Problem D
Transmission Mission

Input file: *testdata.in*
Time Limit: 8 seconds

Problem Description

Practical Transmission Corporation (PTC) is a mysterious organization with agents on missions all over the world. Because security breaches have become increasingly common, the transmission of data is no longer guaranteed to be safe. Therefore, messages exchanged between agents have edged from relying on telecommunication networks to demanding face-to-face contact with other agents. However, it can be difficult to arrange for all agents to meet together, so a message is often passed on from one to another. The time required for agent A to deliver a message to agent B depends on (1) the capability of A for accurately locating B and (2) the time for effectively conveying the message. There is always a way for any two agents to communicate either directly or indirectly.

The organization can be broken down to 4 departments: the Intelligence (I) Department, the Research (R) Department, the Project Planning (P) Department, and the Execution (E) Department. Communication between different departments can be tricky and consequently requires additional time when compared to communication within same departments. Required time for contact between and within departments are listed in the table below:

(hours)	Intelligence	Research	Project Planning	Execution
Intelligence	1	5	3	10
Research	5	1	5	10
Project Planning	3	5	1	10
Execution	10	10	10	1

As part of an organization with a rigid hierarchy, PTCs agents are evaluated on the basis of their loyalty, capability, and achievement to qualify for

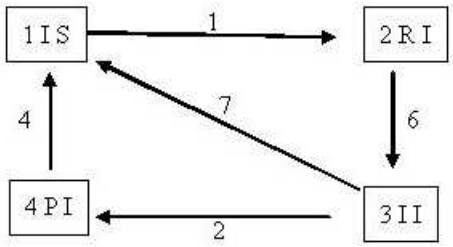

Figure 1: An example of a relation graph between agents.

one of three levels: Superior (S), Intermediate (I), and Apprentice (P). Intermediate and Superior agents are considerably reliable and complete missions within the shortest time, at 3 and 1 hour(s) respectively. Apprentice agents need 5 hours to complete a mission calls for the collaboration of all agents. Missions may also be sorted by urgency into 3 categories: S missions must be completed in 24 hours, A missions in 3 days, B missions in a week.

Figure 1 shows an example of a relation graph between agents. Each agent has a unique number, 1IS denotes the agent 1 is a Superior in Intelligence (I) Department. The weight on the arrow from 1IS to 2RI means agent 1 needs to take an hour to find agent 2.

If agent 1 issues a S mission which has to be completed by agent 3, then the command will have to pass agent 2 to give to agent 3 which takes 17 hours including communication time. Since agent 3 is at Intermediate level, he needs 3 hours to complete the mission. Since 20 hours is within a day, agent 3 can report back to agent 1 that the mission will be completed in time. Since it takes 8 hours for the message to reach agent 1, agent 1 will be able to know that the mission will be successful 25 hours after the mission is ordered. Your task is to help the agent who issue a mission knowing that the mission will be success or fail in the shortest time.

Technical Specifications

1. The number of test cases would be smaller than or equal to 10.
2. The number of agents M will satisfy $1 \leq M \leq 600$.

3. The number of missions Q will satisfy $1 \leq Q \leq 10$.

4. The time that each agent takes to find an agent he can contact to, is an integer no more than 100 (hours).

Input Format

The first line of the input file contains an integer indicating the number of test cases to follow. The first line of each test case contains two integers M and Q, separated by spaces indicating the number of agents and the number of missions respectively. Then it is followed by $M + Q$ lines. Line i $(1 \leq i \leq M)$ contains agent i's information which starts with agent number i, his department $D \in \{I, R, P, E\}$, his level $L \in \{S, I, P\}$, followed by the agent number he can reach and the time that will take. Each letter or number are separated by a space. For example, the first test case in "Sample Input" is the input of the example shown in Figure 1. From line $M+1$ to line $M+Q$, each line contains a letter and two integers indicate category, the issuer and the executor of the mission.

Output Format

For each test case, for each mission, output the shortest time (in hours) it takes for the mission issuer to know the result and the result of the mission (output YES if the mission can be success and NO otherwise) separated by a space. Also output "==========" in a line between each test case.

Sample Input

```
2
4 1
1 I S 2 1
2 R I 3 6
3 I I 4 2 1 7
4 P I 1 4
A 1 3
10 6
1 R S 2 8
2 I S 3 15 1 15
```

```
3 R I 4 14 2 12
4 E S 5 1 3 15
5 P S 6 2 4 4
6 I I 7 12 5 7
7 R S 8 9 6 9
8 P S 9 12 7 11
9 E I 10 10 8 2
10 R I 9 11
B 5 2
S 4 5
A 2 9
B 10 3
A 8 9
S 1 7
```

Sample Output

```
25 YES
==========
111 YES
25 YES
221 NO
225 YES
34 YES
190 NO
```