ACSL

2012 - 2013 **American Computer Science League** **All-Star**

Short Round Questions

1. Boolean Algebra

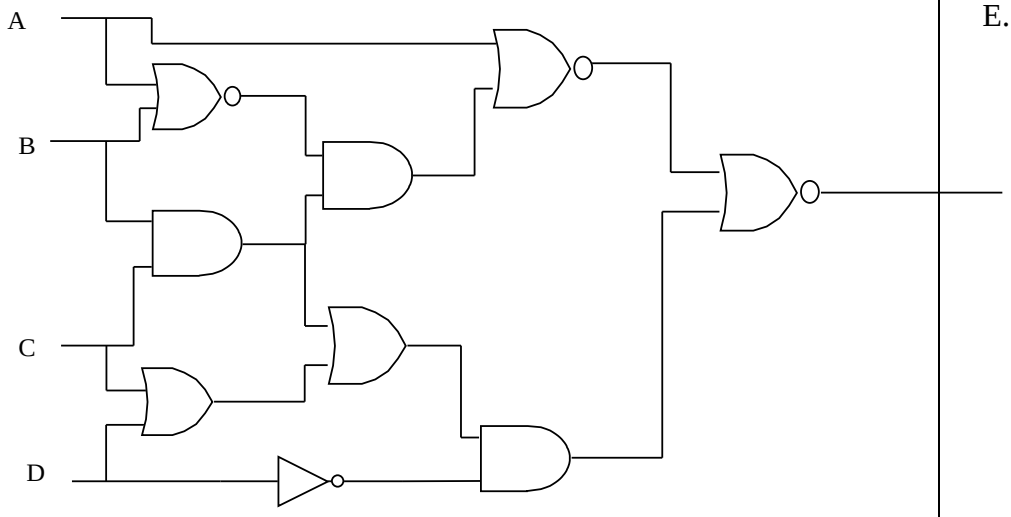
Simplify the following Boolean expression:

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

A. 1
B. $A\overline{B}\,\overline{C}$
C. $A\overline{B}\,C$
D. 0
E. None of the above

2. Digital Electronics

How many ordered quadruples make the following circuit TRUE?



A. 2
B. 6
C. 10
D. 14
E. None of the above

3. Prefix-Infix-Postfix

Define: **a # b** = GCF of a and b (Greatest Common Factor of a and b)
a % b = LCM of a and b (Least Common Multiple of a and b)
a! = a*(a-1)*(a-2)*…3*2*1

Evaluate the following postfix expression: (all single digits)

5 8 % 2 3 8 4 # # + * 4 6 8 # # 2 3 ↑ / * 6 ! 3 8 % / +

A. 22
B. 70
C. 95
D. 250
E. None of the above

4. Computer Number Systems

Find the digit X that satisfies the following:

$X614_8 + X50_{16} = 2012_{10}$

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

5. Bit-String Flicking

Which value(s) of X (five bits long) solve the following equation?

NOT(LCIRC-2 11101) OR RSHIFT-1 01011 AND RCIRC-1(LSHIFT-2 01101) = LSHIFT-2 (RCIRC-2 X)

A. **010
B. *010*
C. 010**
D. *0*10
E. None of the above

6. What Does This Program Do?

What is the output after this program is executed?

```
for i = 1 to 5
   for j = 1 to 5
      a(i,j) = 2*i + j
   next j
next i
for i = 1 to 5
   for j = i to 5
      b(i,j)= a(j,i)+2*(j-i)
      c(i,j)= b(i,j)+ i*j
    next j
next i
print a(2,4)+b(1,3)+c(4,5)
end
```

A. 45
B. 55
C. 56
D. 66
E. None of the above

7. Recursive Functions

Find $f(f(f(1,0),1),0)$ given:

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

A. 5
B. 7
C. 9
D. 11
E. None of the above

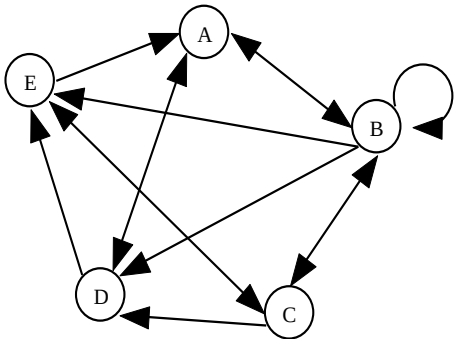
8. Data Structures

Define the command AZ to put the elements of the structure in alphabetical order and the command ZA to put the elements of the structure in reverse alphabetical order. The first element in the new order is then the new "first in" element. Starting with an empty queue, what would be the next element to be popped after the following are executed:
PUSH(M), PUSH(E), PUSH(M), POP(X), PUSH(O), ZA, POP(X), PUSH(R), PUSH(I), POP(X), AZ, POP(X), PUSH(A), PUSH(L), POP(X), PUSH(D), AZ, PUSH(A), POP(X), ZA, PUSH(Y), POP(X)

A. L
B. A
C. D
D. Y
E. None of the above

9. Graph Theory

Given the following directed graph, how many cycles are there from B?



A. 9
B. 13
C. 15
D. 21
E. None of the above

10. LISP

(SETQ X '((1 2) 3 ((4 5) 6) 7 (6 (5 4) (3 2 (1)))))

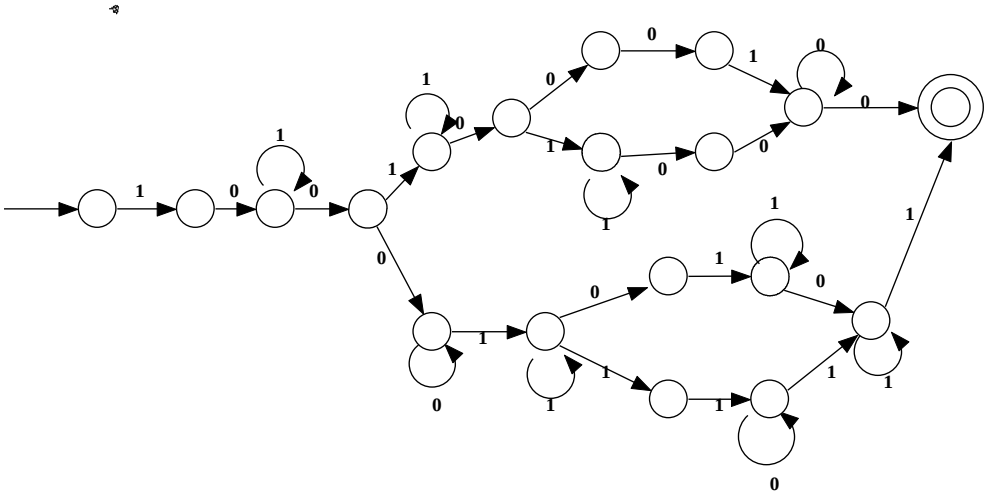
Evaluate the following expression:

(CDR(CAR(REVERSE(CDR(CAR(REVERSE(CDR X)))))))

A. (3 2 (1))
B. (2 (1))
C. (3 2)
D. ((1) 2)
E. None of the above

11. FSA and Regular Expressions

Which of the strings below are represented by the following FSA?



a. 101011001011
b. 101100110101
c. 1010001111001111111
d. 1011100010110010
e. 10000011111111
f. 100101000

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

12. Assembly Language

What is the final value of S when the program is run?

```
        S    DC    0
        X    DC    1
TOP     LOAD    X
        MULT    X
        MULT    X
        STORE   C
        LOAD    S
        ADD     C
        STORE   S
        LOAD    X
        SUB     =10
        BE      DONE
        LOAD    X
        ADD     =1
        STORE   X
        BU      TOP
DONE    LOAD    S
        PRINT   S
        END
```

A. 1296
B. 3025
C. 2025
D. 4356
E. None of the above