CMPEN 271 – Spring 2012

Exam 2

Name: PSU ID:

D	Q+
0	0
1	1

T	Q+
0	Q
1	Q'

S	R	Q+
0	0	Q
0	1	0
1	0	1
1	1	x

J	K	Q+
0	0	Q
0	1	0
1	0	1
1	1	Q'

1. ($1 * 10^{-6}$ pt.) Assuming a word size of 5 bits, interpret 10100 as a 2's complement number.

   a) -24 b) -12 c) -6 d) -2 e) None of the above.

2. ($1*10^{-6}$ pt.) Assuming a word size of 4 bits, determine the 2's complement representation of -7.

   a) 1011 b) 1101 c) 1100 d) 1001 e) None of the above.

3. ($1 * 10^{-6}$ pt.) An If/Then statement represents which piece of hardware?

   a) decoder b) mux c) comparator d) counter e) register

4. ($1 * 10^{-6}$ pt.) How many 2:1 muxes are needed to construct a 4-bit wide 4:1 mux?

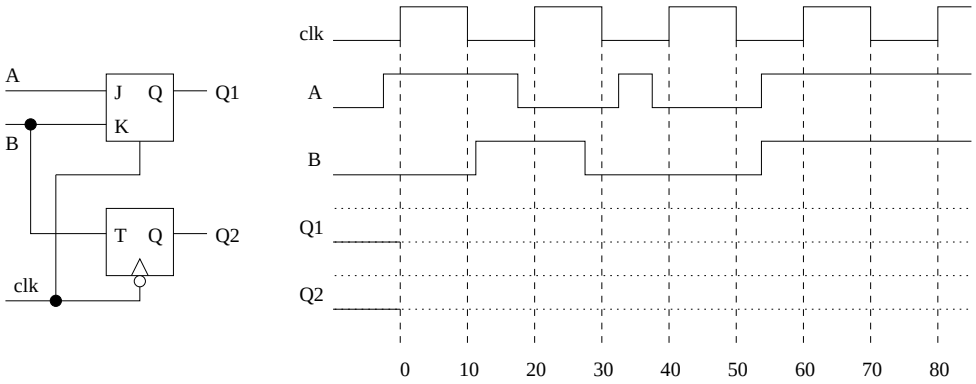
   a) 8 b) 12 c) 18 d) 24 e) None of the above.

Questions 5-7 concern the construction of a bit-slice of a comparator. The questions will ask you to complete the entries in the truth table below denoted by a, b, and c.

G_{in}	L_{in}	E_{in}	x	y	G_{out}	L_{out}	E_{out}
0	0	1	1	0	a		
0	1	0	1	0		b	
1	0	1	1	0			c

5. $(1 * 10^{-6}$ pt.)What is the value of a?
   a) 0 b) 1 c) x
6. $(1 * 10^{-6}$ pt.)What is the value of b?
   a) 0 b) 1 c) x
7. $(1 * 10^{-6}$ pt.)What is the value of c?
   a) 0 b) 1 c) x

For questions 8-11 use the following figure



8. $(1 * 10^{-6}$ pt.) What is the value of Q1 at time 45
   a) 0 b) 1 c) toggling
9. $(1 * 10^{-6}$ pt.) What is the value of Q1 at time 65
   a) 0 b) 1 c) toggling
10. $(1 * 10^{-6}$ pt.) What is the value of Q2 at time 25
    a) 0 b) 1 c) toggling
11. $(1 * 10^{-6}$ pt.) What is the value of Q2 at time 75
    a) 0 b) 1 c) toggling

You have a digital design which calls for a circuit to perform the following task.

```
if      (sum > 18) z = sum-18
else if (sum > 12) z = sum-12
else if (sum > 6)  z = sum-6
else               z = sum
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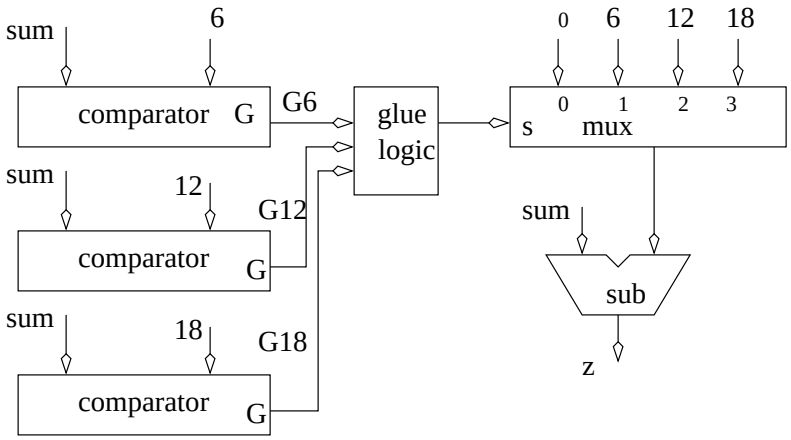
You have decided on the architecture shown below. Its your job to design to complete the truth table for the the glue-logic box (only an arbitrary portion of the complete truth table is shown).

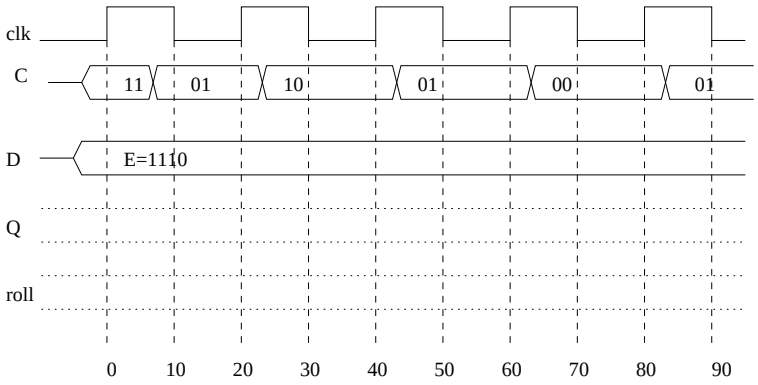


G6	G12	G18	select
1	1	0	a
1	0	0	b
1	1	1	c

12. ($1 * 10^{-6}$ pt.)What is the (decimal) value of a in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x
13. ($1 * 10^{-6}$ pt.)What is the (decimal) value of b in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x
14. ($1 * 10^{-6}$ pt.)What is the (decimal) value of c in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

For questions 15,17 assume that a 4-bit up/down counter with parallel load has the following truth table. Complete the timing diagram below.

clk	c	D	Q^+	roll
0,1,↓	xx	x	Q	1 if Q=15 and c=01
↑	00	x	Q	0
↑	01	x	$Q+1$	1 if Q=15 and c=01
↑	10	x	$Q-1$	0
↑	11	D	D	0



15. ($1 * 10^{-6}$ pt.)What is the value of Q at time 55?

    a) 0000 b) 0001 c) 1110 d) 1111 e) none of the above

16. ($1 * 10^{-6}$ pt.)What is the value of Q at time 90?

    a) 0000 b) 0001 c) 1110 d) 1111 e) none of the above

17. ($1 * 10^{-6}$ pt.)At which of the following times does roll=1

    a) 30 b) 50 c) 70 d) 90 e) none of the above

You have a digital design which calls for a circuit to perform the following task.

```
for (i=0; i<42; i++) total = 2*total + i
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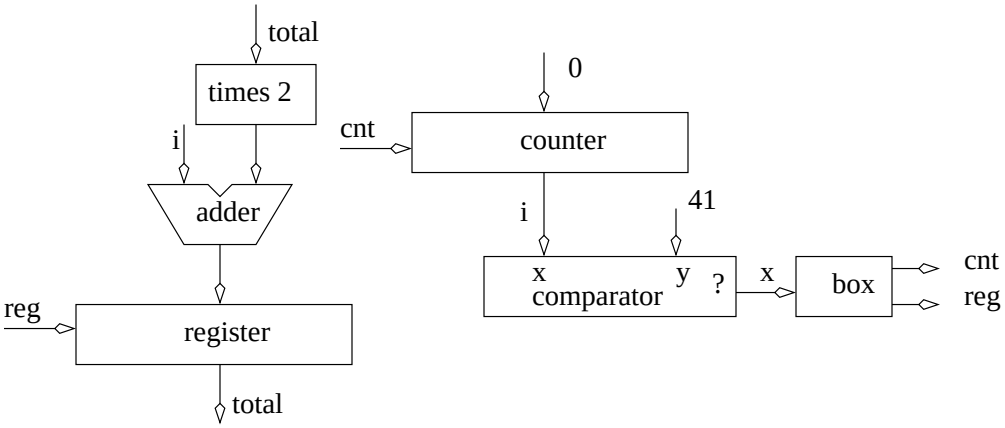
You have decided on the architecture shown below. Its your job to finish the design. The box labeled "times 2" multiplies its input by 2 and outputs this value.



18. ($1 * 10^{-6}$ pt.)Which output of the comparator should be connected to the input of "box"?

    a) G b) L c) E d) none of the above.

19. ($1 * 10^{-6}$ pt.)Assume that the counter has the truth table which is the same as question 15-17. What is the logic inside "box" to control the counter? Note, the output of the comparator is called "x."

    a) $cnt_1 = 0$ and $cnt_0 = 0$

    b) $cnt_1 = x'$ and $cnt_0 = 0$

    c) $cnt_1 = 0$ and $cnt_0 = x'$

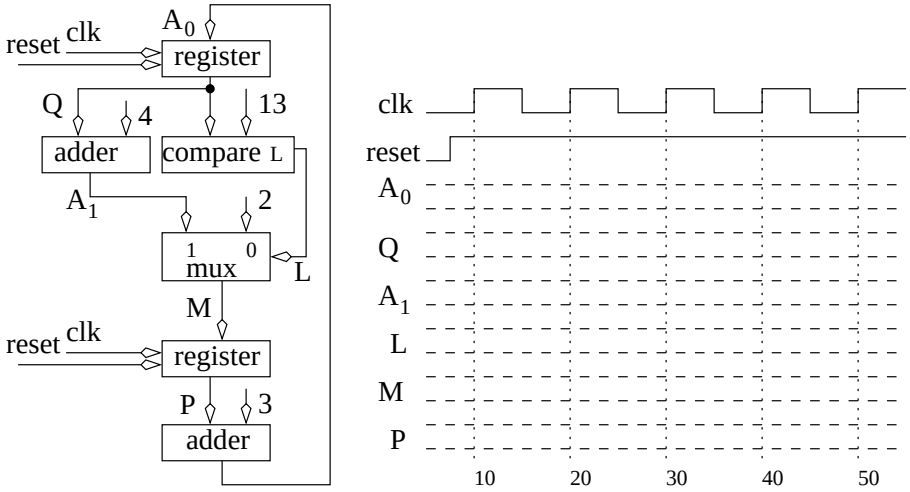
    d) $cnt_1 = x$ and $cnt_0 = x'$

    e) None of the above.

20. ($1 * 10^{-6}$ pt.)How many logic gates are required in the "times 2" box?

    a) none b) a few c) some d) a lot e) infinite

For problems 21-25 use the following figure and timing diagram.



21. ($2 * 10^{-6}$ pts.)What is the value of P at time 15?

    a) 0 b) 3 c) 4 d) 6 e) 11

22. ($2 * 10^{-6}$ pts.)What is the value of A_0 at time 25?

    a) 3 b) 5 c) 7 d) 8 e) 10

23. ($2 * 10^{-6}$ pts.)What is the value of A_1 at time 35?

    a) 8 b) 11 c) 14 d) 15 e) 18

24. ($2 * 10^{-6}$ pts.)What is the value of Q at time 45?

    a) 5 b) 7 c) 11 d) 13 e) 14

25. ($2 * 10^{-6}$ pts.)What is the value of M at time 55?

    a) 2 b) 5 c) 7 d) 8 e) 9