Data Representation Test

1. Briefly describe why binary code is commonly used in computer hardware. ---------- [1]
2. How many bits in a byte? ---------- [1]
3. In the binary number 10101010_2 what is the value of the MSB? ---------- [1]
4. Make a table counting upwards from 0 to 16_{10} in decimal, binary, octal and hexadecimal. ---------- [3]
5. Briefly explain the difference between value and representation, giving an example. ---------- [3]
6. Which of the following are **not** valid hex values?
   a. FEC_{16}
   b. $DEAD_{16}$
   c. FUN_{16}
   d. 1234_{16}
   e. $EGAD_{16}$ ---------- [1]
7. What is 2742_8 in binary? ---------- [1]
8. Convert 1011001011111001_2 to hex. ---------- [1]
9. Convert 42_{10} to binary. ---------- [1]
10. Convert 73_8 to hex. ---------- [1]
11. Convert 1101100100_2 to decimal. ---------- [1]
12. Convert 4000_{10} to octal. ---------- [1]
13. Calculate the following binary sum: ---------- [1]

    10100111
    + 01110001

14. Calculate the following binary sum: ---------- [1]

    10111
    + 11011

15. Show the binary representations for -13_{10} in
    a. signed magnitude and
    b. two's complement. ---------- [2]
16. a. Find the binary two's complement representations of $+12_{10}$ and -10_{10}.
    b. Use your answers to subtract 10 from 12. Show your working. ---------- [2]
17. Do the following statements describe fixed or floating point representations, both or neither?
    a. It's fast
    b. Provides the best resolution
    c. Copes with a wide range of numbers
    d. Implementation is complicated
    e. Can't represent some values
    f. Is described by an international standard
    g. Can represent any value
    h. Allows simple multiplication by two. ---------- [4]
18. Using 4 bit binary arithmetic, illustrate overflow error with an example. ---------- [1]
19. Describe IEEE 754 single precision floating point representation using a labelled diagram. ---------- [3]

Answers:

1. 0s and 1s can be represented easily with voltage levels.
2. 8.
3. 1 (or 128).
4. See Tanenbaum page 635 or Information lecture 1 slide 7.
5. Looking for these three points (although there are probably more):
   - A representation is a way of using or describing a value
   - There can be many representations for one value
   - For example, the representations X, 1010_2, A_{16} and 10_{10} all denote the same value.
6. c) FUN and e) EGAD.
7. $010|111|100|010_2$ (possibly omit the leading 0).
8. $B2F9_{16}$
9. 101010_2
10. $3B_{16}$
11. 868_{10}
12. 7640_8
13. $1|0001|1000_2$
14. $11|0010_2$
15. a) 11101_{2SM},
    b) 11110011_{2TC} (or omit leading 1s, to get answer 10011_{2TC})
16. a) +12 = 1100_{2TC}, –10 = 11110110_{2TC}
    b) ×00001100
    + 11110110
    00000010
    111111
17. a) Fixed
    b) Fixed (all bits are mantissa)
    c) Float
    d) Float
    e) Both
    f) Float
    g) Neither
    h) Both (by shifting bits left)
18. 1111
    + 1111
    11110
    1111
19.