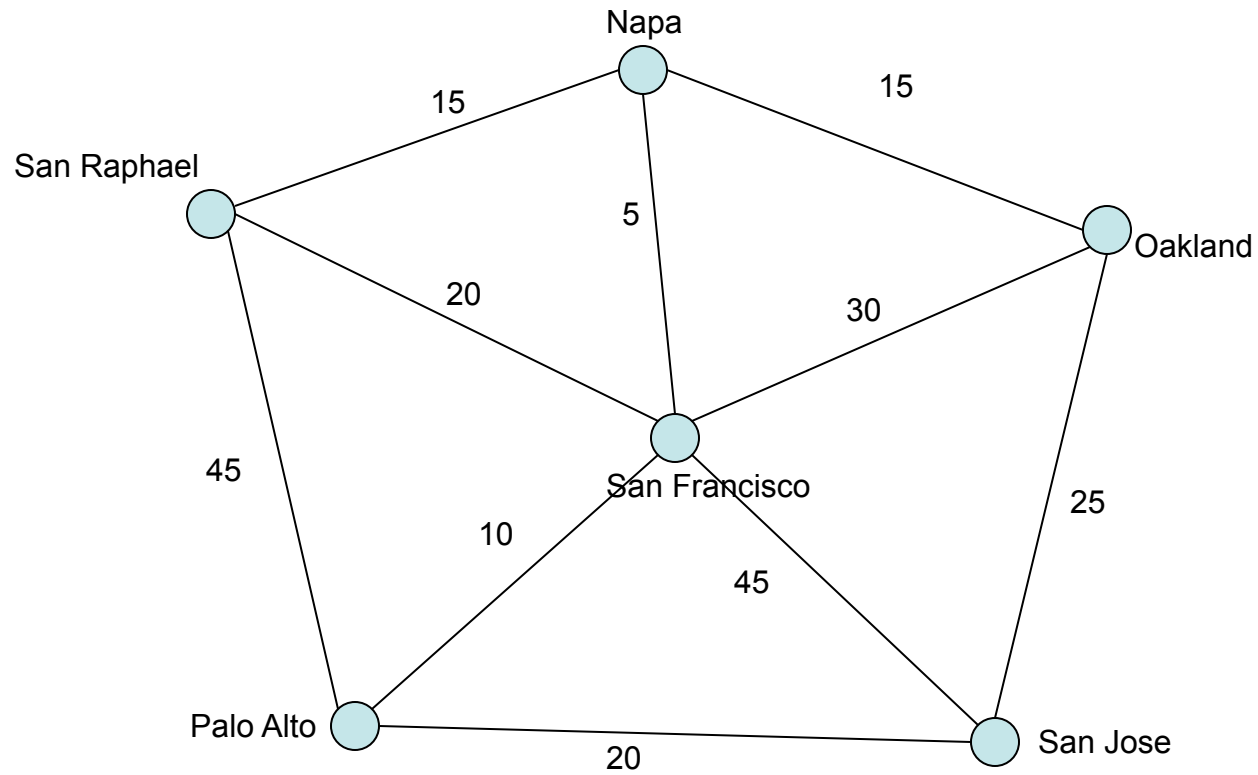


**Problem 1: Shortest Path Problem.**

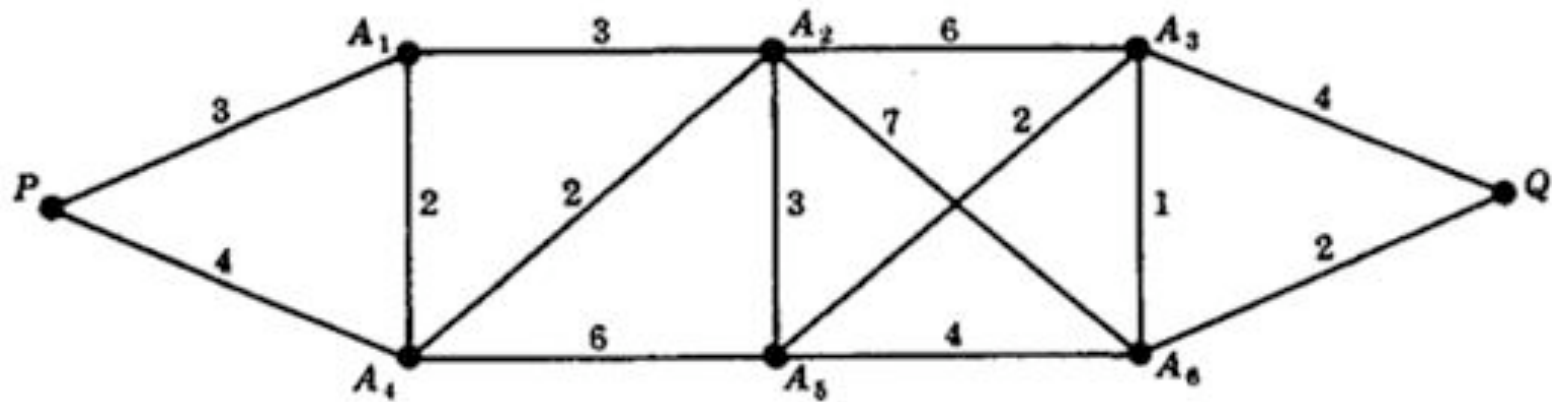
The graph below shows roads and the driving distances (in minutes) between different cities. What is the fastest route from Napa to San Jose? How long is it (in minutes)?



**Problem 2: Another Shortest Path Problem.**

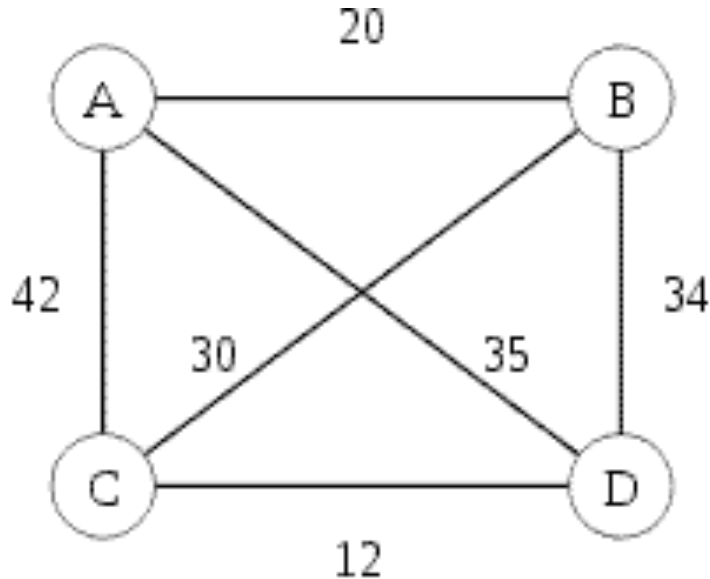
The graph below shows walkways and the walking distances (in minutes) between different school buildings. Find a fastest path to get from building P to building Q? How long is it?

How many different fastest paths from P to Q are there?



**Problem 3: Traveling Salesman Problem.**

A *Hamiltonian cycle* in a graph is a path that visits each node exactly once and then finishes at the starting node. For example, in the graph below, the path  $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$  is a Hamiltonian cycle.



A salesman/tourist has a list of cities that he/she must visit. There is a "cost" (e.g., mileage) to travel between cities. Find the "cheapest" Hamiltonian cycle (i.e., a route that visits every city exactly once, and returns to the starting city) in the above graph.

- (a) use A as the starting city.
- (b) use B as the starting city.
- (b) use C as the starting city.
- (b) use D as the starting city.