# MS115 Mathematics for Enterprise Computing
Tutorial Sheet 4

1. For each of the following relations on $\mathbb{Z}$, determine whether the relation is
   (a) reflexive, (b) symmetric, (c) transitive.

   (i) xRy exactly when $x + y$ is an odd integer.

   (ii) xRy exactly when $x + y$ is an even integer.

2. Let n be a fixed positive integer. Consider the relation R on $\mathbb{Z}$ defined by
   xRy exactly when $x - y$ is divisible by n.

   (i) Prove that R is an equivalence relation on $\mathbb{Z}$.

   (ii) Express the relation xRy in terms of x and y sharing a common
   property.

   (iii) Determine the number of equivalence classes in the associated parti-
   tion of $\mathbb{Z}$.

3. The *graph* of a function f is a graphical representation of all ordered pairs
   $(x, f(x))$ for x an element of the domain of f.

   Consider the following graphs of two functions f and g:
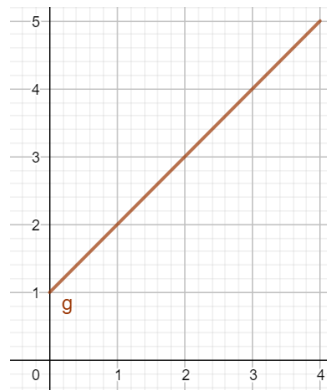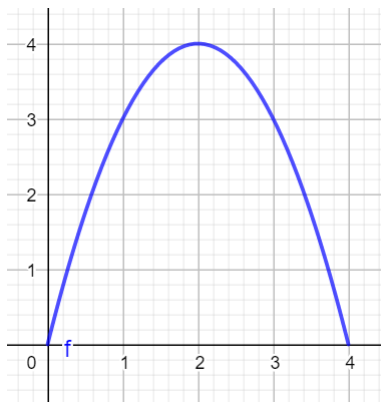
   (i) Determine the domain and range of f.

   (ii) Determine the domain and range of g.

   (iii) Justifying your answer, determine whether f is invertible.

   (iv) Justifying your answer, determine whether g is invertible.

4. Consider the function $f : \mathbb{R} \to \mathbb{R}$ given by $f(x) = 2x - 1$ and the function
   $g : \mathbb{R} \to \mathbb{R}$ given by $g(x) = 3x + 3$.

   (i) Determine the output of the function $g \circ f$.

   (ii) Determine the output of the function $f \circ g$.