43. Let S denote the sample space of the experiment that is the set of 52 cards. Then $E = \{x \in S \mid x \text{ is an ace}\}$ and $F = \{x \in S \mid x \text{ is a spade}\}$ and $E \cap F = \{x \in S \mid x \text{ is the ace of spades}\}$. Now $n(E) = 4$, $n(F) = 13$, and $n(E \cap F) = 1$. Also, $E \cup F = \{x \in S \mid x \text{ is an ace or a spade}\}$ and $n(E \cup F) = 16$, and

$$n(E) + n(F) - n(E \cap F) = 4 + 13 - 1 = 16 = n(E \cup F).$$

44. If E is an event of an experiment then E^c is the event containing the elements in S that are not in E. Therefore $E \cap E^C = \varnothing$ and the two sets are mutually exclusive.

45. $E^C \cap F^C = (E \cup F)^C$ by DeMorgan's Law. Since $(E \cup F) \cap (E \cup F)^C = \varnothing$, they are mutually exclusive.

46. The number of events of this experiment is 2^n.

47. False. Let $E = \{1, 2, 3\}$, $F = \{4, 5, 6\}$, and $G = \{4, 5\}$. Then $E \cap F = \varnothing$ and $E \cap G = \varnothing$, but $F \cap G = \{4, 5\} \neq \varnothing$.

48. True. The sample space is $S = \{(1, 2), (1, 3), (2, 1), (2, 3), (3, 1), (3, 2)\}$.

7.2 CONCEPT QUESTIONS, page 367

1. a. By assigning probabilities to each simple event of an experiment, we obtain a *probability distribution* that gives the probability of each simple event. Examples vary.
   b. The function P that assigns a probability to each of the simple events is called a *probability function.* Examples vary.
2. $P(s_1) = P(s_2) = \cdots P(s_n) = \dfrac{1}{n}$. This type of sample space is said to be uniform.
3. $P(E) = P(s_1) + P(s_2) + \cdots + P(s_n)$; $P(\varnothing) = 0$.

EXERCISES 7.2, page 367

1. $\{(\text{H, H})\}, \{(\text{H, T})\}, \{(\text{T, H})\}, \{(\text{T, T})\}$. 2. $\{h\}, \{d\}, \{s\}, \{c\}$

3. $\{(D,m)\}, \{(D,f)\}, \{(R,m)\}, \{(R,f)\}, \{(I,m)\}, \{(I,f)\}$

4. $\{0\}, \{1\}, \{2\}, \{3\}, \{4\}, \{5\}, \{6\}, \{7\}, \{8\}$.

5. $\{(1,i)\}, \{(1,d)\}, \{(1,s)\}, \{(2,i)\}, \{(2,d)\}, \{(2,s)\}, \ldots, \{(5,i)\}, \{(5,d)\}, \{(5,s)\}$

6. $\{(1,i)\}, \{(1,d)\}, \{(1,u)\}, \{(2,i)\}, \{(2,d)\}, \{(2,u)\}, \ldots, \{(12,i)\}, \{(12,d)\}, \{(12,u)\}$

7. $\{(A, Rh^+)\}, \{(A, Rh^-)\}, \{(B, Rh^+)\}, \{B, Rh^-)\}, \{(AB, Rh^+)\}, \{(AB, Rh^-)\},$ $\{(O, Rh^+)\}, \{(O, Rh^-)\}$

8. $\{(1,a)\}, \{(1,b)\}, \{(MN,c)\}, \{(MN,d)\}, \ldots, \{(MO,a)\}, \{(MO,b)\}, \{(MO,c)\},$ $\{(MO,d)\}$.

9. The probability distribution associated with this data is

Grade	*A*	*B*	*C*	*D*	*F*
Probability	.10	.25	.45	.15	.05

10. The probability distribution associated with this data is

Bloodtype	*A*	*B*	*AB*	*0*
Probability	.41	.12	.03	.44

11. The probability distribution follows:

Answer	**Falling behind**	**Staying even**	**Increasing faster**	**Don't know**
Number of Respondents	.40	.44	.12	.04

12. The probability distribution is

Number of Times	0	1	2	3	4	5	6	7
Probability	.05	.06	.09	.15	.11	.20	.17	.17

13. The probability distribution is

Outcome	**Favor**	**Oppose**	**Don't Know**
Probability	$\frac{910}{1936}$	$\frac{891}{1936}$	$\frac{135}{1936}$

or

Opinion	Favor	Oppose	Don't Know
Probability	.47	.46	.07

14.

Outcome	Sun	Mon	Tues	Wed	Thu	Fri	Sat
Probability	.16	.12	.12	.12	.13	.16	.19

15. The probability distribution associated with this data is

Rating	*A*	*B*	*C*	*D*	*E*
Probability	.026	.199	.570	.193	.012

16. The probability distribution associated with this data is

Rating	*A*	*B*	*C*	*D*	*E*
Probability	.19	.61	.15	.02	.03

17. a. $S = \{(0 < x \leq 200), (200 < x \leq 400), (400 < x \leq 600), (600 < x \leq 800), (800 < x \leq 1000), (x > 1000)\}$

b.

Number of cars (x)	**Probability**
$0 < x \leq 200$	.075
$200 < x \leq 400$	.1
$400 < x \leq 600$	.175
$600 < x \leq 800$	.35
$800 < x \leq 1000$	.225
$x > 1000$	.075

18. a. Let s_1 denote the outcome that the arrival time is later than 7:56 A.M. but on or before 7:58 A.M; let s_2 denote the outcome that the arrival time is later than 7:58 A.M. but on or before 8:00 A.M., and so on. Finally, let s_7 denote the outcome that the arrival time is later than 8:08 A.M., but on or before 8:10 A.M.. Then the required sample space is given by $S = \{s_1, s_2, ..., s_7\}$.

b. $P(s_1) = \frac{4}{120} \approx 0.03$, etc. In this manner we obtain the required probability distribution.

Simple Event	$\{s_1\}$	$\{s_2\}$	$\{s_3\}$	$\{s_4\}$	$\{s_5\}$	$\{s_6\}$	$\{s_7\}$
Probability	.03	.15	.42	.27	.08	.03	.03

19. The probability is $\dfrac{84,000,000}{179,000,000} \approx .469$.

20. The probability is $\dfrac{163,605}{1,778,314} \approx .092$.

21. a. The probability that a person killed by lightning is a male is $\dfrac{376}{439} \approx .856$.

b. The probability that a person killed by lightning is a female is

$$\frac{439-376}{439} = \frac{63}{439} \approx .144.$$

22. The probability that a defective bulb is chosen is $\dfrac{6}{120} = .05$.

23. The probability that the retailer uses electronic tags as antitheft devices is

$$\frac{81}{176} \approx .460.$$

24. The probability that it will be a white ball is $P(W) = \dfrac{2}{3+2+5} = \dfrac{2}{10} = .2$.

25. a. $P(D) = \dfrac{13}{52} = \dfrac{1}{4}$ b. $P(B) = \dfrac{26}{52} = \dfrac{1}{2}$ c. $P(A) = \dfrac{4}{52} = \dfrac{1}{13}$

26. Refer to Example 4, page 356.

a. The required event is $E = \{(1,1),(1,2),(1,3),(2,1),(2,2),(3,1)\}$ and so

$$P(E) = P[\{(1,1)\}] + P[\{(1,2)\}] + \ldots + P\{(3,1)\}]$$

$$= \frac{1}{36} + \frac{1}{36} + \cdots + \frac{1}{36} = \frac{1}{6} \qquad \text{(six terms)}$$

b. The required event is $F = \{(1,6), (2,6), \ldots, (5,6), (6,1), \ldots, (6,6)\}$, and so

$$P(F) = P[(1,6)] + \ldots + P[(6,6)]$$

$$= \frac{1}{36} + \frac{1}{36} + \cdots + \frac{1}{36} \qquad \text{(eleven terms)}$$

$$= \frac{11}{36}.$$

27. The probability of arriving at the traffic light when it is red is

$$\frac{30}{30+5+45} = \frac{30}{80} = 0.375.$$

28. The required event is $E = \{2, 4, \ldots, 36\}$. So

$$P(E) = \frac{1}{38} + \frac{1}{38} + \cdots + \frac{1}{38} \qquad \text{(eighteen terms)}$$

$$= \frac{18}{38}, \text{ or } \frac{9}{19}.$$

29. a. $P(E) = \dfrac{62}{9+62+27} = \dfrac{62}{98} \approx .633$ b. $P(E) = \dfrac{27}{98} \approx .276$

30. a. $P(E) = \dfrac{1}{100,000} = .00001$ b. $P(E) = \dfrac{531}{100,000} = .00531$

31. a. The probability that a registered voter favors the proposition is 0.35.
b. The probability that a registered voter is undecided about the proposition is
1 - 0.35 - 0.32 = 0.33.

32. The required probability is

$$\frac{211+115}{135+404+1057+211+115} \approx 0.1696$$

33. The required probability is given by

$$\frac{281+251}{382+281+251+90} \approx 0.530$$

34. a. The required probability is $\frac{47}{11+47+32+2+8} = .47$.

b. The required probability is $\frac{32+47}{11+47+32+2+8} = .79$.

35. a. The required probability is $\frac{25+15}{37+14+25+15+9} \approx .4$.

b. The required probability is $\frac{14+9}{37+14+25+15+9} \approx .23$.

36. a. The required probability is $\frac{22+7}{21+56+22+7} = .274$.

b. The required probability is $\frac{21}{21+56+22+7} \approx .198$.

37. a. The required probability is $\frac{448}{1000} = .448$.

b. The required probability is $\frac{155+100}{1000} = .255$.

38. a. The required probability is $\frac{827}{827+477+42+56} \approx .5899$

b. The required probability is $\frac{477}{827+477+42+56} \approx .3402$

39. The probability that the primary cause of the crash was due to pilot error or bad weather is given by

$$\frac{327+22}{327+49+14+22+19+15} = \frac{349}{446} \approx 0.783.$$

40. a. The required probability is

$$\frac{152+148}{800}=.375$$

b. The required probability is

$$\frac{240+128}{800}=.46$$

41. There are six ways of getting a 7, one die showing a 3 and the other die showing a 4, and vice versa. Similarly a 5 and a 2, and a 2 and a 5, as well as a 1 and a 6 and a 6 and 1 will yield the sum of 7.

42. No. Since the die is loaded the outcomes are not equally likely.

43. No, the outcomes are not equally likely.

44. Yes, the outcomes are equally likely.

45. a. $P(A)=P(s_1)+P(s_3)=\frac{1}{12}+\frac{1}{12}=\frac{1}{6}$

b. $P(B)=P(s_2)+P(s_4)+P(s_5)+P(s_6)=\frac{1}{4}+\frac{1}{6}+\frac{1}{3}+\frac{1}{12}=\frac{5}{6}$ c. $P(C)=1$.

46. a. $P(A)=P(s_1)+P(s_2)+P(s_4)=\frac{1}{14}+\frac{3}{14}+\frac{2}{14}=\frac{3}{7}$

b. $P(B)=P(s_1)+P(s_5)=\frac{1}{14}+\frac{2}{14}=\frac{3}{14}$ c. $P(C)=P(S)=1$

47. True

48. True. $P(E)=\frac{n(E)}{n(S)}=\frac{3}{n}$.

7.3 CONCEPT QUESTIONS, page 376

1. a. The event *E* cannot occur.
   b. There is a 50 percent chance that the event *F* will occur.
   c. The probability that an event of *S* will occur is a certainty.
   d. The probability of the event $E\cup F$ occurring is given by the sum of the probabilities of *E* and *F* minus the probability of $E\cap F$.

2. Examples will vary.