Q1. How many 1's are there in the binary representation of 2021_{10}?

Notice 2021 is very close to the power-of-2-minus-1 number 2048 - 1 = 2047, which
has all 1's of 11 total. The difference between 2047 and 2021 in binaries is
those 0's in 2021 but are 1's in 2047 and their sum is the result of 2047 - 2021.
If we can count how many 1's in 2047-2021, we get the number of 0's in 2021.
Reversely we know how many 1's in 2021.

2047 - 2021 = 26 -> 16 + 8 + 2 -> 3 ones will be missing from 2047's binary
representation which has 11 ones so 11 - 3 = 8.

Answer: C.

Q2. Evaluate and express the answer in hexadecimal: 72126_8 - 54127_8

Step1. Subtraction in octal:
```
   72126(8)
 - 54127(8)
 C   111      <- carries
 ----------
   15777(8)
```

Step2. Conversion to hexadecmial:
```
   1   5   7   7   7
 001 101 111 111 111
 0001 1011 1111 1111
    1   B    F    F (16)
```

Answer: A.

Q3. f(10), given: f(x) = 2x + 2   if x <= 2
                            = f(x-1) - f(x-2)   if x > 2

```
f(10) = f(9) - f(8)   =   2 -   6 = -4
f( 9) = f(8) - f(7)   =   6 -   4 =  2
f( 8) = f(7) - f(6)   =   4 -(-2)=  6
f( 7) = f(6) - f(5)   =  -2 -(-6)=  4
f( 6) = f(5) - f(4)   =  -6 -(-4)= -2
f( 5) = f(4) - f(3)   =  -4 -   2 = -6
f( 4) = f(3) - f(2)   =   2 -   6 = -4
f( 3) = f(2) - f(1)   =   6 -   4 =  2
f( 2) = 2*2+2 = 6
f( 1) = 2*1+2 = 4
```

Answer: B.

Q4. f(f(17)), given: f(x) = 2+f(x-2) if x >= 8
                            = x - 4   if x < 8

```
f(17) = 2 + f(15)     = 2 +11 = 13
f(15) = 2 + f(13)     = 2 + 9 = 11
f(13) = 2 + f(11)     = 2 + 7 = 9
f(11) = 2 + f(9)      = 2 + 5 = 7
f( 9) = 2 + f(7)      = 2 + 3 = 5
f( 7) = 7 - 4 = 3
```

f(f(17)) = f(13) = 9

Answer: A.

Q5. How many different unique values do the variables a, b, c, and d take on when this program is executed?

```
                                      a    b    c    d
a = 5 : b = 2 : c = 25 : d = 4        5    2    25   4
if c / a > d then                                        c/a=5>4 true
    b = b + d                         5    6    25   4   b+d=2+4=6
else
    b = b + c / a
end if
c = c - a * b / 2                     5    6    10   4   25-5*6/2=10
if (b < c) && (d < a) then                               6<10 && 4<5 true
    d = d / 4                         5    6    10   1
else
    a = c ^ 2 / a
end if
if d % a == 0 then                                       d%a=1%5=1 false
    d = b + c
end if
if (c /2 > b) || ( b - d == a) then                     (10/2>6)||(6-1==5) true
    d = 5 * d                         5    6    10   5   d=5*1=5
end if

5 2 6 25 10 4 1 -> 7
```

Answer: D.