Q1. Convert 2018(10) to octal.

Convert decimal to octal by repeatedly dividing quotients by base 8:

2018 / 8 = 252 R **2**
252 / 8 = 31 R **4**
31 / 8 = 3 R **7**
3 / 8 = 0 R **3**

Answer: 3742 (8)

Q2. How many decimal numbers from 1 to 32 have the same number of 1's and 0's in their binary representation? Note: ignore leading zeroes.

32(10) in binary is 100000(2), which is a power-of-2 number. So in binary, it is a leading 1 with 5 succeeding 0's in 6-digit;

In order to have equal numbers of 0's and 1's, the numbers of digits must be even numbers: 2, 4, and 6. However, there is only 1 6-digit number which is 32(10) and it does not qualify;

For 2-digit binaries, we have only 1 number: 10(2); for 4-digit binaries, we have 3 numbers b/c with given 4 we can only have two 1's and two 0's, where 1 of the two 1's is the leading 1. Therefore the other 1 must be in each of the 3 non-leading digits respectively.

Answer: 1 + 3 = 4

Q3. Find f(18) given:

```
f(x) = f(x-5)+1      if x > 5
     = 7             if x = 5
     = f(x+3)-2      if x < 5
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```
Entering (top-down)                                Exiting (bottom-up)
f(18) = f(18-5) + 1 = f(13) + 1  (top rule)        = 3 + 1 = 4
f(13) = f(13-5) + 1 = f( 8) + 1  (top rule)        = 2 + 1 = 3
f(8)  = f( 8-5) + 1 = f( 3) + 1  (top rule)        = 1 + 1 = 2
f(3)  = f( 3+3) - 2 = f( 6) - 2  (bottom rule)     = 3 - 2 = 1
f(6)  = f( 6-5) + 1 = f( 1) + 1  (top rule)        = 2 + 1 = 3
f(1)  = f( 1+3) - 2 = f( 4) - 2  (bottom rule)     = 4 - 2 = 2
f(4)  = f( 4+3) - 2 = f( 7) - 2  (bottom rule)     = 6 - 2 = 4
f(7)  = f( 7-5) + 1 = f( 2) + 1  (top rule)        = 5 + 1 = 6
f(2)  = f( 2+3) - 2 = f( 5) - 2  (bottom rule)     = 7 - 2 = 5
f(5)  = 7                        (middle rule)
```

Answer: 4

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Q4. Find f(f(f(f(24)))) given:   f(x)  = [x/2] + 1      if x is even
                                       = [x/3] - 2      if x is odd
Note: [x] is the greatest integer ≤ x
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Work from inside-out for the embedded functions by solving the following top-down:

```
f(x)
f(f(x))
f(f(f(x)))
f(f(f(f(x))))

f(24) = [24/2] + 1 = 12 + 1 = 13
f(f(24)) = f(13) = [13/3] - 2 = 4 - 2 = 2
f(f(f(24)) = f(2) = [2/2] + 1 = 2
f(f(f(f(24))) = f(2) = 2
```

Answer: 2

Q5. What is the output when this program is executed?

<table>
<tr><td></td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td></td></tr>
<tr><td>a = 2 : b = 1 : c = 0 : d = 3 : e = 4</td><td>2</td><td>1</td><td>0</td><td>3</td><td>4</td><td></td><td></td></tr>
<tr><td>f = a + b + c + d + e</td><td></td><td></td><td></td><td></td><td></td><td>10</td><td>2+1+0+3+4==10</td></tr>
<tr><td>if f / 5 == a then</td><td></td><td></td><td></td><td></td><td></td><td></td><td>10/5==2, true</td></tr>
<tr><td>f = f / 5</td><td></td><td></td><td></td><td></td><td></td><td>2</td><td></td></tr>
<tr><td>else</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>f = a + 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>end if</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>if a + b < d * e / 2 then</td><td></td><td></td><td></td><td></td><td></td><td></td><td>2+1<3*4/2, 3<6, true</td></tr>
<tr><td>b = d</td><td>2</td><td>3</td><td>0</td><td>3</td><td>4</td><td>2</td><td></td></tr>
<tr><td>else</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>a = e</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>end if</td><td>2</td><td>3</td><td>0</td><td>3</td><td>4</td><td>2</td><td></td></tr>
<tr><td>if 2 * d ↑ c == e / a then</td><td></td><td></td><td></td><td></td><td></td><td></td><td>2*3^0==4/2, 2==2, true</td></tr>
<tr><td>d = e</td><td>2</td><td>3</td><td>0</td><td>4</td><td>4</td><td>2</td><td></td></tr>
<tr><td>else</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>c = a</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>end if</td><td colspan="7">Pop-quiz: Are the parentheses useful in the following expression?</td></tr>
<tr><td>if (b < d) && (c < e) then</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(3<4) && (0<4), true</td></tr>
<tr><td>b = d</td><td>2</td><td>4</td><td>0</td><td>4</td><td>4</td><td>2</td><td></td></tr>
<tr><td>else</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>c = e</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>end if</td><td colspan="7">Pop-quiz: Are the parentheses useful in the following expression?</td></tr>
<tr><td>if (c ↑ a > d * e) || (f < d / e) then</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(0^2>4*4)||(2<4/4),false</td></tr>
<tr><td>c = a</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>else</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>d = c</td><td>2</td><td>4</td><td>0</td><td>0</td><td>4</td><td>2</td><td></td></tr>
<tr><td>end if</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>output 2 * a + b * (c - d) + e / 2 * f</td><td></td><td></td><td></td><td></td><td></td><td></td><td>2*2+4*(0-0)+4/2*2</td></tr>
<tr><td>end</td><td></td><td></td><td></td><td></td><td></td><td></td><td>=4+0+4=8</td></tr>
</table>

Answer: 8