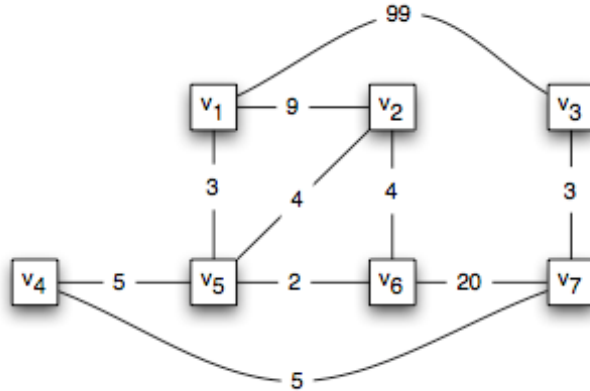


### Questions

1) Consider the following undirected graph where the value of each edge represents the length of that edge: (30 points)



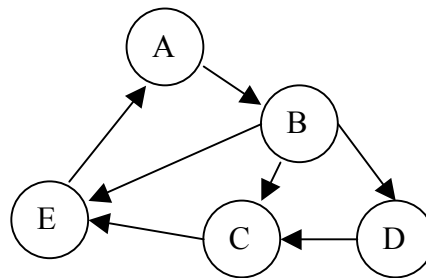
- What is the total length of the shortest path between  $v_1$  and  $v_3$ ?
- What is the total length of the edges in a minimum spanning tree?

**Problem 2: Graphs (25 points)**

- a. [10 points] A graph is called “fully connected” if each of its nodes is connected to every node of the graph. Assume that its edges are not directed.

If the number of nodes of such “fully connected” graph is  $V$ , then what will be the number of its edges?

- b. [15 points] Given the following directed graph and topological sort algorithm, try to apply the algorithm and explain your answer.



TOPOLOGICAL-SORT( $G$ )

- 0 call Depth First Search with  $G$  to compute finishing times for each vertex  $v$
- 1 as each vertex is finished, insert it into the front of a linked list.
- 2 return the linked list of vertices.

**Problem 3: Hashing (25 points)**

Give the keys 39, 0, 1, 28, 24, 20, 11 and 13; insert keys (according to the given order) into an initially empty 13-item hash table using hash function  $h(k) = k \bmod 13$  where  $k$  represents a key. Show the content of hash table after insertion, assuming collisions are handled by

a) [10 points] Linear probing

b) [10 points] Double hashing where the secondary hash function is  $h'(k) = 1 + (k \bmod 11)$