Q1: Write programs with these input and output.

(i) Given the matrix representing a relation on a finite set, determine whether the relation is transitive.

(ii) Given the matrix representing a relation on a finite set, determine whether the relation is symmetric and/or antisymmetric.

Q2: Consider the relation $R = \{(1, 3), (1, 4), (3, 2), (3, 3), (3, 4)\}$ on $A = \{1, 2, 3, 4\}$.
(a) Find the matrix representation of $R$. (d) Draw the directed graph of $R$.
(b) Find the domain and range of $R$. (e) Find the composition relation $R \circ R$.
(c) Find $R^{-1}$. (f) Find $R \circ R^{-1}$ and $R^{-1} \circ R$.

Q3: Let $R$ and $S$ be the following relations on $B = \{a, b, c, d\}$:
$R = \{(a, a), (a, c), (c, b), (c, d), (d, b)\}$ and $S = \{(b, a), (c, c), (c, d), (d, a)\}$
Find the following composition relations: (a) $R \circ S$; (b) $S \circ R$; (c) $R \circ R$; (d) $S \circ S$.

Q4: Construct a relation on the set $\{a, b, c, d\}$ that is
a) reflexive, symmetric, but not transitive.
b) irreflexive, symmetric, and transitive.
c) irreflexive, antisymmetric, and not transitive.
d) reflexive, neither symmetric nor antisymmetric, and transitive.
e) neither reflexive, irreflexive, symmetric, antisymmetric, nor transitive.

Q5: Let $S$ be the set of subroutines of a computer program.
a) Define the relation $R$ by P$R$ Q if subroutine P calls subroutine Q during its execution. Describe the transitive closure of $R$.
b) For which subroutines P does (P, P) belong to the transitive closure of $R$?
c) Describe the reflexive closure of the transitive closure of $R$.

Q6. Determine which of the following statements are true and which are false, and prove your answer

A. If there is a bijection from the set A to the set B and from the set C to the set D, then there is a bijection between AC and BD.

B. There exists a one-to-one function $f : Z \times Z \to Z$.

C. For any three sets A, B, and C, $(A \cup B) \times C = (A \times C) \cup (B \times C)$.

D. The power set of N is countable

Q7. Determine whether each of the following sets is countable or uncountable.
A={x∈Q|−100≤x≤100}
B={(x,y)|x∈N,y∈Z}
C=(0,0.1]
D={1n|n∈N}

8. In a survey of 120 people, it was found that:
65 read *Newsweek* magazine, 20 read both *Newsweek* and *Time*, 45 read *Time*, 25 read both *Newsweek* and *Fortune*, 42 read *Fortune*, 15 read both *Time* and *Fortune*, 8 read all three magazines.
($a$) Find the number of people who read at least one of the three magazines.
($b$) Fill in the correct number of people in each of the eight regions of the Venn diagram in Fig. where $N$, $T$, and $F$ denote the set of people who read *Newsweek*, *Time*, and *Fortune*, respectively.
($c$) Find the number of people who read exactly one magazine.

9. *Prove that the function* $f\colon \mathbb{N} \to \mathbb{N}$ *be defined by* $f(n) = n^2$ *is injective.*

10. *Prove that the function* $g\colon \mathbb{N} \to \mathbb{N}$, *defined by* $g(n) = \lfloor n/3 \rfloor$, *is surjective.*

11. *Prove that the function* $g\colon \mathbb{N} \to \mathbb{N}$, *defined by* $g(n) = \lfloor n/3 \rfloor$, *is not injective.*

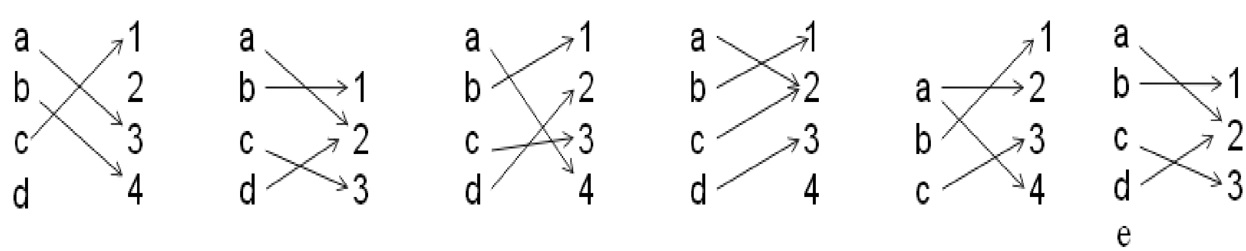
12. *Find the inverse of the function* $f\colon \mathbb{R} - \{-2\} \to \mathbb{R} - \{1\}$ *defined by* $f(x) = \dfrac{x-1}{x+2}$.

13. *Find the inverse of the function* $f\colon \mathbb{R} \to (-\infty, 1)$ *defined by* $f(x) = 1 - e^{-x}$.

14. *Prove that the composition of two injective functions is injective.*

15. *Prove the composition of two surjections is a surjection.*

16. Categorize the following relations into types of function it represents. Identify relations which are not functions.



17. Find formulae for the sequences with the following first five terms

(a). 1, 1/2, 1/4, 1/8, 1/16

(b). 1, 3, 5, 7, 9

(c). 1, -1, 1, -1, 1

18. What is the value of the double summation $\sum_{i=1}^{m}\sum_{j=1}^{n} ij$ ?

**for some positive integer constant m,n >0.**

**Write a function in c++ to solve this problem. Identify the domain, codomain and range you have defined for your function in c++.**