



Vaccination Centres

People from a region consisting of six main cities are in the process of getting vaccinated. Due to resource limitations, only two cities can be equipped with a vaccination centre. The map below shows the region and its cities, with the times needed to travel from one city to another (in hours). Not all cities are directly connected by roads.

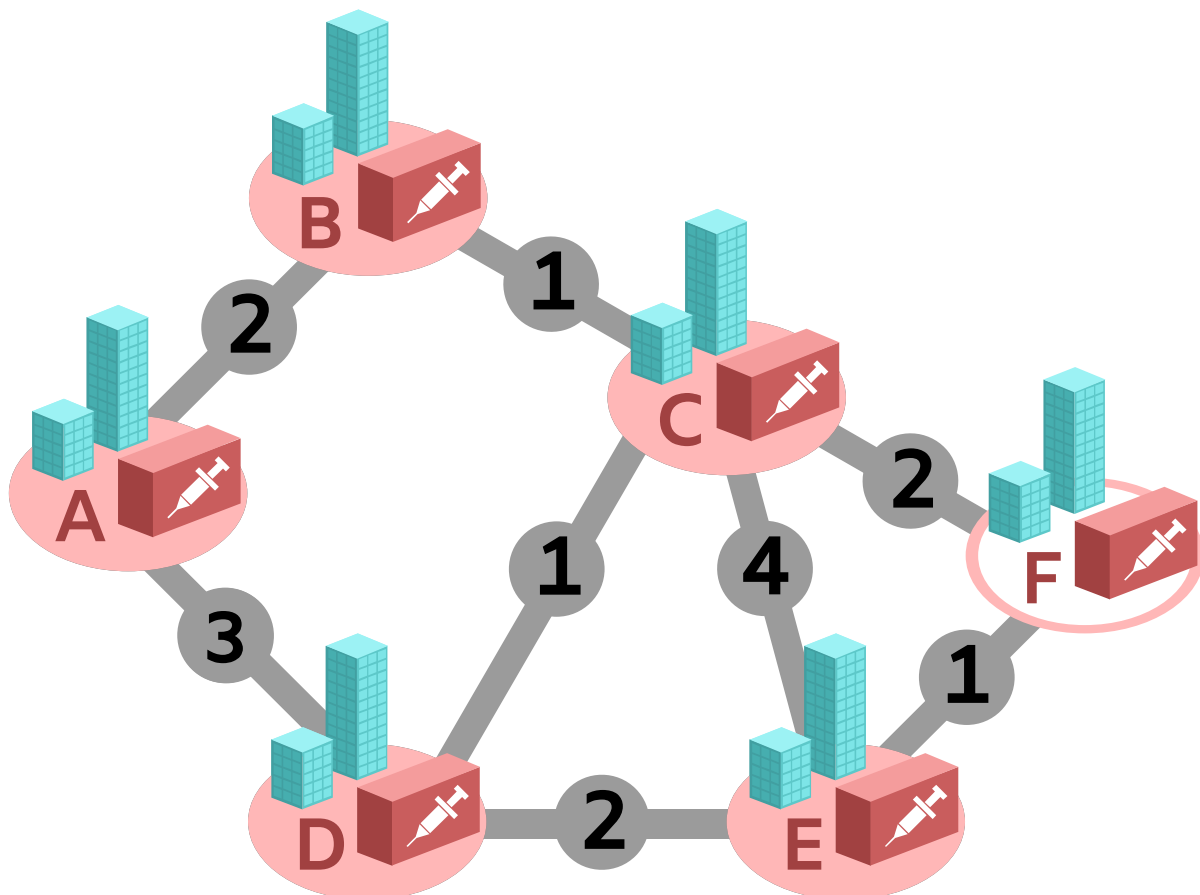
The cities where the two vaccination centres will be located should be chosen so that the time it takes everyone to reach them from their own cities is as short as possible.

This should apply to all cities - this avoids the situation of reducing the travel time for some cities but leaving other cities with long travel times.

Question

Given that one vaccination centre will be placed in the existing hospital in City F, where must the second one be placed?

Select the city to place the centre.





Vaccination Centres - cont'd

EXPLANATION

Answer

The correct answer is City B.

Explanation

Since one hospital is placed in City F, there are five possibilities to place the second one. For each possibility, we have to check the minimum time needed to go from every city to any vaccination centre. In the following table, the columns show each possible placement for the two vaccination centres and the rows show the number of hours needed to reach the closest vaccination centre.

Minimum time go from city...	Locations of vaccination centres				
	A and F	B and F	C and F	D and F	E and F
A	0	2	3	3	5
B	2	0	1	2	3
C	2	1	0	1	2
D	3	2	1	0	2
E	1	1	1	1	0
F	0	0	0	0	0
Max	3	2	3	3	5

The last row shows the largest number of hours needed to reach a vaccination centre. Therefore, placing the second one in City B is the best solution. People in each city would be able to reach a vaccination centre in no more than 2 hours.

BACKGROUND INFORMATION

This task is related to the vertex k -center problem which can be solved by using an algorithm designed by computer scientists. This type of problem can be represented as a graph - a set of nodes that can be connected together with links that have a weight (cities and roads with travel time in this task). The problem consists of choosing k nodes from the graph (2 in this task) so as to minimise the time/distance from any node of the graph to any of the k selected nodes.

Such a problem is very common when trying to choose where to place facilities such as fire stations, schools, police stations, etc. (or hospitals in this task). The criterion that has to be minimised can be the time needed to reach the facilities, the distance to be travelled, or any other criterion that is available.