**Test Bank—Chapter One (Data Representation)**

**Multiple Choice Questions**

1. Which of the following Boolean operations produces the output 1 for the fewest number of input patterns?

A. AND B. OR C. XOR

ANSWER: A

2. Which of the following best describes the NOR operation?

A. An XOR followed by a NOT B. An OR followed by a NOT

C. A NOT followed by an OR C. An AND followed by a NOT

ANSWER: B

3. Which of the following bit patterns cannot be expressed in hexadecimal notation?

A. 11111111 B. 1001 C. 110011 D. 100000000001

ANSWER: C

4. Which of the following is the binary representation of 6 5/8?

 A. 110.11 B. 10.011 C. 110.101 D. 100.101

ANSWER: C

5. Which of the following bit patterns represents the value 9 in two’s complement notation?

 A. 00011010 B. 11111011 C. 00001001 D. 11111011

ANSWER: C

6. Which of the following bit patterns represents the value -9 in two’s complement notation?

 A. 00011010 B. 111110111 C. 10001001 D. 11111011

ANSWER: B

7. What is the result of the following addition problem (using two’s complement notation)?

 00001111

 + 10101010

 A. 011000101 B. 10111001 C. 01010101 D. 10110101

ANSWER: B

8. What is the result of the following subtraction problem (using two’s complement notation)?

 00001111

 - 10101010

 A. 011000101 B. 10111001 C. 01010101 D. 10110101

ANSWER: A

9. In which of the following addition problems (using two’s complement notation) does an overflow error occur?

 A. 0011 B. 1100 C. 1100 D. 0100

 + 1010 + 0100 + 1100 + 0100

ANSWER: D

10. Which of the following representations in two’s complement notation represents the largest value?

 A. 00000010 B. 11110000 C. 00000001 D. 11111111

ANSWER: A

11. Which of the following representations in two’s complement notation represents the smallest value?

 A. 00000010 B. 11110000 C. 00000001 D. 11111111

ANSWER: D

12. Which of the following bit patterns (represented in hexadecimal notation) represents a negative number in two’s complement notation?

 A. 3F B. 55 C. A6 D. 7E

ANSWER: C

13. Which of the following bit patterns (represented in hexadecimal notation) represents a positive number in two’s complement notation?

 A. 9F B. F7 C. A8 D. 7E

ANSWER: D

14. What value is represented by the bit pattern 01011100 when interpreted using floating-point format in which the most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa?

 A. -1 1/2 B. 1 1/2 C. -3/8 D. 3/8

ANSWER: B

15. Which of the following values cannot be stored accurately using a floating-point format in which the most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa?

 A. 2 1/2 B. 3/16 C. 7 D. 6 1/4

ANSWER: D

16. Which of the following bit-patterns represents the smallest value using the floating-point format in which the most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa?

 A. 01001000 B. 01011000 C. 00101000 D. 01111000

ANSWER: C

17. Which of the following data storage systems provides the most efficient random access to individual data items?

 A. Main memory B. Magnetic disk C. CDs/DVDs D. Flash drives

ANSWER: A

18. Which of the following storage systems is best suited for storing and retrieving long strings of data such as music that are processed in a sequential order?

 A. Main memory B. Magnetic disk C. CDs/DVDs D. ROM chips

ANSWER: C

19. Which of the following mass storage system does not require physical motion?

 A. Magnetic tape B. Magnetic disk C. CDs/DVDs D. Flash drives

ANSWER: D

20. Assuming that each of the following bit patterns originally had even parity, which one contains an error?

 A. 100110100 B. 110000011 C. 010011000 D. 100011001

ANSWER: C

21. How many errors per pattern could be corrected when using an error-correcting code in which any two code patterns differ by a Hamming distance of 8?

 A. 3 B. 4 C. 5 D. 6

ANSWER: A

22. Which of the following is a possible LZW compression of the message “xyz xyz xyz”?

 A. 1234 B. 1234545 C. 232 D. 12

ANSWER: B

23. Which of the following systems is least efficient when encoding numeric values?

 A. Two’s complement notation B. Excess notation

 C. ASCII D. Floating-point notation

ANSWER: C

24. Which of the following is a means of encoding music?

 A. ASCII B. MIDI C. JPEG D. GIF

ANSWER: B

25. Which of the following provides a compressed representation of an image by limiting the number of different pixel colors to 256, thereby enabling each pixel in an image to be represented by a single byte whose value indicates which of a palette of entries represents the pixel’s color?

 A. ASCII B. MPEG C. JPEG D. GIF

ANSWER: D

26. A single bit can be used to represent two of the following:

1. Grade on a test B. integer modulo 2 C. car’s speed D. light switch

ANSWER: B, D

 27. Hexadecimal notation is preferred to represent digital data. Choose the incorrect choice.

1. it uses fewer digits than binary B. Computers can understand only hex c. it is convenient and brief d. it is easier to read hex

ANSWER: B

 28. Arrange the following numbers in ascending order

1. Binary 1011
2. Decimal 8

 c. Hexadecimal F

1. a, b, c B. b, a, c C. c, b, a D. All numbers are equal

ANSWER: B

29. Rita was working on a solution to add two 8 bit numbers. She encounters an error when she adds 11111111 and 11111111. What type of error has occurred in this situation?

1. syntax B. overflow C. no error D. logic

ANSWER: B

30. Brad is driving around the city trying to locate the new pizza store but the GPS in his car keeps pointing to the street on which no commercial stores exist. Brad is frustrated and gives up. The most likely cause for this type of error is

1. GPS coordinate calculations were rounded off B. Brad doesn’t know how to read directions

 C.

ANSWER: A

31. RLE(Run Length Encoding) is a data compression technique where data is compressed to store data value and the number of times it is repeated. For example, the following is the technique to represent white text on a black background: B = black pixel and W = white pixel

 BBBBBBWBBBBWWWBBB

RLE data compression renders the above as 6B1W4B3W3B which is interpreted as a sequence of six Bs,one W, four Bs, 3Ws,etc. Which of the following is true about RLE?

1. RLE is lossless compression which keeps data transfer on the internet fast and efficient
2. RLE is lossy compression which causes the original data to be lost due to compression; some data is lost forever.
3. RLE is lossless compressions because original data can be restored to original form using RLE decoding.
4. RLE is lossy compression because it alters the original data permanently.

ANSWER: C

32. Select the correct choice that indicates the increasing level of abstraction in hardware

1. logic gates, chips, memory, motherboard
2. chips, motherboard, logic gates, memory
3. motherboard, memory, chips, logic gates
4. logic gates, memory, motherboard, chips

ANSWER: A

33. Sheena works for a large bank in the IT department. The number of bank customers has been increasing rapidly and the bank’s IT team has to reconsider upgrading the existing storage media to accommodate the new customer data. Sheena knows that choice of storage media depends on

1. Method of manipulating data
2. Cost of manipulating data
3. Convenience of storage media
4. I only
5. II only
6. I and II
7. III only

ANSWER: C

34.

**34.**

**Fill-in-the-blank/Short-answer Questions**

1. A computer’s main memory consists of numerous memory cells, each of which contains \_\_\_\_\_\_\_\_ bits. Each memory cell is identified by a numeric value called the cell’s \_\_\_\_\_\_\_\_\_.

ANSWER: eight, address

2. Represent the bit pattern 1111010010011011 in hexadecimal notation.

\_\_\_\_\_\_\_\_\_

ANSWER: F49B

3. A7DF is the hexadecimal representation for what bit pattern?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 1010 0111 1101 1111

4. How many different bit patterns can be formed if each must consist of exactly 6 bits?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 64

5. How many bits are needed to represent 1024 different bit patterns?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 10

6. Translate each of the following binary representations into its equivalent base ten representation.

 A. 1100 \_\_\_\_\_\_\_\_\_\_

B. 10011 \_\_\_\_\_\_\_\_\_\_

C. 01101 \_\_\_\_\_\_\_\_\_

D. 10001 \_\_\_\_\_\_\_\_\_\_

ANSWER: A. 12 B. 19 C. 13 D. 17

7. Rewrite each of the following values (represented in base ten notation) in binary notation.

 A. 7 \_\_\_\_\_\_\_\_\_\_

B. 23 \_\_\_\_\_\_\_\_\_\_

C. 31 \_\_\_\_\_\_\_\_\_\_

 D. 58 \_\_\_\_\_\_\_\_\_\_

ANSWER: A. 111 B. 10111 C. 11111 D. 111010

8. If the patterns 101.11 and 1.011 represent values in binary notation, what is the binary representation of their sum?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 111.001

9. Using a two’s complement notation system in which each value is represented by a pattern of six bits, represent the value 5.

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 000101

10. Using a two’s complement notation system in which each value is represented by a pattern of six bits, represent the value -5.

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 111011

11. What is the largest positive integer that can be represented in a two’s complement system in which each value is represented by eight bits?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 127 (represented by 01111111)

12. What is the smallest negative integer that can be represented in a two’s complement system in which each value is represented by eight bits?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: -128 (represented by 10000000)

13. In a two’s complement system, what value is represented by the pattern 11111111111111001?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: -7

14. When using two’s complement notation, what bit pattern represents the negation of 01001010?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 10110110

15. What value is represented by each of the following patterns in excess notation?

 A. 10000 \_\_\_\_ B. 0110 \_\_\_\_ C. 1100 \_\_\_\_

ANSWER: A. 0, B. -2, C. 4

16. Using an 8-bit floating-point format in which the most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa, write the bit pattern that represents the value 1 3/4. (Use normalized form.)

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 01011110

17. What is the largest value that can be represented in a floating-point system in which each value is encoded by a byte whose most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 7 1/2 (represented as 01111111)

18. Which of the following addition problems cannot be solved accurately when using a floating-point system in which each value is encoded by a byte whose most significant bit is the sign bit, the next three bits represent the exponent field in excess notation, and the last four bits represent the mantissa?

 A. 2 1/2 + 1 3/8 B. 3 1/2 + 4 1/2 C. 7 + 3/4

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: A, B, and C

19. The following is an error-correcting code in which any two patterns differ by a Hamming distance of at least three.

 Symbol Representation

 A 000000

 B 001111

 C 010011

 D 011100

 E 100110

 F 101001

 G 110101

 H 111010

Decode each of the following patterns

 010011 \_\_\_\_\_\_\_\_ 101010 \_\_\_\_\_\_\_\_ 011000 \_\_\_\_\_\_\_\_ 101101 \_\_\_\_\_\_\_

ANSWER: C, H, D, F

20. How many errors in a single code pattern could be corrected when using an error-correcting code in which each code pattern is a Hamming distance of at least seven from any other code pattern?

 \_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: 3

21. The following is a message that was originally encoded so that each pattern had odd parity. Circle the patterns in which an error has definitely occurred.

 101110101 111110000 100010010 000000000 111111111 010001000 100111101

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ANSWER: First, fourth, sixth, and seventh

22. Data compression techniques apply various principles to reduce the size of data. One, called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, avoids repeating long strings of the same data item. Another, called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, encodes the difference between consecutive blocks of data rather than encoding each block in its entirety. Still another, called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, uses short bit patterns to encode frequently occurring items and longer patterns to encode less frequent items.

ANSWER: Run-length encoding, relative encoding, and frequency-dependent encoding.

23. The \_\_\_\_\_\_\_\_\_\_\_\_\_ adds to the functionality and purpose of a software program.

ANSWER: comments

24. Two or more strings can be combined using the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ operator

ANSWER: concatenation

25. The technique of reducing the size of data for purposes of storing or transferring data is called \_\_\_\_\_\_\_\_\_\_\_\_.

ANSWER: data compression

26. Images are represented as a collection of dots called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

ANSWER: pixel

**Vocabulary (Matching) Questions**

The following is a list of terms from the chapter along with descriptive phrases that can be used to produce questions (depending on the topics covered in your course) in which the students are ask to match phrases and terms. An example would be a question of the form, “In the blank next to each phrase, write the term from the following list that is best described by the phrase.”

**Term Descriptive Phrase**

bit Binary digit

Boolean operation AND, OR, XOR, NOT

address A numeric value used to identify a memory cell

hexadecimal notation An efficient way of representing bit patterns

track A circle on the surface of disk platter on which data is written/read

sector A segment of a track in a mass storage system

cylinder A set of tracks at a given position of the read/write heads

seek time The time required to move the read/write heads from one track to another

latency time The average amount of time required for the desired data to rotate around to the read/write head

transfer rate The rate at which data can be written to or read from a device

zoned-bit recording A means of increasing the storage capacity of a magnetic disk system

ISO An international organization for establishing standards

ANSI A major standardization organization within the United States

ASCII A system developed by the American Standards Institute for encoding

text.

flip-flop A digital circuit capable of holding a single digit

two’s complement notation A means of encoding whole numbers

floating-point notation A means of encoding numeric values that may involve fractions

truncation An error that may occur when using floating-point notation

pixel A small part of an image

GIF A means of compressing an image file by restricting the number of

colors available

JPEG A means of compressing images by blurring the boundaries between

different colors while maintaining all brightness information

Unicode A means of encoding text in which each symbol is represented by 21

bits which may be encoded in UTF-8, UTF-16, or UTF-32 formats.

SD card An application of flash technology

Flash memory A mass storage device that traps electrons in tiny chambers of silicon dioxide

LZW An example of adaptive dictionary encoding

MIDI A means of encoding music in terms of notes and instruments rather

than actual audio

VLSI A means of constructing complex circuitry in a very small space.

**General Format Questions**

1. Describe how a computer can produce an incorrect answer when performing numerical computations even though it has not malfunctioned.

ANSWER: Most students will probably refer to overflow and truncation errors.

2. Describe how the concept of Hamming distance is used to produce an error-correcting code.

ANSWER: By designing a code in which each pattern has a Hamming distance of *n* from any other pattern, patterns with fewer than *n*/2 errors can be corrected by replacing them with the code pattern that is closest.

3. a. What is the output of the circuit below?

 

 b. In general, how does the three-bit input pattern across the top of the diagram relate to the circuit’s output?

ANSWER: a. 0 b. The output is 0 if the input parity is odd; the output is 1 if the input parity is even.

4. If the input and output bit patterns in the circuit below are interpreted as binary representations of numeric values, what operation does the circuit perform?

 

ANSWER: The circuit subtracts one (except for the case of the input being 000).

5. Explain why such terms as kilo, mega, and giga have acquired double meanings.

ANSWER: The prefixes kilo, mega, and giga are used traditionally to refer to units measured in powers of thousand. However, in reference to memory capacities these prefixes are used to reference units that are powers of two. For example, one kilobyte is 210, which is 1024 bytes.

6. Convert the following addition problem into two’s complement notation (using four bits per value), perform the addition, convert the answer back into base ten notation, and explain the results.

 6

 + 3

ANSWER: In two’s complement notation the problem is to add 0110 and 0011. The sum is 1001 which translates to -7. This answer is incorrect due to overflow.

7. Under what condition is each of the following data compression techniques most effective?

 a. Run-length encoding

 b. Relative encoding

ANSWER: a. Compresses most when data consists of long strings of the same entry.

b. Compresses most when each block of data differs little from the previous block.

8. What is frequency-dependent encoding?

ANSWER: Frequency-dependent encoding is an encoding system that uses short bit patterns to represent data items that occur most often and longer patterns to represent less frequently occurring items. The result is that entire blocks of data can be represented in less space than would be required if each data item were represented by the same size bit pattern.

9. Construct the entire two’s complement scale in which each value is represented by three bits.

ANSWER: 3 011

 2 010

 1 001

 0 000

 -1 111

 -2 110

 -3 101

 -4 100

10. To what does the term “normalized form” refer in the context of floating-point notation?

ANSWER: Normalized form refers to a standard for positioning the bit pattern within the mantissa field. Many values can be represented in floating-point notation by different bit patterns, only one of which is in normalized form. Hence, restricting representations to normalized form assures that each value is represented by a unique pattern.

11. Explain why the final version of the dictionary need not be transmitted with a message encoded using LZW compression.

ANSWER: The dictionary can be constructed during decompression in the same way it was constructed during compression.

12. Among the Boolean operations AND, OR, EXCLUSIVE OR, and NOT, which is least like the others? Explain your answer.

ANSWER: There is not really a right or wrong answer. The student’s explanation is the most important part. Most students will probably answer NOT because it has only one input whereas the others have two.

13. If a term paper consisted 42 pages, each containing 40 lines of 100 symbols each (counting each space as a symbol), was to be encoded using Unicode, how many bytes of storage space would be required?

ANSWER: 336,000 bytes (168,000 symbols times 2 bytes per symbol)

14. In a two’s complement system, what value can be added to any other value without causing an overflow? How many values in the system have this property? Explain your answer.

ANSWER: Adding the value 0 to any other value will not produce an overflow. However, if *m* is the largest positive integer that can be represented in the system, then any value in the range 1 to *m* will produce an overflow when added to *m*, and any value in the range -1 to -( *m* + 1) will produce an overflow when added to -( *m* + 1).

15. Why is the rightmost bit in a string of bits considered to be the least significant bit?

ANSWER: It is the least significant digit in a number. A change to this bit will have the least effect on the value of the number. A change to any other bit will have a greater effect on the value of the number.

16. Given that 1 foot = .3048 meters, write a Python script that will convert a height given in feet and inches to a height given in meters.

ANSWER: One possible answer is:

 feet = 5

 inches = 7

 tot\_height\_in\_feet = feet + inches / 12

 tot\_height\_in\_meters = tot\_height\_in\_feet \* .3048

 print('Height in meters is')

 print(tot\_height\_in\_meters)

17. Given that 1 foot = .3048 meters, write a Python script that will convert a height given meters to a height given in feet and inches.

ANSWER: One possible answer is:

 height\_in\_meters = 1.8

 height\_in\_feet = height\_in\_meters / .3048

 feet = height\_in\_feet // 12

 inches = height\_in\_feet % 12

 print('Height is ' + str(feet) + ' ft ' + str(inches) + ' in ')