MA161 Semester 1, Calculus: Problem Sheet 1

1. Let $S = \{\diamondsuit, \clubsuit, \heartsuit, \spadesuit\}$. Which of the following are subsets of S? Justify your answer.
   (a) $T_1 = \{\diamondsuit, \heartsuit\}$
   (b) $T_2 = \{\clubsuit, \bullet, \heartsuit\}$
   (c) $T_3 = \{\diamondsuit, \heartsuit, \clubsuit, \spadesuit\}$
   (d) $T_4 = \heartsuit$
2. Which of the following are subsets of $\mathbb{Q}$? Justify your answer.
   (a) $T_1 = \{1, 2, 3\}$
   (b) $T_2 = \left\{-1, \frac{1}{10}, \pi, -\frac{17}{4}, 88\right\}$
   (c) $T_3 = \left\{-11, 15.25, 3\frac{3}{5}\right\}$
   (d) $T_4 = \{1000000000\}$
   (e) $T_5 = (0, 1)$
   (f) $T_6 = |-1234|$
3. Solve the following inequalities.
   (a) $x^2 < 9$
   (b) $x^2 - 2x - 35 \geqslant 0$
   (c) $x^2 + 2x - 3 < 0$
   (d) $|x| - 6 \geqslant 0$
   (e) $|3 - 4x| \leqslant 19$
   (f) $|2x - 1| - 1 > 4$
4. For each of the following functions, determine the largest possible domain and range as subsets of $\mathbb{R}$.
   (a) $f(x) = 2x$
   (b) $f(x) = -x^2$
   (c) $f(x) = -x^2 - 3$
   (d) $f(x) = -(x-3)^2$
   (e) $f(x) = -10$
   (f) $f(x) = \sqrt{x-5}$
   (g) $f(x) = \sqrt{x} + 5$