1. (a) You can’t have fries and you can’t have salad. (The original was of the form “fries \lor salad.”)
   (b) You don’t like pizza but/and you’re not crazy.
   (c) Sometimes when it rains, my basement does not flood. (The original was of the form “\forall \text{rain}, \text{house floods.”})

2. (a) If you’re crazy, you don’t like pizza.
   (b) If it’s not a mammal, then it’s not a cat. (OR Non-mammals are not cats.)

3. (a) \forall \text{squares } S, S \text{ is a polygon.}
   (b) \forall x \geq y, x^2 \geq y^2.
   (c) \exists x \in \mathbb{R}, x^2 < x. (OR \exists \text{real number } x, x^2 < x.)

4. (a) \( (p \lor q) \land r \) (hypothesis and not conclusion), which is \( (p \land r) \lor (q \land r) \)
   (b) \exists x \in \mathbb{Q}, \exists y \in \mathbb{Z}, x > y (only the quantifier changes in the “quantifier phrase” part.
   (c) \forall a \in \mathbb{R}, a \leq 0 \text{ or } a^2 \geq a

5. Method 1: truth table
   \[
   \begin{array}{cccccccc}
   p & q & p \lor q & \neg p & \neg p \to q & (p \lor q) \land (\neg p \to q) & \neg q & p \to \neg q \\
   t & t & t & f & t & t & f & f \\
   t & f & t & f & t & t & t & t \\
   f & t & t & t & t & t & f & t \\
   f & f & f & t & f & f & f & t \\
   \end{array}
   \]

   \((p \lor q) \land (\neg p \to q)\) is not logically equivalent to \(p \to \neg q\) because their columns in the truth table are not identical.

   Method 2: algebra
   \[
   (p \lor q) \land (\neg p \to q) \iff (p \lor q) \land (p \lor q) \text{ (implication is “not hypoth, or concl”)}
   \iff (p \lor q) \text{ (“idempotence”)}
   \]
   yet \(p \to \neg q \iff \neg p \lor \neg q\), not the same.

6. \((p \to q) \lor \neg(p \land \neg q) \iff (p \to q) \lor (\neg p \lor q) \text{ (negate the “and”)}
   \iff (\neg p \lor q) \lor (\neg p \lor q) \text{ (implication is “not hypoth, or concl”)}
   \iff \neg p \lor q \text{ (“idempotence”)}

7. \(r \land u\) true means that both \(r\) and \(u\) must be true. So we get
   \[
   s \land (t \lor \neg r) \to \neg u \quad \text{“=} \quad \text{true} \land (\text{false} \lor \neg \text{true}) \to \neg \text{true}
   \quad \text{“=} \quad \text{true} \land (\text{false} \lor \text{false}) \to \text{false}
   \quad \text{“=} \quad \text{true} \land \text{false} \to \text{false}
   \quad \text{“=} \quad \text{false} \to \text{false, which is true.}
8. (a) true – \(0 = -2 + 2\), a sum of integers whose squares are equal.
   (b) true – \(4 = 2 + 2\), a sum of integers whose squares are equal.
   (c) false – if \(x^2 = y^2\), \(x\) must equal \(\pm y\), so that \(x + y = 0\) or \(2y\), making \(y = 1/2\), not an integer.
   (d) true – the empty set is a subset of every set, so it’s a member of every power set.
   (e) true – the empty set is a subset of every set.
   (f) false – a subset’s elements always belong to the “bigger” set, but the element 1 by itself does not belong to \(\mathcal{P}\{1\}\).

9. (a) \((A \cup C) \cap \mathcal{B} = \{6, 7, 9\} \cap \mathcal{B} = \{6, 7, 9\} \cap \{6, 8\} = \{6\}\)
   (b) \(C \setminus B = \{6, \emptyset\} = \{6\}\)
   (c) \(C \times B = \{(6, 5), (6, 7), (6, 9), (7, 5), (7, 7), (7, 9)\}\)

10.

11. (a) \(A_3 = \{-1, 1, 3\}, A_4 = \{-1, 1, 4\}, \text{ and } A_5 = \{-1, 1, 5\}\), so \(\cap_{i=3}^5 A_i = \{-1, 1\}\)
    (b) \(\cup_{i=3}^5 A_i = \{-1, 1, 3, 4, 5\}\)
    (c) \(\cap_I A_i = \{-1, 1\}\)

12. (a) \(\cup_I A_i = \mathbb{R} = (\infty, \infty)\)
    (b) \(\cap_I A_i = \{0\}\)