Student Name: ____

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Question #1

There are 26 characters in the alphabet we use for writing English.

1.1) What is the smallest number of bits needed to give each character a unique bit pattern?

1.2) How many bits would we need to distinguish between upper- and lowercase versions of all 26 characters?

Question #2

A collection of 8 bits is known as a “byte”. Java has a “byte” datatype that is stored as an 8-bit two’s complement binary number. What is the largest value that can be stored in a Java “byte”?

Question #3

Convert the following 2's complement binary numbers to decimal.

3.1) 00100001

3.2) 01011010

3.3) 10011001

3.4) 11111111

Question #4

Convert the following decimal numbers to 8-bit 2's complement binary numbers.

4.1) 77

4.2) 102

4.3) -94

4.4) -18

4.5) -129

4.6) 0

Question #5

Your friend tried to convert the decimal number 41 to unsigned binary and got 101101, and wants you to help determine whether it's correct.

5.1) Aside from redoing the conversion yourself, how else can you tell whether this is correct?

5.2) If it's not correct, where do you think they might have gone wrong?

Question #6

If the last digit of a 2's complement binary number is 0, then the number is even. If the last two digits of a 2's complement binary number are 00 (e.g., the binary number 01100), what does that tell you about the number?

Question #7

The decimal number 9 is represented in unsigned binary as 1001. Given this, how could you quickly determine the representation of 72?

<u>Question #8</u>

Another binary representation of signed numbers is called **signed magnitude**, which is a simple representation in which the first bit of the number represents the sign (0 = positive and 1 = negative), and the remaining bits represent the magnitude.

For instance, for a six-bit signed magnitude number:

- 001100 would represent +12, just as it would in two's-complement
- 101100 would represent -12, since the first 1 indicates that it's negative, and the remaining bits (01100) represent the magnitude, which is 12

8.1) First, convince yourself that signed magnitude is different from two's-complement. We said that 101100 represents -12 as a signed magnitude number; what does it represent as a six-bit two's-complement number?

8.2) What is an advantage of two's-complement over signed magnitude in terms of the number of distinct values that can be represented?

<u>Question #9</u>

As we have also learned, it is possible to add binary numbers in the same way that we can add decimal numbers.

Calculate the sum of the following binary numbers:

1) Unsigned numbers 000101 + 001110 = __________

2) Signed 2-'2 Complement numbers: 0000 1000 + 0110 0001 = __________

3) Signed 2-'2 Complement numbers: 0000 1011 + 1111 0101 = __________

For each of the above, think about how you can check if your answers above are correct. Do so to confirm.