# ACSL

# American Computer Science League

TEST INSTRUCTIONS

1. MATERIALS ALLOWED: Plain paper and pencils (no calculators, headphones or any type of electronic device)
2. SCORE SHEETS:   
    THE BLUE SIDE IS SIDE 1. USE THE BLUE SIDE.

Use pencils only to mark the answers.

Put your name, school name, grade and division on the back of the scoresheet.

No erasures are allowed – use an additional score sheet if necessary.

There will be no appeals based upon answer sheet errors.

Answer E is for none of the above – we guarantee at least 1 answer E.

1. STUDENT PROCEDURES:

Keep your eyes on your own paper.

Keep answer sheets and scrap paper guarded.

You must stay in the room until the end of the test.

You can keep all materials at the end.

The time limit is 60 minutes.

1. TEST ANSWERS

Proctors will read the letter answers at the end of the testing period.

Appeals in writing must be brought to the scoring room no later than 3:30 PM. The appeal must show your detailed solution.

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| **2015 - 2016** | **ACSL**  **American Computer Science League**  **All-Star Contest** Short Round Questions |  |

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| 1. Boolean Algebra   Find all ordered triples that make the following Boolean expression TRUE. | 1. (1, 1, 0) (0, 1, 1) (0, 0, 1) 2. (0, 1, 1) (1, 1, 1) (0, 0, 1) 3. (0, 1, 0) (1, 0, 0) (0, 0, 0) 4. (1, 0, 0) (1, 1, 1) (0, 0, 1) 5. None of the above |
| 1. Bit-String Flicking   Solve for X (5-bits) in the following equation:  (LCIRC-2(RSHIFT-1 X)) OR (RCIRC-1(LSHIFT-2 X)) =  NOT X AND (LSHIFT-1(RCIRC-2 01011)) | 1. 10101 2. 01010 3. 01001 4. 10011 5. None of the above |
| 1. Recursive Functions   In the following definition,  represents the greatest integer less than or equal to *x*. Find. | 1. 13 2. 43 3. 58 4. 59 5. None of the above |
| 1. Digital Electronics   Define the following new gates: A *diamond* has three inputs and is TRUE if all inputs are TRUE, an *oval* has three inputs and is TRUE if an odd number of inputs are TRUE, and a *rectangle* has three inputs and is TRUE if all inputs are FALSE.  How many ordered quadruples make the following circuit TRUE? | 1. 0 2. 2 3. 4 4. 8 5. None of the above |
| 1. Prefix-Infix-Postfix   The trinary operator **diff** takes 3 arguments a, b, and c and returns the maximum of abs(a-b), abs(b-c), and abs(a-c), where abs(x) is the absolute value of x.  Evaluate the following prefix expression:  diff / 8 2 diff + 2 1 – 4 3 ↑ 2 3 \* 2 3 | 1. 0 2. 1 3. 2 4. 4 5. None of the above |
| 1. Computer Number Systems   The ACSL hardware engineers have recently developed a 5-bit memory chip using radical new biotechnology. Unfortunately, the chip melts whenever a value containing the pattern "101" appears within the 5 bits. Of the 32 possible values that the chip can hold, how many will cause the chip to melt? | 1. 4 2. 8 3. 11 4. 12 5. None of the above |
| 1. What Does This Program Do?   How many cells of array a$ are not blank when this program is run?  dim a$(30)  z$="abcdefghijklmnopqrstuvwxyz"  for i = 1 to 26  a$(i)=mid$(z$,i,1)  next i  for j = 1 to 26  if j/3=int(j/3) then a$(j)=a$(j+1)+a$(j-1)  next j  for k = 1 to 26  if (k/4=int(k/4))or((k+1)/3=int((k+1)/3)) then  a$(k)=a$(k-1)+a$(k)+a$(k+1)  next k  for b = 1 to 26  if(len(a$(b))=2) and (b/2=int(b/2)) then a$(b)=""  next b  for d = 1 to 26  if len(a$(d)) <= 3 then a$(d)=""  next d  end | 1. 10 2. 12 3. 14 4. 18 5. None of the above |
| 1. Data Structures   Using the ACSL definition, build a heap from the keys  N E W H A M P S H I R E (in that order).  List the nodes at depth 2, from left to right. | 1. A H P W 2. N I M P 3. H H W P 4. H H M P 5. None of the above |
| 1. Graph Theory  |  |  | | --- | --- | | How many cycles are there in the directed graph at the right? |  | | 1. 0 2. 2 3. 4 4. 6 5. None of the above |
| 1. LISP   Evaluate the following LISP expression:  (REVERSE (CONS (CAR (CDR ‘(a b (c d) (e f g))))  (REVERSE (CAR ‘((a b c) (d e) f))))) | 1. ((b) b c a) 2. (c b a b) 3. (b a b c) 4. (a b c b) 5. None of the above |
| 1. FSAs and Regular Expressions   Simplify the regular expression below to eliminate all union symbols.  a(a\*b)\*b(b\*a)\* | 1. a(ab\*)b(b\*a\*)\* 2. a(a\*b\*)\*b(b\*a\*) 3. a(a\*b\*)\*b(ba\*) 4. a(a\*b)b(b\*a)\* 5. None of the above |
| 1. Assembly Language   What is printed when the following program is run?   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | (continued at the right)   |  |  |  | | --- | --- | --- | | N | DC | 1 | | A | DC | 101 | | B | DC | 0 | | TOP | LOAD | N | |  | SUB | A | |  | BE | DOWN | |  | LOAD | N | |  | DIV | =10 | |  | STORE | T | |  | MULT | =10 | |  | STORE | P | |  | LOAD | N | |  | SUB | P | |  | STORE | D | |  | ADD | T | |  | STORE | S | |  | DIV | =3 | |  | STORE | Y | |  | MULT | =3 | |  | SUB | S | |  | STORE | X | |  |  |  | |  |  |  | | |  |  |  | | --- | --- | --- | |  |  |  | |  | BE | Z | |  | LOAD | N | |  | ADD | =1 | |  | STORE | N | |  | BU | TOP | | Z | LOAD | B | |  | ADD | =1 | |  | STORE | B | |  | LOAD | N | |  | ADD | =1 | |  | STORE | N | |  | BU | TOP | | DOWN | PRINT | B | |  | END |  | | | 1. 10 2. 25 3. 33 4. 90 5. None of the above |