Problem 4—Great Circle Trajectory

Captain Jonas "Skipper" Grumby is not an idiot. He knows exactly where the island is located: 10° N latitude, 140° W longitude. He also knows where Honolulu is: 21.3° N latitude, 157.9° W longitude. Looking at these figures, most people would be able to tell that Honolulu is roughly northwest of the island. However, the Skipper needs more information than this if he is ever to get his passengers home.

What the Skipper knows is that the shortest path between two points on a sphere (such as the Earth) is along a great circle—a circle whose center is identical to the center of the sphere. So, if the Skipper wants to sail home he first has to find the circle whose center is the center of the Earth and contains the island and Honolulu, and then he has to compute the trajectory that circle takes to lead him to Honolulu. He can do this because he is an experienced sailor. Can you? Great circle trajectories often appear strange to people who are used to looking at the Earth on flat maps. For example, to travel from Anchorage, Alaska, USA (61.2° N latitude, 149.4° W longitude) to Moscow, Russian Federation (55.8° N latitude, 37.6° E longitude) you would travel almost due north!

You may assume that no strange cases will exist in the input file: the two points will not be identical. They will not be directly across the Earth from each other. Neither point will be the North or South Pole. Each test case will result in a clear, unambiguous trajectory that will point the way from the starting point to the ending point.

INPUT SPECIFICATION. Each input case will consist of lines in the following format: <Start lat> <N or S> <Start long> <E or W> <End lat> <N or S> <End long> <E or W>. The latitude and longitude numbers are floating point and the characters are all uppercase. Exactly one space will separate items in the input case. The position thus specified will be valid. Each input case will be followed by exactly one**<EOLN>**. Following the last test case will be a single line consisting of –1 followed by **<EOLN>**. This case signals the end of input and is not to be processed.

OUTPUT SPECIFICATION. The output solutions should appear in the same order as their corresponding input cases. Each solution will be a line of text that will either be "x degrees east of north" or "x degrees west of north" whichever is appropriate. x is a floating point number with exactly two digits following the decimal point, rounded to the nearest hundredth of a degree. x should be inclusively between 0 and 180. Angles of 0 and 180 are both considered east of north, so that due north is 0.00 degrees east of north, due east is 90.00 degrees east of north, due south is 180.00 degrees east of north, and due west is 90.00 degrees west of north. Each line is terminated by a single **<EOLN>.**

SAMPLE INPUT.

```
10.0·N·140.0·W·21.3·N·157.9·W<EOLN>
61.2·N·149.4·W·55.8·N·37.6·E<EOLN>
-1<EOLN>
<EOF>
```

SAMPLE OUTPUT.

```
54.56·degrees·west·of·north<EOLN>
4.41·degrees·west·of·north<EOLN>
<EOF>
```