1. Consider the relation $R$ on $\{a,b,c\}$ where $R = \{(a,a),(b,b),(c,c),(a,b),(a,c),(c,b)\}$. Determine whether the binary relation is: (1) reflexive, (2) symmetric, (3) antisymmetric, (4) transitive. In each case explain why.

2. Suppose $R$ and $S$ are relations on $\{a,b,c,d\}$, where $R = \{(a,b),(a,d),(b,c),(c,c),(d,a)\}$ and $S = \{(a,c),(b,d),(d,a)\}$. Construct $S \circ R$.

3. Draw the directed graph for the relation defined by the matrix

$$
\begin{bmatrix}
1 & 0 & 1 & 0 \\
1 & 1 & 0 & 1 \\
1 & 1 & 1 & 0 \\
1 & 1 & 0 & 1
\end{bmatrix}
$$

4. Draw the Hasse diagram for the relation $R$ on $A = \{2,3,4,6,10,12,16\}$ where $aRb$ means $a \mid b$.

5. Suppose that $R$ and $S$ are equivalence relations on a set $A$. Prove that the relation $R \cap S$ is also an equivalence relation on $A$. 