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1. (a) (5 points) How many bytes are there in a word in MIPS?

(b) (5 points) Performing a “left shift” of a binary number, by 3 bits, is equivalent to what mathematical operation? (Assume that overflow doesn’t occur.)

(c) (5 points) Suppose that we have a 16-bit integer, encoded with the 2’s complement format. We want to convert it to a 32-bit integer, also in 2’s complement. What is the name of this process? How does it work?
   (Note that you are not required to explain why it works.)

(d) (5 points) Give a pair of 4-bit 2’s complement binary numbers, such that their sum has overflow but does not have carry-out. Calculate their sum, and explain how you know it has overflow.

(e) (5 points) As we did in the ICA, give a round number for the decimal equivalent of each power of 2:

\[ 2^{19} = \text{____________} \quad 2^{31} = \text{____________} \]
2. (a) (5 points) Convert the following unsigned binary number to decimal: 1010 1000. Show your work.

(b) (5 points) Convert the following signed binary number to decimal: 1101 1001. Show your work.

(c) (5 points) Convert the following 16-bit number to both octal and hexadecimal:
1011 0111 0000 1100

(d) (5 points) Convert the following integers, encoded using the 2's complement format, to their decimal values:
1000 0000 = ______  1111 1111 = ______
0111 1111 = ______  0000 0000 = ______
3. (30 points) For the signed 16-bit numbers

\[
\begin{align*}
    a &= 1100 \ 0001 \ 1010 \ 1000 \\
    b &= 1110 \ 1001 \ 1001 \ 1011
\end{align*}
\]

calculate \( a - b \). Do all of your work in binary; do not convert any number to decimal.
4. (25 points) Convert 229 (decimal) to binary. (You may use whatever algorithm works best for you.)
   Write your answer as an 8-bit unsigned number. Then write it as a hexadecimal number.
   Show your work - if you don’t, we cannot give you partial credit!