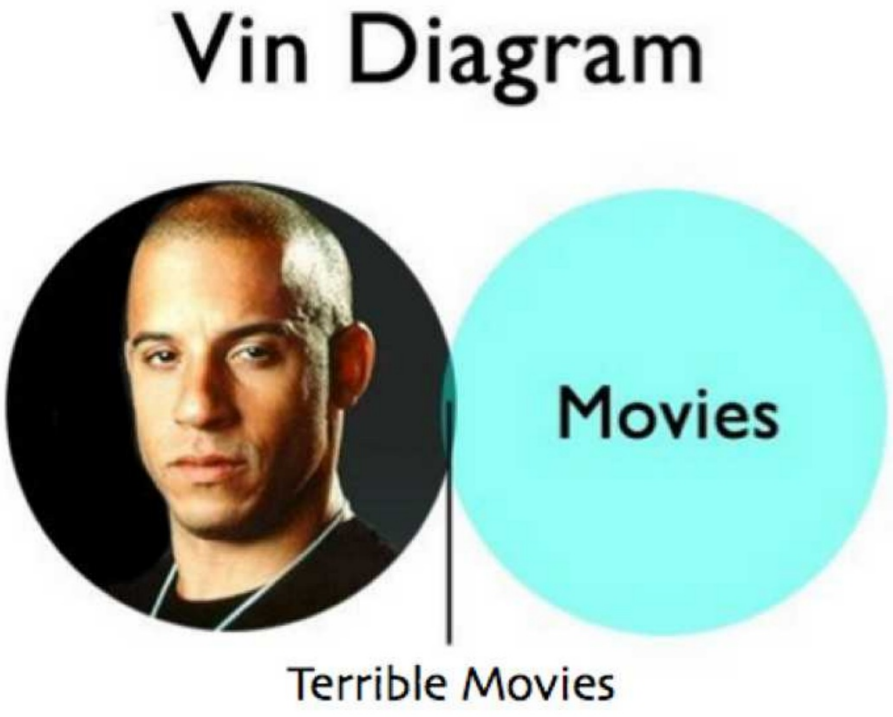
Set Theory, Venn Diagrams & Review



Consider the ***sample space***, the collection of all outcomes, $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. How many elements are in S?

Now consider the following ***events***, or subsets, of the sample space.

A = even numbers
B = numbers less than five

What are the elements of A?

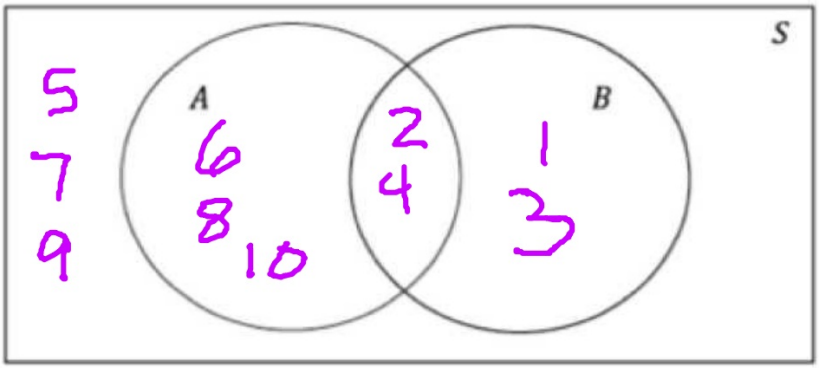
2, 4, 6, 8, 10

List the elements in B.

1, 2, 3, 4

A Venn diagrams can be used to represent various subsets of a sample space, S.

Use the following to represent sets A and B using a Venn diagram. Recall $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.

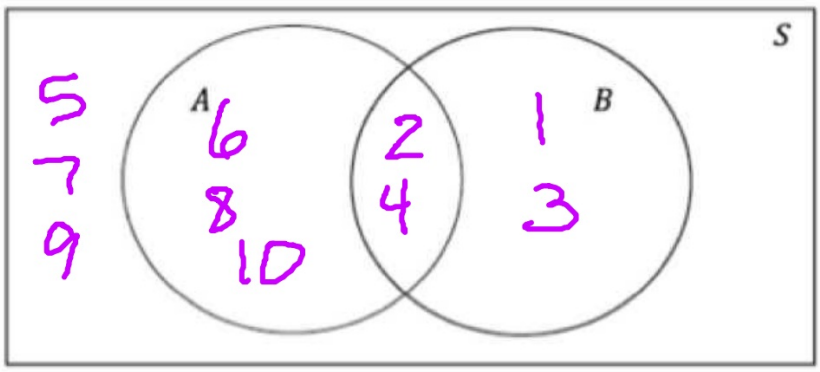


What elements are in A and B? 2, 4

This is called the intersection of A and B, written as

$$A \cap B.$$

Use the following to represent sets A and B using a Venn diagram. Recall $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.

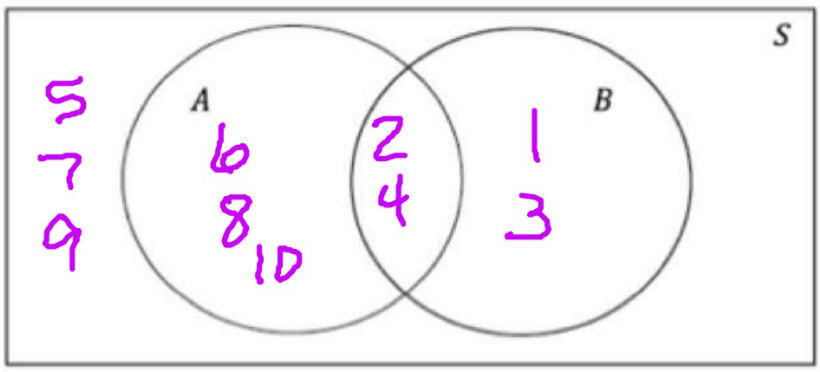


What elements are NOT in A?

1, 3, 5, 7, 9

This is called the complement of A, and is written as $\sim A$.

Use the following to represent sets A and B using a Venn diagram. Recall $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.



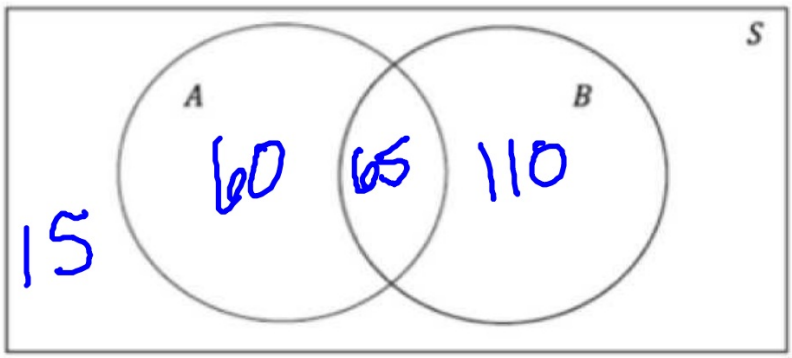
How many elements are in $\sim(A \cup B)$? 3

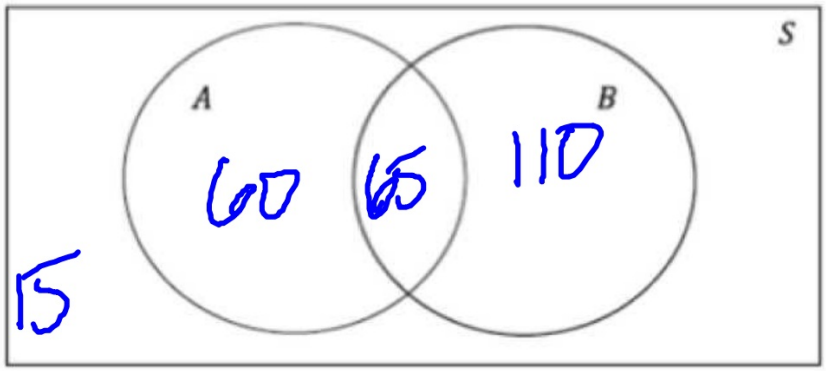
5, 7, 9

1. The following results were found from a recent survey of 250 subscribers to a conspiracy theory web site:

   - 125 believe we never landed on the moon (Set A)
   - 175 believe 9/11 was a government plot (Set B)
   - 65 believe both are true

   a. Draw a Venn diagram to represent the situation.





b. How many people are in $A \cap \sim B$?

15

c. How many people are in $\sim A \cap B$?

110

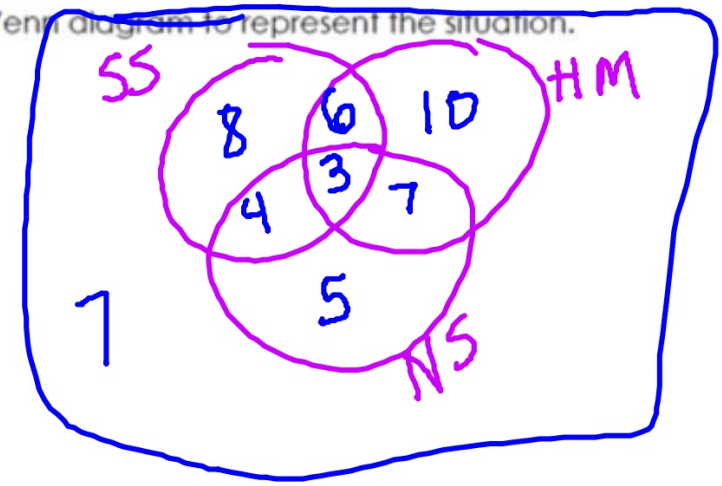
d. How many people are in $\sim(A \cap B)$?

185

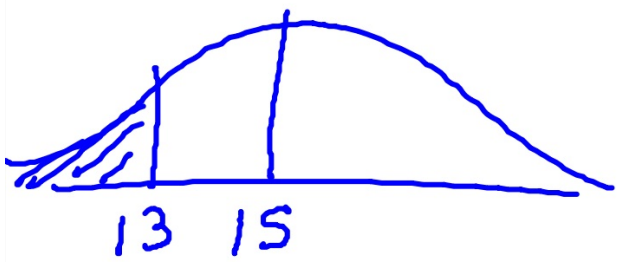
Fifty students were surveyed and asked if they are taking a social science (SS), humanities (HM), or a natural science (NS) course the next quarter.

- **21** students are taking a SS course.
- **26** students are taking a HM course.
- **19** students are taking a NS course.
- **9** students are taking SS and HM.
- **7** students are taking SS and NS.
- **10** students are taking HM and NS.
- **3** students are taking all three courses.
- **7** students are not taking any of the courses.

Construct a Venn diagram to represent the situation.



1a.) $P(x < 13)$



$$Z = \frac{13-15}{3} = -.67$$

$$P(x < 13) = .2514$$

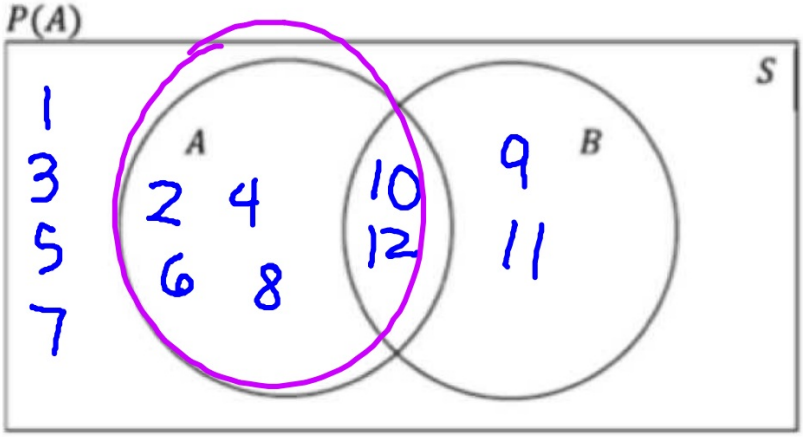
Consider the following dodecahedral die, which is a 12-faced die where each face is numbered from 1 to 12.

2, 4, 6, 8, 10, 12

Suppose event A = {rolling an even number} and event B = rolling a number greater than 8. Use the Venn diagram below to find each probability

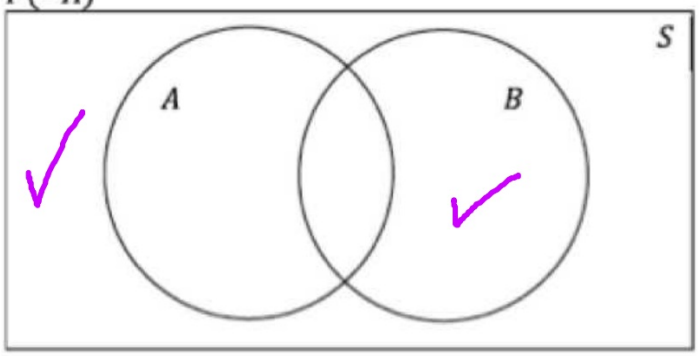
9, 10, 11, 12

a) $P(A)$



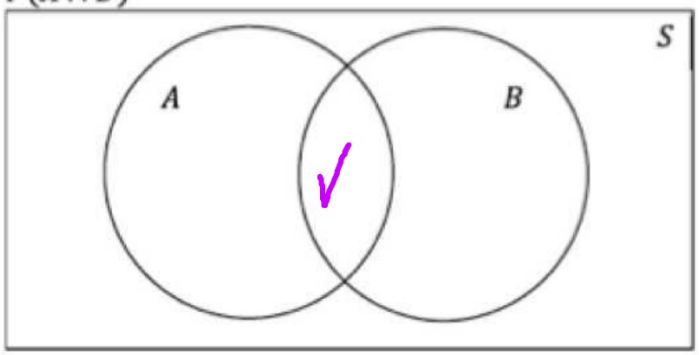
$\frac{6}{12}$

b) $P(\sim A)$



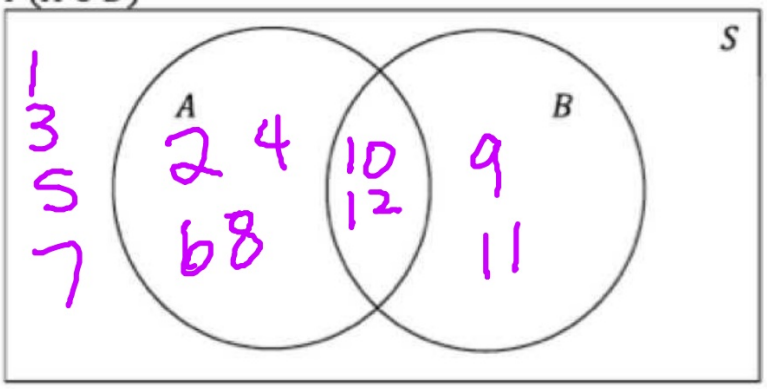
6/12

c) $P(A \cap B)$



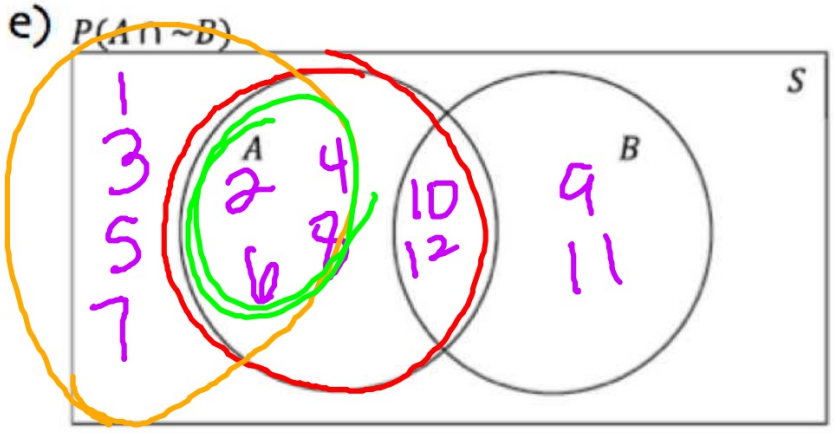
2/12 = 1/6

d) $P(A \cup B)$



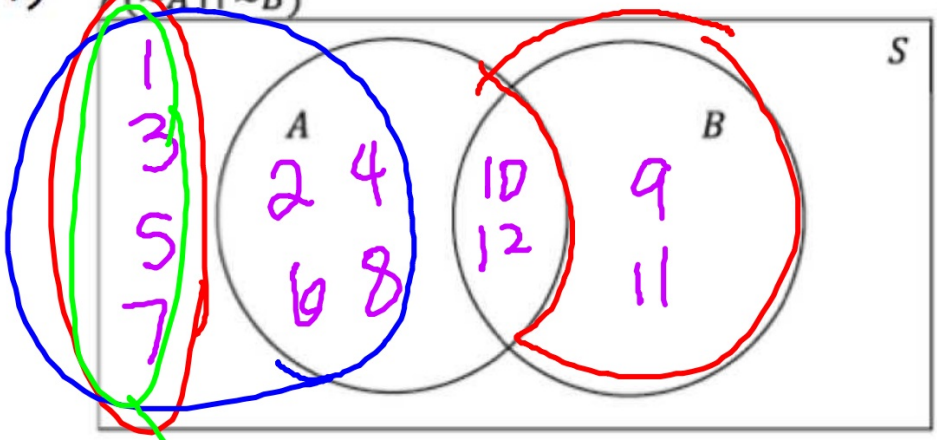
$\frac{8}{12}$

e) $P(A \cap \sim B)$



$\frac{4}{12}$

f) $P(\sim A \cap \sim B)$



$\frac{4}{12}$

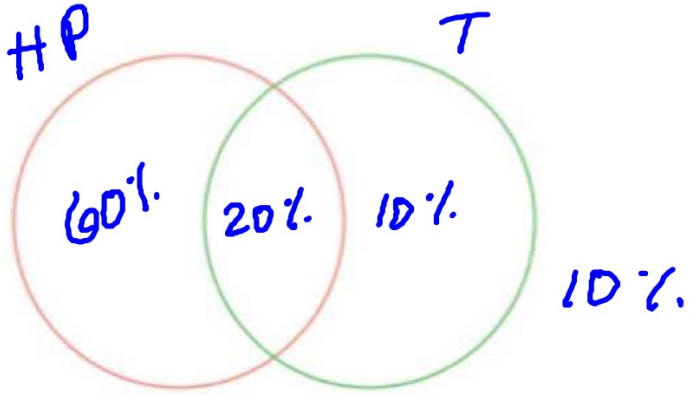
Suppose it is known that **80%** of high school students are *Harry Potter* fans, **30%** are *Twilight* fans, and **20%** are fans of both.

a. What is the probability that a randomly selected student does not like *Harry Potter*?

.2

b. What is the probability that a randomly selected student likes *Harry Potter* but does not like *Twilight*?

.6



c. What is the probability that a randomly selected student likes *Harry Potter* or *Twilight*?

.9

d. What is the probability that a randomly selected student does not like *Harry Potter* or *Twilight*?

.1

Two question multiple choice quiz, 3 choices for each question.

Sample space?

CC
WW
WC
CW

What is the probability of getting only one question correct?

$WC = \frac{2}{3} \cdot \frac{1}{3} = \frac{2}{9}$

$CW = \frac{1}{3} \cdot \frac{2}{3} = \frac{2}{9}$

$P(WC \text{ or } CW) = \frac{2}{9} + \frac{2}{9} = \frac{4}{9}$

Review

1. A fruit bowl consists of 4 red apples, 8 green apples, 6 (green) limes, 3 oranges, and 4 bananas.

a) Selecting a red apple and then a banana without putting the apple back in the bowl.

Review

1. A fruit bowl consists of 4 red apples, 8 green apples, 6 (green) limes, 3 oranges, and 4 bananas.

d) Selecting a banana, (yuck), replacing it, then selecting a lime, (yuck), replacing it, then selecting an orange.

Review

2. On a two question multiple choice test (3 choices per question). List the sample space using "C" for a correct answer and "W" for a wrong answer.

Review $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
$A \cup B$ $A \cap B$

3. Find the missing event with the given information:

P(A or B) = .80

P(A) = .60

P(B) = _____

P(A and B) = .15

$.8 = .6 + P(B) - .15$

$.35 = P(B)$

Review

3. Find the missing event with the given information:

$P(A \mid B) =$ _____

$P(B) = .4$

$P(A \text{ and } B) = .08$

$$P(B|A) = \frac{P(A \cap B)}{P(A)} = \frac{.08}{.4} = \frac{1}{5} = 0.2$$

Review

5. When using the empirical rule if:

a) If 95% of the population score between 100 and 140 what is the mean and standard deviation?

Review

12. 65 girls are on a field trip to a museum. 10 of the 32 sophomores play soccer. There are 28 girls on the soccer team. How many girls are not on the soccer team?

Review

15. Use the z-score table to find:

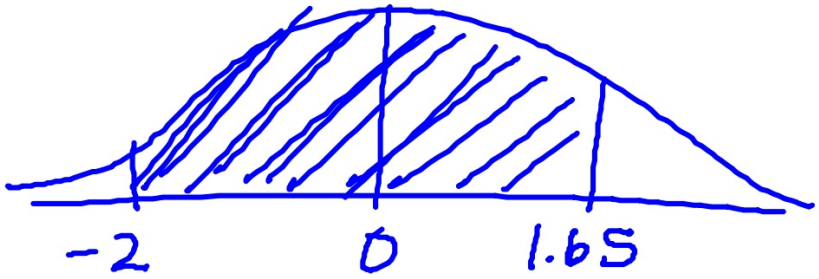
b) $P(z > 2.33)$

Review

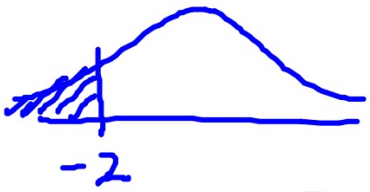
15. Use the z-score table to find:

h) z-score for the top 15% percentile

15f.) $P(-2 < z < 1.65)$



$z = 1.65$ $z = -2$



$.9505 - .0228 =$