ECE113LA Fall 2003 **Lab Quiz** Name:________________________

11-24-2003 ID no.:________________________

Sec.A: Peter Burke 10:00 to 10:50 am

1	2	3	4	5	6	Total
/5	/5	/5	/40	/40	/5	/100

DO NOT BEGIN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

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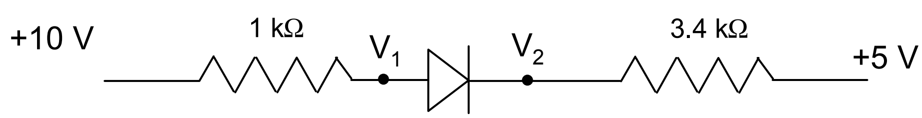
PROBLEM ONE:

5 points



For the circuit shown above find V_1 and V_2. (No partial credit). Assume V_{on} = 0.6 V.

Kirchoff law says
I 1 kΩ + 0.6 V + I 3.4 kΩ = 10-5 V = 5 V

So I = (5 V – 0.6 V)/(1 kΩ + 3.4 kΩ) = 1 mA

So voltage drop across 1k resistor is 1 V.

So V_1 = 10 V – 1 V = 9 V.

So V_2 = 9 V – 0.6 V = 8.4 V.

5 points if you get both V_1 and V_2 correct.
2 points if you only get V_1 or V_2 correct.
0 points else.

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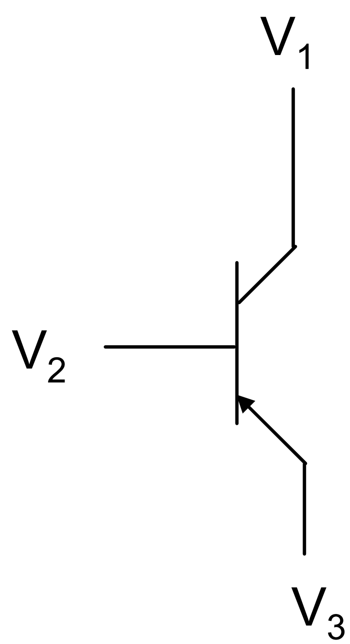
PROBLEM TWO:

5 points



For the circuit shown above, $V_2 = 0$, V_3 is negative, V_1 is positive.
What mode is the transistor biased in?

Inverted active (or inverted) 5 points.
Else 0 points.

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PROBLEM THREE:

5 points

You are given a 1 kΩ resistor and a box of capacitors of various values.

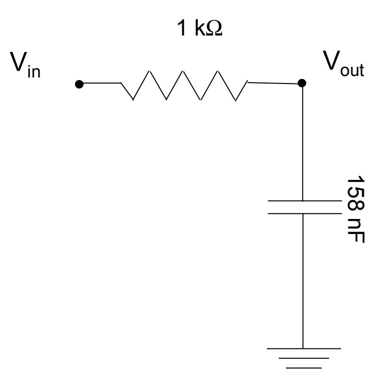
Design a low pass filter with these components such that $|V_{out}/V_{in}| = 0.1$ at 10 kHz.
Draw your circuit labeling V_{in}, V_{out}, and any component values below.

$$\left|\frac{V_{Out}}{V_{in}}\right| = \frac{1}{\sqrt{1+(\omega\tau)^2}} = 0.1 @ 10kHz$$

$$\tau \equiv RC$$

So

$$C = \frac{1}{R2\pi f}\sqrt{\left(\frac{1}{0.1}\right)^2 - 1} = 158\text{ nF}$$



2 points if you draw RC filter correctly (including labeling Vin, Vout), but don't calculate C correctly.

5 points if you draw filter correctly and calculate C correctly (150-180 nF).

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PROBLEM FOUR:

40 points

A hypothetical function generator has a source impedance of 10 Ω, and it drives an oscilloscope with an input impedance of 1 MΩ and an input capacitance of 20 pF. On the scope, a 1 V_{pp} sine wave with 10 Hz frequency appears.

A) The TA gradually turns up the frequency of the function generator. At what frequency will the amplitude of the sine wave displayed on the oscilloscope drop to 0.9 V_{pp}?

The input impedance of the scope is practically infinity at 10 Hz.
At high frequency only the capacitance matters, forming a voltage divider with the 10 Ω source impdedance:

$$\left|\frac{V_{Out}}{V_{in}}\right| = \frac{1}{\sqrt{1+(\omega\tau)^2}} = 0.9$$

$$\tau \equiv RC$$

So

$$f = \frac{1}{2\pi RC}\sqrt{\left(\frac{1}{0.9}\right)^2 - 1} = 385\,\text{MHz}$$

Criteria: 350-400 MHz 20 points.
5 points if you write down

$$\left|\frac{V_{Out}}{V_{in}}\right| = \frac{1}{\sqrt{1+(\omega\tau)^2}} = 0.9$$

$$\tau \equiv RC$$

Else 0

B) Your TA gives you a new oscilloscope with a 50 Ω input impedance, and dials the function generator frequency back to 10 Hz. What is the amplitude of the ac waveform that is displayed on this new oscilloscope?

Back at 10 Hz the capacitance doesn't matter. The scope input impedance forms a voltage divider, so the amplitude is 50/(10+50) times smaller = 0.833 V_{pp}.

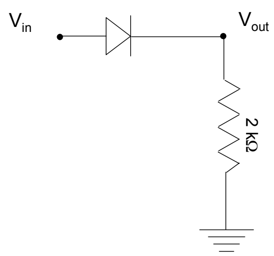
Criteria: 0.8-0.9 V_{pp} 20 points.
Else 0.

PROBLEM FIVE:

40 points

Assume V_{on} = 0.7 V, t_s = 1 μs.

Use the same care in drawing your answer as you would in a lab report.



A) For the circuit shown above, draw $V_{out}(t)$ given $V_{in}(t)$ = 1 mV sin (2*pi*1 kHz * t). On the same graph, draw $V_{in}(t)$ as a dotted line.

For such a low input voltage, there is no current flowing through the diode so there is no voltage drop across the resistor so Vout = 0.

Criteria: Correcly sketch Vout vs t (units, labels correct): 20 points.

Else 0.

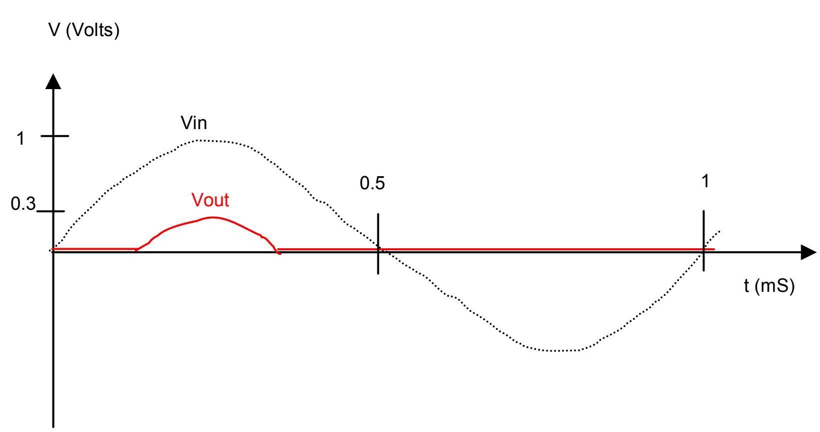
B) For the circuit shown above, draw $V_{out}(t)$ given $V_{in}(t)$ = 1 V sin (2*pi*1 kHz * t). On the same graph, draw $V_{in}(t)$ as a dotted line.

For times when Vin is negative, Vout is zero because no current flows.

When Vin is less than 0.7 V, the output is zero because no current flows.

When Vin is greater than 0.7 V, Vout=Vin – 0.7 V.

So the output is a rectified sine wave as follows:



20 points if everything correct. Else 0.

PROBLEM SIX:

5 points

You are measuring the resistance of a resistor.

You measure the voltage drop across the resistor to be 0.231 V.
You find the current flowing through the transistor to be 0.1015 mA.

What is the resistance, using the correct number of significant figures?

2280 Ω or 2.28 kΩ.

Grading : All or nothing.