CMPEN 271 – Fall 2009

Exam 2

Name: PSU ID:

1. **(2 pts.)** Assuming a word size of 5 bits, interpret 10101 as a 2's complement number.

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

2. **(2 pts.)** 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.

   For questions 3,4 assume that espresso has generated the following output.

```
.i 3
.o 2
.ilb A B C
.ob F G
.p 3
1-1 10
01- 11
-01 01
.e
```

3. **(1 pt.)** Which product term is shared.

   a) AC

   b) A'B

   c) B'C

   d) F and G

4. **(1 pt.)** Which of the following could be equal to G(A,B,C)?

   a) G(A,B,C) = Σm(1,2,3,5)

   b) A'B'C + A'BC + A'BC' + AB'C

   c) A'B + B'C

   d) G(A,B,C) = $\prod$M(0,4,6,7)

   e) All of the above

5. **(2 pts.)** How many 1:2 decoders does it take to build a 3:8 decoder?

   a) 3 b) 7 c) 15 d) 31 e) None of the above.

6. **(1 pt.)** If the delay through a single 2:1 mux is 1 unit of time, then what is the delay through a 16:1 mux built from 2:1 muxes?

   a) 2 b) 4 c) 8 d) 15 e) None of the above.

7. **(2 pts.)** How many inputs do the AND gates in a 8:1 mux have?

   a) 2 b) 4 c) 8 d) 16 e) None of the above.

8. **(1 pt.)** How many 4:1 muxes are needed to construct a 8-bit 4:1 mux?

   a) 4 b) 8 c) 12 d) 32 e) None of the above.

   Questions 9-11 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	0	0	a		
0	1	0	1	0		b	
1	0	1	1	0			c

9. **(1 pt.)**What is the value of a?

   a) 0 b) 1 c) x

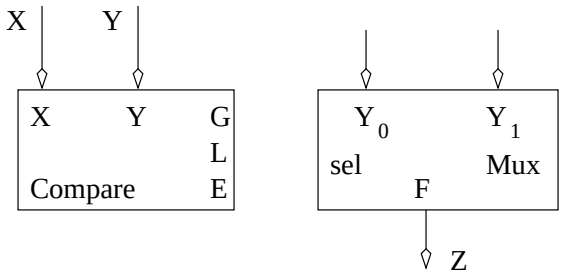
10. **(1 pt.)**What is the value of b?

    a) 0 b) 1 c) x

11. **(1 pt.)**What is the value of c?

    a) 0 b) 1 c) x

Use the following figure for questions 12,13.



12. **(1 pt.)** Which of G, L, E below must be connected to the sel input of the mux to realize: `if (X >= Y) then Z = X else Z = Y;`

    a) G b) L c) E

13. **(2 pt.)** Which of X, Y must be connected to the y_0 input of the mux?

a) X b) Y

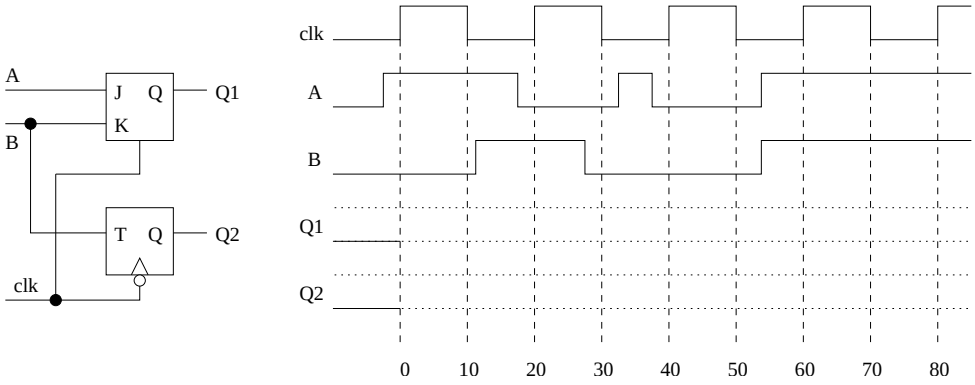
D	Q+
0	0
1	1

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'

For questions 14-19 use the following figure.



14. **(2 pts.)** What is the value of Q1 at time 25

a) 0 b) 1 c) toggling

15. **(2 pts.)** What is the value of Q1 at time 35

a) 0 b) 1 c) toggling

16. **(2 pts.)** What is the value of Q1 at time 65

a) 0 b) 1 c) toggling

17. **(2 pts.)** What is the value of Q2 at time 25

a) 0 b) 1 c) toggling

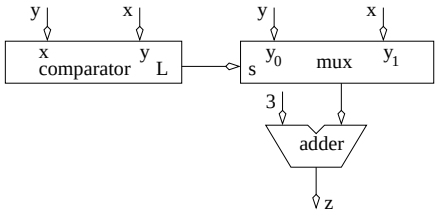
18. **(2 pts.)** What is the value of Q2 at time 35

a) 0 b) 1 c) toggling

19. **(2 pts.)** What is the value of Q2 at time 65

a) 0 b) 1 c) toggling

20. **(2 pts.)** Which line of pseudo-code best characterizes the following piece of hardware.



a) `if (X < Y) then Z = X+3 else Z = Y+3;`

b) `if (X < Y) then Z = Y+3 else Z = X+3;`

c) `if (X > Y) then Z = X+3 else Z = Y+3;`

d) `if (X > Y) then Z = Y+3 else Z = X+3;`

e) None of the above

In problems 21,22 you are designing a circuit which multiplies a 4-bit binary number by (decimal) 10.

21. **(1 pt.)** How many bits wide does the result have to be?

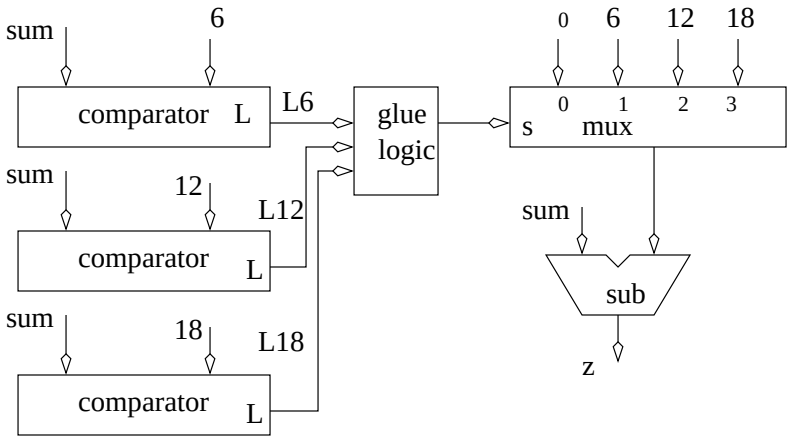
a) 4 b) 5 c) 6 d) 8 e) None of the above.

22. **(1 pt.)** What is the fewest number of adders required?

a) 1 b) 2 c) 3 d) 9 e) 10

You have a digital design which calls for a circuit which performs the following task (written as a C if/then statement). You have decided on the architecture. 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). I would recommend drawing a number line and putting the values of L6, L12, and L18 on it.

```
if      (sum < 6)  z = sum
else if (sum < 12) z = sum-6
else if (sum < 18) z = sum-12
else               z = sum-18
```



L6	L12	L18	select
0	0	0	a
0	1	1	b
1	0	1	c

23. **(2 pts.)**What is the (decimal) value of a in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

24. **(2 pts.)**What is the (decimal) value of b in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

25. **(2 pts.)**What is the (decimal) value of c in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x