Part I: Propositional Logic.

1. Propositions and truth tables

   4.1, 4.2, 4.3, 4.4, 4.20, 4.21, 4.22

2. Conditional statements

   4.6, 4.7, 4.8, 4.9

3. Propositional functions

   4.15, 4.16, 4.17, 4.18, 4.19, 4.25, 4.28

Part II: Proof techniques.

1. Prove that the product of two odd numbers is odd.
2. Prove that if n is perfect square, then $n+2$ is not a perfect square[1]
3. Prove that if n is an integer and $3n+2$ is even, then n is even by using
   (a) a proof by contraposition.
   (b) a proof by contradiction.
4. Prove that if n is a positive integer, then n is even if and only if $7n+4$ is even.
5. For a positive integer n, let $P(n)$ be the statement that

$$1^3 + 2^3 + \cdots + n^3 = \left(\frac{n(n+1)}{2}\right)^2.$$

   (a) What is the statement $P(1)$?
   (b) Show that $P(1)$ is true (completing the basis step of the proof by mathematical induction).
   (c) What is the inductive hypothesis?
   (d) What do you need to prove in the inductive step?
   (e) Complete the inductive step.
   (f) Explain why these steps show that the statement $P(n)$ is true whenever n is a positive integer.
6. Prove that whenever n is a nonnegative integer,

$$2 - 2\cdot 7 + 2\cdot 7^2 - \cdots + 2(-7)^n = \frac{1-(-7)^{n+1}}{4}$$

7. The harmonic numbers H_j are defined by

$$H_j = 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{j} \quad \text{for } j = 1, 2, 3, \ldots.$$

   Show that

$$H_{2^n} \geq 1 + \frac{n}{2}$$

   whenever n is a nonnegative integer.
8. (a) Find a formula for

$$\frac{1}{1\cdot 2} + \frac{1}{2\cdot 3} + \cdots + \frac{1}{n(n+1)}$$

   by examining the formula of this expression for small values of n.
   (b) Proof the formula you conjectured in part (a).

[1] An integer n is a perfect squares if there is an integer m such that $n = m^2$.