COMPUTER SCIENCE TEST

1. You are given a string $abacabaabracadabra$, consisting of 5 different letters. Also, you've got 5 codes: 0, 11, 101, 1000, 1001. Your task is to match the letters with the codes so that the length of the encoded version of $abacabaabracadabra$ is the minimum possible. What is the minimum length of the result?

   (a) 28
   (b) 35
   (c) 36
   (d) 41
   (e) 44
   (f) 47
   (g) 49
   (h) 56

2. Let's consider all the powers of 2 from 1 to 2^{16}, all the powers of 4 from 1 to 4^{16}, and all the powers of 8 from 1 to 8^{16}. What number is in position 31? Positions in the array are numbered from 1.

   (a) 512
   (b) 1024
   (c) 2048
   (d) 4096
   (e) 8192
   (f) 16384
   (g) 32768
   (h) 65536

3. You are given an array a of size n (positions are numbered from 0). Also, you are given a function $f(pos)$:
   Java

```java
void f(int pos) {
    System.out.println(pos);
    pos = pos + a[pos];
    if (pos < 0 || pos >= n) {
        pos = n - 1;
    }
    f(pos);
}
```

   C++

```cpp
void f(int pos) {
    std::cout << pos;
    pos = pos + a[pos];
    if (pos < 0 || pos >= n) {
        pos = n - 1;
    }
    f(pos);
}
```

Python

```python
def f(pos):
    print(pos)
    pos = pos + a[pos]
    if (pos < 0) or (pos >= n):
        pos = n - 1
    f(pos)
```

Pascal

```pascal
procedure f(pos: integer);
begin
    writeln(pos);
    pos := pos + a[pos];
    if (pos < 0) or (pos >= n) then
    begin
        pos := n - 1;
    end;
    f(pos);
end;
```

For which of the following arrays will $f(0)$ display the maximum number of **unique** values?

(a) $[1, -1, 0, -4, 2, 2, -1]$
(b) $[2, -1, 0, -1, 2, -4, 1]$
(c) $[0, -1, 1, 2, 2, -1, -4]$
(d) $[1, 2, -4, 2, 0, -1, -1]$
(e) $[-4, -1, 2, 1, 2, 0, -1]$
(f) $[0, -4, 1, -1, 2, -1, 2]$
(g) $[-4, 2, 1, 2, 0, -1, -1]$
(h) $[2, 2, -1, -1, 1, 0, -4]$

4. Consider 4 positive integers a, b, c, d, having exactly 10^{11} bits (considering the leading zeros) in the binary representation, Positions are numbered from 1 to 10^{11}. Every 3-d bit of a is equal to 1 (in other words, bits number 3, 6, 9 and so on), every 7-th bit of b is equal to 1, every 4-th bit of c is equal to 1, every 5-th bit of d is equal to 1. Your task is to determine number of 1 bits in $a \oplus b \oplus c \oplus d$, where $\oplus$ is bitwise XOR operation.

(a) 238095238
(b) 3571428570
(c) 19047619050
(d) 42857142856
(e) 46428571426
(f) 53571428574
(g) 65714285714
(h) 99761904762

5. You are given an array of length 5 in the binary representations. Let's call an array *good*, if it is possible to rearrange the numbers so that each element (except the first one) differs from the previous element **exactly** in one bit.

   For example, an array $[1000, 0100, 1001, 0101, 1101]$ is good, because we can get the following array after rearrangement: $[1000, 1001, 1101, 0101, 0100]$, where each element (except the first one) differs from the previous element exactly in one bit.

   Which of the following arrays is good?

   (a) $[0000, 1010, 1001, 1101, 0111]$
   (b) $[0000, 1010, 1110, 0101, 1011]$
   (c) $[1001, 1010, 1011, 0011, 0111]$
   (d) $[0000, 0100, 1100, 0010, 1011]$
   (e) $[1010, 0110, 1001, 0101, 1101]$
   (f) $[0010, 1010, 0101, 0011, 0111]$
   (g) $[1000, 1100, 0010, 0110, 0101]$
   (h) $[1000, 0100, 1110, 0001, 0111]$

6. Given an array a of size n, where *n* is an odd number. Positions are numbered from 1 to n, and value of i-th element is equal to i.

   Also, you are given a function $f(pos)$, which is used for reversing subarray of a from position pos to position $n - pos + 1$. For example, if $n = 9$, after performing $f(3)$ an array a is the following: $[1, 2, 7, 6, 5, 4, 3, 8, 9]$.

   There was consistently performed $f(1)$, $f(2)$, $f(3)$, $\ldots$, $f(\frac{n-1}{2})$. You need to find the number of such pairs of indices (i, j), that $i < j$ and $a_i > a_j$, given $n = 10^5 + 1$.

   (a) 0
   (b) 50000
   (c) 100000
   (d) 100001
   (e) 2500075000
   (f) 5000050000
   (g) 10000000000
   (h) 10000100000