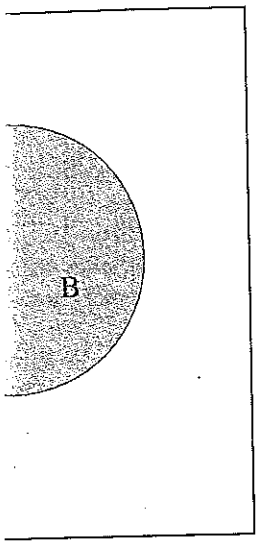
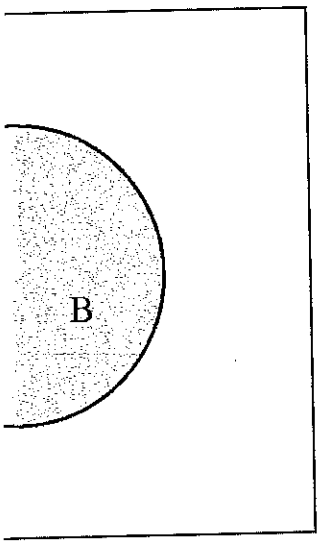


gram for $A \cup B$.



agram for $B \cap \overline{A}$.

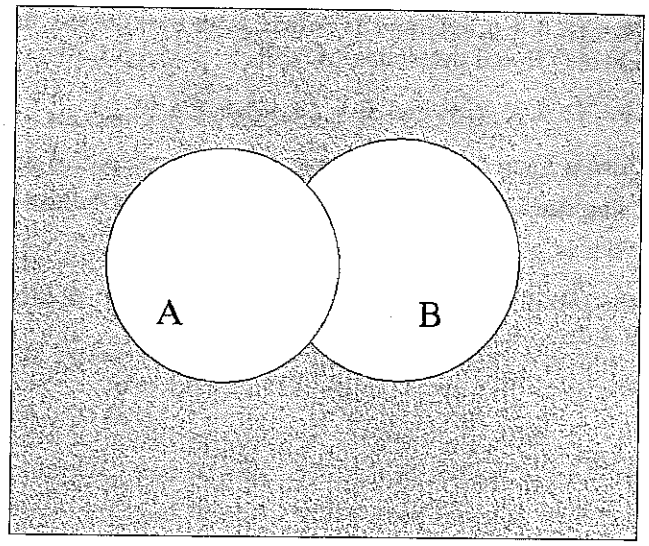


FIGURE 9.3: Venn diagram for $\overline{A} \cap \overline{B}$.

Example 9.1.4. *Of* 200 *moviegoers surveyed* 123 *always bought candy or popcorn. Of those people,* 45 *always bought only candy while* 51 *always bought only popcorn. How many people always buy both popcorn and candy?*

Solution: Using Venn diagrams it is easy to compute the intersection to be:

$$123 - (45 + 51) = 27.$$

□

Exercises:

A.1.1 Wite the integers from 1 to 7 as a set in two different ways.

A.1.2 Write the positive integers as a set in two different ways.

A.1.3 Write the negative integers as a set in two different ways.

A.1.4 Let $A = \{1, 3, 5, 7\}$ and $B = \{x | x \text{ is an odd integer and } x \leq 20\}$.

1. Find $A \cup B$.
2. If $C = \{y | y \text{ is an integer and } 1 \leq y \leq 10\}$, then find $A \cap C$.
3. Find $BG \cap C$.
4. What is $|A \cap C|$?
5. What is $|B \cap C|$?

A.1.5 Let $A = \{2, 3, 4, 5, 6, 7\}$ and $B = \{x | x \text{ is an even integer and } x \leq 10\}$, then find $A \cap B$ and determine $|A \cap B|$.

A.1.6 Let $A = \{1, 2, , 5, 7, 8\}$ and $B = \{3, 4, 5, 6, 7, 8, 9\}$.

1. Draw a Venn diagram showing the relationship of A and B.
2. Using the Venn diagram, determine the sets $A \cap B$ and $A \cup B$.
3. What is $|A \cap B|$ and $|A \cup B|$?

A.1.7 For the sets in the previous problem, if they are subsets of the set $S = \{0, 1, 2, \ldots, 12\}$, then find

1. $\overline{A}$;
2. $\overline{B}$;
3. $\overline{A \cap B}$;
4. $\overline{A \cup B}$.

A.1.8 If $C = \{\text{cards in a standard deck}\}$ and $H = \{\text{hearts between 3 and 9}\}$, then find $\overline{C}$.

A.1.9 If we consider one die, what is the set of possible outcomes of rolling that die?

A.1.10 What is the set of even outcomes for rolling one die?

A.1.11 If we draw one card from a standard deck, what is the set of possible outcomes? What if we ignore the suit of the card?

A.1.12 Let $S = \{1, 2, \ldots, 15\}$ be the sample space. Let $P = \{2, 4, 6, \ldots, 14\}$ and let $Q = \{3, 6, 9, 12, 15\}$. Write out the following subsets:

1. $P \cup Q$.
2. $P \cap Q$.
3. $Q \cap \overline{P}$.
4. $P \cap \overline{Q}$
5. $\overline{P} \cup S$.
6. $P \cup S$.
7. $Q \cap S$.
8. $\overline{P} \cap S$.

A.1.13 Illustrate the following by shading in a Venn diagram:

1. $\overline{A} \cap B$.
2. $\overline{A} \cap \overline{B}$.
3. $\overline{A} \cup \overline{B}$.

4. $(A \cup B) \cap \overline{C}$.
5. $(\overline{A \cap B \cap C})$.

What is another way

A.1.14 Let A be the set of set of positive integer

1. $|A \cap B|$.
2. $|A \cup B|$.

A.1.15 Let H be the set o students who take Bi What is $|H \cup B|$ if:

1. history 102 and I
2. history 102 and there are 15 stud

A.1.16 Let S be a sample s another way to expres

1. $\overline{A} \cap S$.
2. $B \cup S$.
3. $\overline{(A \cap B)} \cap S$.

A.1.17 In a survey of 100 Coke while 45 drink P

A.1.18 The Nielson ratings *Andy Griffith* every da people watch *Andy Gri*

A.1.19 In a survey at Emor beer or wine, 70 drink people drink both beer problem and Problem

9.2 Relations and Fu

One of the most fundamer The simplest way to think of

4. $(A \cup B) \cap \overline{C}$.
5. $(\overline{A \cap B \cap C})$.

What is another way of describing this last set?

A.1.14 Let A be the set of odd positive integers less than 100. Let B be the set of positive integers less than 100 that are divisible by 3. Compute:

1. $|A \cap B|$.
2. $|A \cup B|$.

A.1.15 Let H be the set of students who take History 102 and B the set of students who take Biology 112. Assume that $|H| = 40$ and $|B| = 45$. What is $|H \cup B|$ if:

1. history 102 and Biology 112 meet at the same time?
2. history 102 and Biology 112 do not meet at the same time and there are 15 students who take both?

A.1.16 Let S be a sample space and A and B be any two subsets of S. Find another way to express each of the following sets.

1. $\overline{A} \cap S$.
2. $B \cup S$.
3. $\overline{(\overline{A} \cap B)} \cap S$.

A.1.17 In a survey of 100 people drink who Coke® or Pepsi®, 70 drink Coke while 45 drink Pepsi. How many people drink both?

A.1.18 The Nielson ratings claim 232,679 people watch *The Brady Bunch* and *Andy Griffith* every day while 532,568 watch either program. If 392,101 people watch *Andy Griffith*, how many people watch *The Brady Bunch*?

A.1.19 In a survey at Emory University, of 200 students who say they drink beer or wine, 70 drink only beer while 45 drink only wine. How many people drink both beer and wine? Explain the difference between this problem and Problem A.1.6.

9.2 Relations and Functions

One of the most fundamental ideas in all mathematics is that of a *relation*. The simplest way to think of a relation is as a set of ordered pairs.