

1.
 - a. $S' = \{5, 6, 7\}$
 - b. $S \cup T = \{1, 2, 3, 4, 5, 7\}$
 - c. $S \cap T = \{1, 3\}$
 - d. $S' \cap T = \{5, 7\}$
2.
 - a. $S' = \{4, 5\}$
 - b. $S \cup T = \{1, 2, 3, 5\}$
 - c. $S \cap T = \emptyset$
 - d. $S' \cap T = \{5\}$
3.
 - a. $R \cup S = \{a, b, c, e, i, o, u\}$
 - b. $R \cap S = \{a\}$
 - c. $S \cap T = \emptyset$
 - d. $S' \cap R = \{b, c\}$
4.
 - a. $R \cup S = \{a, b\}$
 - b. $R \cap S = \{a\}$
 - c. $T' = \{a, c\}$
 - d. $T' \cup S = \{a, b, c\}$
5. $\emptyset, \{1\}, \{2\}, \{1, 2\}$
6. $\emptyset, \{1\}, \{2\}, \{3\}, \{4\}, \{1,2\}, \{1,3\}, \{1,4\}, \{2,3\}, \{2,4\}, \{3,4\}, \{1,2,3\}, \{1,3,4\}, \{1,2,4\}, \{2,3,4\}, \{1,2,3,4\}$
7.
 - a. $F \cap B = \{\text{all freshman college students who like basketball}\}$
 - b. $B' = \{\text{all college students who do not like basketball}\}$
 - c. $F' \cap B' = \{\text{all college students who are neither freshman nor like basketball}\}$
 - d. $F \cup B = \{\text{all college students who are either freshman or like basketball}\}$
8.
 - a. $S' = \{\text{all corporations with headquarters not in New York City}\}$
 - b. $T' = \{\text{all publicly owned corporations}\}$
 - c. $S \cap T = \{\text{all privately owned corporations with headquarters in New York City}\}$
 - d. $S \cap T' = \{\text{all publicly owned corporations with headquarters in New York City}\}$
9.
 - a. $S = \{1999, 2003, 2006, 2010, 2013\}$
 - b. $T = \{1996, 1997, 1998, 1999, 2003, 2009, 2013\}$
 - c. $S \cap T = \{1999, 2003, 2013\}$
 - d. $S \cup T = \{1996, 1997, 1998, 1999, 2003, 2006, 2009, 2010, 2013\}$
 - e. $S' \cap T = \{1996, 1997, 1998, 2009\}$
 - f. $S \cap T' = \{2006, 2010\}$
10.
 - a. $A = \{1998, 2000, 2001, 2005, 2007, 2008, 2014\}$
 - b. $B = \{2000, 2001, 2002, 2008, 2015\}$
 - c. $A \cap B = \{2000, 2001, 2008\}$
 - d. $A' \cap B = \{2002, 2015\}$
 - e. $A \cap B' = \{1998, 2005, 2007, 2014\}$
11. From 1996 to 2015, there were only two years in which the Standard and Poor's Index increased by 2% or more during the first five days and not increase by 16% or more for the entire year.
12. From 1996 to 2015, there were only two years in which the Standard and Poor's Index did not decline during the first five days but declined for the entire year.

13. a. $R \cup S = \{a, b, c, d\}$
 $(R \cup S)' = \{e, f\}$
- b. $R \cup S \cup T = \{a, b, c, d, e, f\}$
- c. $R \cap S = \{a, b\}$
 $R \cap S \cap T = (R \cap S) \cap T = \emptyset$
- d. $T' = \{a, b, c, d\}$
 $R \cap S \cap T' = (R \cap S) \cap T' = \{a, b\}$
- e. $R' = \{d, e, f\}; S \cap T = \emptyset$
 $R' \cap S \cap T = R' \cap (S \cap T) = \emptyset$
- f. $S \cup T = \{a, b, d, e, f\}$
- g. $R \cup S = \{a, b, c, d\};$
 $R \cup T = \{a, b, c, e, f\}$
 $(R \cup S) \cap (R \cup T) = \{a, b, c\}$
- h. $R \cap S = \{a, b\}; R \cap T = \emptyset$
 $(R \cap S) \cup (R \cap T) = \{a, b\}$
- i. $R' = \{d, e, f\}; T' = \{a, b, c, d\}$
 $R' \cap T' = \{d\}$
14. a. $R \cap S = \{3, 5\}$
 $R \cap S \cap T = (R \cap S) \cap T = \emptyset$
- b. $T' = \{1, 3, 5\}$
 $R \cap S \cap T' = (R \cap S) \cap T' = \{3, 5\}$
- c. $S' = \{1, 2\}; R \cap S' = \{1\}$
 $R \cap S' \cap T = (R \cap S') \cap T = \emptyset$
- d. $R' = T = \{2, 4\}$
 $R' \cap T = T = \{2, 4\}$
- e. $R \cup S = \{1, 3, 4, 5\}$
- f. $R' \cup R = U = \{1, 2, 3, 4, 5\}$
- g. $S \cap T = \{4\}$
 $(S \cap T)' = \{1, 2, 3, 5\}$
- h. $S' = \{1, 2\}; T' = \{1, 3, 5\}$
 $S' \cup T' = \{1, 2, 3, 5\}$
15. $(S')' = S$
16. $S \cap S' = \emptyset$
17. $S \cup S' = U$
18. $S \cap \emptyset = \emptyset$
19. $T \cap S \cap T' = S \cap (T \cap T') = S \cap \emptyset = \emptyset$
20. $S \cup \emptyset = S$
21. {divisions that had increases in labor costs or total revenue} = $L \cup T$
22. {divisions that did not make a profit} = P'
23. {divisions that made a profit despite an increase in labor costs} = $L \cap P$
24. {divisions that had an increase in labor costs and were either unprofitable or did not increase their total revenue}
 $= L \cap (P' \cup T')$
25. {profitable divisions with increases in labor costs and total revenue} = $P \cap L \cap T$
26. {divisions that were unprofitable or did not have increases in either labor costs or total revenue}
 $= P' \cup (L \cup T)'$
27. {applicants who have not received speeding tickets} = S'
28. {applicants who have caused accidents and been arrested for drunk driving} = $A \cap D$
29. {applicants who have received speeding tickets, caused accidents, or were arrested for drunk driving}
 $= S \cup A \cup D$
30. {applicants who have not been arrested for drunk driving but have received speeding tickets or have caused accidents}
 $= D' \cap (S \cup A)$
31. {applicants who have not both caused accidents and received speeding tickets but who have been arrested for drunk driving}
 $= (A \cap S)' \cap D$

32. {applicants who have not caused accidents or have not been arrested for drunk driving} = $A' \cup D'$
33. $A \cap D = \{\text{students at Mount College who are younger than 35}\}$
34. $B \cap C = \{\text{teachers at Mount College who are older than 35}\}$
35. $A \cap B = \{\text{people who are both student and teachers at Mount College}\}$
36. $B \cup C = \{\text{people at Mount College who are teachers or older than 35}\}$
37. $A \cup C' = A \cup D = \{\text{people at Mount College who are students or are at most 35}\}$
38. $(A \cap D)' = \{\text{people at Mount College who are not students younger than 35}\}$
39. $D' = C = \{\text{people at Mount College who are at least 35}\}$
40. $D \cap U = D = \{\text{people at Mount College who are younger than 35}\}$
41. {people who don't like vanilla ice cream} = V'
42. {people who like vanilla but not chocolate ice cream} = $V \cap C'$
43. {people who like vanilla but not chocolate or strawberry ice cream} = $V \cap (C \cup S)'$
44. {people who don't like any flavor of the three flavors of the ice cream} = $(S \cup V \cup C)'$
45. {people who like neither chocolate nor vanilla ice cream} = $(V \cup C)'$
46. {people who like only strawberry and chocolate ice cream} = $S \cap C \cap V'$
47. a. $R = \{B, C, D, E\}$
 b. $S = \{C, D, E, F\}$
 c. $T = \{A, D, E, F\}$
 d. $R' = \{A, F\}$
 $R' \cup S = \{A, C, D, E, F\}$
- e. $R' \cap T = \{A, F\}$
- f. $R \cap S = \{C, D, E\}$
 $R \cap S \cap T = (R \cap S) \cap T = \{D, E\}$
48. a. $R = \{C, D, E\}$
 b. $S = \{A, B, C, D\}$
 c. $T = \{A, B, C, F\}$
 d. $S' = \{E, F\}$
 $R \cap S' = \{E\}$
 e. $R' = \{A, B, F\}$
 $R' \cup T = \{A, B, C, F\}$
 f. $R' \cap S' = \{F\}$
 $R' \cap S' \cap T' = (R' \cap S') \cap T' = \emptyset$
49. There are eight different ways. They are no toppings; peppers; onions; mushrooms; peppers and onions; peppers and mushrooms; onions and mushrooms; all three toppings.
50. There are 16 different ways. They are no toppings; butter; cheese; chives; bacon; butter and cheese; butter and chives; butter and bacon; cheese and chives; cheese and bacon; chives and bacon; butter, cheese, and chives; butter, cheese, and bacon; butter, chives, and bacon; cheese, chives, and bacon; all four toppings.
51. Any subset of T with 2 as an element is an example. Possible answer: {2}
52. If T is a subset of S , then $S \cap T = T$.
53. If S is a subset of T , then $S \cup T = T$.
54. There are many possible subsets. Possible answer: $R = \{1\}$, $S = \{1, 2\}$, $T = \{2, 3\}$. Then $R \cup (S \cap T) = \{1, 2\}$ and $(R \cup S) \cap T = \{2\}$.
55. True; 5 is an element of the set {3, 5, 7}.
56. True; {1, 3} is a subset of the set {1, 2, 3}.
57. True; {b} is a subset of the set {b, c}.
58. False; 0 is not an element of the set {1, 2, 3}.
59. False; 0 is not an element of the empty set \emptyset .
60. True; the empty set \emptyset is a subset of any set.
61. True; any set is a subset of itself.
62. False; 1 is an element of the set {1}.