Problem Set 8

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1a)

To select chip b, the chip selector bit will be 0, so cell 74 stays as 74, and 0xD132 = 53554.

li $t1, 74
li $t2, 53554

1b)

To select chip a, the chip selector bit will be 1, so cell 43 becomes 2147483691, and 0xB133 = 45363.

li $t1, 2147483691
li $t2 45363

2a)

The time for each read will be $5ns + 25ns = 30ns$. The amount of data transferred per read will be 64 bits = 8 bytes. Thus the bandwidth will be $\frac{8bytes}{30e-9seconds} = 2.667e8\frac{bytes}{second}$ or .266 Gigbytes per second.

2b)

LW retrieves 1 word, which is 32 bits or 4 bytes. Thus, LW would need only 1 read which would take a minimum of 30ns. The LW, in practice, would take more time depending on the architecture of the pipeline and the time required for the other 4 stages.

3)

- a) 1
- b) 1
- c) 0
- d) 0

4a)

Presuming you mean problem 3 instead of problem 1:

This is best characterized by a latch as the output changes in response to the input, not in response to a clock.

4b)

This is best characterized by S-R, as the output state can be set or reset based on which input is triggered, and remembers that state when the inputs are turned off.

5Ia)

$15e9 = \frac{4 \times N}{10e-9} = 37.5$. Thus, 38 memory banks would be required to provide 15 billion bytes per second.

5Ib)

22 bits are required to address the bytes on a given chip, and 4 bits are required to select the chip, so the total number of bits is 26.

5IIa)

Longest stage = 20ns, so clock rate = $\frac{1}{20e-9} = .05GHz$.

5IIb)

Width = word size = 32 bits = 4 bytes. Depth = $\frac{2^30}{4} = 268435456 = 2^{28}$ bytes.

5IIc)

This pipeline would need 1 new instruction every 20 ns, for a bandwidth of $\frac{4}{20e-9} = 2e8\frac{bytes}{second}$. However, DDRAM transfers twice the data with each read, so the bandwith could be halved to 1e8 $\frac{bytes}{second}$.

5IId)

$128e6\frac{bytes}{second} = \frac{width}{cycletime} = \frac{4\frac{bytes}{cycle}}{cycletime}$. Thus the cycle time is 3.125e-8 seconds/cycle.

6)

CMD	Big-Endian	Little-Endian
lw $t0,0($t1)	0x89875543	0x43558789
lh $t0,0($t1)	0x00008987	0x87890000
lb $t0,3($t1)	0x00000043	0x43000000
lh $t0,2($t1)	0x00005543	0x43550000