1 A $114_{(10)} = 01110010_{(2)}$

B $-44_{(10)} = 11001111_{(2)}$

C $87_{(10)} = 01010111_{(2)}$

D $-108_{(10)} = 10010100$ / $10100110_{(2)}$

E $-97_{(10)} = 10011111_{(2)}$

2

G $11011001_{(2)} = -39_{(10)}$

0100110
0100111
32+4+2+1 = 39

B $01110100_{(2)} = 116_{(10)}$

64+32+16+4
96+20 = 116

C $10110001 = -79_{(10)}$

1001110
1001111
64+8+4+2+1
16

$114_{(10)}$: 114/2 r=0, 57/2 r=1, 28/2 r=0, 14/2 r=0, 7/2 r=1, 3/2 r=1, 1/2 r=1 → 01110010

$-44_{(10)}$: 44/2 r=0, 22/2 r=0, 11/2 r=1, 5/2 r=1, 2/2 r=0, 1/2 r=1 → 00101100 → 11001111 + 1 = 11010011

$87_{(10)}$: 87/2 r=1, 43/2 r=1, 21/2 r=1, 10/2 r=0, 5/2 r=1, 2/2 r=0, 1/2 r=1 → 01010111

$-108_{(10)}$: 108/2 r=0, 54/2 r=0, 27/2 r=1, 13/2 r=1, 6/2 r=0, 3/2 r=1, 1/2 r=1 → 01101100 → 10010011 + 1 = 10010100

$-97_{(10)}$: 97/2 r=1, 48/2 r=0, 24/2 r=0, 12/2 r=0, 6/2 r=0, 3/2 r=1, 1/2 r=1 → 01100001 → 10011110 + 1 = 10011111

$11011001_{(2)} = -39_{(10)}$: 00100110 + 1 = 00100111

$01110100_{(2)} = 116_{(10)}$

$10110001 = -79_{(10)}$: 01001110 + 1 = 01001111

D $10111101_{(2)} = -67_{(10)}$

10000010
10000011

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Witness:	Date:	
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Title: Two's Complement Arithmetic

(E)

$00011011_{(2)} = 27_{(10)}$ ✓

(3)

(A)

  00010110
+ 00110101
= 01001011

53 + 22 = 75

(B)

  01110100
+ 10101011
= 00011111

4 + 16 + 32 + 64 = 116

1 + 2 + 4 + 8 + 16 = 31

1010100
1010101

1 + 4 + 16 + 64 = 85

116 − 85 = 31

(C)

  10011110
+ 00101011
= 11001001

1 + 2 + 8 + 64 = 75

(D)

  11011101
+ 11100011
= 11000000

1100001
1100010

64 + 32 + 2 = −98

2 + 8 + 32 = 43

98 − 43 = 55

(4)

(A) 23 + 14 = 37 ✓

2|23 r=1, 2|11 r=1, 2|5 r=1, 2|2 r=0, 2|1 r=1

2|14 r=0, 2|7 r=1, 2|3 r=1, 2|1 r=1

  00010111
+ 00001110
= 00100101

(B) 16 − 28 = 8 (36 − 28 = 8)

2|36 r=0, 2|18 r=0, 2|4 r=0, 2|1 r=1

2|4 r=1, 2|2 r=0, 2|1 = 1

2|28 r=0, 2|14 r=0, 2|7 r=1, 2|3 r=1, 2|1 r=1

  00100100
+ 11100100
= 00000000

00011100
11100011
11100100 ✓

(G) 64 − 47 = 17

  01000000
+ 11010001
= 00010001 ✓

2|47 r=1, 2|23 r=1, 2|11 r=1, 2|5 r=1, 2|2 r=0, 2|1 r=1

00101111
1101000
1101001

Conclusion

(1) The largest positive decimal number in 8-bit 2's complement is 127 (01111111). The smallest negative decimal number is −127 (10000000). This range exists since the left-most bit represents the sign.

(2) B

Left most ~~sign~~ bit determines the sign. B is the only negative option here.

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