Problem 146: Countdown to Launch

Difficulty: Medium

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Problem Background

In July 2019, Lockheed Martin began work with the UK Space Agency to construct a new satellite launch complex in Thurso, Scotland. The United Kingdom has been a leader in satellite production for years, but has had to rely on other countries to actually get them into space. With this new launch facility, set to open early this decade, the UK will be able to cement its position at the forefront of spacefaring countries.

Even if you haven't been to Scotland, you're probably aware that it's famous for a number of things: bagpipes, haggis, and its almost constantly wet climate. While the opening ceremonies for the launch site will likely include a large number of the first two items, the last one could prevent the UK's inaugural rocket launch from happening. Launching rockets is a difficult and precise operation, and poor weather can easily put a damper on launch plans.

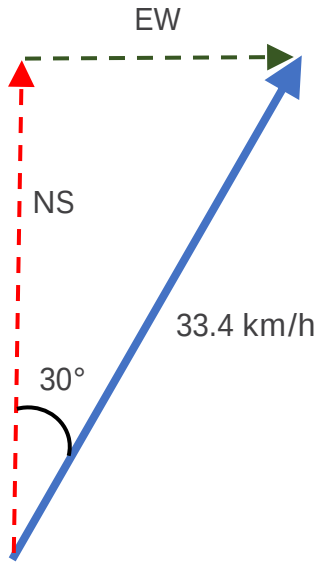
Problem Description

In order for a rocket launch to be carried out, a large number of conditions need to be met in order to ensure the success of the mission and the safety of the rocket and everyone in its vicinity. A launch must take place during a certain timeframe, known as the "launch window." Additionally, poor weather can prevent a launch from taking place, due to the risk that a rocket may be blown off target or become damaged during the launch. Launch times must be scheduled with all of these factors in mind.

As part of Lockheed Martin's efforts to build the new launch facility, your team is working on developing a system to recommend the ideal launch time for future missions based on their launch window and upcoming weather forecasts. The UK's rocket scientists recommend that a launch only take place if all of the following conditions are true:

- The cloud thickness is no higher than 1000 meters (1 kilometer)
- The windspeed along the North-South axis is no higher than 20 kilometers per hour (km/h)
- The windspeed along the East-West axis is no higher than 40 kilometers per hour (km/h)

The wind conditions will be reported as a speed and direction; you will need to use trigonometry to determine what the windspeed is across the respective axes. For example, if the wind is travelling at 33.4 km/h at a direction of 30°:



$$\sin\theta = \frac{wind_{EW}}{wind_{total}}$$

$$\cos\theta = \frac{wind_{NS}}{wind_{total}}$$

$$wind_{EW} = 33.4 * \sin 30° = 16.7$$

$$wind_{NS} = 33.4 * \cos 30° = 28.9$$

In this case, the windspeed across the East/West axis is within tolerances, but the windspeed across the North/South axis is too high. The launch will have to be delayed. Refer to the reference materials at the beginning of the problem packet for more information about the math demonstrated above.

Your system will automatically download the weather forecasts for 00:00, 06:00, 12:00, and 18:00 on each day within a mission's launch window. Your team must develop a program that is able to use that information to determine the earliest timeframe within the launch window that meets all of these conditions. In the event the weather is particularly bad and no timeframe within the launch window meets the conditions above, the program should recommend the launch be cancelled entirely.

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing a positive integer, X, representing the number of possible launch times within the launch window
- X lines containing information about the possible launch times and forecasted weather conditions at those times. Launch times will be presented in increasing chronological order. Values listed below are separated by spaces.
    - The date of the potential launch time, in YYYY-MM-DD format
    - The time of the potential launch time, in 24-hour HH:MM format
    - A non-negative integer value representing the expected cloud thickness in meters
    - A non-negative decimal value representing the expected windspeed at that time in km/h
    - An integer between 0 and 359 inclusive representing the expected wind direction at that time in degrees (0° = North, 90° = East, 180° = South, 270° = West)

```
2
4
2020-05-02 00:00 1100 25.0 45
2020-05-02 06:00 950 33.4 30
2020-05-02 12:00 875 22.2 60
2020-05-02 18:00 600 18.2 75
4
2020-05-03 00:00 800 22.0 180
2020-05-03 06:00 975 27.0 195
2020-05-03 12:00 1150 24.2 210
2020-05-03 18:00 1075 23.4 210
```

Sample Output

For each test case, your program must print the date and time, in 24-hour YYYY-MM-DD HH:MM format, of the earliest potential launch time meeting the safety parameters outlined above. In the event no launch time provided meets parameters, print the text "ABORT LAUNCH" instead.

```
2020-05-02 12:00
ABORT LAUNCH
```