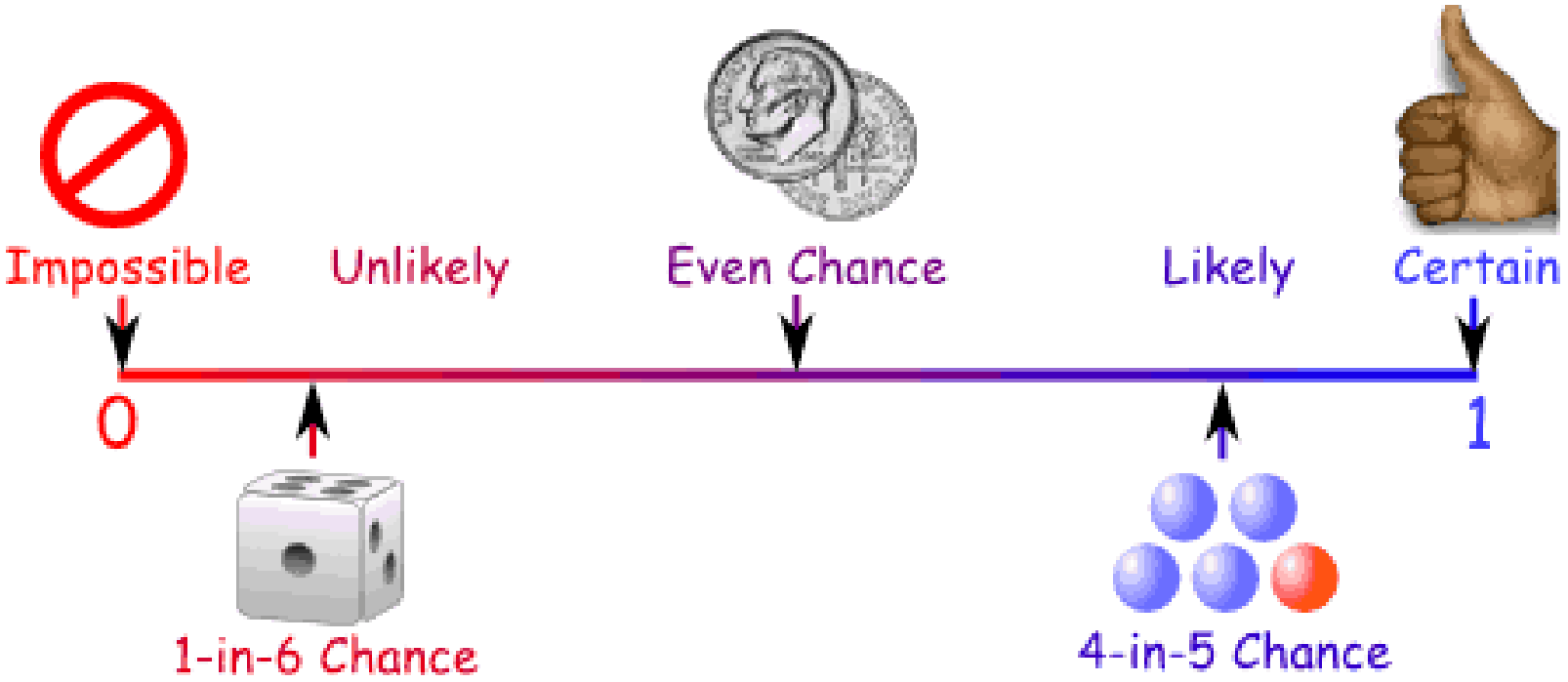
Let's review what we found:

- When would you expect a probability of an event occurring to be 1 or 100%?

Probability should be 1 or 100% for a certain event, for something that MUST happen.

- When would you expect the probability of an even occurring to be 0 or 0%?

Probability should be 0 or 0% for an impossible event, for something that CANNOT happen.



Probability is always between 0 and 1

Part B: Experimental Probability

Experimental Probability: The ratio of the number of times the event occurs to the total number of trials.

Probability based on an experiment

$$P(\text{Event}) = \frac{\text{\# of times the event occurs}}{\text{Total number of trials}} = \frac{\text{desired}}{\text{total}}$$

Do you think that theoretical and experimental probabilities will be the same for a certain event occurring? Not necessarily. In most cases, the theoretical and experimental probabilities will be different.

Rolling Dice Experiment

2. Roll a six-sided die and record the number on the die. Repeat this 9 more times

Number on Die	Tally	Frequency
1		
2		
3		
4		
5		
6		
Total		10

Based on your data, find the following experimental probabilities:

P(2) P(3 or 6) P(odd) P(not a 4)

Did you get the same answers as those around you on this part? Why or why not?

Experimental probability is due to chance, so it is unlikely you'll get the same answers as others.

Class combined (Add to your notes)

Number on Die	Frequency
1	
2	
3	
4	
5	
6	
Total	

Based on the whole class data, find the following experimental probabilities:

P(2) P(3 or 6) P(odd) P(not a 4)

Let's compare the whole class data to the theoretical probabilities from part A:

P(2) 1/6 P(3 or 6) 1/3 P(odd) 1/2 P(not a 4) 5/6

What happens in the long run??
(add in to the notes)

Law of Large Numbers: As the number of trials increase, the experimental probability should approach the theoretical probability.

Why can there be differences between experimental and theoretical probability in general?

-Theoretical probability tells us what we can expect to happen.

-Experimental probability is dependent on chance and on the number of trials conducted.

Part C: Which one do I use??

Fairness: For a game to be fair the theoretical probability for each player winning should be equal.

Why should we base our decision about the fairness of a game on theoretical probability not experimental probability?

Experimental Probability is based on data and chance, so it is not as accurate. Theoretical Probability is based on sample space and what should happen in theory, so it is more accurate.

Which one do I use??

Theoretical probability is always the best choice when it can be calculated.

Experimental probability is best used when we cannot know all the possible outcomes.

Ex. Calculating the probability a student's favorite color is green – we would have to collect data on the class and then use experimental probability.

Practice!

Which type of Probability is better?

1. What is the probability of someone tripping on the stairs today between first and second period?

   Experimental

2. What is the probability of rolling a 3 on a six-sided die, then tossing a coin and getting a head?

   Theoretical

3. What is the probability that a student will get 4 of 5 true false questions correct on a quiz?

   Theoretical

4. What is the probability that a student in class is wearing exactly four buttons on his or her clothes?

   Experimental

Trying a Game. Is it fair?

Jennifer and Jamie are playing a game that involves emptying marbles from two separate bags. The first person to empty their bag wins the game. A spinner with the numbers #4-8 is spun two times and the outcomes are added together. If the sum of the spins is **8,9,10,14,15,16 Jennifer** can remove one marble from her bag. If the sum of the spins is **11,12,13 Jamie** can remove one marble from his bag. To begin the game, each person's bag has 25 marbles.

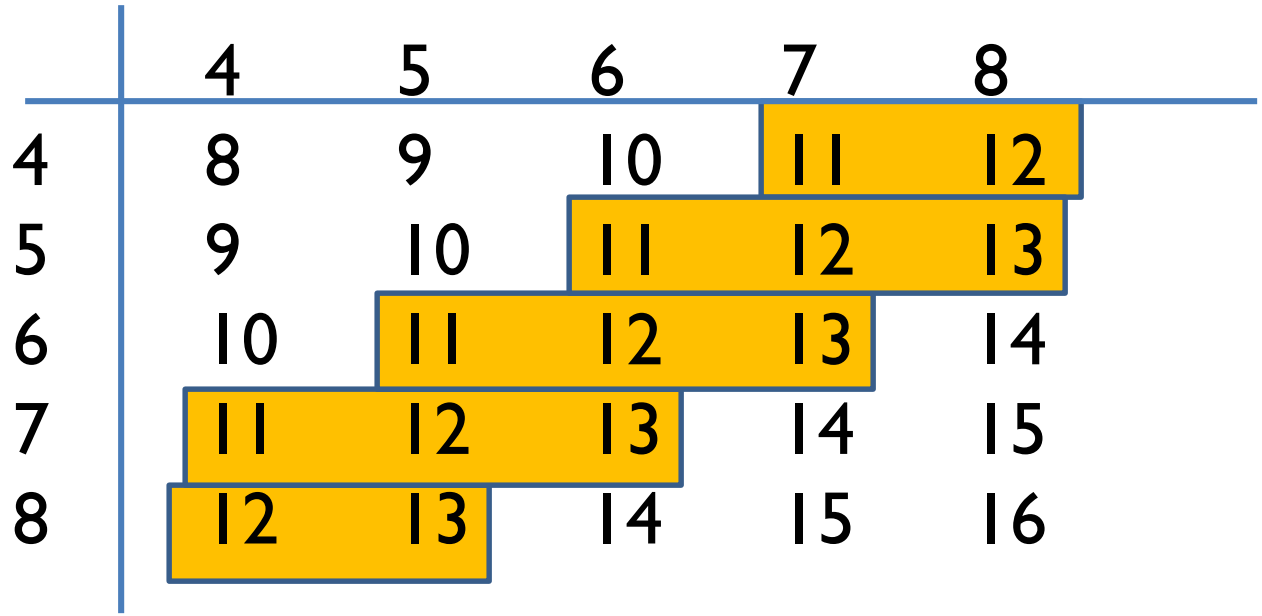
Is this a fair game? Why or why not?

Hint: Make a sample space of the possible outcomes and then find the appropriate probabilities.

Jennifer and Jamie's Sample Space

If the SUM= 8,9,10,14,15,16 Jennifer removes a marble

Therefore, P(Jennifer removes a marble)= **12/25**



	4	5	6	7	8
4	8	9	10	11	12
5	9	10	11	12	13
6	10	11	12	13	14
7	11	12	13	14	15
8	12	13	14	15	16

If the SUM= 11, 12, 13 Jamie removes a marble

Therefore, P(Jamie removes a marble)= **13/25**

The game is not fair because the probability of winning is not equal.

Fairness Practice

Packet p. 12 #1 & 2

Practice Answers

1. a.) on next slide

   b.) 9/36 = 1/4

   c.) 27/36 = 3/4

   d.) no because they do not have an equal probability

2. a.) on next slide

   b.) 6/16 = 3/8

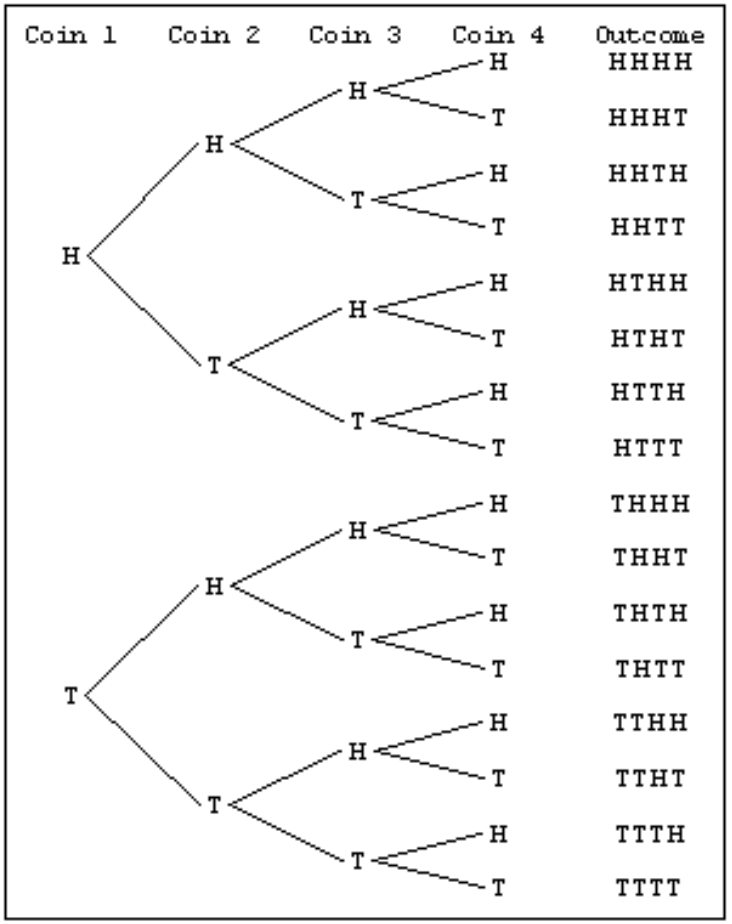
   c.) 10/16 = 5/8

   d.) no because the probabilities are not equal

1A)

second cube \ first cube	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

2a.)



Pt to

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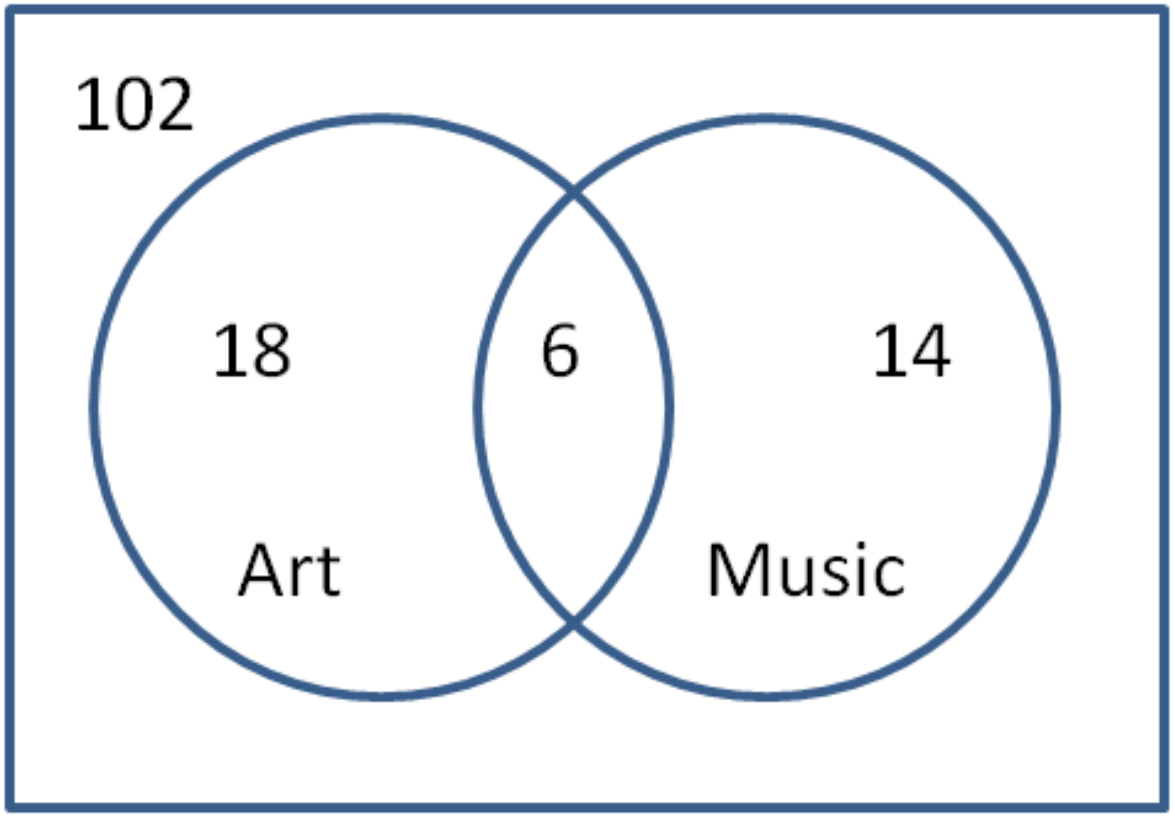
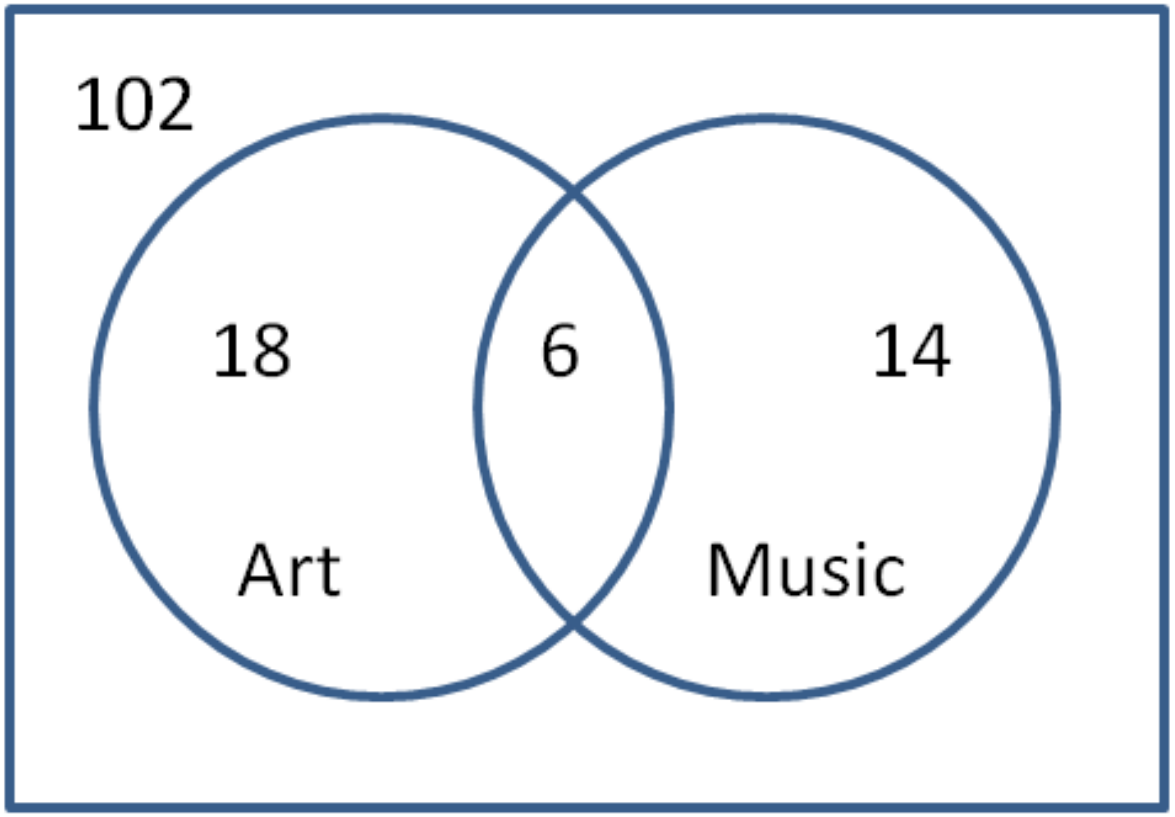
Let’s Start a Review Activity!

Given the following Venn Diagram, how many students are taking an art AND a music class?



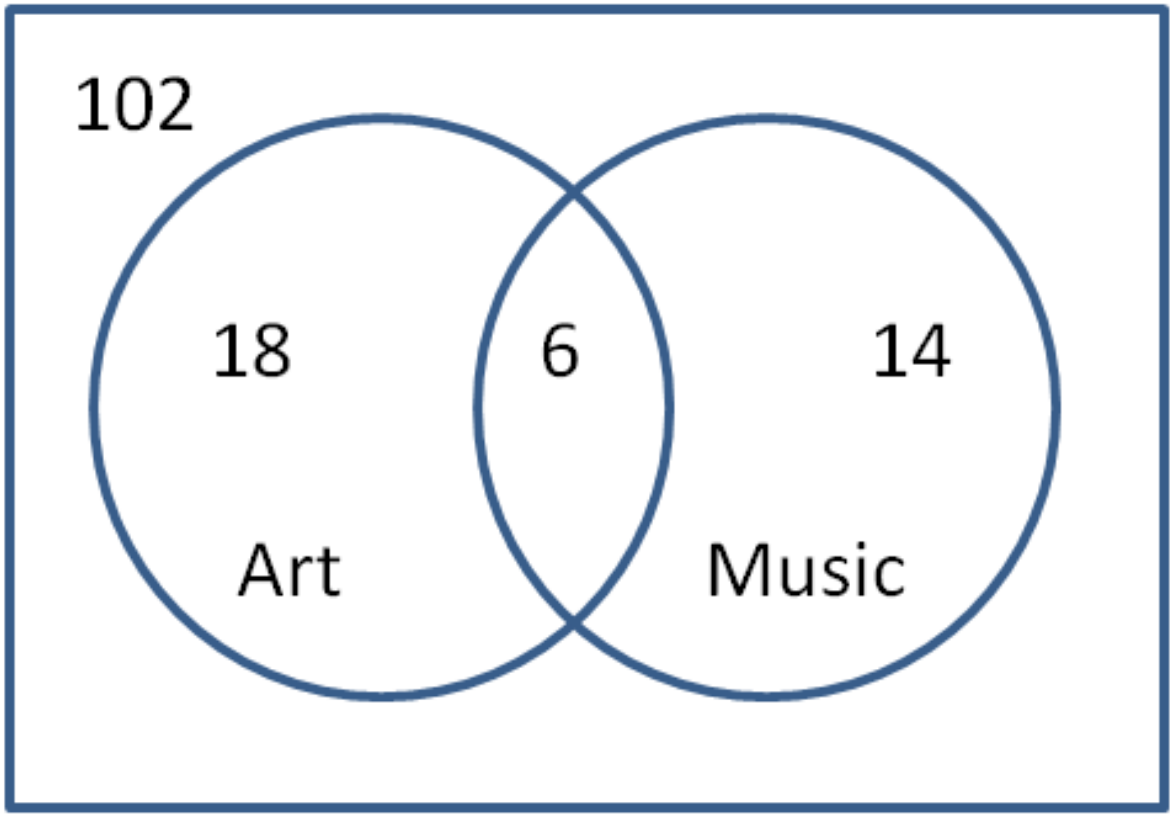
6

Given the following Venn Diagram, how many students are taking an art OR a music class?



38

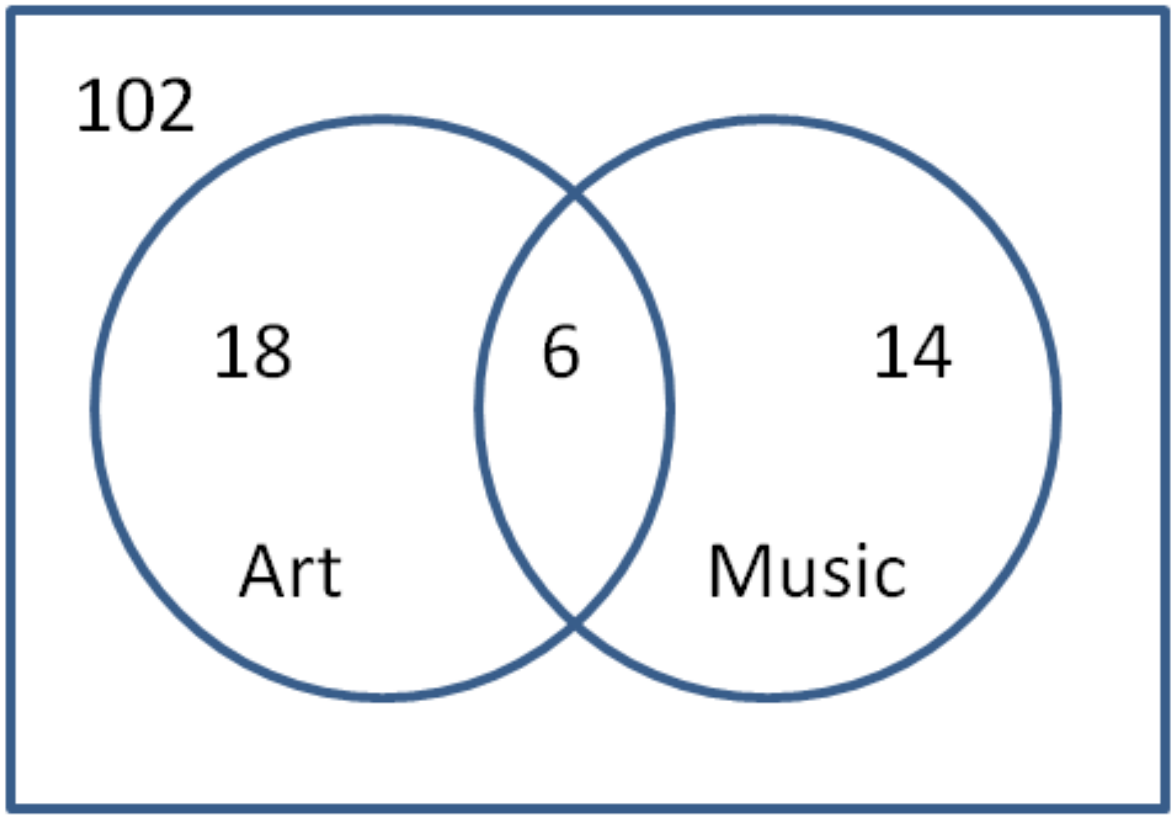
Given the following Venn Diagram, how many students are in the Venn Diagram?



140

Given the following Venn Diagram, find the PROBABILITY that a student is taking an art AND a music class.

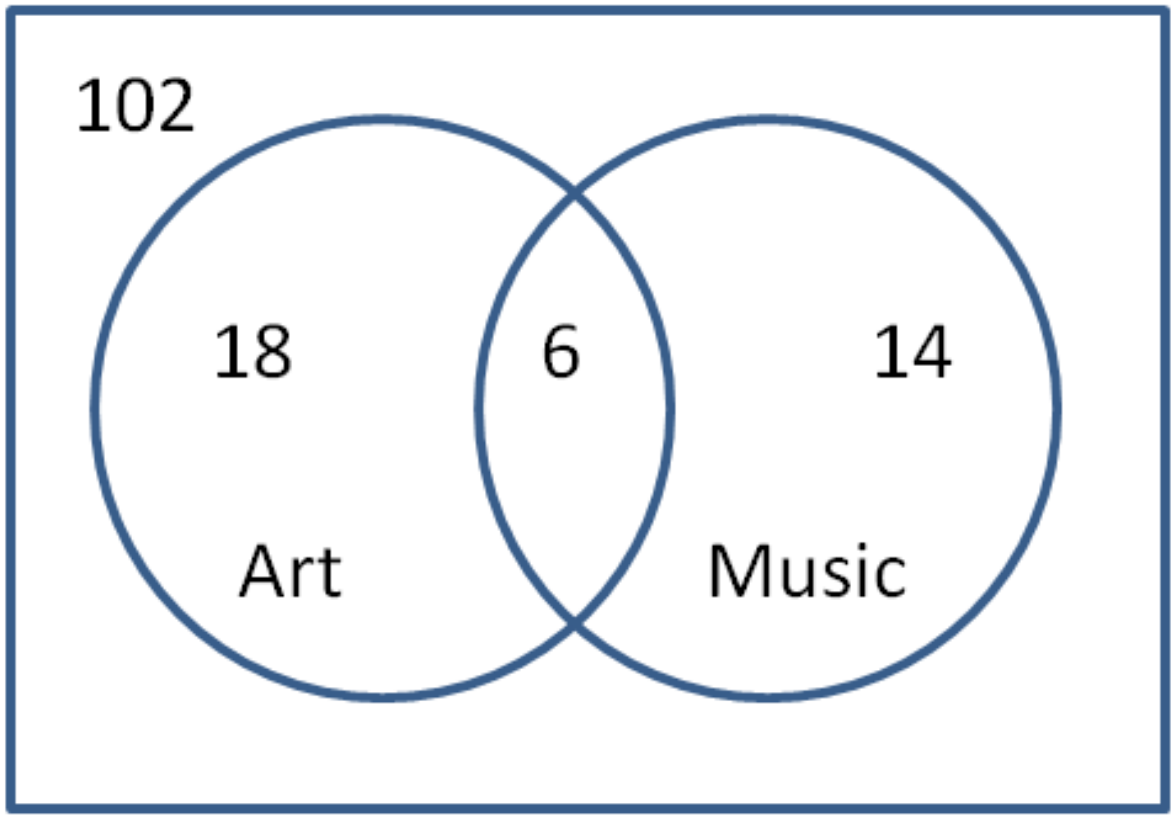
P(art AND music) = _____



$\frac{6}{140}$ or $\frac{3}{70}$

Given the following Venn Diagram, find the PROBABILITY that a student is taking an art OR a music class.

P(art OR music) = _____

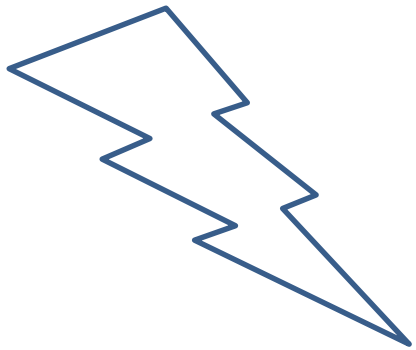


$$38/140$$

or $$19/70$$

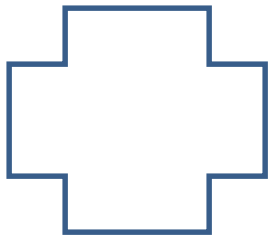
The probability of an event + the probability of its complement = _____

$P(A) + P(A^C) =$ _____



1

The probability of rain tomorrow is 40%. What is the probability that it doesn't rain?



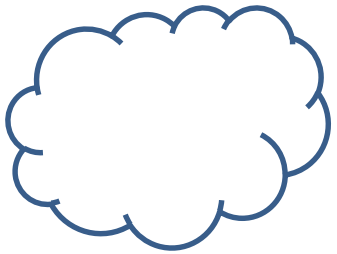
0.60

The probability of rain tomorrow is 40%. What are the odds of rain?

4:6 or 2:3

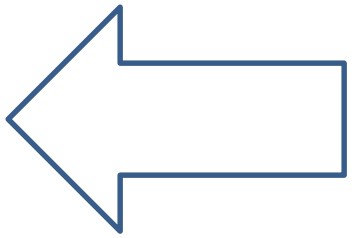
At SWGHS, 30% of the students are sophomores.
48% of the students are female.

What is the probability that a student is a female AND a sophomore?



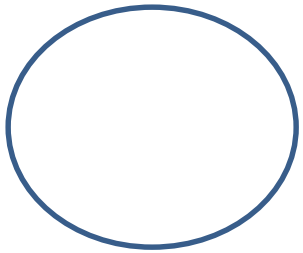
14.4%

A coin and a die are tossed/rolled. What is the probability of getting tails and a 4.



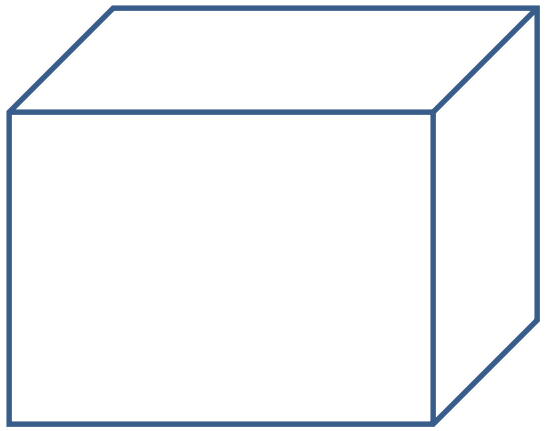
1/12

If the probability of receiving a piece of mail is 25% on any given day, what is the probability of receiving a piece of mail today and no mail tomorrow?



18.75%

Given a standard deck of cards, what is the probability of drawing a diamond?



25%

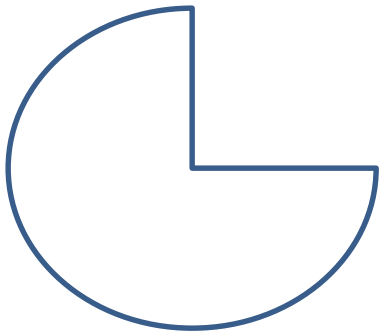
Given a standard deck of cards, what is the probability of drawing a king?

1/13

Given a standard deck of cards, what is the probability of drawing the king of diamonds?

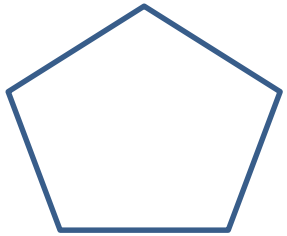
$1/52$

Given a standard deck of cards, what is the probability of drawing a king OR a diamond?



$\frac{16}{52}$ or $\frac{4}{13}$

Given a standard deck of cards, what are the ODDS of drawing a diamond?



13:39 or

1:3