

American Computer Science League

2021-2022 • Contest 1: Short Problem Solutions • Junior Division

1. Computer Number Systems $2122_{10} = 4 * 8^3 + 1 * 8^2 + 1 * 8^1 + 2 * 8^0$ $= 4112_8$	D. 4112
2. Computer Number Systems Fibonacci sequence 0, 1, 1, 2, 3, 5, 8, 13, ... in base 10 Fibonacci sequence 0, 1, 1, 10, 11, 101, 1000, 1101, ... in binary 1st: 10 from 2 2nd: 101 from 5 3rd: 1000 from 8 4th: 1101 from 13	B. 13
3. Recursive Functions $f(10) = f(10 - 2) + 3 = f(8) + 3 = 9 + 3 = 12$ $f(8) = f(8 - 2) + 3 = f(6) + 3 = 6 + 3 = 9$ $f(6) = f(6 - 1) - 1 = f(5) - 1 = 7 - 1 = 6$ $f(5) = f(5 - 1) - 1 = f(4) - 1 = 8 - 1 = 7$ $f(4) = f(4 - 1) - 1 = f(3) - 1 = 9 - 1 = 8$ $f(3) = 3^2 = 9$	E. 12
4. Recursive Functions $f(20, 12) = f(20 - 3, 12 + 1) + 3 = f(17, 13) + 3 = 60 + 3 = 63$ $f(17, 13) = f(17 - 3, 13 + 1) + 3 = f(14, 14) + 3 = 57 + 3 = 60$ $f(14, 14) = 2 * f(14 + 2, 14 - 3) - 1 = 2 * f(16, 11) - 1$ $= 2 * 29 - 1 = 57$ $f(16, 11) = f(16 - 3, 11 + 1) + 3 = f(13, 12) + 3 = 26 + 3 = 29$ $f(13, 12) = f(13 - 3, 12 + 1) + 3 = f(10, 13) + 3 = 23 + 3 = 26$ $f(10, 13) = 10 + 13 = 23$	C. 63

5. What Does This Program Do? (Branching)

The following table can be used to trace the program:

a	b	c	d
0	2	4	6
0	2	12	6
0	4	12	6
0	4	12	6
0	10	12	6

$$\begin{aligned}c / d - b + a ^ 3 * d \\&= 12 / 6 - 10 + 0 ^ 3 * 6 \\&= 2 - 10 + 0 * 6 \\&= 2 - 10 + 0 \\&= -8\end{aligned}$$

A. -8