**Q1: Maximum flow problem**



Based on the virtual link added from node 6 to node 1, solving this maximum flow problem using LP in GAMS, the results are shown as below.

x(1,2) = 5, x(1,3) = 10, x(2,4) = 3, x(2,5) = 2, x(3,4) = 5, x(3,5) = 5, x(4,6) = 8, x(5,6) = 7, x(6,1) = 15, z = 15.

That is the maximum flow in the given network is 15.

**Q2: Min-cost flow problem**

1. The decision variables are amount of gas distributed by each link.
2. Min

1. By formulating the problem above in the GAMS, the optimal solution was obtained.

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The calculation results mean that 500, 700, 100, 600 and 600 mcf gas are distributed by link 1, 2, 4, 5 and 6 respectively.

**Q3: Integer programming model**

1. By defining x as integer variables, we can obtain programming result directly from GAMS. When and , variable z reaches minimum value 22.
2. Using branch and bound method to manually solve the problem above, the branch tree is shown as below.



As can be seen from the graph, the results are consistent with the outcomes given by mixed integer programming solver.

**Q4: Warehouse location problem**

The problem can be formulated as below.

Min

By phrased this problem in GAMS, we can get the results as follow.

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It means that all three warehouses should open, while 70 and 30 goods are distributed from warehouse 1 to customer 1 and 2 respectively, 200 goods are distributed from warehouse 2 to customer 2, 100 and 150 goods are distributed from warehouse 3 to customer 3 and 4 respectively. In this way, minimum cost 3430 could be reached.