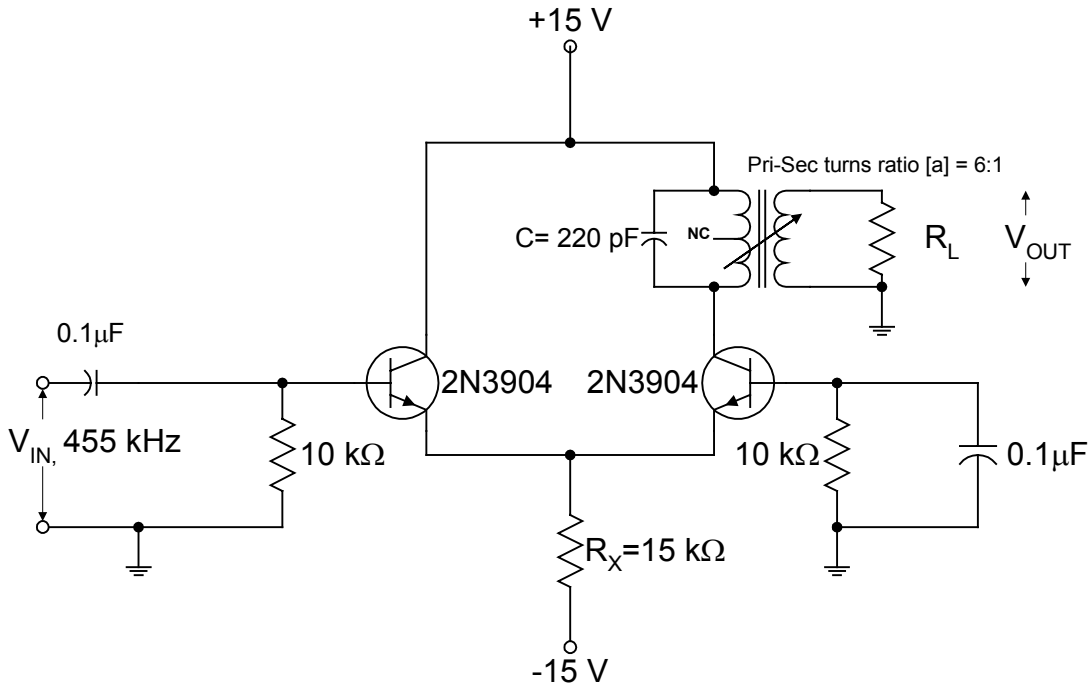


Name: \_\_\_\_\_ Date: \_\_\_\_\_

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE  
**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**  
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Quiz 1  
 6.101 Introductory Analog Electronics Laboratory

NOTE: USE CLOSEST 5% TOLERANCE RESISTOR VALUES FOR ALL RESISTORS.  
 NOTE: SHOW ALL CALCULATIONS FOR ALL ANSWERS BUT THE MOST OBVIOUS!



1a. For the circuit above, calculate the bandwidth you could expect at  $V_{OUT}$  assuming that all circuit elements are perfect.  $R_L = 6.8k\Omega$ .

BW= \_\_\_\_\_

1b. What are  $f_{lo}$  and  $f_{hi}$  [the  $-3dB$  frequencies] for this circuit?

$f_{lo}$  = \_\_\_\_\_

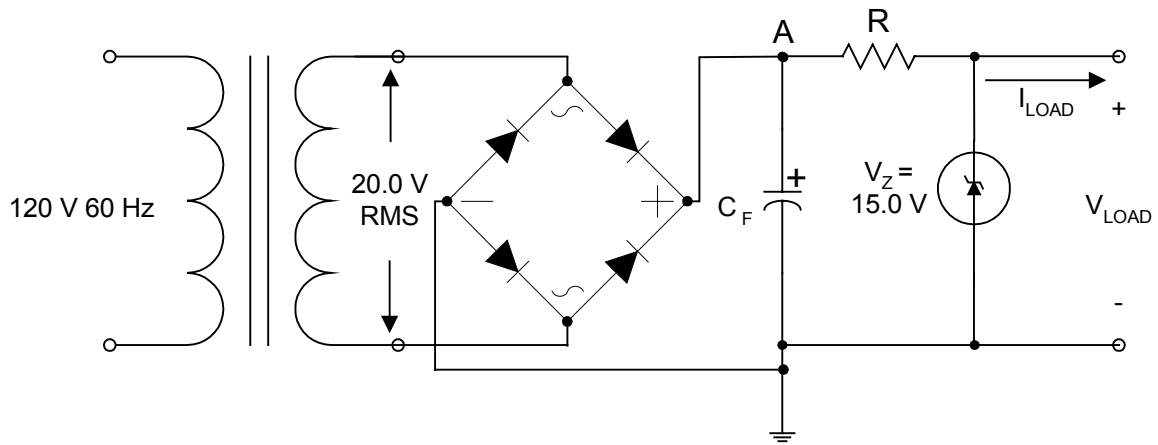
$f_{hi}$  = \_\_\_\_\_

1c. If the actual measured bandwidth of this circuit is 8kHz, then what is the total value of the resistance in the resonant circuit at the primary?

$R_{tot}$  = \_\_\_\_\_

1d. What is the value of all parasitic resistances that account for the difference in bandwidth, measured at the primary?

$R_{para}$  = \_\_\_\_\_



**$V_{\text{Diode}} = 0.7 \text{ volts}, R_Z = 5 \Omega$**

2a. If  $C_F$  is  $2000 \mu\text{F}$ , what is the peak-to-peak ripple voltage at point "A" when 200 mA is flowing through R?

$V_{\text{ripple}} = \underline{\hspace{2cm}}$

2b. What is the average DC voltage at point "A", under the conditions in 2a?

$V_{\text{AV}} = \underline{\hspace{2cm}}$

2c. Calculate R for a maximum load current of 199 mA, and a minimum Zener current of 1 mA.  
Note: Both of these conditions occur together!

$R = \underline{\hspace{2cm}}$

2d. What will be the maximum power dissipation in the Zener diode?

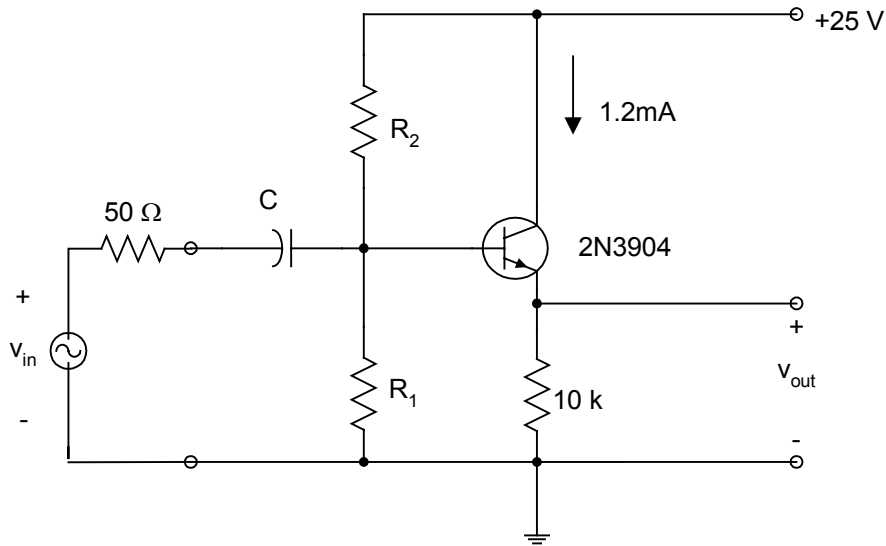
$P_Z = \underline{\hspace{2cm}}$

2e. Calculate the minimum allowed load resistance [not a standard value] if 1 mA is required to keep the Zener diode in its reverse breakdown region.

$R_L = \underline{\hspace{2cm}}$

2f. What will the ripple voltage be across the load [as seen by the load] with 199 mA through the load and 1 mA through the Zener diode?

$V_{\text{RIPPLE}} = \underline{\hspace{2cm}}$



$$\beta_F = 150; \beta_o = 120$$

3a. Design a biasing circuit [ $R_1$  and  $R_2$ ] using the “stiff” biasing approach. Make the current through  $R_1 - R_2$  equal to 20 times  $I_B$  [not including the value of  $I_B$  that flows through  $R_2$ ]; that will give only a 5% error. Assume  $V_{BE} = 0.6$  volts, and  $I_E = I_C$ . **NOTE:** Use  $V_T = 25\text{mV}$ .

$$R_1 = \underline{\hspace{2cm}}$$

$$R_2 = \underline{\hspace{2cm}}$$

3b. Determine the three AC equivalent circuit parameters/elements.

$$\beta_o = \underline{\hspace{2cm}}$$

$$g_m = \underline{\hspace{2cm}}$$

$$r_\pi = \underline{\hspace{2cm}}$$

3c. Find the input impedance to the transistor alone, looking into the base, between base and ground. Ignore the effects of the biasing network.

$$R_{inQ} = \underline{\hspace{2cm}}$$

3d. Find the total input impedance for the whole circuit, taking into account your answer to 3d above and including the effects of your biasing network.

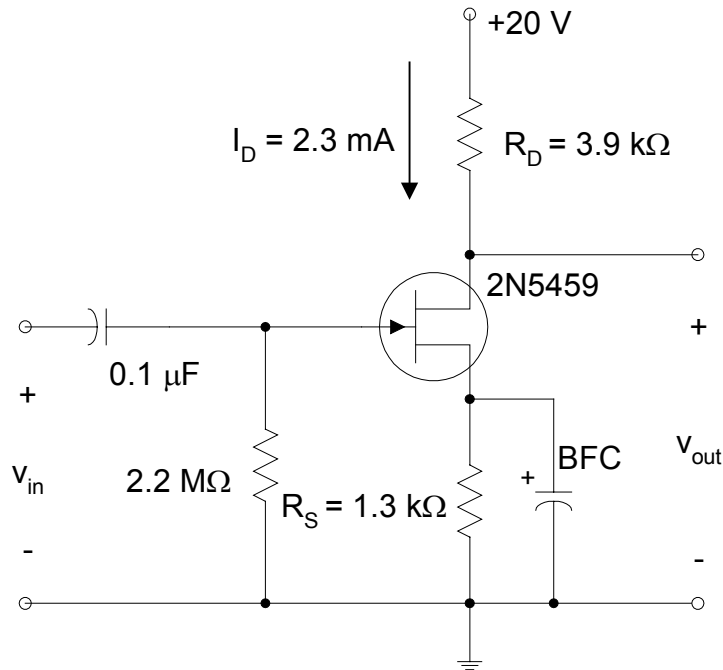
$$R_{in} = \underline{\hspace{2cm}}$$

3e. Find the voltage gain  $A_v = V_{out}/V_{in}$  of this circuit at 1000 Hz. Ignore any effects due to the input capacitor.

$$A_v = \underline{\hspace{2cm}}$$

3f. Find the value of the input coupling capacitor “C” to give a  $-3\text{dB}$  point at 10 Hz.

$$C = \underline{\hspace{2cm}}$$



4a. Refer to the JFET characteristics attached. Plot the load line on the characteristics. Label the actual value of the intercept of the load line with the Drain Current axis and write it here:

$$I = \underline{\hspace{2cm}}$$

4b. On your load line, label the Q point with a large dot and a letter Q. Write the values of the Drain Current and the Drain-Source voltage for the Q point here:

$$V_{DS} = \underline{\hspace{2cm}}$$

$$I_D = \underline{\hspace{2cm}}$$

4c. What is the value of  $I_{DSS}$  for this JFET at  $V_{DS} = 10\text{ V}$ ?

$$I_{DSS} = \underline{\hspace{2cm}}$$

4d. What is the value of  $V_P [V_{GS(off)}]$  for this JFET?

$$V_{GS(off)} = \underline{\hspace{2cm}}$$

4e. Calculate the value of  $g_m$  for this device.

$$g_m = \underline{\hspace{2cm}}$$

4f. Calculate the Voltage Gain of this circuit as it is shown above.

$$A_v = \underline{\hspace{2cm}}$$

4g. Calculate the Voltage Gain of this circuit with the BFC removed.

$$A_v = \underline{\hspace{2cm}}$$

4h. Name one characteristic of the JFET that makes us choose it over an ordinary bipolar transistor.

\_\_\_\_\_

4i. What is the input resistance to this amplifier as seen by the source, ignoring the  $0.1\mu\text{F}$  input coupling capacitor?

$$R_{in} = \underline{\hspace{2cm}}$$