Question 1 [2 pt]: What is 0xC2 in decimal?

Information for questions 2–5

The following assume 8-bit 2’s-complement numbers. For each number, bit 0 is the low-order bit, bit 7 is the high-order bit.

Question 2 [2 pt]: (see above) Complete the following sum, showing your work (carry bits, etc)

\[
\begin{array}{cccccccc}
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\
+ & 0 & 0 & 1 & 1 & 1 & 1 & 0 \\
\hline
\end{array}
\]

Question 3 [2 pt]: (see above) If you add two negative numbers, you have experienced overflow if

A the carry resulting from adding bit 7 is 0
B the carry resulting from adding bit 7 is 1
C the result is negative
D the result is positive

Answer:
Information for questions 4–5
The following ask about biassed signed integers.

Question 4 [2 pt]: (see above) If the high-order bit of a biassed number is 1, then the value it represents is

A. < 0
B. <= 0
C. == 0
D. != 0
E. >= 0
F. > 0

Answer:

Question 5 [2 pt]: (see above) If the high-order bit of a biassed number is 0, then the value it represents is

A. < 0
B. <= 0
C. == 0
D. != 0
E. >= 0
F. > 0

Answer:

Information for questions 6–11
Each question gives two expressions of 32-bit two’s-compliment integers x and y. If the two are equivalent for all x and y, write “same”; otherwise, write an example x (and y if used in the expressions) for which the two are different.

Question 6 [2 pt]: (see above)
x + y and \( \sim((-x) + (\sim y)) \) (note that’s two \( \sim \) and one \( - \))

Question 7 [2 pt]: (see above)
x + x + x and \( (x<<1) + x \)

Question 8 [2 pt]: (see above)
\(!x \) and \( 1 & \sim((x>>16) | (x>>8) | (x>>4) | (x>>2) | (x>>1) | x) \)
**Question 9 [2 pt]:** The register type we discussed in class (the positive-edge-triggered D flip-flop) has inputs \(D\) and \(\text{clock}\) and output \(Q\). What signals need to be provided to \(D\) and \(\text{clock}\) to change \(Q\) from 1 to 0? Assume \(D\), \(\text{clock}\), and \(Q\) are all 1 before your description is used.

Answer: _____________________________

**Question 10 [2 pt]:** Draw a 4-bit decrement circuit: that is, a set of logic gates with 4 input wires (\(x_0\) through \(x_3\)) and four output wires (\(z_0\) through \(z_3\)) such that the output is numerically 1 less than the input (\(z = x + \neg 1\)).

**Information for questions 11–12**

Suppose we extended the ISA simulator you wrote in Lab 04 and PA 03 with the following code:

```c
if (reserved == 1 && icode == 1) {
    M[oldPC + 1] = M[oldPC + 2];
    return oldPC + ____;
}
```

**Question 11 [2 pt]:** (see above) What number should be placed in the `return` statement where the code above has ____?

Answer: _____________________________

**Question 12 [2 pt]:** (see above) Using the new instruction, write a program that moves a value from address 0x12 to address 0x34. Answer in hexadecimal bytes, separated by spaces.

Answer: _____________________________
Information for questions 13–14

Suppose we extended the ISA simulator you wrote in Lab 04 and PA 03 with the following code:

```c
if (reserved == 1 && icode == 2) {
    R[a] = M[M[oldPC + 1] + R[b]];
    return oldPC + ____;
}
```

**Question 13 [2 pt]:** (see above) What number should be placed in the return statement where the code above has ____?

**Question 14 [2 pt]:** (see above) Suppose there is an array of bytes starting at address 0x40. Using the new instruction, write a program that reads into R3 the byte at index R0 of that array. Answer in hexadecimal bytes, separated by spaces.

**Answer:**

**Question 15 [2 pt]:** If the 32-bit number 0x12345678 is stored in big-endian at address 0x20, what is the value of the byte at address 0x22? Answer in hexadecimal.

**Answer:**

**Question 16 [2 pt]:** If you read the bytes [ba, 98] as an unsigned little-endian 16-bit number, what is that number? Answer in hexadecimal.

**Answer:**

**Question 17 [2 pt]:** Which of the following are true statements about back doors? Select all that apply by putting 1 or more letters in the box. If none are true, write “none” in the box.

A. They can allow others to control your computer without your knowledge.
B. They can be added to a large project by one or two people with relatively little work.
C. They can be hidden in a way that makes them very hard to find.
D. They can be added in hardware.
E. They can be added in compilers.
F. They can be added in software.

**Answer:**
Information for questions 18–19
We discussed in class about patenting an ISA. These questions are about that and related ideas.

Question 18 [2 pt]: (see above) Why would copyrighting an ISA not be sufficient intellectual property protection to prevent clone products being created?

Answer:

Question 19 [2 pt]: (see above) Many people consider patents an important way to fuel invention and share knowledge. Why?

Answer:

Pledge:
On my honor as a student, I have neither given nor received aid on this exam.

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