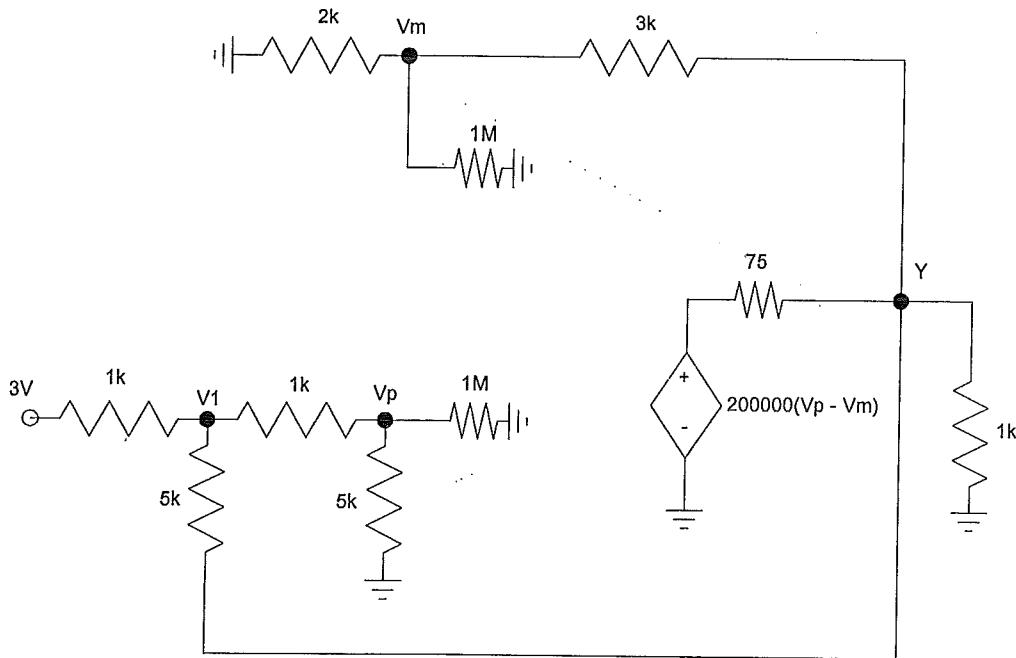


ECE 321 - Quiz #1: Name _____

Op-Amps, Instrumentation Amplifiers, Push-Pull Amplifiers. April 7, 2016

1) Write the voltage node equations for the following op-amp circuit.



$$\frac{V_1 - 3}{1k} + \frac{V_1 - V_p}{1k} + \frac{V_1 - Y}{5k} = 0$$

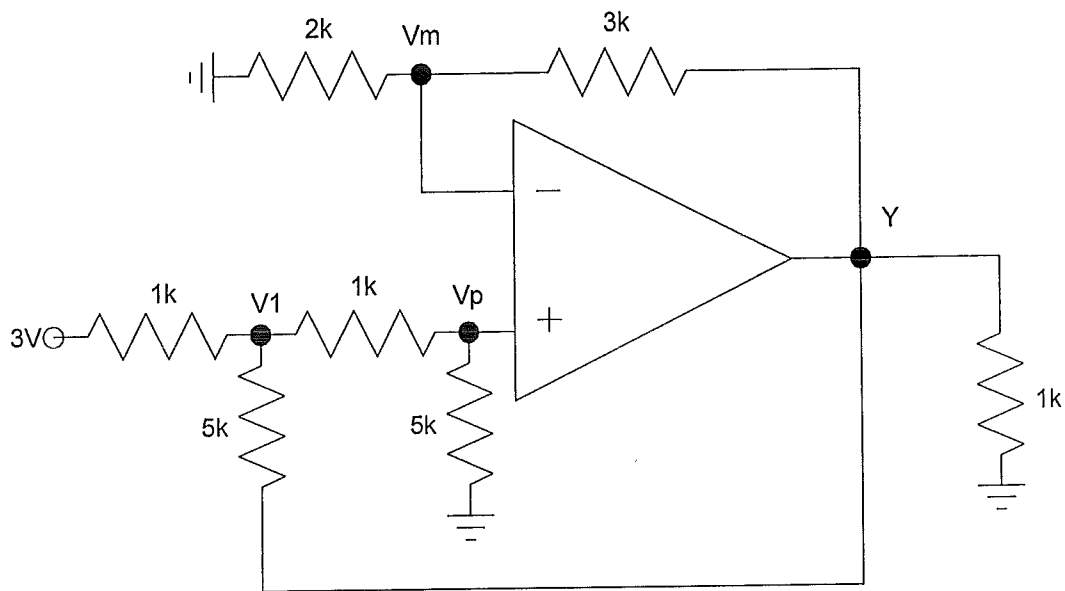
$$\frac{V_p - V_1}{1k} + \frac{V_p}{5k} = 0$$

$$\frac{V_m}{2k} + \frac{V_m}{1M} + \frac{V_m - Y}{3k} = 0$$

$$\frac{Y}{1k} + \frac{Y - 200000(V_p - V_m)}{75} + \frac{Y - V_1}{5k} + \frac{Y - V_m}{3k} = 0$$

er

2) Assume an ideal op-amp. Write the voltage node equations for the following op-amp circuit:



$$V_p = V_m$$

$$\frac{V_m}{2k} + \frac{V_m - Y}{3k} = 0$$

$$\frac{V_p}{5k} + \frac{V_p - V_1}{1k} = 0$$

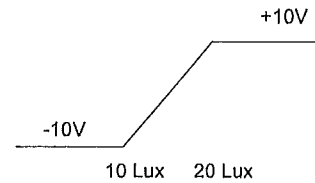
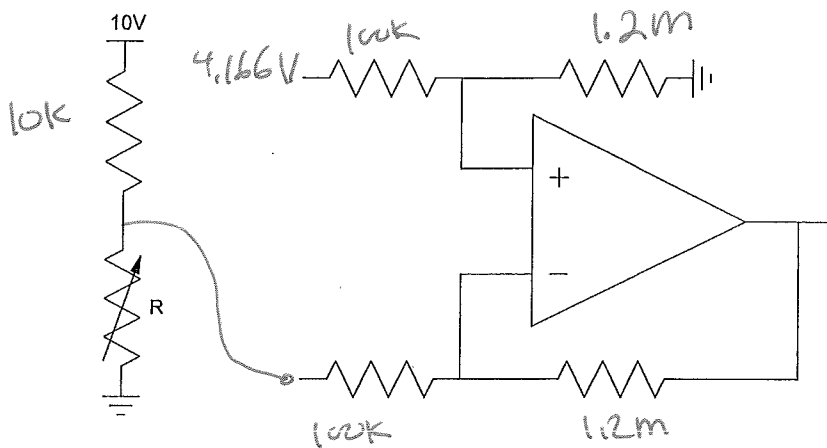
$$\frac{V_1 - 3}{1k} + \frac{V_1 - V_p}{1k} + \frac{V_1 - Y}{5k} = 0$$

3) A light sensor has the following voltage - resistance relationship

$$R = \left(\frac{100,000}{\text{Lux}} \right) \Omega$$

Design a circuit which outputs

- -10V at 10 Lux
- +10V at 20 Lux
- Proportional (-10V to +10V) for light levels between 10 and 20 Lux



10 lux

20 lux

$$R = 10k$$

$$R = 5k$$

$$V_{in} = 5V$$

$$v_{out} = Av$$

$$V = 3.333V$$

$$v = Av$$

$$\text{gain} = 12$$

$$V_o = 12(V_p - v_m)$$

@ 20 lux

$$V_o = 10$$

$$10 = 12(V_p - 3.33V)$$

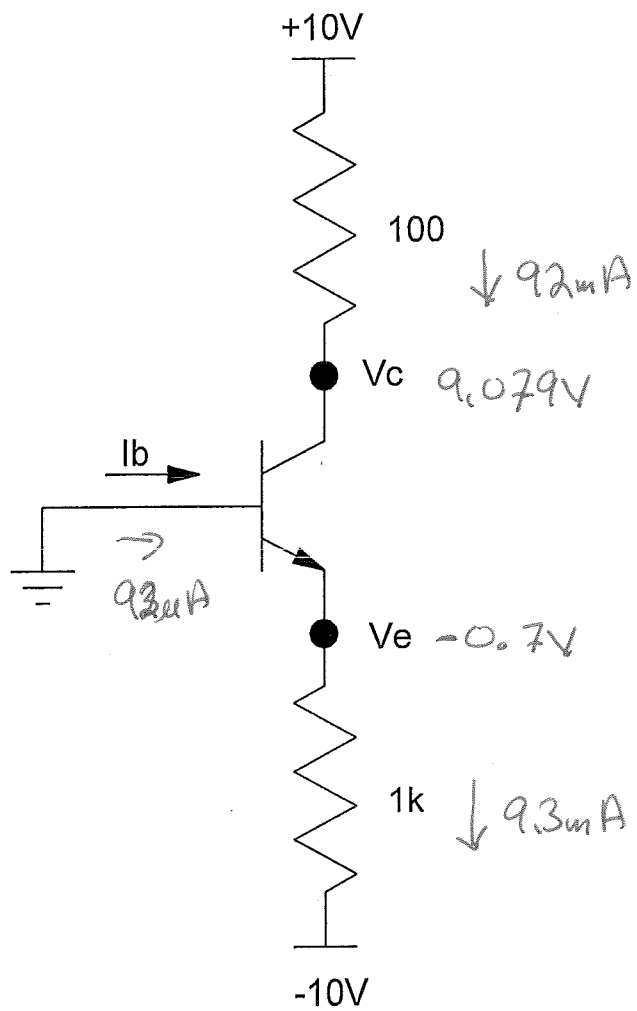
$$V_p = 4.1666V$$

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4) Determine the voltages and currents for the following transistor circuit. Assume an ideal transistor with

- $V_f = 0.7V$
- $\beta = 100$

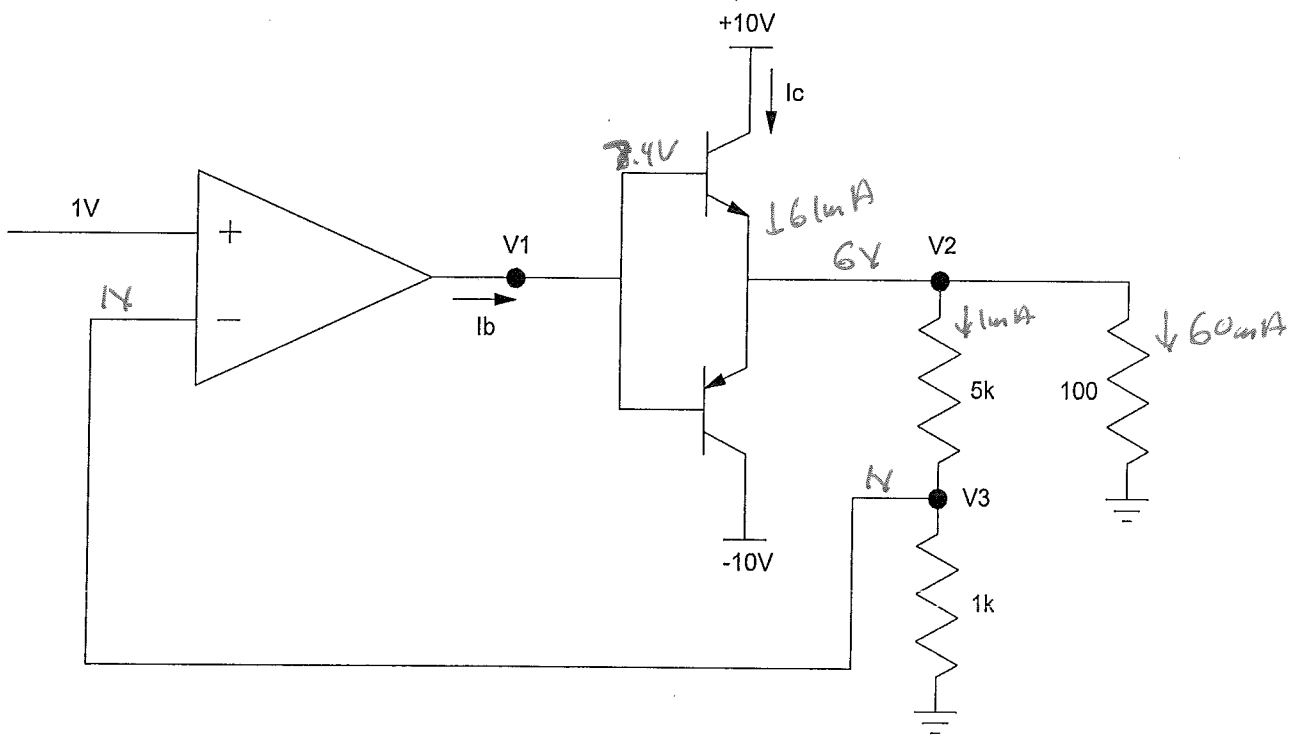
I_b	V_c	V_e
$92\mu A$	$9.079V$	$-0.7V$



5) Find the voltages and currents for the following push-pull amplifier. Assume both transistors are Darlington pairs:

- $V_f = 1.4V$
- $\beta = 1000$

V1	V2	V3	Ib	Ic
7.4V	6V	1V	61 μA 60.94 μ A	60.94 mA



Bernie Sanders Trivia!!! Which four of the following are fellow Senators of Bernie Sanders? (Senators from Minnesota, North Dakota, South Dakota, and Montana - the other four are monsters from Godzilla films)

- Baragon - Daines - Ghidorah - Heitkamp - Klobuchar - Minya - Thune - Varan
- MINN
ND
SD
MINN