

American Computer Science League

2021-2022 • Contest 1: Short Problems • Intermediate Division

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|---|--|
| 1. Computer Number Systems Convert 2122_{10} to hexadecimal. | A. A48 B. B37 C. 849 D. 84A E. 73A |
| 2. Computer Number Systems The Fibonacci sequence $\{0, 1, 1, 2, 3, 5, 8, 13, \dots\}$ is formed by adding the two previous terms: $5 + 8 = 13$. Which number in the sequence when converted to octal would have the 6th occurrence of the digit “1” when counting every digit? | A. 34 B. 55 C. 89 D. 144 E. 233 |
| 3. Recursive Functions Find $f(20)$, given $f(x) = \begin{cases} 2 * f(x - 3) + 1 & \text{if } x \geq 15 \\ \left\lceil \frac{f(x + 2)}{3} \right\rceil & \text{if } 12 < x < 15 \\ 2 * x - 3 & \text{if } x \leq 12 \end{cases}$ where $[y]$ returns the greatest integer less than or equal to y | A. 43 B. 39 C. 19 D. 14 E. 9 |
| 4. Recursive Functions Find $f(f(f(f(20))))$, given $f(x) = \begin{cases} f\left(\frac{x-2}{2}\right) - 1 & \text{if } x \text{ is even} \\ 2 * x & \text{if } x \text{ is odd} \end{cases}$ | A. 34 B. 18 C. 17 D. 12 E. 9 |

5. What Does This Program Do? (Branching)

What is printed when this program is executed?

```
a = 10 : b = 4 : c = 0 : d = 6
if a > b + d then
    b = b + d
else
    d = a - d
end if
if c ^ 2 < c ^ 4 then
    d = d * 2
else
    c = 1
end if
if b / d == c then
    c = c * 2
else
    a = a / c
end if
if b > c && d < b then
    d = d / 4
else
    a = c ^ 2 / d
end if
if d - b < a + b || b + c == d then
    d = d / 2
end if
x = a - b * c + d
output x
```

- A. 7
- B. 3
- C. 1
- D. -5
- E. -9