**American Computer Science League**

**2019-2020** **ACSL Finals**

**Elementary Shorts Solutions**

**1. Boolean Algebra**

NOT (10 - 3 ^ 2 ≤ 1) = NOT(1 ≤ 1) = NOT (true) = false

Therefore, the other expression must be true for OR to be true.

4 + 5 * 2 > 13 is the same as 14 > 13 which is always true.

Therefore, 56 / 8 - 1 ? 7 means 6 ? 7 must be true for AND to be true.

6 < 7 is the only option. That gives the correct solution: false OR (true AND true) = true.

1. < (B)

**2. Boolean Algebra**

~(A + ~B) * ~AB + ~(A~B)

= (~A + ~(~B)) * ~AB + ~A + ~(~B)

= ~A(~AB) + B(~AB) + ~A + B

= ~AB + ~AB + ~A + B = ~AB + ~A + B

You may use either

~A(B + 1) + B = ~A + B or B(~A + 1) + ~A = B + ~A.

The only possible answer is ~A + B which is choice b.

2. ~A+B (B)

**3. Boolean Algebra**

If A $ B = ~AB, then A $ B + (~A $ B) (~A $ ~B)

= ~AB + (~(~A) B) (~(~A) (~B))

= ~AB + (AB) (A~B)

= ~AB + A(~B)(B) = ~AB + A(0) = ~AB

Therefore, there is 1 solution: (0,1).

3. 1 (A)

**4. Prefix-Infix-Postfix**

2 3 2 ^ * 4 - 8 4 / / 5 2 * 2 + 2 / *

= ((((2 (3 2 ^) *) 4 -) (8 4 /) /) (((5 2 *) 2 +) 2 /) *)

= ((((2 9 *) 4 -) 2 /) ((10 2 +) 2 /) *)

= (((18 4 -) 2 /) (12 2 /) *)

= ((14 2 /) 6 *) = (7 6 *) = 42

4. 42 (B)

**5. Prefix-Infix-Postfix**

+ / * 4 + 2 7 ^ 6 2 * ^ + 1 4 2 2

= (+ (/ (* 4 (+ 2 7)) (^ 6 2)) (* (^ (+ 1 4) 2) 2))

= (+ (/ (* 4 9) 36) (* (^ 5 2) 2))

= (+ (/ 36 36) (* 25 2)) = (+ 1 50) = 51

5. 51 (D)

**6. Prefix-Infix-Postfix**

/ # * - ^ 3 2 4 7 ^ 6 $ 2 8 4

= (/ (# (* (- (^ 3 2) 4) 7) (^ 6 ($ 2 8))) 4)

= (/ (# (* (- 9 4) 7) (^ 6 2)) 4)

= (/ (# (* 5 7) 36) 4) = (/ (# 35 36) 4) = (/ 36 4) = 9

6. 9 (B)

**7. Computer Number Systems**

$2020_8 - 202_8 - 20_8 + 2_8 = 1616_8 - 20_8 + 2_8 = 1576_8 + 2_8 = 1600_8$
Remember, when subtracting in base 8, you must borrow 8, not 10. Also, when adding in base 8, you must carry 8 which occurs twice.
$1600_8$ = 001 110 000 000 = 11 1000 0000 = $380_{16}$

7. 380 (C)

**8. Computer Number Systems**

The 4 digits for all hexadecimal numbers are 0000=0, 0001=1, 0010=1, 0011=2, 0100=1, 0101=2, 0110 = 2, 0111=3 or a total of 12 for the first 8 and another 12+8 for the second 8. That equals 32. The numbers 16 to 31 have an additional 16 1's at the beginning for a total of 48. The number 32=100000 which makes 49.

8. 49 (B)

**9. Computer Number Systems**

a. $4A_{16} = 4 * 16 + 10 = 74_{10}$

b. $1001001_2 = 1 + 8 + 64 = 73_{10}$

c. $112_8 = 1 * 64 + 1 * 8 + 2 = 74_{10}$

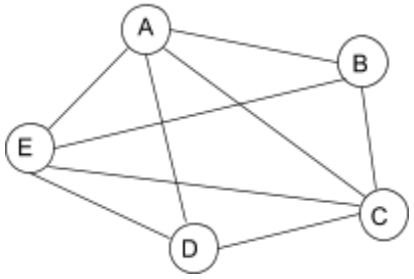
d. $49_{16} = 4 * 16 + 0 = 73_{10}$

e. $110_8 = 64 + 8 = 72_{10}$

9. $110_8$ (E)

**10. Graph Theory**

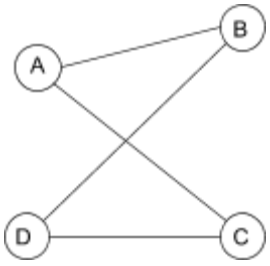
The degree on each vertex is: A = 4, B = 3, C = 4, D = 3, and E = 4. Traversable graphs are possible when there are either 0 or 2 vertices with an odd degree. Because there are 2 of them, all possible paths must start with B or D and end at the other vertex. One path is BCABEADCED, but others are possible. The vertices must be listed alphabetically as BD.




10. BD (C)

**11. Graph Theory**

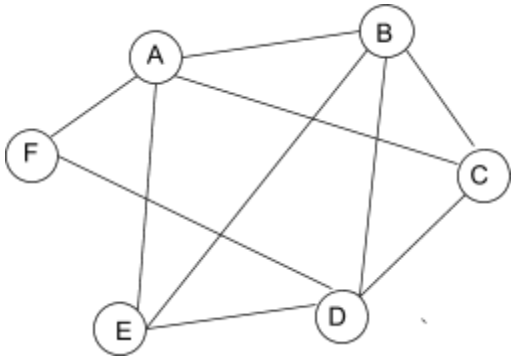
The graph can be drawn as follows. From vertex A, the 2 cycles are ABDCA and ACDBA. There are no cycles using just 3 vertices and all others from another vertex are the same path.




11. 2 (B)

**12. Graph Theory**

By inspection, there is no direct path from A to D. There are 4 paths of length 2: ABD, ACD, AED, and AFD. There are 4 paths of length 3: ABCD, ABED, ACBD, and AEBD. There are 2 paths of length 4: ACBED and AEBCD. There are none of length 5 which would include all 6 vertices. That's a total of 10.




12. 10 (D)