EECS 100/42 Spring 2009 Midterm # 1

PRINT NAME (Last, First): _____

SIGN YOUR NAME: _____

STUDENT ID #: _____

CIRCLE ONE: **EE 100** **EE 42**

# 1	# 2	# 3	SUBTOTAL
5	5	8	18

# 4	# 5	# 6	SUBTOTAL	TOTAL
14	16	12	42	60

Instructions:

1 Print and sign your name and enter your student ID number above.

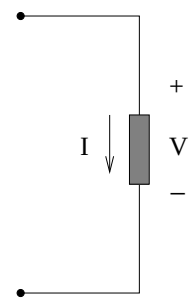
2 Read the questions carefully.

3 Write your solution clearly.

4 You must show your work to get full credit.

5 This exam has 6 questions worth 60 points, so you should proceed at approximately 1 point per minute.

Problem # 1 ($4 + 1 = 5$ points)



A linear circuit is driven by an AC source.
The frequency of the source is 60 Hertz.
We isolate one of the circuit elements.
We find that the phasor of current though the element is $\mathbb{I} = 3 - 4j$.
The phasor of the voltage across the element is $\mathbb{V} = 5\exp(j\pi/2)$.
These are in the sign conventions shown.

What is the average power P_{av} <u>delivered</u> by the element?

$P_{\text{av}} =$

Problem # 2 ($5 * 1 = 5$ points)

Circle the most appropriate answers.
Incorrect answers receive -1 points.
No explanations are necessary.

It **is/is not** possible to find the phasor of the signal $2\cos(2t) + 3\cos(3t)$.

For a well-designed circuit with a practical voltage source, the internal resistance R of the source should be much **larger/smaller** than the load resistance.

For maximum power transfer from a practical voltage source to a resistive load, the internal resistance R should be much **larger than /smaller than /equal to** the load resistance.

In a circuit driven by AC sources, the average power delivered to a capacitor is **positive/negative/zero**.

The internal resistance of a typical antenna source is $\mathbf{10^6/100/1}$ Ω.

Problem # 3 ($4 + 4 = 8$ points)

A lightbulb is basically a resistor. The power rating of a lightbulb is the amount of power that it would dissipate if it was connected to a 100 volts DC source

(a) A 50 watt lightbulb and a 100 watt lightbulb are connected in <u>series</u> with a 100 volt DC source. Which one glows brighter, i.e. dissipates more energy? Explain your answer.

50W bulb or **100W bulb**

(b) A 50 watt lightbulb and a 100 watt lightbulb are connected in <u>parallel</u> with a 100 volt DC source. Which one glows brighter, i.e. i.e. dissipates more energy? Explain your answer.

50W bulb or **100W bulb**

Problem # 4 $(4 + 4 + 3 + 3 = 14$ points)

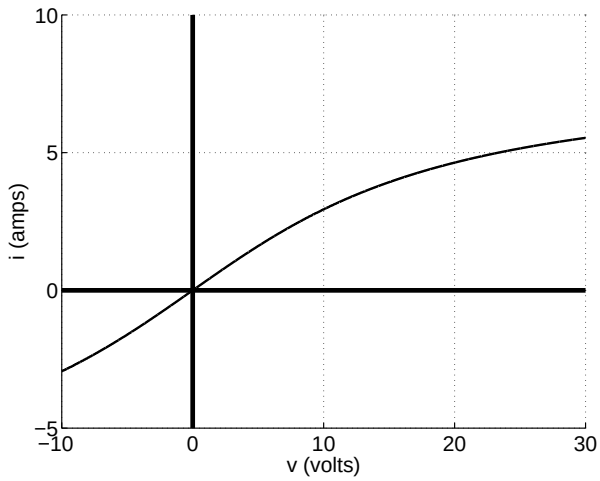
The resistive network shown below is connected to a berkelistor B. The berkelistor is a nonlinear device with $i - v$ characteristic shown below.

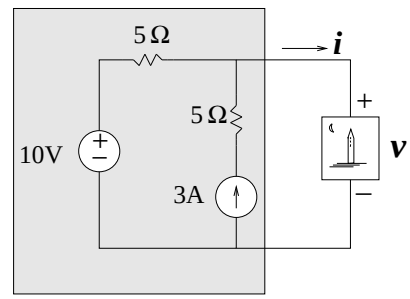
(a) Find the thevenin voltage V_T for the linear part of the circuit.

(b) Find the thevenin resistance R_T for the linear part of the circuit.

(c) Find the current i drawn by the berkelistor

(d) Find the voltage v across the berkelistor.

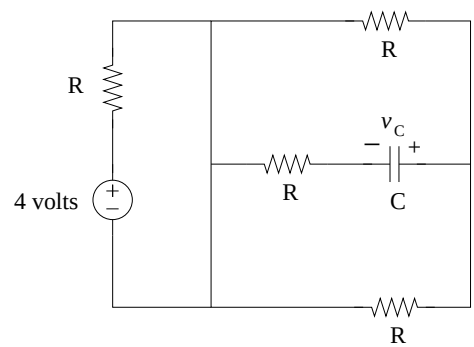




$V_T =$	$R_T =$
$i =$	$v =$

Problem # 5 $(3 + 5 + 5 + 3 = 16$ points)

Consider the circuit shown across.
The capacitor has an initial charge of 2 nano-coulombs.
The element values are $R = 2K\Omega$, and $C = 400pF$.



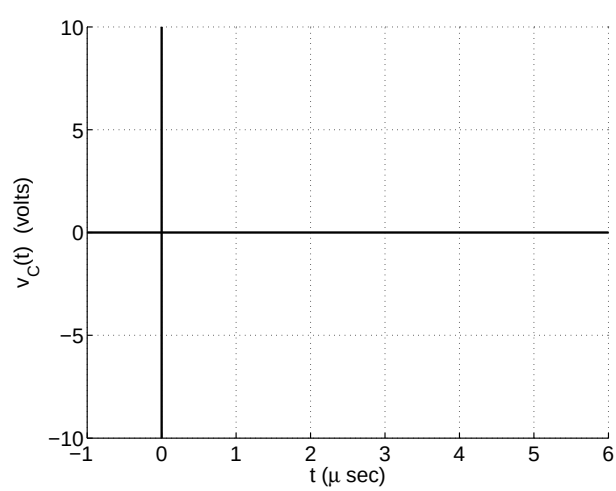
(a) Find the initial value of the capacitor voltage.

(b) Find the asymptotic value of the capacitor voltage.

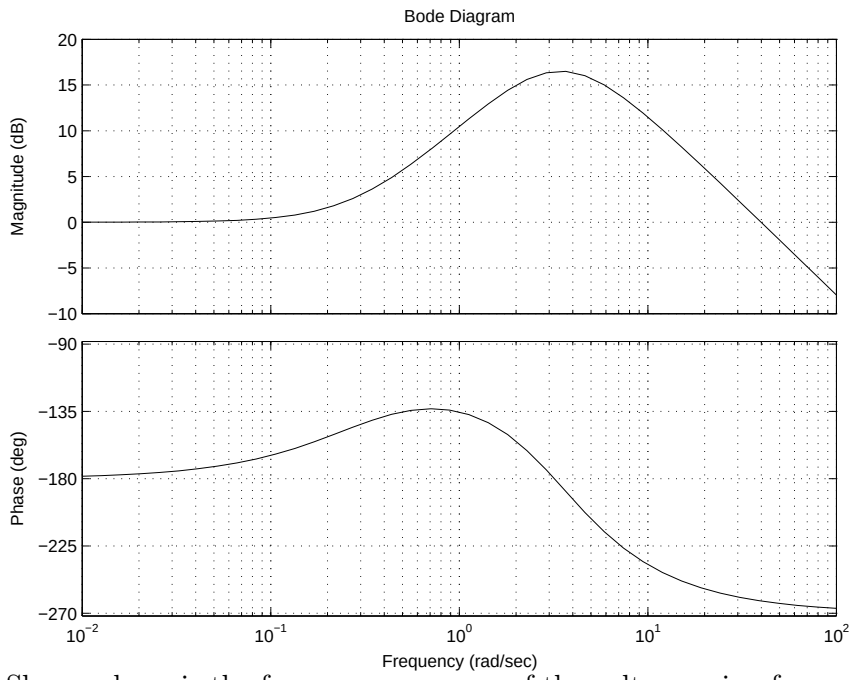
(c) Find the time constant of the circuit.

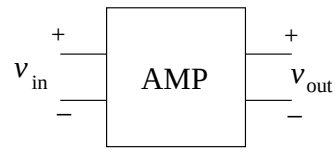
(d) Sketch $v_C(t)$ on the graph below.

$v_C(0) =$
$v_C(\infty) =$
time constant $=$



Problem # 6 (6+6 = 12 points)





Shown above is the frequency response of the voltage gain of some amplifier.
For each of the following input voltages, find the steady-state output voltage.

(a) $v_{in}(t) = \sin(t+1)$

$v_{out}(t) =$

(b) $v_{in}(t) = 10$

$v_{out}(t) =$