1. The relation $f$ is defined by $f(x) = \begin{cases} x^2, & 0 \leq x \leq 3 \\ 3x, & 3 \leq x \leq 10 \end{cases}$

The relation $g$ is defined by $g(x) = \begin{cases} x^2, & 0 \leq x \leq 2 \\ 3x, & 2 \leq x \leq 10 \end{cases}$

Show that $f$ is a function and $g$ is not a function.

2. If $f(x) = x^2$, find $\frac{f(1.1) - f(1)}{(1.1 - 1)}$.

3. Find the domain of the function $f(x) = \frac{x^2 + 2x + 1}{x^2 - 8x + 12}$.

4. Find the domain and the range of the real function $f$ defined by $f(x) = \sqrt{x - 1}$.

5. Find the domain and the range of the real function $f$ defined by $f(x) = |x - 1|$.

6. Let $f = \left\{ \left( x, \frac{x^2}{1 + x^2} \right): x \in \mathbb{R} \right\}$ be a function from $\mathbb{R}$ into $\mathbb{R}$. Determine the range of $f$.

7. Let $f, g : \mathbb{R} \rightarrow \mathbb{R}$ be defined, respectively by $f(x) = x + 1$, $g(x) = 2x - 3$. Find $f + g$, $f - g$ and $\frac{f}{g}$.

8. Let $f = \{(1,1), (2,3), (0,-1), (-1, -3)\}$ be a function from $\mathbb{Z}$ to $\mathbb{Z}$ defined by $f(x) = ax + b$, for some integers $a, b$. Determine $a, b$.

9. Let $R$ be a relation from $\mathbb{N}$ to $\mathbb{N}$ defined by $R = \{(a, b) : a, b \in \mathbb{N} \text{ and } a = b^2 \}$. Are the following true?
   (i) $(a,a) \in R$, for all $a \in \mathbb{N}$
   (ii) $(a,b) \in R$, implies $(b,a) \in R$
   (iii) $(a,b) \in R$, $(b,c) \in R$ implies $(a,c) \in R$.

Justify your answer in each case.

10. Let $A = \{1,2,3,4\}$, $B = \{1,5,9,11,15,16\}$ and $f = \{(1,5), (2,9), (3,1), (4,5), (2,11)\}$. Are the following true?
    (i) $f$ is a relation from $A$ to $B$
    (ii) $f$ is a function from $A$ to $B$.
    Justify your answer in each case.