1. [4 points] Circle the correct answer among the choices given. If you circle more than one answer, you will lose the grade of the corresponding question.

(A) Two values $A = 1111111111111111101010101$ and $B = 1111010101$ are representations of 2’s complement integers.
   a. A is larger
   b. B is larger
   c. A and B are equal
   d. You cannot tell from the information provided.

(B) If we want to design a computer system, what is the correct order?
   a. develop the ISA first, then the control unit, then the datapath
   b. develop the datapath, then the ISA, then the control unit
   c. develop the control unit, then the ISA, then the datapath
   d. develop the ISA first, then the datapath, then the control unit

(C) For the data path given in question 4, which of the following statements is not a valid microinstruction?
   a. MDR $\rightarrow$ MAR
   b. PC $+4 \rightarrow$ PC
   c. M[PC] $\rightarrow$ IR
   d. SE(imm) $\rightarrow$ offset
   e. Rrt+Rrs $\rightarrow$ AOR

(D) “1100” is interpreted as “-4” in which type of encoding?
   a. sign-magnitude
   b. 1’s complement
   c. 2’s complement
   d. (a and b)
   e. (b and c)
   f. (a and c)
2. [3 points] Suppose you wish to express -64 as 2’s complement number.
   a. What is the minimum number of bits we will need?

   b. With this number of bits you mentioned above, what is the largest positive number you can represent, assuming signed numbers of course? (Please give answer both in hexadecimal and binary)

   c. With that same number of bits you used in the above two questions, what is the largest unsigned number you can represent? (Please give answer both in hexadecimal and binary).
3. Given the following logic circuit:

a. [4] Draw the truth table

b. [1] Is this circuit sequential or combinational? Justify.

c. [2] Using a decoder of your choice, as a block box, and one gate only build a circuit that does exactly the same function as the above one.
4. For the following datapath:
   a. [1] Why is the sign-extension needed?

   b. [2] State two different MIPS assembly instructions that require sign-extension.

   c. [3] Do we lose anything if we remove the register called “offset”? If yes, what will be broken and cannot be executed? If no, justify.