Radix FE Questions

- **Conversion between Hexadecimal and Decimal Fractions**
  - **Q1. Which of the following is the correct decimal fraction equal to hexadecimal fraction 0.248?**
    - a) 31/32
    - b) 31/125
    - c) 31/512
    - d) 73/512
  - **Q1. Which of the following is equal to the hexadecimal fraction 2A.4C?**
    - a) $2^5 + 2^3 + 2^1 + 2^{-2} + 2^{-5} + 2^{-6}$
    - b) $2^5 + 2^3 + 2^1 + 2^{-1} + 2^{-4} + 2^{-5}$
    - c) $2^6 + 2^4 + 2^2 + 2^{-2} + 2^{-5} + 2^{-6}$
    - d) $2^6 + 2^4 + 2^2 + 2^{-1} + 2^{-4} + 2^{-5}$
  - **Q1. Which of the following represents the hexadecimal fraction 3A.5C as a decimal fraction?**
    - a) 939/16
    - b) 3735/64
    - c) 14939/256
    - d) 14941/256
  - **Q1. Which of the following decimal values is equivalent to a hexadecimal fraction 0.B1?**
    - a) 177/256
    - b) 179/256
    - c) 181/256
    - d) 183/256
  - **Q2. Which of the following is the binary fraction that is the nearest equivalent to the decimal fraction 23.375?**

        - a) 10111.011
        - b) 10111.110
        - c) 11101.011
        - d) 11101.110
    - **Q1. What is the decimal representation of the hexadecimal number 123.4?**
        - a) 83.25
        - b) 83.5
        - c) 291.25
        - d) 291.5
- **Arithmetic Operations with Hexadecimal, Binary, and Other Radices**
    - **Q2. Which of the following is the correct value of the quadruple of hexadecimal fraction 0.FEDC?**
        - a) 1.FDB8
        - b) 2.FB78
        - c) 3.FB70
        - d) F.EDC0
    - **Q1. Which of the following arithmetic expressions is correct? Here, a number is written in radix notation; that is, a decimal subscript following the number (i.e. numberradix) is used to indicate the radix.**
        - a) $1010_2 + 10_8 = 17_{10}$
        - b) $1101_2 + 4_{16} = 17_{10}$
        - c) $14_8 + 11_2 = 16_{10}$
        - d) $B_{16} + 10_2 = 14_{10}$
    - **Q2. When the binary fraction 11101.110 is subtracted from the binary fraction 101101.101, what is the correct result?**
        - a) 111.001
        - b) 111.111
        - c) 1111.001

- d) 1111.111

- **Q1. Which of the following is equivalent to the result of the arithmetic expression "$168_{16} - 6A7_{53}$"**? (Note: The radix 53 in the second number appears unusual and might be a typo in the source.)
  - a) 101001101_2
  - b) 501_8
  - c) 325_{10}
  - d) 135_{16}
- **Q1. Which of the following is the result of calculating the arithmetic expression "B6–7C"? Here, all numbers are represented in unsigned hexadecimal.**
  - a) 32
  - b) 3A
  - c) B2
  - d) BA
- **Q1. Which of the following is equivalent to the calculation result of the arithmetic expression shown below? Here, each number is represented in radix notation; that is, the radix is represented by a subscript following the number. $6140_8 + 10011100_2 - C46_{16}$**
  - a) 10110101_2
  - b) 256_8
  - c) 180_{10}
  - d) $B6_{16}$
- **Q1. What is the sum of two binary fractions 1.0101 and 1.0111 expressed in decimal?**
  - a) 2.5
  - b) 2.75
  - c) 2.875
  - d) 2.9375

- **Q4. What is the sum of two binary fractions 1.0101 and 1.0111 expressed in decimal form?**
  - a) 2.5
  - b) 2.75
  - c) 2.875
  - d) 2.9375

- **Radix Determination from an Equation**
  - **Q2. In what radix does the following equation hold? 131− 45 = 53**
    - a) 6
    - b) 7
    - c) 8
    - d) 9
  - **Q1. When the equation "100n −34n = 44n" holds, which of the following represents 26n? Here, each number is written in radix notation; that is, each subscript "n" indicates the radix. In addition, when there is no subscript, the radix 10 is implied.**
    - a) 18
    - b) 20
    - c) 22
    - d) 38

- **Two's Complement Representation and Range**
  - **Q4. The decimal value "-72" is stored in an 8-bit register using 2's complement. If the data in the register is logically shifted two bits to the right, which of the following is the correct result that is represented in decimal?**
    - a) -19
    - b) -18
    - c) 45
    - d) 46

- **Q1. What range of decimal numbers can be represented with an 11-bit two's-complement number?**
  - a) -2048 to 2047
  - b) -2048 to 2048
  - c) -1024 to 1023
  - d) -1024 to 1024
- **Q3. In fixed-point representation that expresses negative numbers by two’s complement, which range of integers can be expressed with n bits? Here, the position of the binary point is to the right of the least significant bit.**
  - a) -2^n through $2^n - 1$
  - b) $-2^{n-1}-1$ through 2^{n-1}
  - c) -2^{n-1} through $2^{n-1} -1$
  - d) -2^{n-1} through 2^{n-1}
- **Q1. There is an 8-bit register where integers are represented in binary by using 2’s complement for negative numbers. When the decimal integer “–24” is stored in the register and is logically shifted right by one bit, which of the following is the resulting value in decimal?**
  - a) –13
  - b) –12
  - c) 12
  - d) 116
- **Q1. Which of the following is the appropriate combination that represents the decimal number “–19” in 8-bit one’s complement binary and 8-bit two’s complement binary?**
  - a) 00010011 11101100
  - b) 00010011 11101101
  - c) 11101100 11101100
  - d) 11101100 11101101

- **Q2. When 4-bit signed numbers in 2's complement are used, which of the following calculations results in an overflow?**
  - a) 3 + 4
  - b) 4 + 4
  - c) 6 + 1
  - d) 7 + 0
- **Q1. For an eight-bit integer x represented in two’s complement format, which of the following yields the value of 5x?**
  - a) x shifted left by 2 bits, then add x to the result.
  - b) x shifted left by 2 bits, then subtract x from the result.
  - c) x shifted left by 3 bits, then add x to the result.
  - d) x shifted left by 3 bits, then subtract x from the result.
- **Q1. For two 8-bit signed integers A and B in 2’s complement format, which of the following will cause an overflow when the addition of A and B is executed?**
  - a) 01111111 11111110
  - b) 01111111 01111110
  - c) 10000000 01110000
  - d) 11111111 11111111
- **Q2. n is a binary integer represented in two’s complement. Which of the following operations get the value 7 × n using only bit shifting and an addition or subtraction operation?**
  - a) Shift n 2 bits to the left, then add n to the result.
  - b) Shift n 2 bits to the left, then subtract n from the result.
  - c) Shift n 3 bits to the left, then add n to the result.
  - d) Shift n 3 bits to the left, then subtract n from the result.

- **Floating-Point Representation (IEEE 754) and Normalization**
  - **Q5. By definition of the IEEE754 standard, 32-bit floating point numbers are represented as follows: S (1 bit) E (8 bits) M (23 bits)... Which of the following is the correct “mask bits” in hexadecimal to be**

used for extracting only the exponent part of the above format? Here, “mask bits” means a bit pattern which is logically ANDed with the 32-bit floating point value.

- a) 107FFFFF
- b) 7F800000
- c) FF100000
- d) FF800000

- **Q3. In a floating-point number format, which of the following is the correct operation for adjusting the radix point and the exponent so that the most significant digit of the mantissa can be a non-zero value? Here, an absolute value is used for the mantissa.**
  - a) Carry
  - b) Normalize
  - c) Round down
  - d) Round up
- **Q4. In the single precision of “IEEE Standard for Binary Floating-Point Arithmetic” (IEEE 754), the value “V” is represented as follows: S: Sign (1 bit) E: Exponent (8 bits) F: Fraction (23 bits)... When the hexadecimal value C1E00000 is represented in IEEE 754, what is the correct value converted to decimal?**
  - a) −59
  - b) −44
  - c) −28
  - d) 26
- **Q3. Which of the following is the appropriate reason why the mantissa is normalized in the floating point representation?**
  - a) The arithmetic operation algorithm can be simplified.
  - b) The maximum number of significant digits can be maintained.
  - c) The range of representable values can be expanded.
  - d) The relative size relationships can be investigated as if in fixed point numbers.

- **Q1. Computer A uses the single precision of "IEEE Standard for Binary Floating-Point Arithmetic" (IEEE 754)... When the hexadecimal value 3F200000 is represented in IEEE 754, what is the correct value converted to decimal?**
  - a) 0.625
  - b) 0.65
  - c) 0.66
  - d) 0.6875
- **Q1. When the decimal arithmetic expression, 7 / 32, is evaluated, which of the following is the correct single-precision floating-point number represented in IEEE 754 standard?**
  - a) $3D800000_{16}$
  - b) $3E800000_{16}$
  - c) $3F800000_{16}$
  - d) 40800000_{16}
- **Q2. Which of the following is an appropriate explanation of the loss of significance?**
  - a) It occurs when the result of an operation exceeds the maximum handle limit and raises an exception.
  - b) It occurs when two nearly equal floating-point numbers are subtracted to produce a result of unacceptably reduced significant digits.
  - c) It occurs when the most significant digit of the mantissa becomes zero and is left unnormalized.
  - d) It occurs when the smallest representable value is too large to represent the calculation result.

- **Decimal to Octal Finite Fractions**
  - **Q2. Which of the following decimal fractions becomes a finite fraction in an octal representation?**
    - a) 0.3
    - b) 0.4

        - c) 0.5
        - d) 0.8
    - **Q1. Which of the following decimal fractions becomes a finite fraction when represented as an octal number?**
        - a) 0.3
        - b) 0.4
        - c) 0.5
        - d) 0.8
    - **Q2. Which of the following is a decimal that is represented as a finite digit octal fraction?**
        - a) 0.3
        - b) 0.4
        - c) 0.5
        - d) 0.8
- **Binary Number Properties and Operations**
    - **Q3. When a certain natural number x is expressed as a 2n-digit binary number "1010...10" consisting of 1 and 0 arranged alternately, which of the following equations can be formulated in terms of the number x?**
        - a) x + x/2 = 2^(2n)
        - b) x + x/2 = 2^(2n-1)
        - c) x + x/2 = 2^(2n+1)
        - d) x + x/2 = 2^(2n+1)-1
    - **Q4. An integer m is stored in a register as a binary value. If this value is shifted to the left by three bits and m is added to the shifted value, how many times as large as m is the resulting number? Here, no overflow occurs.**
        - a) 4
        - b) 7
        - c) 8

- d) 9

- **Q5. Which of the following is the reason why a large number of computers use “complement representation” to simplify arithmetic circuits?**
  - a) Addition can be processed by subtraction.
  - b) Division can be processed by a combination of subtractions.
  - c) Multiplication can be processed by a combination of additions.
  - d) Subtraction can be processed by addition.
- **Q2. A register stores a numerical value representing a binary number. After a positive integer x is entered in the register, the following operation is performed: “shift the register value two bits to the left and add x.” How many times as large as x is the new value of the register? Here, the shift does not cause an overflow.**
  - a) 3
  - b) 4
  - c) 5
  - d) 6
- **Q3. Which of the following is the appropriate way to check whether or not an 8-bit unsigned binary number x is a multiple of 16?**
  - a) The bit-by-bit logical product between x and the binary number 00001111 is 0.
  - b) The bit-by-bit logical product between x and the binary number 11110000 is 0.
  - c) The bit-by-bit logical sum between x and the binary number 00001111 is 0.
  - d) The bit-by-bit logical sum between x and the binary number 11110000 is 0.
- **Q7. Which of the following operations does not change the lower 4 bits of an 8-bit string?**
  - a) A logical product (i.e. AND) with a bit string 0F in hexadecimal
  - b) A logical sum (i.e. OR) with a bit string 0F in hexadecimal

    - c) A negative logical product (i.e. NAND) with a bit string 0F in hexadecimal
    - d) An exclusive logical sum (i.e. exclusive OR) with a bit string 0F in hexadecimal
- **Q4. When the resulting value of the expression "$13 \times 16^3 + 11 \times 16^2 + 9 \times 16 + 3$" is represented in binary, how many "1" bits are included in the binary value?**
    - a) 6
    - b) 10
    - c) 13
    - d) 16
- **Q1. If a given bit string contains at least one 1-bit, the algorithm below leaves the rightmost 1-bit unchanged but makes all the others 0. For example, if the given bit string is 00101000, the result will be 00001000. Which of the following is the appropriate logical operation to be filled in D? Step 1: By regarding the given bit string A as an unsigned binary number, let B be the result of subtracting 1 from A. Step 2: Calculate the XOR (exclusive logical sum) of A and B, and let C be the result. Step 3: Calculate the D of A and C, then set the result back to A.**
    - a) AND (logical product)
    - b) NAND (negative logical product)
    - c) OR (logical sum)
    - d) XOR (exclusive logical sum)
- **Q2. When the hexadecimal value ABCD in a 32-bit register is logically shifted right by two bits, which of the following is the resulting value in hexadecimal?**
    - a) 2AF3
    - b) 6AF3
    - c) AF34
    - d) EAF3

- **Q1. For an 8-bit binary integer, which of the following sets the middle 4 bits to 1s while inverting the remaining bits?**
  - a) Performing a bitwise AND operation with 00111100
  - b) Performing a bitwise NAND operation with 11000011
  - c) Performing a bitwise OR operation with 11000011
  - d) Performing a bitwise XOR operation with 00111100
- **Q2. What is the Hamming distance of bit strings 10101 and 11110?**
  - a) 0
  - b) 2
  - c) 3
  - d) 5
- **Q1. For an 8-bit binary integer, which of the following is the operation that extracts the most significant 4-bits while making the other bits zero?**
  - a) Bitwise AND operation with 11110000.
  - b) Bitwise NAND operation with 11110000.
  - c) Bitwise OR operation with 00001111.
  - d) Bitwise XOR operation with 00001111.
- **Q5. What is the Hamming distance of bit strings 10101 and 11110?**
  - a) 0
  - b) 2
  - c) 3
  - d) 5
- **Q1. For an 8-bit binary integer, which of the following sets the least significant bit to 1 while leaving the other bits unchanged?**
  - a) Perform bitwise AND operation with 00000001.
  - b) Perform bitwise NAND operation with 11111110.
  - c) Perform bitwise OR operation with 00000001.
  - d) Perform bitwise XOR operation with 00000001.

- **Q2. For a non-negative integer x, which of the following gives the remainder after division of x by 8 as a result?**
  - a) Performing a bitwise AND operation on x and 7
  - b) Performing a bitwise AND operation on x and 248
  - c) Performing a bitwise OR operation on x and 8
  - d) Performing a bitwise OR operation on x and 15
- **Q2. For non-negative integer A, which of the following has the same value as (A mod 32) + 64? Here, mod, +, AND, and OR are remainder-after-division, arithmetic addition, bitwise-AND, and bitwise-OR operators, respectively.**
  - a) (A AND 31) OR 64
  - b) (A AND 32) OR 32
  - c) (A OR 31) AND 64
  - d) (A OR 64) AND 32
- **Q33. In an OS where permissions for reading, writing, or executing a file can be independently set as attributes of the file, one bit is allocated for each of these three (3) permissions to determine whether they are allowed or not. When these three bits are configured using an octal value from 0 through 7, the trial results below are obtained. Which of the following is an appropriate trial result? [Trial results] (1) When 0 is set, reading, writing, and execution can no longer be performed. (2) When 3 is set, reading and writing can be performed, but execution cannot. (3) When 7 is set, reading, writing, and execution can be performed.**
  - a) When 2 is set, reading and execution can be performed.
  - b) When 4 is set, only execution can be performed.
  - c) When 5 is set, only writing can be performed.
  - d) When 6 is set, reading and writing can be performed.

- **Hexadecimal to Octal and Vice Versa**
  - **Q1. What is the octal equivalent value of the hexadecimal number 7B5?**

        - a) 735
        - b) 3665
        - c) 7551
        - d) 7561
    - **Q1. What is the octal representation of a hexadecimal fraction F1B0.C?**
        - a) 170660.6
        - b) 361540.14
        - c) 743300.6
        - d) 5213052.3
- **Counting Bits and Character Encoding**
    - **Q4. What is the minimum number of bits required to uniquely encode upper-case alphabetic characters (i.e., A through Z) and numeric characters (i.e., 0 through 9) in the same number of bits?**
        - a) 5
        - b) 6
        - c) 7
        - d) 8
    - **Q25. Currently, the number of customers is 8,000 with annual increase rate of 20%. By assigning a fixed length code using 26 uppercase alphabet A- Z to each customer, what is the minimum code length required to accommodate all the customers for next three years?**
        - a) 3
        - b) 4
        - c) 5
        - d) 6
    - **Q35. A monochrome image is digitalized at 300 dpi (dots per inch) and saved as 1-bit data. When the image is printed on a paper whose width is 11 inches, how many bits are required for the width?**
        - a) 32

        - b) 64
        - c) 128
        - d) 256
    - **Q4. When the resulting value of the expression "$13 \times 16^3 + 11 \times 16^2 + 9 \times 16 + 3$" is represented in binary, how many "1" bits are included in the binary value?**
        - a) 6
        - b) 10
        - c) 13
        - d) 16
- **Audio/Image Digitalization (Implicit Conversions)**
    - **Q29. When a 60-minute monaural audio signal is digitalized using a PCM format with a sampling rate of 44.1 kHz and a resolution of 16 bits, what is the appropriate size of the digitalized audio data in MB?**
        - a) 2.5
        - b) 25.2
        - c) 50.4
        - d) 423.4
    - **Q29. Audio is sampled 11,000 times a second, and each sampled value is recorded as 8-bit data. How many minutes of audio at maximum can be recorded in flash memory with a capacity of 512×10^6 bytes?**
        - a) 77
        - b) 96
        - c) 775
        - d) 969
    - **Q30. Audio is sampled and recorded at a frequency of 11,000 times per second with a resolution of 8 bits per sample. How many minutes of audio at maximum can be recorded in flash memory with a capacity of 512×10^6 bytes?**

        - a) 77
        - b) 96
        - c) 775
        - d) 969
    - **Q26. An audio signal is sampled 11,000 times per second while each sample is recorded as an 8-bit data. When a 512×10^6-byte capacity flash memory is used, what is the maximum number of minutes to record such data?**
        - a) 77
        - b) 96
        - c) 775
        - d) 969
    - **Q4. Analog audio data is being sampled and converted to 8-bit digital audio data using the PCM method, then transmitted in 64,000 bits per second. What is the sampling interval in microseconds?**
        - a) 15.6
        - b) 46.8
        - c) 125
        - d) 128
    - **Q25. Audio signals are recorded using 8-bit samples at a sampling rate of 11,000 times per second. When a flash memory of 512×10^6 bytes is used, what is the maximum recording time of such data in minutes?**
        - a) 77
        - b) 96
        - c) 775
        - d) 969
    - **Q17. Audio signals are recorded using 8-bit samples at a sampling rate of 11,000 times per second. When a flash memory of 512×10^6 bytes is used, what is the maximum recording time of such data in minutes?**

        - a) 77
        - b) 96
        - c) 775
        - d) 969
    - **Q24. Which of the following is a process in PCM to capture analog values from audio signals at a regular interval?**
        - a) Encoding
        - b) Reverse quantization
        - c) Quantization
        - d) Sampling
    - **Q25. Which of the following is a process in PCM to capture analog values from audio signals at a regular interval?**
        - a) Encoding
        - b) Reverse quantization
        - c) Quantization
        - d) Sampling
    - **Q25. Audio signals are recorded using 8-bit samples at a sampling rate of 11,000 times per second. When a flash memory of 512×10^6 bytes is used, what is the maximum recording time of such data in minutes?**
        - a) 77
        - b) 96
        - c) 775
        - d) 969
- **Digital to Analog (D/A) Conversion**
    - **Q24. A D/A (digital-to-analog) converter with a resolution of 8 bits generates the output voltage 0 volts for the digital input value 0, and the output voltage 2.5 volts for the digital input value 128. When the lowest one bit of the digital input value is changed, which of the**

following is the change (in volts) of the output voltage that is generated by the D/A converter?

- a) 2.5/128
- b) 2.5/255
- c) 2.5/256
- d) 2.5/512

- **Q21. A D/A (digital-to-analog) converter with a resolution of 8 bits generates the output voltage of 0 volts for the digital input value of 0, and an output voltage of 2.5 volts for a digital input value of 128. When the lowest 1 bit of the digital input value is changed, which of the following is the change (in volts) of the output voltage that is generated by the D/A converter?**
  - a) 2.5/128
  - b) 2.5/255
  - c) 2.5/256
  - d) 2.5/512

- **Disk Drive Capacity / Memory Addressing (Implicit Radix Calculation)**
  - **Q1. When a total of 400 data records are stored in contiguous memory starting from the address 02748, which of the following is the address where the last data record is stored? Here, each data record occupies one address location, and each address is represented in radix notation.**
    - a) 06738
    - b) 06748
    - c) 06758
    - d) 06768
  - **Q7. There is a three-dimensional array A starting with A and ending with A, and consecutive integers starting with 0 are stored in ascending order. What is the maximum value (in hexadecimal) of the integers that can be stored in the array? Here, each number in the answer list is written in radix notation.**

        - a) 68_{16}
        - b) 69_{16}
        - c) 104_{16}
        - d) 105_{16}
    - **Q13. There is a disk drive that has a capacity of 8 GB. The drive has five (5) platters with two (2) surfaces: 10,000 tracks per surface and 200 sectors per track. How many bytes are in each sector? Here, 1 GB is 1,000,000,000 bytes.**
        - a) 100
        - b) 200
        - c) 400
        - d) 800
    - **Q12. A computer system uses memory-mapped I/O, and its memory space is 2^{32} bytes. If 2^{26} bytes are allocated to the memory, and 2^{8} input/output ports are provided independently of those address lines, what is the maximum number of addressable memory that can be mapped to I/O devices? Here, the management information can be ignored.**
        - a) 22
        - b) 26
        - c) 28
        - d) 32
    - **Q14. A RAID 6 server is configured with six hard disk drives, and each drive's capacity is one TB. What is the maximum total data storage capacity in TB? Here, spare disks are not used.**
        - a) 3
        - b) 4
        - c) 5
        - d) 6
- **Check Digit Calculation**

- **Q24. For a given data, the check digit is calculated with the method below and is appended to the original data. When the given data are 7394, what is the result? Here, the weight is 1234 and base number is 11. (1) For each digit of the data, calculate the product with the digit at the same radix of the weight; then calculate the sum of the products. (2) Calculate the remainder of dividing the sum by the base number. (3) Subtract the remainder from the base number; then take the one's place of the result as the check digit. However, if the result is 10, X is used as the check digit. For example, if the check digit of 12345 is 6, the resulting data are 123456.**
  - a) 73943
  - b) 73945
  - c) 73946
  - d) 73947
- **Q23. For a given decimal data, the check digit is calculated with the method below and is appended to the original data. When the given data is 7394, what is the result? Here, the weight is 1234 and the base number is 11. (1) For each digit of the data, calculate the product with the digit at the same radix of the weight and calculate the sum of these products. (2) Calculate the remainder after the division of the sum by the base number. (3) Subtract the remainder from the base number and let the last digit of the result be the check digit. However, if the result is 10, X is used as the check digit. For example, if the check digit of 12345 is 6, the resulting data are 123456.**
  - a) 73943
  - b) 73945
  - c) 73946
  - d) 73947

- **Radix-related Program Logic**
  - **Q6. When a certain natural number x is expressed as a 2n-digit binary number "1010...10" consisting of 1 and 0 arranged alternately, which of the following equations can be formulated in terms of the number x?**

- a) x + x/2 = 2^(2n)
- b) x + x/2 = 2^(2n-1)
- c) x + x/2 = 2^(2n+1)
- d) x + x/2 = 2^(2n+1)-1

- **Q6. Which of the following is an appropriate input for a common anode seven-segment display to display a character shown as output? Here, A represents the most significant bit (MSB) and G represents the least significant bit (LSB).** (Image of 'E' displayed)
  - a) 0110000
  - b) 0000110
  - c) 1001111
  - d) 1111001
- **Q6. There is a two-dimensional integer array A whose (i, j)-th element A[i, j] is 2 × i + j. What is the value of the element A[A × 2, A + 1]?**
  - a) 12
  - b) 13
  - c) 18
  - d) 19