2 Number System

1. Which of the following numbers is the best representation of the octal number: $(651.124)_8$
   (A) $(1A9.2C)_{16}$
   (B) $(1B0.160)_{16}$
   (C) $(1A8.123)_{16}$
   (D) $(1A9.298)_{16}$

2. Consider following numbers as representation of the decimal number: $(7569.1737)_{10}$
   (i) $(16621.13073640)_8$
   (ii) $(EC81.2C779A6B5)_{16}$
   (iii) $(3230201.0230130)_4$
   (iv) $(1D91.2C779A6B5)_{16}$
   Which of the following is correct statement regarding the best representation of the decimal number:
   (A) (i) only
   (B) (i) and (iii) only
   (C) (i) and (iv) only
   (D) (i), (iii) and (iv) only
   (E) (i), (ii), and (iii) only

3. Fraction of a number in decimal number system is represented as: pqr while the fractional part of same number in Hexadecimal number system is given by: PQR where p, q, r and P, Q, R are digits in respective number systems. Then which of the following is correct:
   (A) $(P * 100 + Q * 10 + R = p * 100 + q * 10 + r)_{10}$
   (B) $(P * 100 + Q * 10 + R \geq p * 100 + q * 10 + r)_{10}$
   (C) $(P * 100 + Q * 10 + R \leq p * 100 + q * 10 + r)_{10}$
   (D) $(P * 100 + Q * 10 + R < p * 100 + q * 10 + r)_{10}$

4. What will be the best way to represent 01010101 in an 8 bits 2's complement number system:
   (A) 10101010
   (B) 10101011
   (C) 10101100
   (D) 01010101

5. If $(402)_y$ is 7 less than $(173)_x$ then possible values of x and y are:
   (A) $11, 16$
   (B) $15, 12$
   (C) $19, 12$
   (D) $16, 13$

(E) $15, 9$

6. The result of this binary addition in a 16-bits system is:
   $01011011010 + 01110110111 = ?$
   (A) 0101011010010001
   (B) 0010011010010001
   (C) 0101001010010001
   (D) 0000011010010001

7. When a binary number 011011000111 is subtracted from another binary number 011000100001, the result in 2's complement binary number system can be shown as:
   (A) 111110100110
   (B) 000010100110
   (C) 000101011001
   (D) 111101011010

8. When a binary number 0100010011101110 is divided with another binary number 0000000010101101, the result in 1's complement binary number system can be given as:
   (A) 0000010101100110
   (B) 0000101001100111
   (C) 1111111110011001
   (D) 0000000001100110

9. When a binary number 0101.1100 is multiplied with another binary number 0110.1010, the result in 2's complement binary number system can be given as:
   (A) 100100.001010
   (B) 100010.000110
   (C) 101010.101010
   (D) 100110.000110

10. Consider a base 11 number system with following digits in it: $(0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A)$. Given two numbers in this number system as 2019 and 1990 when multiplied, produce output P which is again in same number system. Which of the following represents P better?
    (A) 3904940_{11}
    (B) 3804940_{11}
    (C) $38A4940_{11}$
    (D) $39A4940_{11}$

11. Excess-3 BCD has sum of its weights as:
    (A) 9
    (B) 10
    (C) 15
    (D) 16

12. Assume that result of addition of two binary numbers 1000 and 0101 in Excess-3 BCD is represented as P. The octal representation of P can be given by:
    (A) 163_8
    (B) 263_8
    (C) 204_8
    (D) 106_8

13. Assume that result of subtraction of two BCD numbers 2285 and 1957 in Excess-3 BCD is represented as P. The Hexadecimal representation of P can be given by:
    (A) $67E_{16}$
    (B) $92E_{16}$
    (C) $92B_{16}$
    (D) $65B_{16}$

14. The decimal equivalent of the excess-3 number 11100101000111.0101010011 is
    (A) 614.549
    (B) 3947.543
    (C) 1204.549
    (D) 614.219

15. To represent a decimal number in a system it needs n digits. What will be the size of a two dimensional array storing all such numbers where each cell of array stores one bit.
    (A) 10^{3n} bits
    (B) $10^n * n^3$ bits
    (C) $10^{3*n} * n$ bits
    (D) $10^n * 3n$ bits

16. The number of bits required to represent signed decimal integers having magnitude ranging from 0 to 99999 is:
    (A) 17
    (B) 20
    (C) 19

(D) 18

17. Reflected binary codes are well known as:
(A) BCD code
(B) Excess-3 Code
(C) ASCII code
(D) Gray Code

18. Consider an extension of Excess-3 scheme to excess-K scheme in order to represent integer numbers from 0 to 119, (instead of 0 to 9). Answer the following:
(i) Is it possible to do so?
(ii) If yes, how many bits are required to represent any number in this excess-K code system?
(iii) What should be the value of K (in excess-K), such that this system is self complementing.

19. Which of the following is a self complementing binary coding scheme:
(A) Excess-5 BCD code
(B) Gray code
(C) 1242 code
(D) 1621 code

20. The Gray code representation of 117_{10} is:
(A) 1111001
(B) 1001111
(C) 1110110
(D) 1110101

21. A logical circuitry is designed by combining two circuits. When given an n bit binary word first circuit converts it into its corresponding Gray code followed by another circuitry which does the reverse operation of the first circuitry.
If only Ex-OR gates are employed what is the minimum number of gates required to realize this logic?
(A) n
(B) 2n
(C) n-1
(D) 2n-2
(E) None of the above.

22. When two Gray coded binary numbers 0111101 and 1001011 are added together the result produced is stored in a 16 bit register A. The content of A is converted into its decimal equivalent followed by multiplication of 16_{10}.
Which of the following Hex-strings represents the resultant number:
(A) 08C1
(B) 19C0
(C) 18A0
(D) 09B0

23. Consider numbers represented in 4-bit gray code. Let $h_3h_2h_1h_0$ be the gray code representation of a number n and let $g_3g_2g_1g_0$ be the gray code of (n + 2) (modulo 16) value of the number.
Which one of the following functions is correct?
(A) $g_0 + g_1 = h_3 \odot h_2$
(B) $g_1 = h_3 \oplus h_2$
(C) $g_2 + g_1 = h_2 \oplus h_1$
(D) $g_2 + g_3 = h_2 + h_1$

24. The gray code for a decimal number N is 11111111_2. This number N is converted into P which belongs to $84 - 2 - 1$ code system. What is the Hexadecimal representation for P?
(A) ABC
(B) F55
(C) 170
(D) 790

25. Assuming all the numbers are in 2's complement representation. Consider following numbers:
(i) 11001000
56 (ii) 10111100
68 (iii) 11011101
35 (iv) 10001001
119 Which of the following numbers is/are divisible by 11101111:
(A) (i) and (ii) only
(B) (i) and (iii) only
(C) (ii) and (iii) only
(D) (ii) and (iv) only
(E) (i), (ii) and (iv) only

26. In 2's complement addition, overflow
(A) is flagged whenever there is carry from sign bit addition
(B) cannot occur when a positive value is added to a negative value

(C) is flagged when the carries from sign bit and previous bit match
(D) none of the above

27. Let $A = 11111010$ and $B = 00001010$ be two 8 bit 2's complement numbers. Their product in 2's complement in Hexadecimal format is shown as:
(A) 9C
(B) D5
(C) C4
(D) A5

28. Using a 4-bit 2's complement arithmetic, which of the following additions will result in an overflow?
(i) 1100 + 1100
(ii) 0011 + 0111
(iii) 1111 + 0111
(A) (i) only
(B) (ii) only
(C) (iii) only
(D) (i) and (iii) only

29. Zero has two representations in:
(a) Sign magnitude
(b) 1's complement
(c) 2's complement
(d) None of the above
(A) Only a
(B) a and b
(C) a and c
(D) a, b and c

30. A is a 32-bit signed integer. The 2's complement representation of A is $(F87B)_{16}$.The 2's complement representation of $8 * A$:
(A) $(F25D7138)_{16}$
(B) $(FF25D7138)_{16}$
(C) $(3F25D7138)_{16}$
(D) $(F25D7178)_{16}$

31. The number $(123456)_8$ is equivalent to:
(A) $(A72E)_{16}$ and $(22130232)_4$
(B) $(A72E)_{16}$ and $(22131122)_4$
(C) $(A73E)_{16}$ and $(22130232)_4$

(D) $(A62E)_{16}$ and $(22120232)_4$

32. What is the result of evaluating the following two expressions using three-digit floating point arithmetic with rounding?
(113. + -111.) + 7.51
113. + (-111. + 7.51)
(A) 9.51 and 10.0 respectively
(B) 10.0 and 9.51 respectively
(C) 9.51 and 9.51 respectively
(D) 10.0 and 10.0 respectively

33. Which of the following pairs represents maximum and minimum numbers which can be represented in n bits 2's complement integer representation?
(A) $(2^n, 0)$
(B) $(2^n - 1, -2^n)$
(C) $(2^{n-1}, -2^{-n})$
(D) $(2^{n-1} - 1, -2^{n-1})$

34. Write the 2's complement for each of the following 8-bit binary numbers.
(i) 01001000
(ii) 10101011
(iii) 1100111
(iv) 01100101
(v) 11111111
(vi) 00001111
(vii) 11001
(vii) 01010101

35. A processor that has carry, overflow and sign flag bits as part of its program status word (PSW) performs addition of the following two 2's complement numbers 01001101 and 11101001. After the execution of this addition operation, the status of the carry, overflow and sign flags, respectively will be:
(A) 1, 1, 0
(B) 1, 0, 0
(C) 0, 1, 0
(D) 1, 0, 1

36. Convert the following numbers to binary numbers using 8-bit 2's complement representation.
(i) -160_{10}
(ii) 136_{10}
(iii) -167_8

(iv) -1010_4
(v) 26_{10}
(vi) -31_6
(vii) $7F1C9_{16}$

37. If range of numbers which can represented in signed magnitude representation system, 2's complement system and 1's complement system are shown as S, A and B then which of the following correctly explains the relationship among the three ranges:
(A) $S = A = B$
(B) $S < A = B$
(C) $A > B > S$
(D) $A > S = B$

38. Consider the values $A = 2.0 * 10^{30}$, $B = -2.0 * 10^{30}$, $C = 1.0$, and the sequence
$X := A + B$ $Y := A + C$
$X := X + C$ $Y := Y + B$
executed on a computer where floating-point numbers are represented with 32 bits. The values for X and Y will be
(A) X = 1.0, Y = 1.0
(B) X = 1.0, Y = 0.0
(C) X = 0.0, Y = 1.0
(D) X = 0.0, Y = 0.0

39. Consider the addition of two 2's complement numbers $a_{n-1}a_{n-2}\dots a_0$ and $b_{n-1}b_{n-2}\dots b_0$. A binary adder for adding unsigned binary numbers is used to add the two numbers. The sum is denoted by $c_{n-1}c_{n-2}\dots c_0$ and the carry-out by c_{out}. Which one of the following options correctly identifies the overflow condition?
(A) $a_{n-1} \oplus b_{n-1} \oplus c_{n-1}$
(B) $c_{out} \odot c_{n-1}$
(C) $a_{n-1}b_{n-1}\overline{c_{n-1}} + \overline{a_{n-1}b_{n-1}}c_{n-1}$
(D) $c_{out} \oplus c_{n-1}$
(E) $\overline{c_{out}a_{n-1} \oplus b_{n-1}}$

40. Consider a number system with 32 digits in it as $\{0, 1, 2, 3, ...9, a, b, c, ...v\}$. Find 2's complement of each of the following numners in this system:
(i) $ps91$
(ii) $mnba$
(iii) $12uv$
(iv) $dfjk10$

41. Solve each of the following 8-bit subtraction problems using 2's complement representation.
(i) $01111111_2 - 78_{10}$
(ii) $00110010_2 - 123_{10}$
(iii) $01001001_2 - 111_{10}$
(iv) $00000111_2 - 35_{10}$

42. Represent each of the following using the 8-bit floating-point format which has 3 rightmost bits for the mantissa and 4 bits for the excess-7 exponent in the middle and most significant bit stands for sign of the float number.
(i) 2.25
(ii) -80.05
(iii) $\frac{1}{32}$
(iv) -0.625

43. Consider a 7-bit floating-point representation with a sign bit at MSB, 3 bits for the excess-3 exponent and rightmost 3 bits for the mantissa.
(i) What values do 1010100 and 00000100 represent as a decimal number.
(ii) What is the bit pattern of the smallest positive normalized number supported by this representation?
(iii) What is the bit pattern of the largest denormalized number supported by this representation?
(iv) Suppose we add 0101010 and 1111000 as 7-bit floating-point numbers. What is the bit pattern of the result?

44. Consider the 8-bit floating-point format which has 3 rightmost bits for the mantissa and 4 bits for the excess-7 exponent in the middle and most significant bit stands for sign of the float number. If a, b and c are 3 bit patterns in this system then which of the following is always true?
(A) $(a + b) + c = a + (b + c)$
(B) $a - b = b - a$
(C) $a - (b - c) = (a - b) - c$
(D) $a + a = 2a$

45. Consider the 16-bit floating-point format which has 9 rightmost bits for the mantissa and 6 bits for the excess-31 exponent in the middle and most significant bit stands for sign of the float number. Which of the following represents the difference between the smallest and third smallest normalized positive float value in this system?
(A) 2^{-39}
(B) 2^{-40}
(C) 2^{-38}
(D) 2^{-37}

46. Consider the 16-bit floating-point format which has 9 rightmost bits for the mantissa and 6 bits for the excess-31 exponent in the middle and most significant bit stands for sign of the float number. Which of the following represents the difference between the largest and eighth largest normalized positive float value in this system?
(A) 2^{22}
(B) 2^{23}
(C) 2^{24}
(D) 2^{25}

47. Consider the 16-bit floating-point format which has 9 rightmost bits for the mantissa and 6 bits for the excess-31 exponent in the middle and most significant bit stands for sign of the float number. If subnormal numbers are allowed in this system, which of the following represents the second smallest positive denormal float value in this system?
(A) 2^{-38}
(B) $1.5 * 2^{-39}$
(C) $2.5 * 2^{-40}$
(D) $3.5 * 2^{-41}$

48. In 16-bit floating point representation mentioned in previous question what is the range of denormalized numbers:
(A) $[2^{-38}, 2^{-30}]$
(B) $[2^{-38(1-2^{-1})}, 2^{-30}]$
(C) $[2^{-39}, 2^{-30}]$
(D) $[2^{-38}(1-2^{-1}), 2^{-30} * (1-2^{-9})]$
(E) None.

49. Which of the following hexadecimal representations represents -35.75 to its correct IEEE-754 standard single precision floating point format value:
(A) $0xC11F1000$
(B) $0xC20F1000$
(C) $0xE20F1000$
(D) $0xC20F0000$

50. Which of the following real numbers represents IEEE-754 standard single precision floating point value $0x40200000$ to its correct decimal value:
(A) 2.5
(B) 3.5
(C) 4.125
(D) 5.125

51. In IEEE-754 single precision floating point representation the hexadecimal value $ff800001$ corresponds to:
(A) Special value -0
(B) Special value $-\infty$
(C) A denormalized number
(D) None of the above

52. The following bit pattern represents a floating point number in IEEE 754 single precision format 11000010110110000000000000000000 The value of the number in decimal form is
(A) -106
(B0 -103
(C) -206
(D) -108
(E) None of these

53. What is the radix of the number if the solution to quadratic equation $x^2 - 10x + 31 = 0$ is $x = 5$ and $x = 8$?
(A) 10
(B) 8
(C) 5
(D) 13

54. The maximum possible finite positive value in IEEE single precision format in hexadecimal form can be given by:
(A) $7F7FFFFE$
(B) $7FFF7FFF$
(C) $7F7FFFFF$
(D) $7FFFFFFE$

55. The minimum possible normalized positive value in IEEE single precision format in decimal format can be given by:
(A) $1.175494351 * 10^{-38}$
(B) $1.042542784 * 10^{-38}$
(C) $1.241549361 * 10^{-38}$
(D) $1.241542784 * 10^{-38}$

56. Consider this C-like code fragment conforming to IEEE standards for float values:

float f = 0.01;
double d = 0.01;
if (f==d)

```
printf("Equal");
else if (f < d)
printf("Smaller");
else printf("Greater");
```

What is the output of this code:
(A) Equal
(B) Smaller
(C) Greater
(D) None

57. The fractional value $\frac{1}{3}$ is to be represented as a float value in double precision format defined by IEEE-754 standard. Which of the following hex values represents the number correctly:
(A) fd5 5555 5555 5555
(B) fd6 3333 3333 3333
(C) fd4 4444 4444 5555
(D) fd7 4444 4444 4444
(E) None

58. Let A and B are the largest and second largest numbers respectively in IEEE-754 Double precision format. What is the value of $|A - B|$?
(A) 2^{1023}
(B) 2^{678}
(C) 2^{937}
(D) 2^{971}

59. IEEE single precision floating point system a number with exponent all 0's and mantissa part with some nonzero value is called as *Denormalized number* or *Subnormal number*. What is the standard way to represent this number:
(A) $1.MANTISSA * 2^{-127}$
(B) $0.MANTISSA * 2^{-127}$
(C) $0.MANTISSA * 2^{-126}$
(D) $0.MANTISSA * 2^{-125}$