1. **Boolean Algebra**

How many ordered quadruples make the following Boolean expression FALSE?

\[
(\overline{AB} + C(B + D))(\overline{B + C}(A\overline{BC} + D))
\]

A. 0  
B. 1  
C. 5  
D. 9  
E. None of the above

2. **Bit-String Flicking**

How many different values of X (a bitstring of 5 bits) make the following equation TRUE? Let X = abcde and NOT X = ABCDE.

\[
(\text{LSHIFT-1 (LCIRC-2 01010)}) \text{ OR } (\text{LCIRC-2 (NOT (LCIRC-2(X OR 01100)))}) = 1BC1E
\]

A. 0  
B. 2  
C. 4  
D. 8  
E. None of the above

3. **Recursive Functions**

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

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

Note: \( \lfloor x \rfloor \) 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 = a^2 - ab + b^2

Evaluate this prefix expression. Note: all numbers are single digits.

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

| A. 15 | B. 20 | C. 38 | D. 56 | E. None of the above |

6. **Computer Number Systems**

How many numbers from 200 to 400 in base 10 consist of distinct ascending digits and also have distinct ascending hex digits when converted to base 16?

| A. 6 | B. 8 | C. 10 | D. 12 | E. None of the above |

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
```

| A. 7 | B. 20 | C. 48 | D. 58 | E. None of the above |

8. **Data Structures**

Consider all binary search trees with 16 nodes. What is the smallest value for the internal path length?

| A. 34 | B. 38 | C. 42 | D. 44 | E. None of the above |
9. **Graph Theory**

Given the following directed graph of airports and the flights available among them, how many flights from ATL to ORD have only 1 intermediate stop?

A. 1  
B. 3  
C. 4  
D. 9  
E. None of the above

10. **LISP**

Evaluate the following sequence of Lisp functions:

(SETQ U ‘((a (b c)) (d e f) (g (h i j k)) (l m n)))
(SETQ V ‘(p (q r) (s (t u v)) (w (x y) z)))
(SETQ X (CDR (CAR (CDR (CDR V)))))
(SETQ Y (CAR (CDR (CAR (CDR (CDR (CDR U)))))))
(REVERSE (CONS Y X))

A. ((t u v) (i j k))  
B. (t u v (i j k))  
C. (t u v i j k)  
D. ((t u v) i j k)  
E. None of the above

11. **FSAs and Regular Expressions**

List all of the strings that are accepted by the regular expression

\[((0 1)* (11 00) 1*100*)\]

A. a, d, e, g  
B. a, c, e, f, g  
C. b, c, d, f, g  
D. c, e, f, g  
E. None of the above

12. **Assembly Language**

What is the final value printed when this program is executed?

```
NUM           DC        24            STORE     NUM
CNT           DC        0             BU        START
START         LOAD       NUM           CONT      LOAD     NUM
              SUB        =1            DIV        =2
              BE         DONE         STORE      CNT
              LOAD       CNT           BU        START
              ADD        =1            DONE      PRINT     CNT
              STORE      CNT           END
              LOAD       NUM           
              DIV        =2            
              MULT       =2            
              SUB        NUM           
              BE         CONT         
              LOAD       NUM           
              MULT       =3            
              ADD        =1
```

A. 8  
B. 10  
C. 12  
D. 16  
E. None of the above