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**1. Graded Problems**

* **[Question 1]**

1. Residual graph :

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Feasible flow #1: and flow = 2.

Feasible flow #2: and flow = 1.

1. **Max-flow is 3**.

Min-cut is [S, A, C] and [B, D, E, T]:

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Description automatically generated

* **[Question 2]**

Based on the description of the problem, we can create a bipartite graph which has one set of nodes (call “trader nodes”) of all traders as what is in the problem, and the other set is a set of nodes (call “currency nodes”) of currencies as what is in the problem. Then, we make this bipartite graph a circulation with demand by adding as the demand of each corresponding trader node *t*.

Diagram

Description automatically generated

If this circulation is feasible, then all traders are able to convert their currencies. In order to solve this, we can use a reduction to a maximum flow problem. We can reconstruct the bipartite graph to the graph below by using the method in the textbook:

Diagram

Description automatically generated

If there is a flow *f* in this network with , then all traders are able to convert their currencies.

*Proof.*

At the *Begin* node, we send total , units of flow. By passing edges , the requests of traders to convert money are satisfied. And when reach the *End* node, means the totally amount of money can be converted while complying the bank’s limitations of currencies (). If , that means all the money that were sent from *Begin* node have been converted.

* **[Question 3]**

Based on the description

* **[Question 4]**

We can use Reduction to a maximum flow problem. Let each edge *E* of *G* has capacity 1, and then add new vertices *S* and *T* and new edges such that new edges point to {} from the node *S*, and also have other new edges point to node *T* from {}, and all these edges also have capacity 1. Then, we can solve it by using algorithms such as Ford-Fulkerson algorithm, and if there is then there are feasible paths that satisfy the requirements in the problem.

* **[Question 5]**



Diagram

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1. No. The total demand is 12, but the max flow is 9. Thus, the circulation is not feasible.

* **[Question 6]**

Based on the description

**2. Practice Problems**

* **[Question 1]**

Sort