(1), (2), (3), (4), (5) See Answer Key.

(6)

$$\begin{aligned} Pr(A \cup B) &= Pr(A) + Pr(B) - Pr(A \cap B) \\ &= (1 - 1/3) + 1/2 - 1/4 = 11/12 \end{aligned}$$

(7) The sum of the probabilities for art, geology, and psychology should add up to 1.

$$\begin{aligned} p + p + 2p &= 1 \\ p &= 1/4 \end{aligned}$$

So, Pr(art) = 1/4, Pr(psychology) = 1/4, Pr(geology) = 1/2.

(8) Assuming that order doesn't matter:

$$\begin{aligned} \text{Number of ways to place two rooks, } |\Omega| &= \binom{64}{2} \\ \text{Number of ways to place two attacking rooks, } |E| &= \frac{64 \times 14}{2!} \\ \text{Then, } Pr(E) &= \frac{(64 \times 14)/2!}{\binom{64}{2}} = \frac{2}{9} \end{aligned}$$

Assuming that order does matter:

$$\begin{aligned} \text{Number of ways to place two rooks, } |\Omega| &= 64 \times 63 \\ \text{Number of ways to place two attacking rooks, } |E| &= 64 \times 14 \\ \text{Then, } Pr(E) &= \frac{64 \times 14}{64 \times 63} = \frac{2}{9} \end{aligned}$$

Both yield the same probability.

(9)

$$\begin{aligned} \text{Sample Space, } \Omega &= \{S, O\}^9 \\ \text{Number of ways to achieve 9-tuple strings, } |\Omega| &= 2^9 \\ \text{Number of ways to spell SOS, } |E| &= 1 \\ \text{Then, } Pr(E) &= \frac{1}{2^9} = \frac{1}{512} \end{aligned}$$

(10) First, compute the probability of rolling each face of the die:

$$\begin{aligned} p + 2p + 3p + 4p + 5p + 6p &= 1 \\ p &= 1/21 \end{aligned}$$

So, Pr(Rolling 1) = 1/21, Pr(Rolling 2) = 2/21, etc. Then, sum the probabilities of the events of interest:

$$\begin{aligned}\text{Pr(Even)} &= \text{Pr(Rolling 2)} + \text{Pr(Rolling 4)} + \text{Pr(Rolling 6)} \\ &= 2/21 + 4/21 + 6/21 = 4/7\end{aligned}$$

(11)

$$\begin{aligned}\text{Number of ways for 5 people to line up, } |\Omega| &= 5! \\ \text{Number of ways for 5 people to line up in correct order, } |E| &= 1 \\ \text{Then, } Pr(E) &= \frac{1}{5!} = \frac{1}{120}\end{aligned}$$

(12)

$$\begin{aligned}\text{Number of ways for 5 people to get off at 5 floors, } |\Omega| &= 5^5 \\ \text{Number of ways for 5 people to all get off at different floors, } |E| &= 5! \\ \text{Then, } Pr(E) &= \frac{5!}{5^5} = \frac{24}{625}\end{aligned}$$

(13)

$$\begin{aligned}\text{Part a: Number of ways to deal first two cards, } |\Omega| &= 52 \times 51 \\ \text{Number of ways that first two cards have same suit, } |E| &= 52 \times 12 \\ \text{Then, } Pr(E) &= \frac{52 \times 12}{52 \times 51} = \frac{4}{17} \\ \text{Part b: Number of ways to deal 13 cards, } |\Omega| &= \binom{52}{13} \\ \text{Number of ways for 13-card hand to all have same suit, } |E| &= 4 \\ \text{Then, } Pr(E) &= \frac{4}{\binom{52}{13}}\end{aligned}$$

(14)

$$\begin{aligned}\text{Number of ways to choose 10 apples, } |\Omega| &= \binom{100}{10} \\ \text{Number of ways 10 apples to be good, } |E| &= \binom{90}{10} \\ \text{Then, } Pr(E) &= \frac{\binom{90}{10}}{\binom{100}{10}}\end{aligned}$$

(15)

$$\begin{aligned}
\text{Number of ways to schedule jobs, } |\Omega| &= 3^n \\
\text{Part a: Number of ways to schedule all jobs with one processor, } |E| &= 3 \\
\text{Then, } Pr(E) &= \frac{3}{3^n} = \frac{1}{3^{n-1}} \\
\text{Part b: Number of ways to schedule all jobs with exactly one processor, } |E| &= \binom{3}{2}(2^n - 2) \\
\text{Then, } Pr(E) &= \frac{\binom{3}{2}(2^n - 2)}{3^n} = \frac{2^n - 2}{3^{n-1}}
\end{aligned}$$

In part b, it is easier to compute the number of ways to schedule exactly two jobs, which is $2^n\binom{3}{2}$. However, this also includes two cases in which only one of the two processors are scheduled for all jobs, which we must subtract.