1. (a) \([p \lor q] \Rightarrow r ⇔ [\sim (p \land q) \lor r] ⇔ [(\sim p \land \sim q) \lor r] ⇔ [(\sim p \lor r) \land (\sim q \lor r)] \Rightarrow [(p \Rightarrow r) \land (q \Rightarrow r)]\]

(b) Case 1, \(n\) is even: Write \(n = 2k\), for some integer \(k\). Then \(n^2 + 3n + 8 = (2k)^2 + 3(2k) + 8 = 4k^2 + 6k + 8 = 2(2k^2 + 3k + 4)\), which is even.

Case 2, \(n\) is odd: Write \(n = 2k+1\), for some integer \(k\). Then \(n^2 + 3n + 8 = (2k+1)^2 + 3(2k+1) + 8 = 4k^2 + 4k + 1 + 6k + 3 + 8 = 4k^2 + 10k + 12 = 2(2k^2 + 5k + 6)\), which is even.

2. (a) \([p \Rightarrow (q \lor r)] ⇔ [\sim p \lor (q \land r)] ⇔ [(\sim p \land q) \lor r] ⇔ [(\sim p \lor q) \land r]

(b) Suppose \(x/(x - 1) \leq 2\). If \(x < 1\), we are done. If \(x = 1\), then \(x/(x - 1)\) is not defined, so we suppose that \(x > 1\) and show that \(x \geq 2\). Since \(x > 1\), we have \(x - 1 > 0\) and hence \(x \leq 2(x - 1)\), which implies \(2 \leq 2x - x = x\).

3. We prove the statement by assuming \(x\) is irrational, but \(\sqrt{x}\) is rational. In other words, \(\sqrt{x}\) can be expressed as \(\sqrt{x} = \frac{p}{q}\) for some \(p, q \in \mathbb{Z}\). Then \(x^2 = \frac{p^2}{q^2}\), and \(p^2, q^2 \in \mathbb{Z}\), so \(x\) is rational, a contradiction. We have shown that if \(x\) is irrational, then \(\sqrt{x}\) is irrational, as well.

4. (a) \(A \cap B = \{4, 6\}\)
(b) \(A \cup B = \{2, 3, 4, 5, 6, 8\}\)
(c) \(A - B = \{2, 8\}\)
(d) \(B \cap C = \{4, 5\}\)
(e) \(B - C = \{3, 6\}\)
(f) \((B \cup C) - A = \{3, 5\}\)
(g) \((A \cap C) - B = \emptyset\)
(h) \(C - (A \cup B) = \emptyset\)
(i) \(D^c = \{1, 3, 5, 7, \ldots\}\)
(j) \((D - A)^c = \{2, 4, 6, 8\} \cup \{1, 3, 5, 7, \ldots\}\)
(k) \((B \cap D)^c = \{1, 2, 3, 5\} \cup \{7, 8, 9, \ldots\}\)
(l) \(B^c \cup D^c = \{1, 2, 3, 5\} \cup \{7, 8, 9, \ldots\}\)

5. (proofs not included here)
(a) \(\cup B = (0, \infty)\), \(\cap B = \emptyset\).
(b) \(\cup B = [0, \infty)\), \(\cap B = \{0\}\).
(c) \(\cup B = (-1, 5]\), \(\cap B = \{2, 3\}\).