

3312 British Map Grids

The famous Ordnance Survey (OS) maps cover Great Britain in many levels of detail. The large scale maps are used as highway road atlases, the medium scale maps for driving in rural areas and the small scale maps for hiking. Being typically British, where the roads are measured in miles and degrees of longitude are measured from Greenwich, the OS maps are based on the metric system and don't use degrees of longitude and latitude. Instead they use the British Grid system.

The entire island is overlaid with Grid Squares that are 100 kilometers on a side and assigned a two-letter name (see Figure 1). Each grid square is subdivided into cells which are numbered.

There are two cell sizes used for grid references. Large scale maps tend to use a 1 kilometer cell size, thus a grid square is divided into 100 by 100 cells and a cell is referenced by a 4 digit number. Smaller scale maps use a 0.1 km cell and cells are referenced by a 6 digit number. In both cases, the first half of the reference counts cells in the Easterly direction from the lower left corner and the second half counts cells in the Northerly direction. For example, the grid reference SP4583 can be found by looking at the 46-th cell to the East and the 84-th cell to the North inside grid square SP.

SJ	SK	TF
SO	SP	TL
ST	SU	TQ

Figure 1 - Grid Squares

Your task is to determine the distance (in kilometers) between two grid cells. You may assume that the problem will be restricted to the subset of the British Grid system that is shown in Figure 1 and that distances are measured from the center of one cell to the center of another.

Input

The input will consist of one or more data sets. Each data set is a single line containing a pair of grid references which will be whitespace delimited and may be surrounded by an arbitrary amount of whitespace. A grid reference is guaranteed to be two upper case letters followed by 4 (for 1 km cells) or 6 digits (for 0.1 km cells).

You must check for invalid grid references. If the two letters are not shown in Figure 1, the reference is considered invalid. If the one reference is for a 1 km cell and the other is for 0.1 km cell, the line is invalid.

End of input will be marked by end of file.

Output

For each data set, you should print the two grid references input, separated by the word 'to'. If the input is invalid, you should then print the message 'Invalid Grid Reference'. If the input is valid, you should print the distance in km between the two grid cells rounded to two decimal places. Your output should follow the format shown in the Sample Output.

Sample Input

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ST1035 S02158
SK9320 TM1234
  SP102085 ST201072
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SU120456 TF1020

Sample Output

ST1035 to S02158: 123.49 km
SK9320 to TM1234: Invalid Grid Reference
SP102085 to ST201072: 135.57 km
SU120456 to TF1020: Invalid Grid Reference