



**Digital Electronics™**  
**Final Examination**

**Part B**  
**High School Performance**

**Spring 2007**

**Student Name:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Class Period:** \_\_\_\_\_

**Total Points:** \_\_\_\_\_ /85

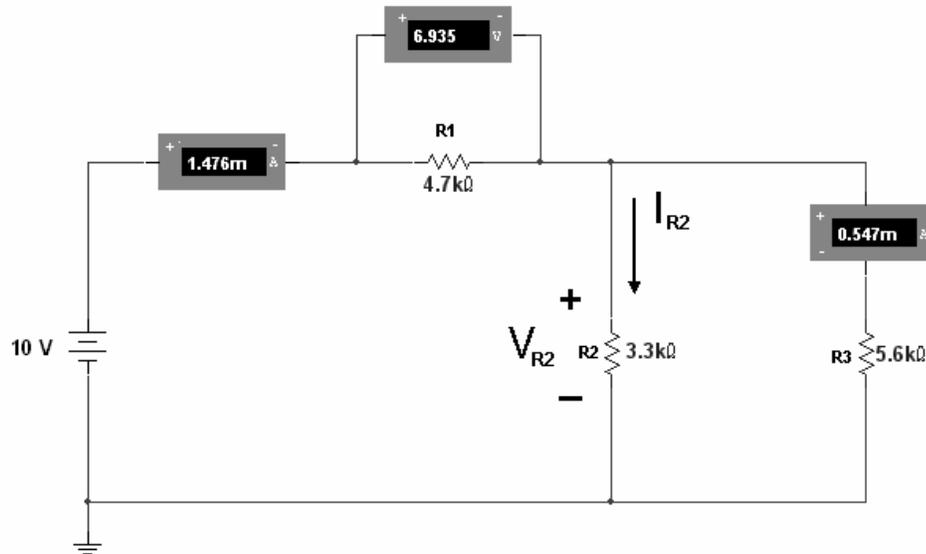
**Converted Score:** \_\_\_\_\_ /50

## Short Answer - Design Problems

**Directions:** Show ALL work – Partial credit may be awarded.

- 1) Using the meter readings shown, calculate  $I_{R2}$  and  $V_{R2}$  using Kirchhoff's Current Law and Kirchhoff's Voltage Law. Be sure to use correct engineering notation and units.

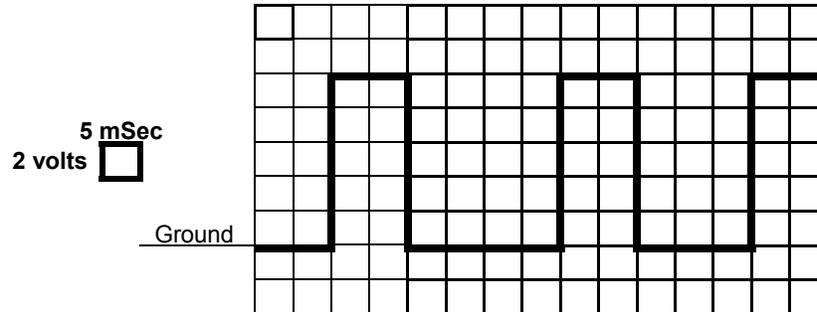
(6 pts)



---

2) For the square wave shown below, determine its (a) Period, (b) Frequency, (c) Duty Cycle, and (d) Amplitude. Be sure to show correct units.

(8 pts)



---

A) Period = \_\_\_\_\_

B) Frequency = \_\_\_\_\_

C) Duty Cycle = \_\_\_\_\_

D) Amplitude = \_\_\_\_\_

---

---

3) Perform the indicated base conversions. (**Show each step, not just the answer.**)

(6 pts)

---

A)  $10100110_{(2)} = \underline{\hspace{2cm}}_{(10)}$

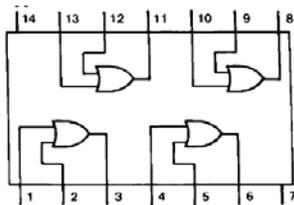
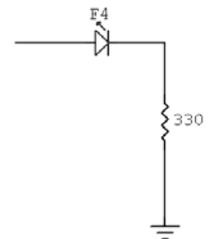
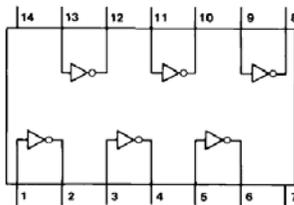
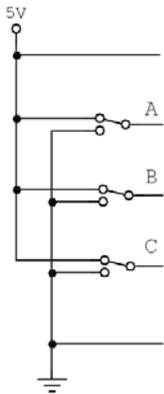
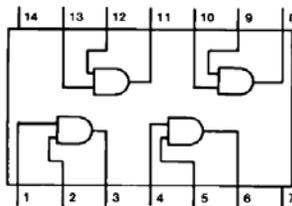
B)  $164_{(10)} = \underline{\hspace{2cm}}_{(16)}$

- 4) Using the chip block diagrams shown below, draw the wires to connect the gates to the input switches and output LED to implement the Boolean equation:

(8 pts)

$$F_4 = \overline{B} + AC$$

*Note: Don't forget the power and ground connections.*



- 
- 5) Using the rules of Boolean algebra, including DeMorganizing, simplify the following expression into its simplest sum-of-products form.

(8 pts)

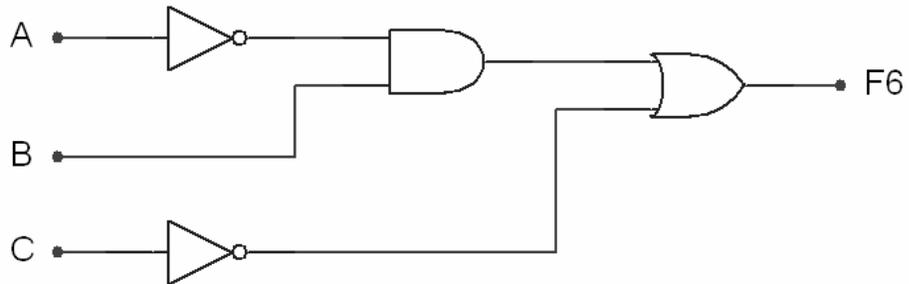
$$F_5 = \overline{\overline{X}} + Y + \overline{\overline{XZ}} + Y$$

---

---

6) Using only two-input NAND gates, re-implement for the A-O-I circuit shown below using the fewest number of gates.

(8 pts)



- 
- 7) Using the K-Mapping technique, determine the simplest Sum-Of-Products Boolean equation for the truth table shown below.

(8 pts)

A	B	C	F <sub>7</sub>
0	0	0	1
0	0	1	0
0	1	0	X
0	1	1	X
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	X

---

- 
- 8) Using the fewest number of two-input AND, two-input OR & logic inverters, draw the A-O-I implementation for the following Boolean expression.

(6 pts)

$$F_8 = \bar{A}C + A\bar{B}C$$

---

- 
- 9) Using an 8-Bit number system, perform the following math operation using the 2's complement process. (**Show each step, not just the answer.**)

(8 pts)

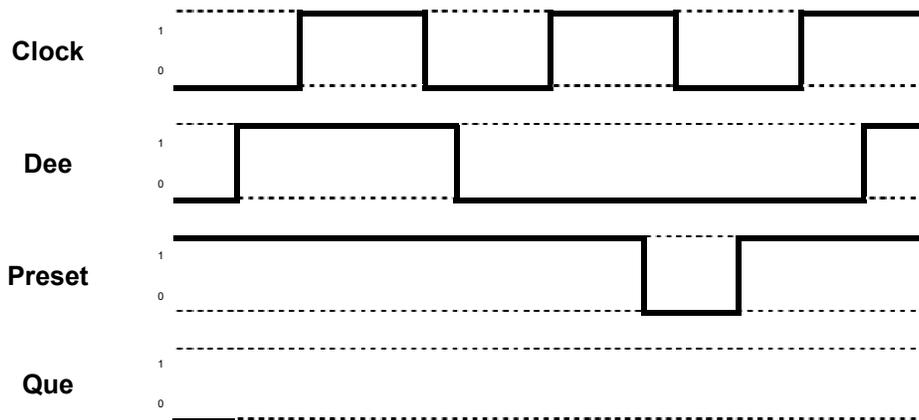
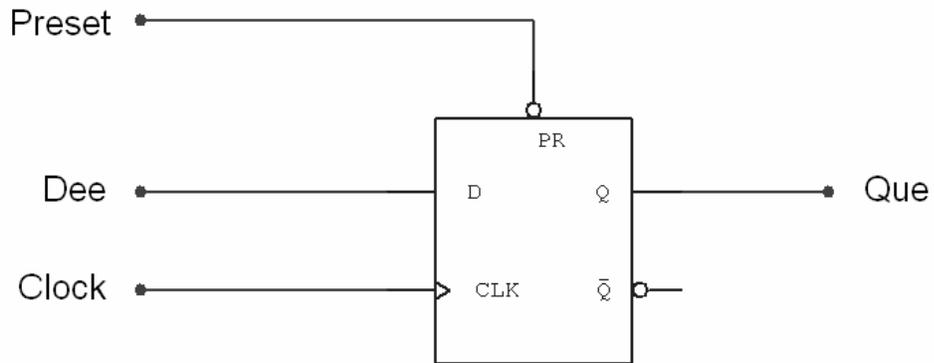
$$6 - 4 = ?$$

---

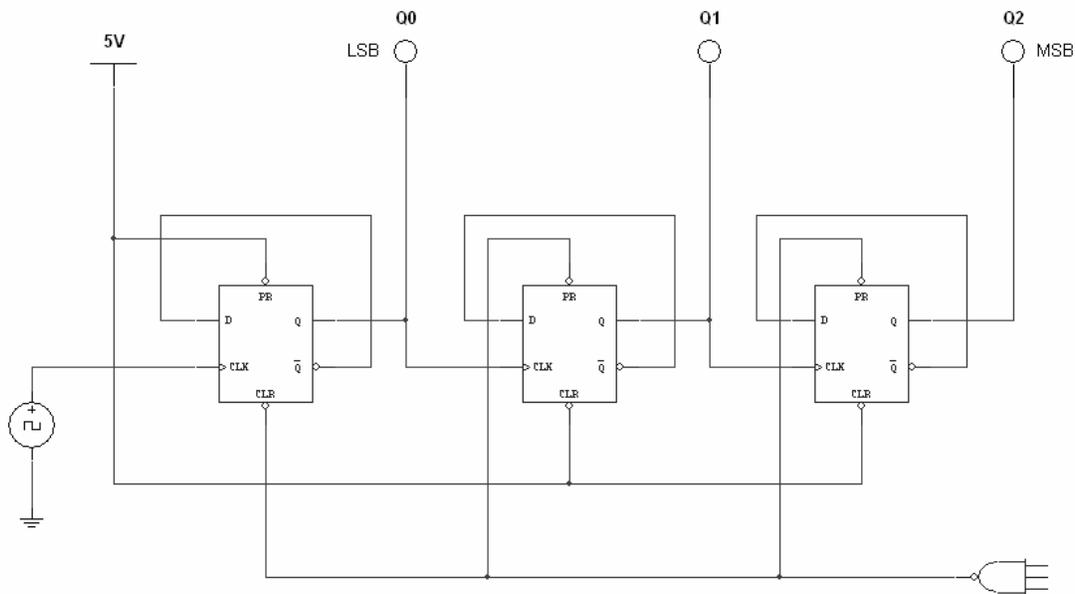
---

10) For the D Flip-Flop shown below, sketch the waveform for signal QUE.

(6 pts)

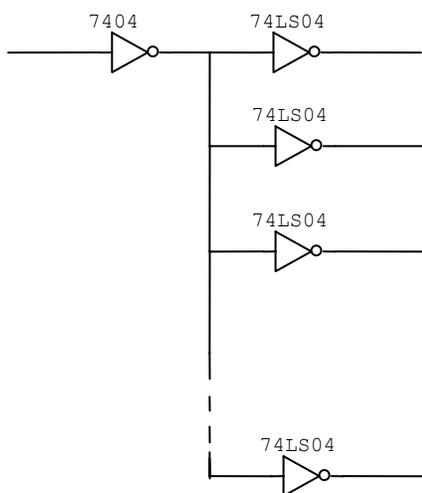


- 
- 11) Using the incomplete, three-bit, asynchronous down counter shown below as a starting point, design a counter that will display the binary numbers 6 down to 2 on the logic displays.  
(6 pts)
- 



- 12) Given the input/output current specifications for a 7404 and 74LS04 Inverters shown below, calculate the maximum number of 74LS04's that can be driven by the one 7404 as shown below.

(7 pts)



7404	
Output Current Specifications	Input Current Specifications
$I_{OH} = -0.25 \text{ mAmps}$	$I_{IH} = 15 \text{ uAmps}$
$I_{OL} = 6.0 \text{ mAmps}$	$I_{IL} = -0.22 \text{ mAmps}$

74LS04	
Output Current Specifications	Input Current Specifications
$I_{OH} = -0.4 \text{ mAmps}$	$I_{IH} = 12 \text{ uAmps}$
$I_{OL} = 4.0 \text{ mAmps}$	$I_{IL} = -0.4 \text{ mAmps}$