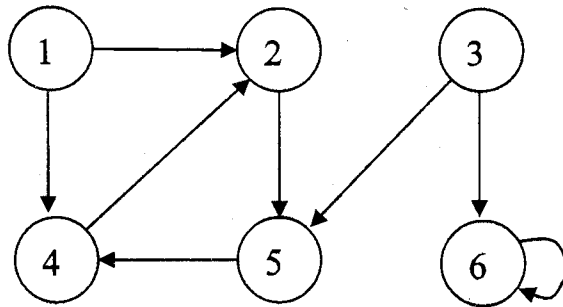


※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、Data Structures (50%)

1. (10%) Is an array that is in sorted order a min-heap?
2. (10%) What are the minimum and maximum numbers of elements in a heap of height h .
3. (20%) Give an algorithm that determines whether or not a given undirected graph $G = (V, E)$ contains a cycle. Your algorithm should run in $O(V)$ time, independent of $|E|$.
4. (10%) Represent the following directed graph by using the adjacency-list and adjacency-matrix.



二、Algorithms (50%)

5. (10%) Solving the recurrence $T(n) = 9T(\frac{n}{3}) + n$ using Θ notation.
6. (10%) Express the function $\frac{n^3}{1000} - 90n^2 - 870n + 88$ in terms of Θ -notation.
7. (10%) Describe a linear time topological sorting algorithm for a directed acyclic graph.
8. (10%) Is $2^{2n} = O(2^n)$?
9. (10%) Describe a $\Theta(n \lg n)$ -time algorithm that, given a set S of n integers and another integer x , determine whether or not there exist two elements in S whose sum is exactly x .