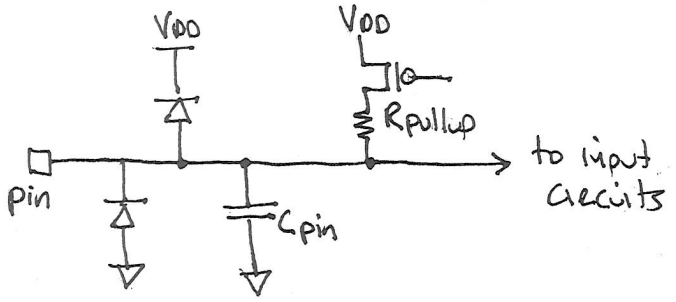
ECE473-F07 Quiz 2 Name: Ray

ID (last 4):

1.(2) Draw the input port structure of an AVR input pin that shows the protective ESD diodes and the input pullup resistor.



2.(2) Using single cycle instructions, an input port is read immediately after writing it. Will you read what you wrote? Why?

Clarification: writing A PORTx, reading A PINx immediately.
You will not read what was written because of the 1.5 cycle delay incurred by the synchronization circuitry.

3.(2) How many ESD events are the ESD diodes at chip pins supposed to protect against?

Just A few, the diodes Are quite small.

4.(2) How could you tell if an ESD diode was blown?

Attempt to force A small current into or out of the pin. Observing A 0.7 volt drop between the pin And VDD or Vss would indicate the diode was still intact.

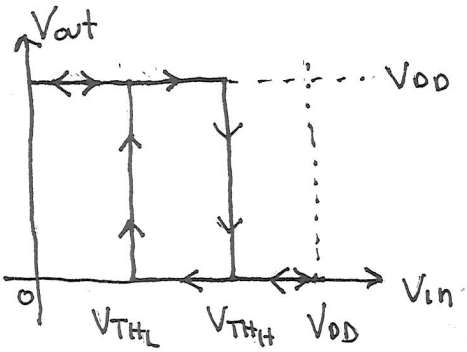
5.(6) When an ESD event occurs, roughly (order of magnitude)....

-how fast is the current rise time? nanoseconds, 10s of nanoseconds

-what is the peak current? Amps, tens of Amps

-what is the voltage? kilovolts, tens of kilovolts

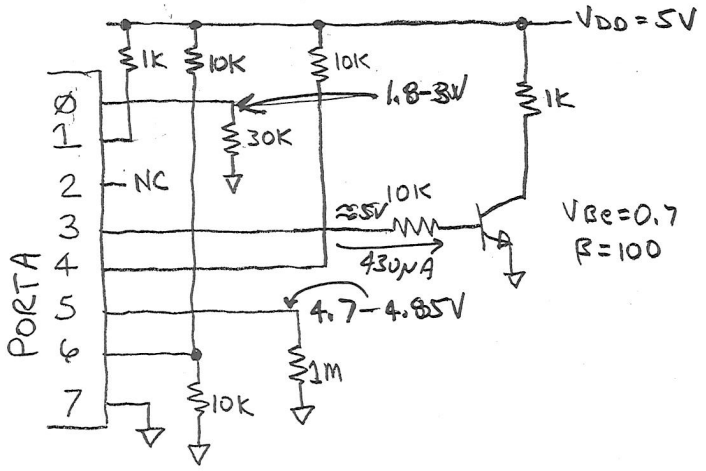
3.(4) Plot Vout(y-axis) versus Vin(x-axis) for a schmitt trigger inverter. Indicate where Vdd, ground, and any thresholds are.



4.(24) Suppose we want to configure port A as follows:

bit 0 input, pullup on
bit 1 output, forcing low
bit 2 input, pullup off
bit 3 output, forcing high
bit 4 input, pullup off
bit 5 input, pullup on
bit 6 input, pullup off
bit 7 input, pullup off

Port A is also connected as shown below:



Internal pullups are as stated in the datasheet (20-50K) as well as the logic low and logic high levels(0.2Vdd, 0.6Vdd).

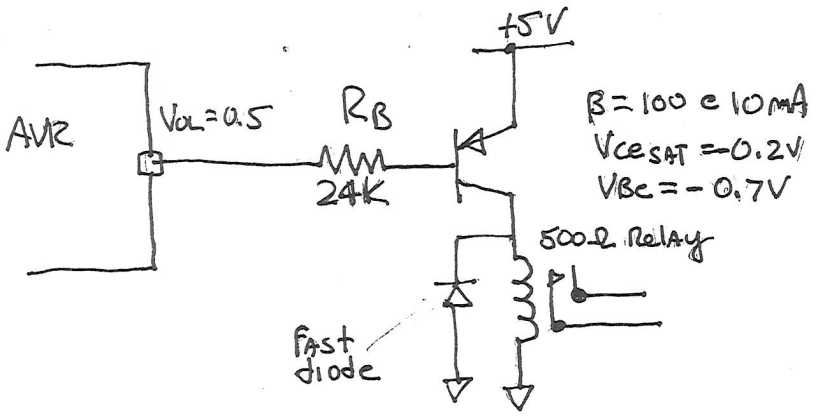
(a) Show the correct port bit settings to configure the port as directed above.

	7	6	5	4	3	2	1	0
DDRA:	0	0	0	0	1	0	1	0
PORTA:	0	0	1	0	1	0	0	1

(b) Show what values (0, 1, X) PINA will show if read (X = either 1 or 0 but unknown)

	7	6	5	4	3	2	1	0
PINA:	0	X	1	1	1	X	0	X

5.(10) Draw the schematic diagram of how an AVR port pin could be used to actuate a 500 ohm relay coil using a PNP BJT with beta of 100 at 10mA. Show computation of all resistor values. Assume the AVR can sink the required base current at 0.5 volts. BJT Vce(sat) is -0.2V, and Vbe is -0.7V. Don't forget to protect against flyback voltages.



BJT must source 10mA to actuate relay. This will require at least $\frac{10mA}{\beta} = 100\mu A$ of base current. To ensure saturation assume base current will be 150μA. Thus

$$R_B = \frac{5 - 0.7 - 0.5}{150 \times 10^{-6}} = 25{,}333\,\Omega$$; 24K is the nearest value

Solution must show correct equation for R_B, & calculation/justification for base current chosen.

52 points possible