1. Functions (9 points)

(1) (3 points) Exercise 10 (page 153).
(2) (2 points) Exercise 22 a,b (page 153).
(3) (1 point) Find $f \circ g$ and $g \circ f$ where $f, g : \mathbb{R} \to \mathbb{R}$ with $f(x) = 3x + 4$ and $g(x) = x^2$.
(4) (3 points) Give an example of a function from $\mathbb{N}$ to $\mathbb{N}$ that is:
   (a) one-to-one but not onto
   (b) onto but not one-to-one
   (c) neither one-to-one nor onto

2. Sequences and Summations (7 points)

(1) (2 points) Exercise 4 a,c (page 167).
(2) (2 points) Use index substitution to rewrite the following summation such that the index starts at 0. Then use the geometric series theorem to compute the value of the summation.

$$\sum_{i=2}^{10} \left(\frac{1}{3}\right)^{i-2}$$

(3) (3 points) For each of the sequences below, find a formula that generates the sequence.
   (a) 6, 10, 14, 18, 22, 26, 30, . . .
   (b) 5, 15, 45, 135, 405, . . .
   (c) 3, 6, 11, 18, 27, 38, 51, . . .

3. Growth of Functions (10 points)

(1) (3 points) Exercise 2 b,c,e (page 216).
(2) (2 points) Use the definition of $\Theta$ to show that $5n^5 + 4n^4 + 3n^3 + 2n^2 + n \in \Theta(n^5)$.
(3) (2 points) Use the definition of $\Theta$ to show that $2n^2 - n + 3 \in \Theta(n^2)$.
(4) (3 points) Let $f, g, h : \mathbb{N} \to \mathbb{R}^+$. Use the definition of big-Oh to prove that if $f(n) \in O(g(n))$ and if $g(n) \in O(h(n))$ then $f(n) \in O(h(n))$. You should use different letters for the constants (i.e. don’t use $c$ to denote the constant for each big-Oh).