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1. Boolean Algebra

How many ordered quadruples make the following
Boolean expression FALSE?

$$(\overline{\overline{AB}+C(B+\overline{D})})((\overline{\overline{B}+\overline{C}})(\overline{A(\overline{BC}+D)}))(\overline{\overline{ABC}\overline{D}})$$

A. 4
B. 6
C. 8
D. 10
E. None of the above

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2. Bit-String Flicking

How many different values of x (a bitstring of 6 bits) make the
following equation TRUE?

$$(x \text{ OR } 110110 \text{ AND } x) = (\text{LSHIFT-1 } x)$$

A. 1
B. 2
C. 4
D. 8
E. None of the above
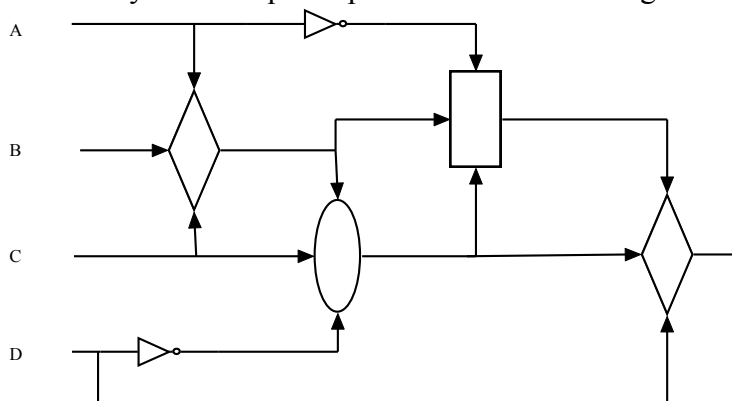
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3. Recursive Functions

Find $f(20,2)$ given:

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

Note : $[x]$ represents the greatest integer less than or equal to x

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

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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**	A. 15
	B. 20
Define a # b = a^2 − ab + b^2	C. 38
Evaluate this prefix expression. Note: all numbers are single digits.	D. 56
	E. None of the above
$+ - / * 3 \# \# 0\,2\,2 * 2\,3 / \# 4 - 8\,6 * 3\,2 \uparrow 2\,4$	

6. **Computer Number Systems**	A. 13
	B. 14
How many numbers from 100 to 400 in base 10 consist of distinct	C. 23
ascending digits and also have distinct ascending hex digits when	D. 25
converted to base 16?	E. None of the above

7. **What Does This Program Do?**

What value is output when the following program is executed?

```
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**	A. 98
	B. 103
Consider all binary search trees with 32 nodes. What is the	C. 108
smallest value for the internal path length?	D. 135
	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 at most 2 intermediate stops? (No airport may be visited twice.)
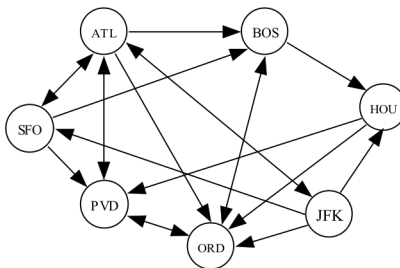
A. 8
B. 9
C. 13
D. 16
E. None of the above

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

$$((0 \quad 1)^* (11 \quad 00) 1^*100^*)^*$$

a. 0001111101
b. 11111111111111
c. λ
d. 0101010101010101
e. 0010111011111111110
f. 000010000000000000
g. 111111111111101111

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   NUM
          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