ME218a Final Exam

Due by 5pm on 12/11/95

Name:_____

I Certify that I have taken this examination in compliance with the Stanford University Honor Code.

_____

This is the cover sheet for what you turn in !

1.1_____

1.2_____

1.3_____

1.4_____

1.5_____

1.6_____

2.1_____

2.2_____

3.1_____

3.2_____

3.3_____

Total_____

Design 70 Points

Imagine that is now late June, 1996. You have just reported for work at Widgets 'R Us Inc. and have been assigned to take over a project that is behind schedule. As the savior of the company, you have been asked to do several things to get the project back on track:

1.1) Given a +10V supply, an LTR3208E Photo-transistor, an LM324 OpAmp and assorted resistors of your choosing, design a circuit that will produce an output voltage that is as linear as possible with the light level falling onto the LTR3208E. The output of the circuit should change by 1V for every mW/cm^2 change in light level. The output voltage should not exceed 5V, nor go below 0V.

1.2) As the light level drops from 3 mW/cm^2 to 2 mW/cm^2 , how does the output voltage from your circuit change?

1.3) Over what light level range would you expect the voltage output to be linear with light level?

1.4) One subsystem of the machine depends on knowing whether the current light level is more than 3 mW/cm^2. Design a circuit which takes the output of the sensor circuit in Part 1.1 as its input. The circuit should provide an indication when the specified light level is exceeded. To make the behavior robust, the indicator should not change states more than once for light level variations of $\pm$.03 mW/cm^2 or less. Please be sure to note what indication your circuit provides.

Part of the project entails driving a small DC motor. The motor has already been chosen and it requires a maximum of 2A at 12V. Your new boss really wants to use a new motor driver chip, but no one in the company has any experience with it. She has asked you to work up a design for evaluation and testing. The chip she would like you to use is the LMD18200. The machine will ultimately provide 3 control signals:

> **Enable**: When this line is high, the LMD18200 should actively drive the motor in the direction indicated by the direction line. When this line is low, the motor should be allowed to coast (no drive voltage applied)

> **Direction**: This line will control the direction of rotation of the motor.

> **Brake**: When high, this line will override the other two lines and cause the two leads of the motor to be shorted to the power supply

1.5) You should design an interface from 3 lines of a 68HC11 having the behavior described above to the LMD18200. The design should use 74HCxx series logic for any logic required.

1.6) You have been assigned bits 0,3 &5 on Port B to provide the Enable, Direction and Brake signals to the motor. Please write some debugging Forth words that you can use to demonstrate the control of the motor:

Forward: should actively drive the motor in one direction for approximately 2 seconds.

Reverse: should actively drive the motor in the other direction for approximately 2 seconds.

Brake: should actively brake the motor for approximately 0.5 seconds.

Coast: should put the motor in a coasting mode.

When not actively driving or braking, the motor should be coasting.

Since there are other devices connected to the other pins of port B, please be sure that your words do not disturb the states on those lines.
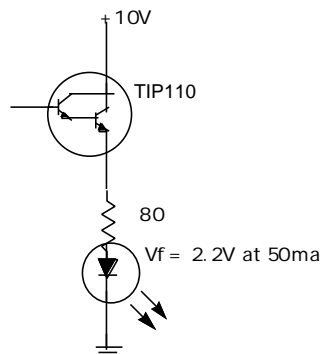
To do the timing, the system provides a location, address 0000, that is incremented every 4.1mS.

Note: reading an output port returns the levels on the output pins.
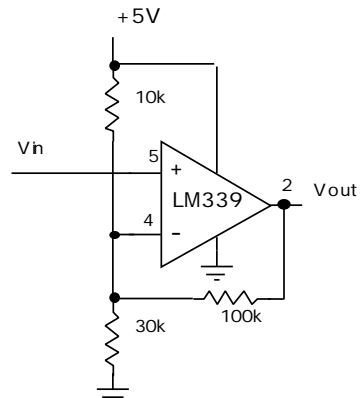

Analysis 15 Points
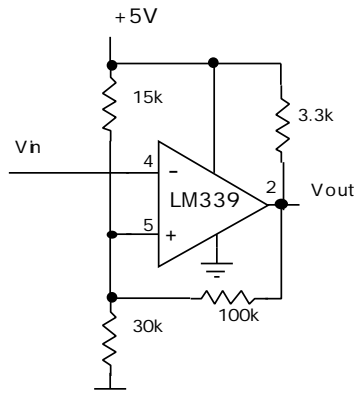
2.1) Given the circuit shown above, as accurately as possible, describe the output as the input voltage Vin is ramped from 0 to 5 Volts.
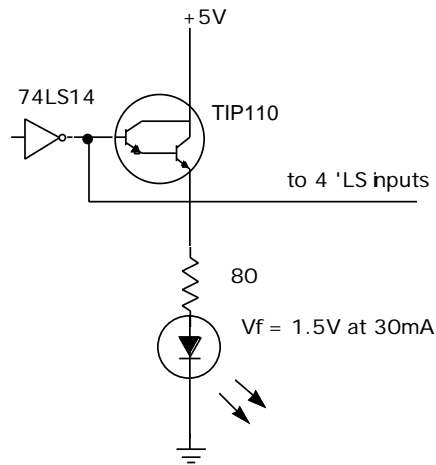

2.2) In the circuit above, what voltage is necessary at the base of the Darlington in order to get 50mA through the LED ?

Part 3 Debugging 15 Points

+5V

Vin

5

+

LM339

4

−

2   Vout

10k

30k

100k

3.1) This comparator doesn't seem to be working as we would expect, why ?

Can you explain how to fix it ?

3.2) The circuit above does not produce the expected result. The driven LS inputs seem to indicate everything is working, but the LED doesn't come on. Can you explain why ?

How would you change it to get the LED to light with 30mA of current flowing & Why ?

3.3) Some C code:

```
printf("Enter A,B, or C to print a nice message, E to quit");
for (c = getch(); c != 'E'; c = getch());
{
     if ((c = 'A') || (c = 'B') || (c = 'C'))
          printf("\nNice message for letter %c\n",c);
     else
          printf("\nUgly message for letter %c\n",c);
}
```

After running this program, when I enter 'C', nothing seems to happen, why ?

How would you have to change it to get it to behave as the prompt implies ?