1. Boolean Algebra

How many ordered quadruples make the following Boolean expression TRUE?

\[(A + B + C + D)(ABCD)\]

A. 4
B. 5
C. 8
D. 9
E. None of the above

2. Bit-String Flicking

Let X be a 5 bit string.
Simplify the following expression:

\(\text{LSHIFT-1 (LCIRC-2 01010)) OR (RCIRC-1 (LSHIFT-2 X AND 01110)) AND (LCIRC-2 (NOT (LCIRC-2 (X OR 01100)))}}\)

A. 11010
B. 10110
C. 10011
D. 10010
E. None of the above

3. Recursive Functions

Find \(f(20, 2)\) given:

\[f(x, y) = \begin{cases} 
  f(2y, x - 3) - 1 & \text{if } x > y \\
  f\left(\left\lfloor \frac{y}{2}\right\rfloor, x - 1\right) + 3 & \text{if } x < y \\
  4 & \text{if } x = y 
\end{cases}\]

Note: \(\left\lfloor x \right\rfloor\) represents the greatest integer less than or equal to \(x\)

A. 6
B. 7
C. 9
D. 10
E. None of the above

4. Digital Electronics

Define the following new gates: A diamond has 3 inputs and is TRUE if only 1 input is TRUE, an oval has 3 inputs and is TRUE if at most 1 input is TRUE, and a rectangle has 3 inputs and is TRUE if all inputs are TRUE. How many ordered quadruples make the following circuit TRUE?

A. 1
B. 3
C. 9
D. 13
E. None of the above
### 5. Prefix-Infix-Postfix

Define a # b = a² - ab + b²
Evaluate this prefix expression. Note: all numbers are single digits.

\[ + - / * 3 # # 0 2 2 * 2 3 / # 4 - 8 6 * 3 2 \uparrow 2 4 \]

<table>
<thead>
<tr>
<th>Choice</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>15</td>
</tr>
<tr>
<td>B.</td>
<td>20</td>
</tr>
<tr>
<td>C.</td>
<td>38</td>
</tr>
<tr>
<td>D.</td>
<td>56</td>
</tr>
<tr>
<td>E.</td>
<td>None of the above</td>
</tr>
</tbody>
</table>

### 6. Computer Number Systems

How many numbers from 100 to 200 in base 10 consist of distinct ascending digits and also have distinct ascending hex digits when converted to base 16?

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>A.</td>
<td>13</td>
</tr>
<tr>
<td>B.</td>
<td>14</td>
</tr>
<tr>
<td>C.</td>
<td>15</td>
</tr>
<tr>
<td>D.</td>
<td>16</td>
</tr>
<tr>
<td>E.</td>
<td>None of the above</td>
</tr>
</tbody>
</table>

### 7. What Does This Program Do?

What value is output when the following program is executed?

```plaintext
for x = 0 to 4
  for y = 0 to 4
    A(x,y) = (x+1)^2 + y
  next y
next x
for x = 0 to 4
  for y = 0 to 4
    if A(x,y) % 3 == 0 then
      A(x,y) = A(x,y) / 3
    if A(x,y) % 4 == 0 then
      A(x,y) = A(x,y) / 4
    if A(x,y) % 5 == 0 then
      A(x,y) = A(x,y) / 5
  next y
next x
s = 0
for x = 0 to 4
  for y = 0 to 4
    if A(x,y) % 2 == 0 then
      s = s + A(x,y)
  next y
next x
output s
```

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>A.</td>
<td>7</td>
</tr>
<tr>
<td>B.</td>
<td>20</td>
</tr>
<tr>
<td>C.</td>
<td>48</td>
</tr>
<tr>
<td>D.</td>
<td>58</td>
</tr>
<tr>
<td>E.</td>
<td>None of the above</td>
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</table>

### 8. Data Structures

Consider all binary search trees with 8 nodes. What is the smallest value for the internal path length?

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<tbody>
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<td>A.</td>
<td>10</td>
</tr>
<tr>
<td>B.</td>
<td>13</td>
</tr>
<tr>
<td>C.</td>
<td>16</td>
</tr>
<tr>
<td>D.</td>
<td>19</td>
</tr>
<tr>
<td>E.</td>
<td>None of the above</td>
</tr>
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