1. In order to show that TSP is NP Complete we must first show that it is in NP and is NP Hard.

   To prove TSP is in NP:
   A polynomial time verifier for TSP would be

   Inputs: Graph G(V,E), integer k, Certificate: A tour of G:T

   ```
   If T does not contain all vertices:
       return false
   If sum of all edges in T < k:
       return true
   Else:
       return false
   ```

   The time taken for this is O(n+m) which is in polynomial time meaning it is in NP.

   To prove TSP is NP Hard we must show that we can reduce it to a known example of something which is NP Hard. We can use the Hamiltonion Cycle for this.

   The reduction:
   Assume a graph exists G(V,E)

   Create a new graph G' with |V| (= n) vertices which is the same graph but complete, meaning there are edges between each pair of vertices.

   For each pair of vertices G'(u,v):

   ```
   If (u,v) is an edge in G:
       set its cost to 0
   Else:
       Set its cost to 1
   Return G'(0)
   ```

   Now we will take O(n^2) because it is polynomial and prove that the reduction is correct.

   Assume G has a hamiltonian cycle K. K visits each vertex exactly once and K's edges have a cost of 0

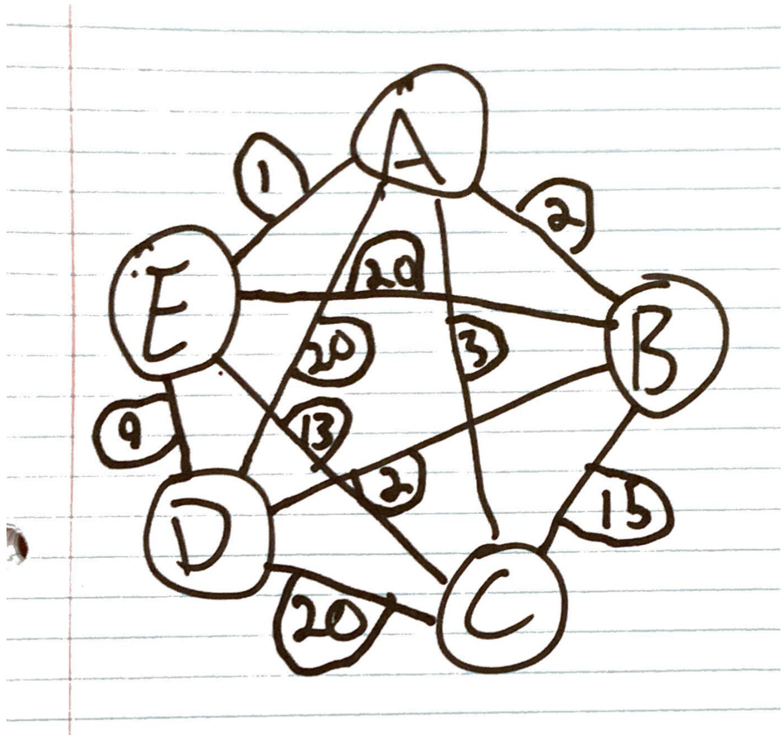
   K is a TSP solution of G' with cost of 0

   To prove: G' has a TSP solution with a cost of no more than 0
   Assume G' has a TSP solution with a cost of 0, say L, all edges in L have a cost of 0

   Edges in L are present in G, and T is a hamiltonian cycle of G

Therefore, the reduction is correct and TSP is NP Hard
This means that TSP is both in NP and NP Hard.

2. Problem 2
    a. Graph:



    b. The approximate solution would be A->E->D->B->C
    With a weight of 30
    c. The ration is 1.76(approx) or 30/17