# Answer of 1

TSP is NP-Complete if:

1. TSP is in NP
2. TSP is NP-hard

**1. TSP is in NP:**

* TSP is in NP because, given a proposed tour and its cost, we can verify in polynomial time if it visits each city exactly once and the total cost is ≤ D.

**2. Reduction from Hamiltonian Cycle (HC) to TSP:**

* **Hamiltonian Cycle (HC)**: Given a graph G, determine if there is a cycle that visits each vertex exactly once.
* **Reduction**: Given a graph G with n vertices, create an equivalent TSP instance:
  + Each vertex is a city.
  + If (u,v) is an edge in G, set distance d(u,v)=1; otherwise, set d(u,v)=n+1.
  + Set the target distance D= n.
* A Hamiltonian Cycle in G corresponds to a TSP tour of length n, and vice versa.

**3. Conclusion:**

* TSP is in NP, and HC reduces to TSP in polynomial time, so TSP is NP-complete.

# Answer of 2

1. False.
2. False. Reducibility is not symmetric.
3. True. If NP-complete can be solved using polynomial time, then all NP-complete problems can be solved in polynomial time. Thus proving, P= NP.
4. False. We can only conclude B is NP-hard. B may not be in NP.

# Answer of 3

A piece of paper with writing on it

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A notebook with writing on it

Description automatically generated

# Answer of 4

A notebook with writing on it

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