Pascal
Level IV

Question 1: Magic Squares

A magic square of order N is an N x N matrix of integers, where N is odd and greater than 1, such that the sum of the values in each row, column, and major diagonal are all equal. For example, consider the 3 x 3 matrix

9	2	7
4	6	8
5	10	3

Each row, column and major diagonal sums to 18.

Magic squares may be produced by the following algorithm. This algorithm defines the order in which to fill the cells of the square with a sequence of numbers K, K+1, K+2, ..., $K+N^2-1$.

Place the <u>first number</u> K in the middle of the top row. (You are now in row *R*, column *C*.)
Move up one row. If this takes you out of the matrix, move to the bottom row. You are still in column *C*, but you are now in some new row R_2.
Move to the right one column. If this takes you out of the matrix, move to the left-most column. You are still in row R_2, but you are now in a new column C_2.
If this position is occupied by a number you have previously placed, go back to row *R*, column *C*. Then stay in the same column and move down one row. If this takes you out of the matrix, stay in the same column and go to the top row.
Place the <u>next number</u> in the cell you arrived in by following steps 2-4.
If you have filled the square, you are done. Otherwise, call your current row *R* and your current column *C* and go to step 2.

For this problem you will read two integers on one line. The first will tell you the number of rows in the magic square. The second will be the number with which to start in step 1. Your output will be a magic square produced by the algorithm above.

Example:

Input:

```
5 1
```

Output:

```
17 24  1  8 15
23  5  7 14 16
 4  6 13 20 22
10 12 19 21  3
11 18 25  2  9
```

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Question 2: Grade Manipulation

Professor Moriarity keeps a gradebook of the raw scores his students received on the three tests they took during the semester. He bases his final grades on a weighted average of curved scores. First the tests are curved according to the following rules:

For test 1, everyone's score is increased by 10 points. For example, a raw score of 75 is curved to 85.
For test 2, everyone's score is increased by 15%. For example, a raw score of 75 is curved to 86.25.
For test 3, first the difference between the raw score and 100 is calculated, and then 25% of that difference is added to the raw score. For example, a raw score of 75 is cured to 81.25.

Then they are averaged according to the rule:

Test 1 counts 20% of the total; test 2 counts 35%; and test 3 counts 45%.

You are to write a program to help his grader, Sherlock, transform the raw scores into cooked scores and a final total. The input to this program will be one line of the three raw scores for one student. The output will be the three cooked scores and their weighted average.

Example 1:

Input:

```
40      90      60
```

Output:

```
50      103.5   70      77.725
```

Example 2:

Input:

```
90      60      40
```

Output:

```
100     69      55      68.9
```

Example 3:

Input:

```
60      40      90
```

Output:

```
70      46      92.5    71.725
```

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Question 3: Anagrams

An anagram is a word or phrase formed by rearranging the letters of another word or phrase. For example, "carthorse" is an anagram of "orchestra". Blanks, punctuation, and the case of characters within a phrase are ignored in forming anagrams. Thus, "CART, HORSE" and "Horse-cart" are also anagrams.

Write a program that reads a list of phrases and prints all pairs of anagrams occurring in the list.

Input: Input will consist of from 1 to 20 lines. A completely empty or blank line signals the end of input. Each line constitutes one phrase. No line will contain more than 100 characters.

Output: Some number of lines (including possibly 0 if there are no anagrams in the list), each line containing two anagrammatic phrases separated by ' = '. Each anagram pair should be printed exactly once, but the order of the two phrases within a printed pair is irrelevant.

Example: For the input

```
carthorse
horse
horse cart
i do not know u
ok i now donut
orchestra
```

the output could be:

```
carthorse = orchestra
carthorse = horse cart
horse cart = orchestra
i do not know u = ok i now donut
```

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Question 4: Manhattan Banko

As our history books tell us, in the year 1624 a local group of native American Indians gave up their claim to a portion of land known as Manhattan Island for $24.00 worth of jewelry. The Manhattan Banko project is simply to calculate the net worth of the bank account for the chief of the tribe. There is a little known fact that the chief of tribe quickly sold the jewelry trinkets and placed the cash in the local Frontier Island Savings Bank branch.

Of course this bank has been absorbed, taken over, and consolidated several times over the years. Throughout the years this account has continued to be maintained as an active account. The Federal Deposit Insurance Corporation is conducting an audit trail of the account and needs some help in validating the account status from its beginnings.

Our task is to write a complete program that will evaluate the net worth of the chief's account. FDIC and the survivors of the tribe want an accounting in terms of the net worth of the account at the turn of each century (the last days of the years 1700, 1800, 1900, and 2000) and at each of the hundred year anniversaries of the sale (the last days of the years 1724, 1824, and 1924).

We note that the initial interest paid to depositors in the early years was 0.50% per year and was paid only at the end of the year. Thus on the first day of the year 1625, the account was worth the sum of $24.00 (the initial amount) + $0.12 (interest for year 1624). The interest rate increased in 1705 to 1.0%, effective beginning with account balances existing in 1705 (the first payment at the new rate occurred at the end of 1705), to 1.5% in 1805, and again in 1850 to 2.5%. In the year 1900, after the great bank mergers, the interest rate on the account was increased to 3.75%. This was a fixed agreement for old accounts and remains the rate of interest for the account today.

Your program should produce readable output that clearly identifies the values of the account after interest has been paid for the years identified above, one to a line.

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Question 5: The Price Is Right

The popular midday game show, "The Price Is Right" has one game in which contestants have to select quantities of a variety of items. For example a contestant may select three of item A at a cost of $10.00 each and one of B at a cost of $4.99 each. The contestants are given a target value. They win if the total cost of the items in the quantity they select is **less than** the target value but **no more than** $1.00 less than the target value. Continuing the example, the total cost of three As and one B is $34.99. If the target value was $35.00 the contestant would be a winner. He or she would also be a winner if the target was $35.99, but not if the target were $34.99 or $36.00. Of course, the contestants are not told the values of any of the items, only the target amount.

Write a complete program that can be used by the show's management to verify that the contestant's selections are either correct (in the range) or incorrect (not in the range). The contestant has five items from which to select. Your program should accept one line of input with 6 numbers on it. The first number is the target value in dollars. The remaining 5 numbers are the costs of items 1 through 5. Your program should produce a listing, one solution per line, of all of the possible winning combinations.

Example

For the input:

```
  10.00 0.89 3.69 1.29 0.99 2.39
```

Some of the output would be:

```
  4 of item 1 + 4 of item 3 + 1 of item 4   total 9.71
  11 of item 1  total 9.79
  2 of item 2 + 1 of item 5   total 9.77
7 of item 3  total 9.03
```