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| **2017-2018** | **American Computer Science League** Junior Shorts Solutions | **All-Star Contest** |

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| 1. Boolean Algebra   =  =  =  =  =  =  =  =  =  If  = 0, then  So  If  (0, 1, \*, \*)  If  (0, 0, 0, 1)  If  (0, 0, 1, 1)  Therefore 5 ordered triples make it TRUE. | B. 5 |
| 1. Bit-String Flicking   (LSHIFT-1 (LCIRC-2 01010)) OR (RCIRC-1 (LSHIFT-2 X  AND 01110)) AND (LCIRC-2 (NOT (LCIRC-2 (X OR 01100))))  = (LSHIFT-1 (LCIRC-2 01010)) OR (RCIRC-1 (LSHIFT-2 abcde  AND 01110)) AND (LCIRC-2 (NOT (LCIRC-2 (abcde OR 01100))))  = (LSHIFT-1 01001) OR (RCIRC-1 (cde00 AND 01110)) AND  (LCIRC-2 (NOT (LCIRC-2 a11de)))  = 10010 OR (RCIRC-1 0de00) AND (LCIRC-2 (NOT 1dea1))  = 10010 OR 00de0 AND (LCIRC-2 0DEA0)  = 10010 OR 00de0 AND EA00D  = 10010 OR 00000  = 10010 | D. 10010 |
| 1. Recursive Functions   = − 1 = 10 − 1 = 9  =  = 7 + 3 = 10  =  = 8 − 1 = 7  =  = 9 − 1 = 8  =  = 10 − 1 = 9  =  = 7 + 3 = 10  =  = 4 + 3 = 7  = 4 | C. 9 |
| 1. Digital Electronics   Let D represent the diamond, R represent the rectangle  and O represent the oval. The digital circuit is represented  by the following Boolean expression:  (~A R (A D B D C) R ((A D B D C) O C O ~D))  D ((A D B D C) O C O ~D) D D  Let # = A D B D C and & = (A D B D C) O C O ~D   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | A | B | C | D | ~A | ~D | # | & | ~AR#R& | ~A#&D&DD | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |   Therefore there are 3 that make it TRUE: (0, 0, 0, 0), (0, 0, 1, 1), (1, 1, 0, 0). | B. 3 |
| 1. Prefix-Infix-Postfix   + − / \* 3 # # 0 2 2 \* 2 3 / # 4 − 8 6 \* 3 2 ↑ 2 4  = + − / \* 3 # (# 0 2) 2 (\* 2 3) / # 4 (− 8 6) (\* 3 2) (↑ 2 4)  = + − / \* 3 (# 4 2) 6 / (# 4 2) 6 16  = + − / (\* 3 12) 6 (/ 12 6) 16  = + − (/ 36 6) 2 16  = + (− 6 2) 16  = (+ 4 16)  = 20 | B. 20 |
| 1. Computer Number System     There are 13 numbers that have ascending digits in both bases from 100  to 200. They are (in base 10):  123, 124, 125, 126, 127, 137, 138, 139, 156, 157, 158, 159, 189 | A. 13 |
| 1. What Does This Program Do   The first nested loop defines the array.  The initial array is:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 1 | 2 | 3 | 4 | 5 | | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | 13 | | 16 | 17 | 18 | 19 | 20 | | 25 | 26 | 27 | 28 | 29 |   The second nested loop checks for numbers divisible by 3, 4 and 5. The  resulting array is:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 1 | 2 | 1 | 1 | 1 | | 1 | 1 | 2 | 7 | 2 | | 3 | 2 | 11 | 4 | 13 | | 4 | 17 | 6 | 19 | 1 | | 5 | 26 | 9 | 7 | 29 |   The final nested loop sums all the even entries. The sum is 44.  This is not one of the choices, so the answer is E. None of the above. | E. None of the above |
| 1. Data Structures     The smallest internal path length would occur for a balanced tree with  no gaps. For 8 nodes, levels 0 through 2 would be filled with 7  nodes and 1 on level 3. The internal path length would be:  2 \* 1 + 4 \* 2 + 1 \* 3 = 13 | B. 13 |