# Tutorial Sheet 10
# (Defining Relations)

1. a) List all the ordered pairs in the relation $R = \{(a, b) \mid a \text{ divides } b\}$ on the set $\{1, 2, 3, 4, 5, 6\}$.
   b) Display this relation graphically.
   c) Display this relation in tabular form.

2. Let $R_1 = \{(1, 2), (2, 3), (3, 4)\}$ and $R_2 = \{(1, 1), (1, 2), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3), (3, 4)\}$ be relations from $\{1, 2, 3\}$ to $\{1, 2, 3, 4\}$. Find
   a) $R_1 \cup R_2$.
   b) $R_1 \cap R_2$.
   c) $R_1 \setminus R_2$.
   d) $R_2 \setminus R_1$.

3. Represent each of the following relations on $\{1, 2, 3\}$ with a matrix (with the elements of this set listed in increasing order).
   a) $\{(1, 1), (1, 2), (1, 3)\}$
   b) $\{(1, 2), (2, 1), (2, 2), (3, 3)\}$
   c) $\{(1, 1), (1, 2), (1, 3), (2, 2), (2, 3), (3, 3)\}$
   d) $\{(1, 3), (3, 1)\}$

4. List the ordered pairs in the relations on $\{1, 2, 3\}$ corresponding to the following matrices (where the rows and columns correspond to the integers listed in increasing order).

   a) $$M_R = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}$$

   b) $$M_R = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{pmatrix}$$

   c) $$M_R = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$