

February 1, 2000

## Physics 432/532 Practice Midterm

Closed book exam. No calculators. There are 4 problems with possible points indicated for a total of 100. You can write on this exam, on separate (clearly identified) pages, or both.

Possibly useful information:  $\overline{A + B} = \overline{A} \cdot \overline{B}$ ,  $\overline{A \cdot B} = \overline{A} + \overline{B}$

1. (30 points) We wish to design a circuit which compares two 2-bit numbers,  $A = a_1a_0$  and  $B = b_1b_0$ , and sends an output  $Q$  HIGH when  $A > B$ . Start by finding a logical expression for  $Q$ . Show how to implement this using standard digital gates with no more than 2 inputs.

2. (20 points)

- (a) Make a 2-input OR gate from 2-input NAND gates.
- (b) Convert  $103_{10}$  to standard binary.
- (c) Convert  $103_{10}$  to hexadecimal.
- (d) Convert  $-103_{10}$  to 8-bit 2's complement binary.

3. (30 points) Design a 4-input multiplexer for digital signals using standard digital gates. Include an “enable” function in your design with a  $\overline{E}$  input. Clearly label all inputs and outputs.

4. (20 points) Consider the following circuit involving D-type flip-flops and complete the timing diagram below.

