ACSL

2007 - 2008 **American Computer Science League** **All-Star**

Short Round Questions

1.Boolean Algebra

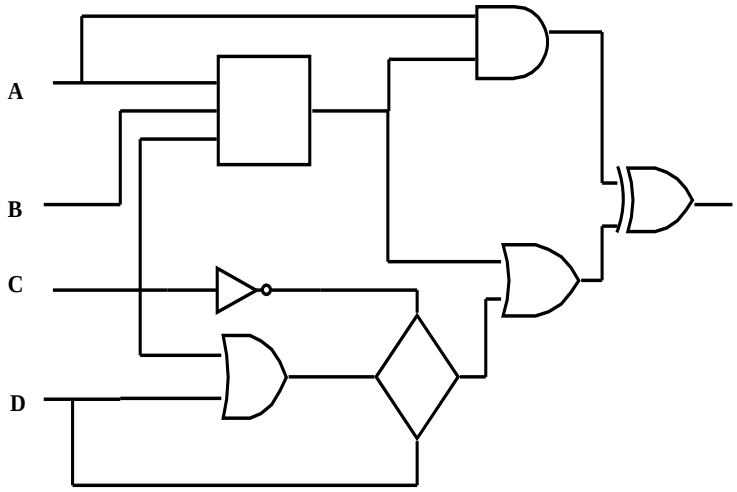
Simplify:

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

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

2. Digital Electronics

Let □ be a gate with 3 inputs that is true if only one input is true. Let ◊ be a gate with 3 inputs that is true if at most 2 inputs are true. How many ordered quadruples make the following circuit true?



A. 11
B. 12
C. 13
D. 14
E. None of the above

3. Prefix-Infix-Postfix

Define a # b = b - a and a % b = a + b

Evaluate the following postfix expression:

Note all numbers are single digits.

1 2 # 3 % 4 5 % # 5 % 6 # 7 8 # #

A. 4
B. 5
C. 6
D. 7
E. None of the above

4. Computer Number Systems

Find the values of A, B, and C that solve the following octal cryptarithm. A, B, and C are unique octal numbers. $A \neq 0$ and $C \neq 0$. How many solutions are there?

```
  A B C
+   A B
-------
  C 2 2
```

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

5. Bit String Flicking

How many values of X (five bits long) solve the following equation?

(RCIRC-3 (LSHIFT-2 X)) OR (11110 AND 11001) =
(RCIRC-3 (NOT X)) OR (11010 OR 10001)

A. 0
B. 2
C. 4
D. 6
E. None of the above

6. What Does This Program Do?

Given an initially empty array, A, what is the output after the program is run?

```
S = 0
FOR  I = 1 TO 5
      FOR  J = 1 TO 4
            IF J < I THEN A( I, J) = I ^ J
                  ELSE A ( I, J) = I + J
      NEXT J
NEXT I
FOR  I = 1 TO 5
      FOR  J = 1 TO 4
            IF A(I,J)^0.5<>INT(A(I,J)^0.5) THEN
                  S = S + A(I,J)
      NEXT J
NEXT I
PRINT S
END
```

A. 139
B. 147
C. 177
D. 202
E. None of the above

7. Recursive Functions

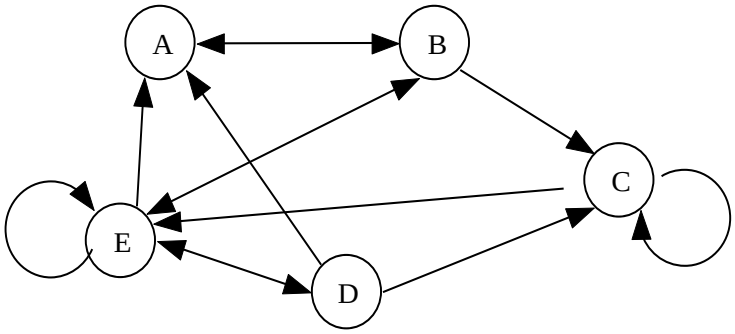
Find $f(11,-4)$ where $[a]$ is the greatest integer less than or equal to a, $|a|$ = absolute value function and $gcf(a,b)$=greatest common factor of a and b

$$f(x,y)=\begin{cases} f(\,[x/2]-2,\ 2*|y-1|)+x*y & \text{if } x>9 \\ f(\,|\,|y|-x|,\ [x/y]-2)-y & \text{if } 1<x\le 9 \\ gcf(x,y)*[y/x] & \text{if } x\le 1 \end{cases}$$

A. -37
B. -49
C. -51
D. -63
E. None of the above

8. Graph Theory

How many more cycles would there be from A if the directed edges AE and BD were added to the directed graph below?



A. 3
B. 4
C. 5
D. 6
E. None of the above

9. Data Structures

What is the positive difference between the internal path lengths in the binary search trees of :

MARRIOTTSRIDGE and MARRIOTTSVILLE?

A. 4
B. 5
C. 6
D. 7
E. None of the above

10. LISP

Evaluate the following LISP expression:

(REVERSE(CDR ‘ ((1 2) 3 4)))

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

11. FSA and Regular Expressions

What is the length of the longest string that can be generated by the following regular expression, given that the string must contain at most 3 a’s and at most 4 b’s?

$$\mathbf{a\ b\ (\ (\ b\ c\ )^{*}\ a^{*}\ \cup\ c\ b^{*}\ )\ a^{*}}$$

A. 7
B. 8
C. 9
D. 10
E. None of the above

12. Assembly Language

After the code is executed, what is the final value of S?

```
S     DC     0          LOAD   I
A     DC     5          ADD    A
B     DC     40         STORE  I
I     DC     1          LOAD   B
TOP   LOAD   I          SUB    I
      MULT   A          BG     TOP
      ADD    S          PRINT  S
      STORE  S          END
```

A. 405
B. 560
C. 740
D. 950
E. None of the above