Introduction to Computing Systems Homework 4

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Question 1.

Set R0 to R2 − R0. If the result is negative, set R4 to 0, otherwise set R4 to 1.

Question 2.

If R1 is odd, set R5 and R0 to 1, otherwise set them to 0.

Question 3.

0001 101 000 1 11000

Question 4.

    a. Put 5 in R0, and shift it left the value at location `x3007` times.

    b. See Table 1.

Table 1: The contents of PC, register R0-R7 and NZP condition codes.

Register	Content
PC	x3006
R0	x0050
R1	x0000
R2	x0000
R3	x0000
R4	x0000
R5	x0000
R6	x0000
R7	x0000
N	0
Z	1
P	0

    c. Instruction `AND(0101)` & `ADD(0001)` needs 10 cycles to execute.
Instruction `LD(0010)` needs 17 cycles to execute.
Instruction `BR(0000)` needs 11 cycles to execute if the condition is true, otherwise it needs 10 cycles to execute.
So the total number of CPU clock cycles is $(2 + 4 \times 2) \times 10 + 17 + 3 \times 11 + 10 = 160$.

Question 5.

Count the number of bits at location `x3100` that are 0.

Question 6.

See Table 2.

Table 2: The missing instruction.

Memory Location	Value
x3001	0110 001 000 000000
x3002	0000 100 000000010

Question 7.

Instruction `LDI` and `STI` would cause one extra read access when executed, that is, a `LDI` instruction would read twice, and a `STI` instruction would read once and write once. So a large number of `LDI` instructions and `STI` instructions could account for this discrepancy.

Question 8.

Instruction a) & c) could be used for NOP.
Instruction b) would skip the next instruction.

Question 9.

9.2) 1001 101 010 111111

9.4) 1001 011 110 111111