**Coin sums**

**Problem 31**

In England the currency is made up of pound, £, and pence, p, and there are eight coins in general circulation:

1p, 2p, 5p, 10p, 20p, 50p, £1 (100p) and £2 (200p).

It is possible to make £2 in the following way:

1×£1 + 1×50p + 2×20p + 1×5p + 1×2p + 3×1p

How many different ways can £2 be made using any number of coins?

**Distinct powers**

**Problem 29**

Consider all integer combinations of *ab* for 2 ≤ *a* ≤ 5 and 2 ≤ *b* ≤ 5:

22=4, 23=8, 24=16, 25=32  
32=9, 33=27, 34=81, 35=243  
42=16, 43=64, 44=256, 45=1024  
52=25, 53=125, 54=625, 55=3125

If they are then placed in numerical order, with any repeats removed, we get the following sequence of 15 distinct terms:

4, 8, 9, 16, 25, 27, 32, 64, 81, 125, 243, 256, 625, 1024, 3125

How many distinct terms are in the sequence generated by *ab* for 2 ≤ *a* ≤ 100 and 2 ≤ *b* ≤ 100?

**Digit fifth powers**

**Problem 30**

Surprisingly there are only three numbers that can be written as the sum of fourth powers of their digits:

1634 = 14 + 64 + 34 + 44  
8208 = 84 + 24 + 04 + 84  
9474 = 94 + 44 + 74 + 44

As 1 = 14 is not a sum it is not included.

The sum of these numbers is 1634 + 8208 + 9474 = 19316.

Find the sum of all the numbers that can be written as the sum of fifth powers of their digits.

**Coin sums**

**Problem 31**

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## Pandigital prime

### Problem 41

We shall say that an *n*-digit number is pandigital if it makes use of all the digits 1 to *n* exactly once. For example, 2143 is a 4-digit pandigital and is also prime.

What is the largest *n*-digit pandigital prime that exists?

## XOR decryption

### Problem 59

Each character on a computer is assigned a unique code and the preferred standard is ASCII (American Standard Code for Information Interchange). For example, uppercase A = 65, asterisk (\*) = 42, and lowercase k = 107.

A modern encryption method is to take a text file, convert the bytes to ASCII, then XOR each byte with a given value, taken from a secret key. The advantage with the XOR function is that using the same encryption key on the cipher text, restores the plain text; for example, 65 XOR 42 = 107, then 107 XOR 42 = 65.

For unbreakable encryption, the key is the same length as the plain text message, and the key is made up of random bytes. The user would keep the encrypted message and the encryption key in different locations, and without both "halves", it is impossible to decrypt the message.

Unfortunately, this method is impractical for most users, so the modified method is to use a password as a key. If the password is shorter than the message, which is likely, the key is repeated cyclically throughout the message. The balance for this method is using a sufficiently long password key for security, but short enough to be memorable.

Your task has been made easy, as the encryption key consists of three lower case characters. Using [cipher1.txt](http://projecteuler.net/project/cipher1.txt) (right click and 'Save Link/Target As...'), a file containing the encrypted ASCII codes, and the knowledge that the plain text must contain common English words, decrypt the message and find the sum of the ASCII values in the original text.