

# Story of Seasons

## Problem

You are a super farmer with some vegetable seeds and an infinitely large farm. In fact, not only are you a farmer, but you are also secretly a super programmer! As a super programmer, you hope to maximize the profit of your farming using your programming skills.

Since your daily energy is limited, you can plant at most  $X$  seeds each day. In the beginning, you have  $N$  kinds of vegetable seeds. The number of seeds of the  $i$ -th kind of vegetable is  $Q_i$ , and each seed of this kind needs  $L_i$  days to mature from the day it is planted. Once it matures, you can sell it for  $V_i$  dollars. Assume that no energy or time is required for harvesting and selling vegetables. Also, your farm is infinitely large so the growing vegetables do not crowd out each other.

Notice that although the area of your farm is infinite, the number of days that you can plant seeds is limited. The warm season only lasts  $D$  days, and after that, the harsh winter comes. Any vegetable that has not matured yet will die immediately and cannot be turned into profit. The remaining seeds that were not planted cannot be turned into profit either.

As a super farmer and a super programmer, you want to come up with a perfect planting plan that will maximize your profit. Find the total amount of profit you will earn.

## Input

The first line of the input gives the number of test cases,  $T$ .  $T$  test cases follow.

The first line of each test case contains three integers  $D$ ,  $N$ , and  $X$ : the number of days of the warm season, the number of kinds of vegetable seeds you have to start with, and the maximum number of seeds you can plant each day, respectively.

The next  $N$  lines describe the seeds. The  $i$ -th line contains three integers  $Q_i$ ,  $L_i$ , and  $V_i$ : the quantity of this kind of seed, the number of days it needs to mature, and the value of each matured plant, respectively.

## Output

For each test case, output one line containing `Case #x: y`, where  $x$  is the test case number (starting from 1) and  $y$  is the maximum amount of money you can earn by optimizing your farming plan.

## Limits

Memory limit: 1 GB.

$$1 \leq T \leq 100.$$

$$1 \leq V_i \leq 10^6, \text{ for all } i.$$

$$1 \leq L_i \leq D, \text{ for all } i.$$

## Test Set 1

Time limit: 20 seconds.

$$2 \leq D \leq 1000.$$

$$1 \leq N \leq 15.$$

$\mathbf{X} = 1$ .  
 $\mathbf{Q}_i = 1$ , for all  $i$ .

## Test Set 2

Time limit: 60 seconds.

$2 \leq \mathbf{D} \leq 10^5$ .  
 $1 \leq \mathbf{N} \leq 10^5$ .  
 $1 \leq \mathbf{X} \leq 10^9$ .  
 $1 \leq \mathbf{Q}_i \leq 10^6$ , for all  $i$ .

## Test Set 3

Time limit: 60 seconds.

$2 \leq \mathbf{D} \leq 10^{12}$ .  
 $1 \leq \mathbf{N} \leq 10^5$ .  
 $1 \leq \mathbf{X} \leq 10^9$ .  
 $1 \leq \mathbf{Q}_i \leq 10^6$ , for all  $i$ .  
 $\mathbf{D} \times \mathbf{X} \leq 10^{18}$ .

## Sample

*Note: there are additional samples that are not run on submissions down below.*

Sample Input	Sample Output
2 5 4 1 1 2 3 1 3 10 1 4 5 1 2 2 5 1 1 1 1 1	Case #1: 18 Case #2: 1

In Sample Case #1, there are  $\mathbf{D} = 5$  days,  $\mathbf{N} = 4$  kinds of vegetables and you can plant at most  $\mathbf{X} = 1$  seed each day. Supposing the 4 kinds of vegetables are spinach, pumpkin, carrot and cabbage, we have that

- Spinach needs 2 days to grow, each matured one is worth 3 dollars, and you start with 1 spinach seed.
- Pumpkin needs 3 days to grow, each matured one is worth 10 dollars, and you start with 1 pumpkin seed.
- Carrot needs 4 days to grow, each matured one is worth 5 dollars, and you start with 1 carrot seed.
- Cabbage needs 2 days to grow, each matured one is worth 2 dollars, and you start with 1 cabbage seed.

The maximum profit you can make is 18 dollars. One of the schedules you can use is:

- Day 1: plant 1 carrot
- Day 2: plant 1 pumpkin
- Day 3: plant 1 spinach

- Day 4: plant 1 cabbage
- Day 5: do nothing

And with this schedule, the vegetables will mature and turn into profit as following days:

- Day 1: nothing harvested
- Day 2: nothing harvested
- Day 3: nothing harvested
- Day 4: nothing harvested
- Day 5: 1 spinach, 1 pumpkin and 1 carrot harvested, you earn 18 dollars

Note that the cabbage is supposed to mature on day 6, but it will actually die because of the winter.

## Additional Sample - Test Set 2

*The following additional sample fits the limits of Test Set 2. It will not be run against your submitted solutions.*

Sample Input	Sample Output
<pre> 1 5 3 4 5 2 3 2 3 10 2 4 5 </pre>	<pre> Case #1: 45 </pre>

In Additional Sample Case #1, there are  $D = 5$  days,  $N = 3$  kinds of vegetables and you can plant at most  $X = 4$  seeds each day. Supposing the 3 kinds of vegetables are spinach, pumpkin and carrot, we have that

- Spinach needs 2 days to grow, each matured one is worth 3 dollars, and you start with 5 spinach seeds.
- Pumpkin needs 3 days to grow, each matured one is worth 10 dollars, and you start with 2 pumpkin seeds.
- Carrot needs 4 days to grow, each matured one is worth 5 dollars, and you start with 2 carrot seeds.

The maximum profit you can make is 45 dollars. One of the schedules you can use is:

- Day 1: plant 1 pumpkin, 2 carrots and 1 spinach
- Day 2: plant 2 spinach and 1 pumpkin
- Day 3: plant 2 spinach
- Day 4: do nothing
- Day 5: do nothing

And with this schedule, the vegetables will mature and turn into profit as following days:

- Day 1: nothing harvested
- Day 2: nothing harvested
- Day 3: 1 spinach harvested, you earn 3 dollars
- Day 4: 2 spinach and 1 pumpkin harvested, you earn 16 dollars

- Day 5: 2 spinach, 1 pumpkin and 2 carrots harvested, you earn 26 dollars