

# ECE 320 - Final Exam - Name \_\_\_\_\_

Spring 2020. Due Friday, March 27th, midnight

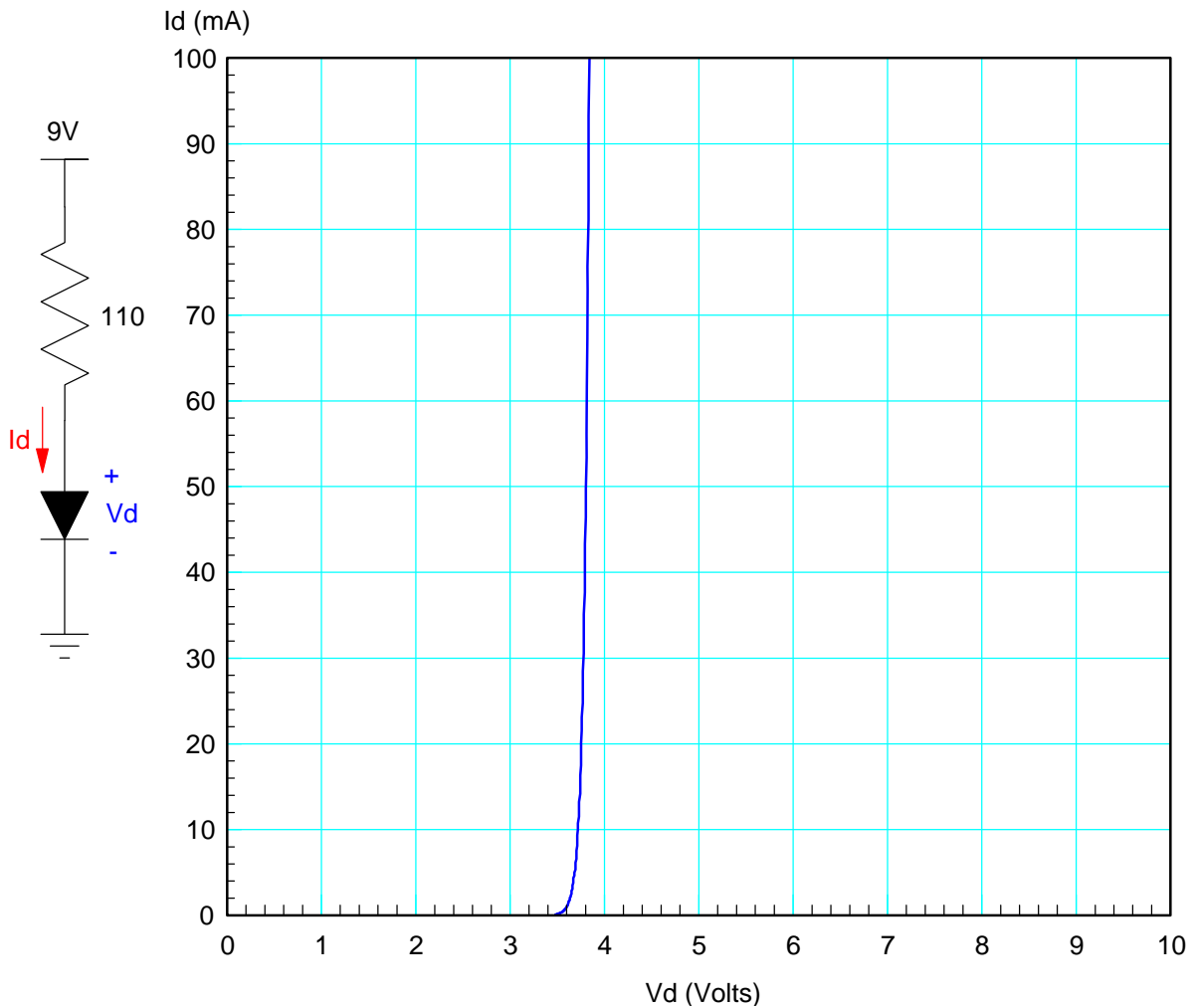
Individual Effort. Matlab, CircuitLab, and Calculators Permitted

No Aid Given, Received, or Observed: (please sign if possible): \_\_\_\_\_

1) The VI characteristics for a diode are shown on the graph below.

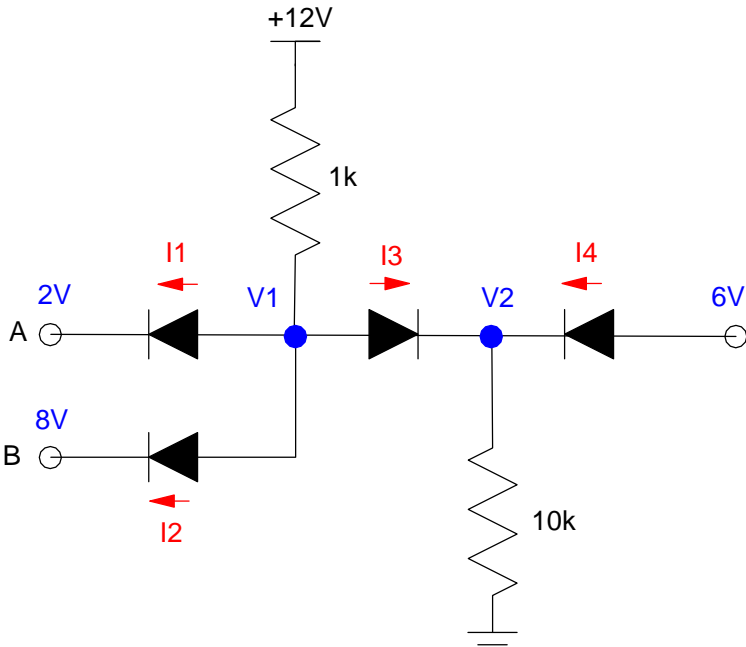
- Draw the load line for the circuit shown to the left, and
- Determine the operating point ( $V_d$ ,  $I_d$ )

Load Line	$V_d$	$I_d$
show on graph		



2) Assume ideal silicon diodes. Determine the currents and voltages for the following diode circuit.

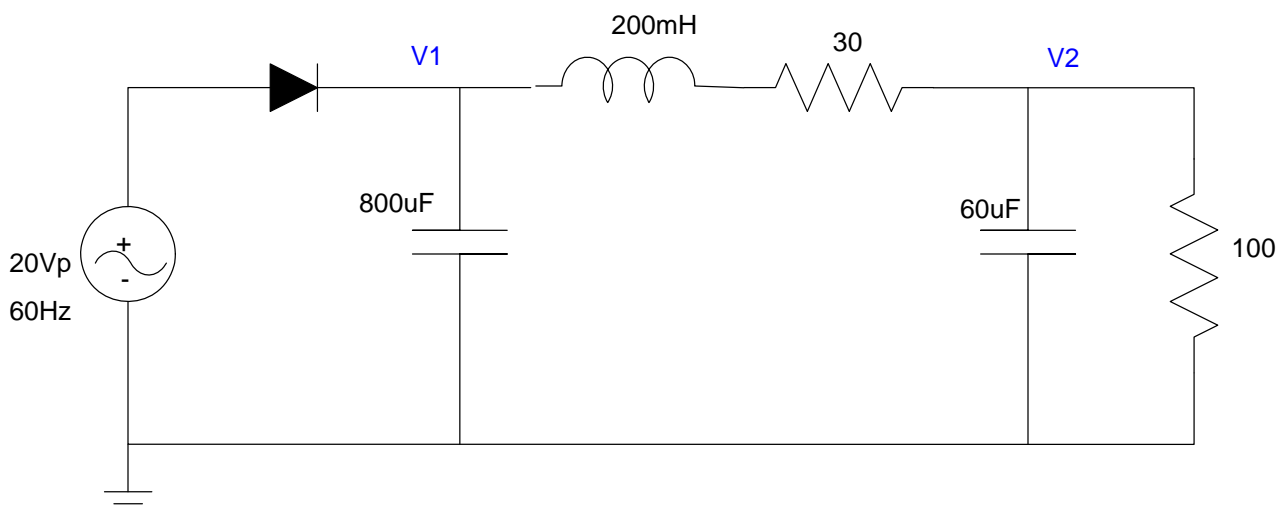
I1	I2	I3	I4	V1	V2



3) AC to DC Converter: Calculate the voltages at V1 and V2 (both DC and AC).

- Assume ideal silicon diodes ( $V_f = 0.7V$ ).
- Note: your answers should be slightly different from problem #4

V1		V2	
DC	AC (V1pp)	DC	AC (V2pp)



Bonus! (last page): Verify your answers using CircuitLab

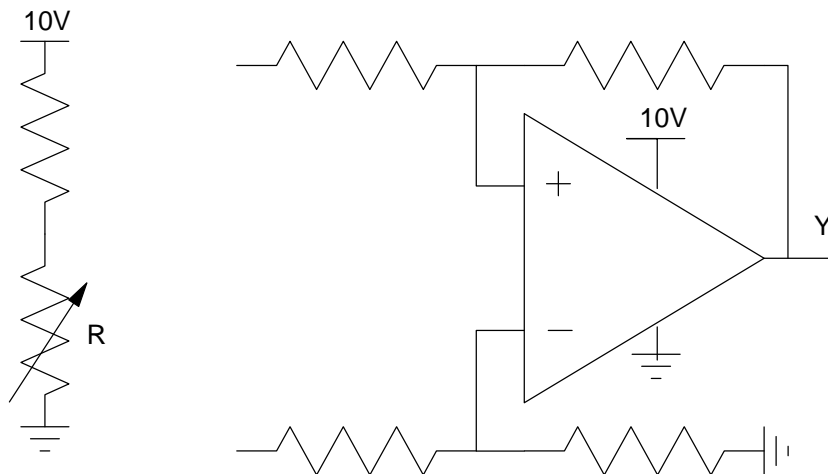
4) Design a Schmitt Trigger which

- Outputs +10V when the temperature goes above 8C,
- Outputs 0V when the temperature drops below 4C, and
- No change for  $4C < T < 8C$

Assume you are using a thermistor with a temperature - resistance relationship of

$$R = 1000 \cdot \exp\left(\frac{3905}{T} - \frac{3905}{298}\right) \Omega$$

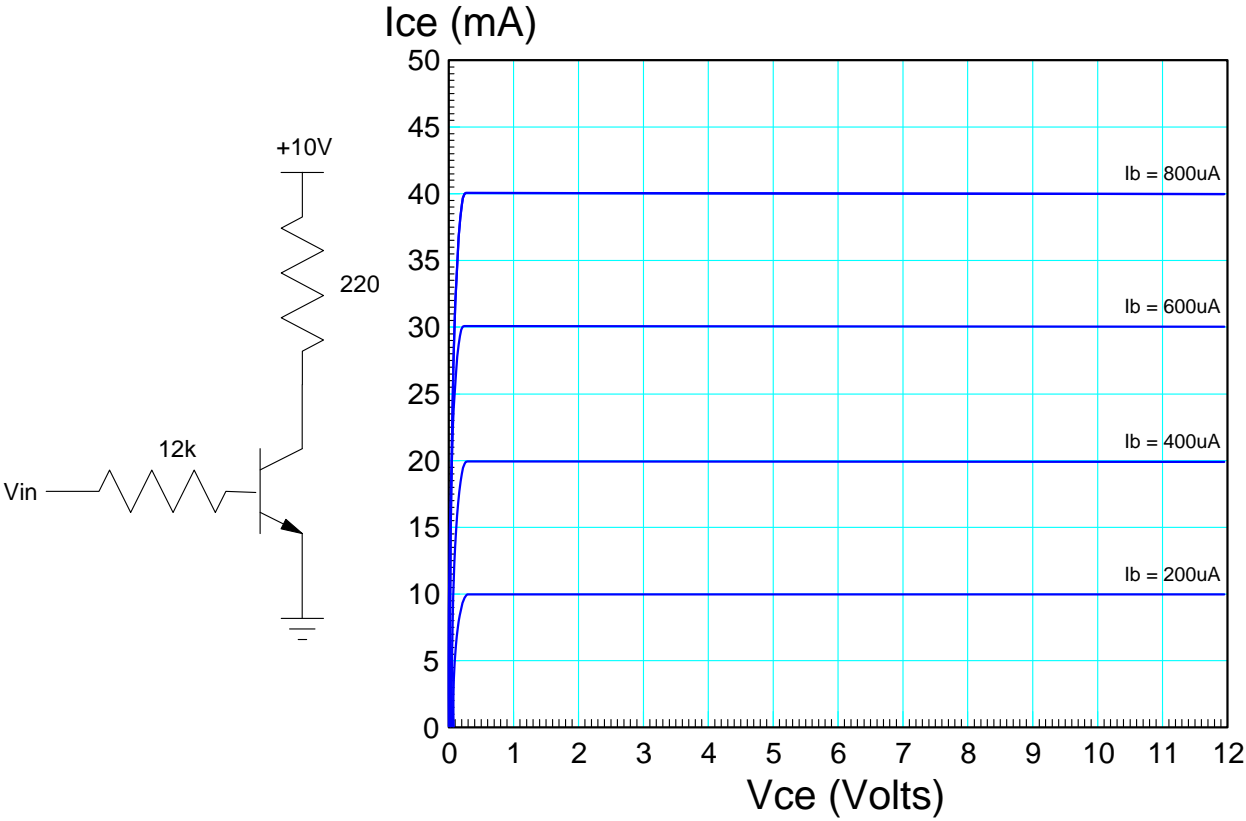
where T is the temperature in degrees Kelvin ( $C + 273$ ).



5) Transistors and Load Lines

Determine the following for the following transsitor circuit

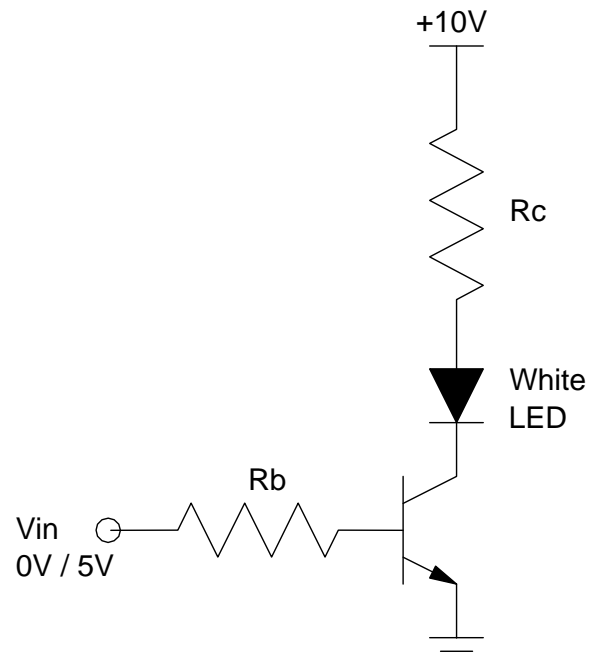
Beta	Load Line	Operating Point for		
		a) Vin = 0V	b) Vin = 5V	c) Vin = 10V
	show on graph	show on graph	show on graph	show on graph



6) Transistor Switch. Determine  $R_c$  and  $R_b$  so that you can turn on and off a white LED at 3A. Assume

- $V_f = 3.0V$  @ 4A for the LED
- The transistor has a gain of 300
- $V_{be} = 0.7V$ ,  $V_{ce(sat)} = 0.2V$
- $V_{in}$  is capable of driving currents up to 10mA

Min value of $R_b$	Max value of $R_b$	$R_c$

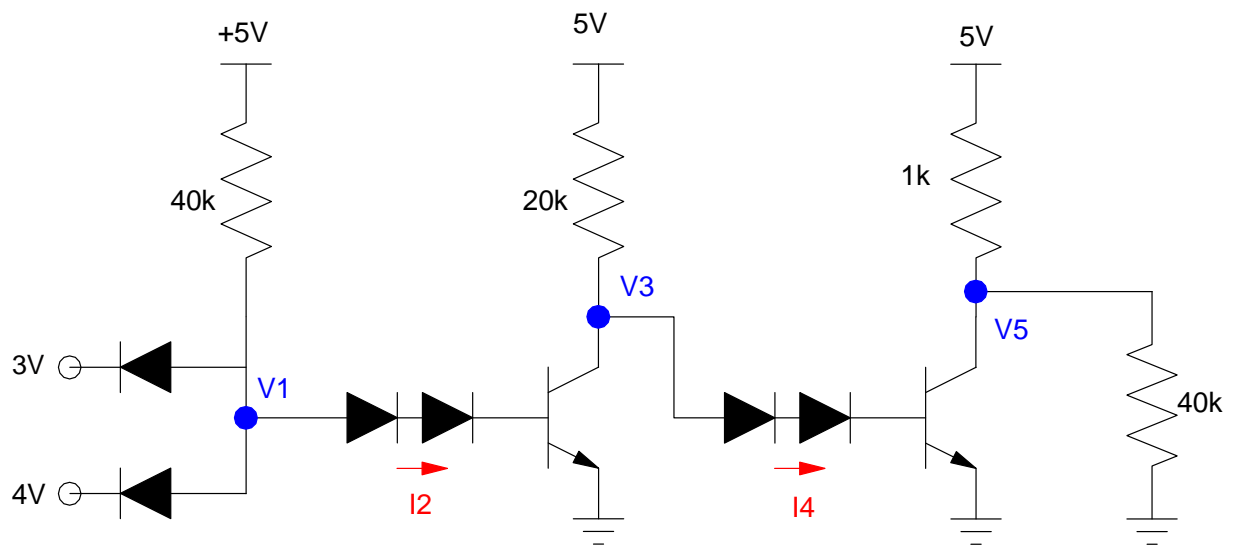


7) Determine the voltages for the following DTL gate. Assume ideal silicon diodes ( $V_f = 0.7V$ ) and transistors:

$V_{be} = 0.7V$

- $V_{ce(sat)} = 0.2V$
- $\beta = 100$

V1	I2	V3	I4	V5

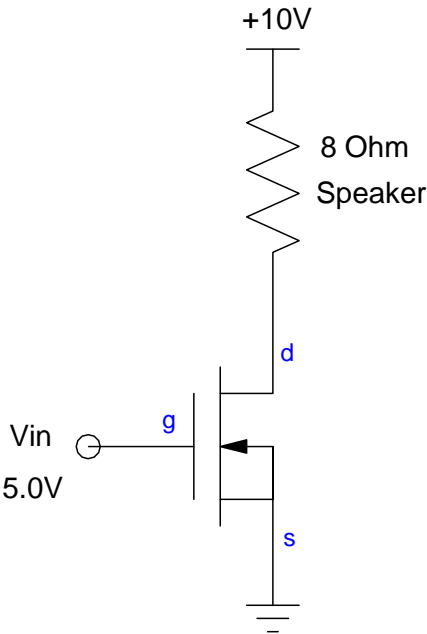


8) The characteristics for a MOSFET are

- Part: IRFD-3-BF
- Current - Continuous Drain ( $I_d$ ) @ 25°C 2.4A ( $T_c$ )
- $R_{ds\ On}$  (Max) @  $I_d$ ,  $V_{gs}$  100mOhm @ 1.4A, 10V
- $V_{gs(th)}$  (Max) @  $I_d$  4V @ 250μA

Determine the transconductance gain,  $k_n$ ,  $V_{ds}$ , and  $I_{ds}$  for the following MOSFET circuit

$k_n$ (A/V <sup>2</sup> )	$V_{ds}$ (Volts)	$I_{ds}$ (mA)	$R_{ds}$



Bonus! What does CircuitLab predict the voltage at V2 is for problem #3?