**PHY2250 - Electronics & Circuit Theory, Spring '09 *Practice* Exam**

**Name:___Dr. Hawley____**

Turn off (OFF) all cell phones

Answer on these papers

**Part I (72 points): Circle the "best" answer. No need to show your work.**

1. (4 points) The smallest unit of an element is: (circle one)

a) An electron b) A molecule

c) A compound (d) An atom

2. (4 points) In a series RC circuit:

a) The current flowing in the circuit lags the voltage across the capacitor by 90 degrees.

b) The circuit current and resistor voltage are in phase with one another

c) The current leads the voltage by 45 degrees

d) All of the above

(e) Both (a) and (b), but not (c)

3. (4 points) What are the majority carriers in an N-type semiconductor?

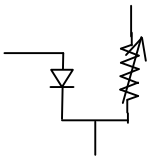
a) Positrons (b) Electrons

c) Holes d) Protons

4. (4 points) The following diagram of a diode and variable resistor can serve as a model of what electronic component? (circle one)

a) capacitor b) op-amp

(c) transistor d) regulator



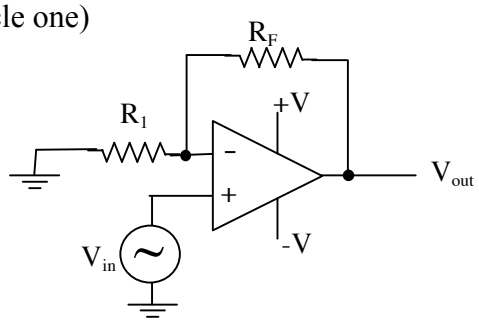
5. (4 points) The op-amp circuit shown the right is a/an (circle one)

(a) Closed-loop noninverting amplifier

b) Active high-pass filter

c) Open-loop signal generator

d) Closed-loop inverting amplifier




*Los Angles, CA*. In a drug deal gone horribly wrong, rising hip-hop star "KillahWatt" lodged his "grill" across the output terminals of a step-down transformer putting out 20A at 240V RMS.

6. (4 points) Calculate the *average* power coursing through his grill.

a) 12 W b) 120 W

c) 2880 W (d) 4800 W

7. (4 points) Calculate the impedance of said grill.

a) 2 Ω b) 8 Ω

(c) 12 Ω d) 4800 Ω

*Nashville, TN*. Honky-tonk legend Dwayne Rufus McGathright decides to lick the two contacts of a parallel plate capacitor. "The dang thing's only been charged to 5 Volts!" he exclaims with confidence. Unfortunately it is a 1F capacitor.

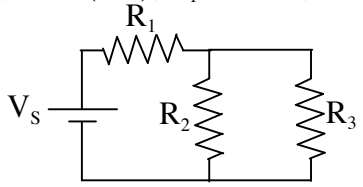
8. (4 points) Calculate the charge on the capacitor prior to said licking.

a) 0.2 C b) 1 C
(c) 5 C d) 10 C e) None of the above

9. (4 points) If McGathright's tongue's resistance is 10,000 Ω, calculate the time it takes for the capacitor to discharge to 1V.

(a) 4.5 hours b) 7.6 hours
c) 2.2 days d) Over a week e) None of the above

*Springfield, USA*. Three lovable, misfit squirrels bridge the two wires of a DC high-voltage line, forming a circuit as shown below. The three squirrels, "Blacky," "Sparky" and "Crispy" are represented as resistors $R_1$, $R_2$ and $R_3$, respectively. In this circuit, $V_S = 10{,}000V$ (DC), $R_1 = 40k\Omega$, $R_2 = 30k\Omega$ and $R_3 = 60k\Omega$…




10. (4 points) Find the power dissipated by Blacky's body.

a) 1670 W b) 3300 W
c) 6700 W d) 8600 W (e) None of the above

**1111W**

11. (4 points) A transformer has 100 turns on the primary and 400 turns on the secondary. If a 10V signal is found on the secondary, what is the voltage on the primary?

a) 2 V (b) 2.5 V
c) 4 V d) 6 V

Two sine wave signals of frequency 500 Hz and amplitude 2V are added together, but one is time-delayed by 500μs with respect to the other.

12. (4 points) What is the phase shift between the two signals?

a) 45° (b) 90°
c) 180° d) 270° e) None of the above

13. (4 points) What is the amplitude of the resulting summed signal?

a) 0V b) 1.4V
(c) 2.8 V d) 4 V e) None of the above

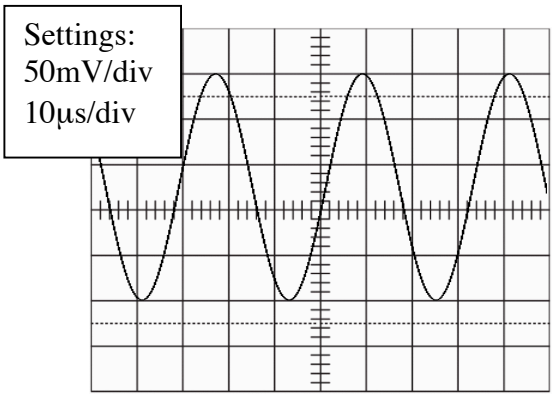
14. (4 points) The capacitor any condenser microphone has a variable plate separation. The voltage across the capacitor is kept at a constant 48V by phantom power. If one such a capacitor in its "default" separation has a capacitance of 13μF and then the plate separation *decreases* by a factor of 2 in 9ms, find the current that flows.

(a) 70 mA b) 140 mA
c) 35 mA d) 22 mA e) None of the above

15. (4 points) Rob G. has a favorite resistor to use, with the color bands Red, Orange, Blue and Gold. What is the value of Rob's favorite resistor (with tolerance)?

a) 12 MΩ ± 5% b) 120 kΩ ± 5%
c) 120 kΩ ± 10% (d) 23 MΩ ± 5% e) None of the above

Regarding the following oscilloscope trace, what are…




16. (4 points) the amplitude

a) 50 mV b) 100 mV
(b) 125 mV d) 150 mV

17. (4 points) the frequency

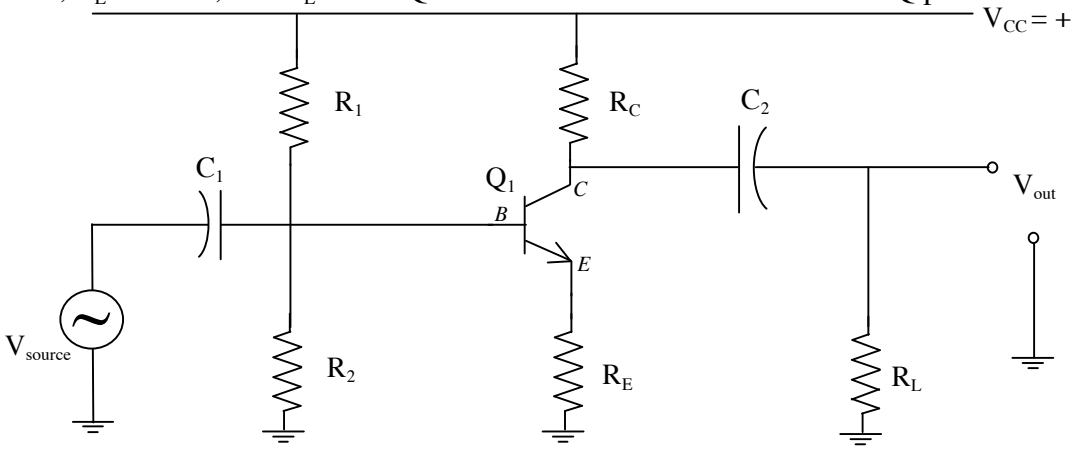
a) 8.4 µs b) 16 µs
(c) 32 µs d) 154 µs

**Part II: Short Answer (28 points): Answer the following and show any relevant work.**

19. (6 points) Describe the difference(s) and similarity(/ies) between "resistance" and "impedance".

**Both are opposition to currentflow and measured in amps.**
**Resistance includes dissipation of power by heat, whereas impedance does not necessarily.**
**Impedance is a super-set including resistance and reactance, thus resistance is a form of impedance.**

"A Simple Amplifier. Again!" In the following circuit, use the values $R_1 = 8k\Omega$, $R_2 = 4k\Omega$, $R_C = 200\Omega$, $R_E = 100\Omega$, and $R_L = \infty$. Questions 20 to 22 deal with the DC "Q point" of the amplifier…




20. (4 points) What is the value of $V_B$?

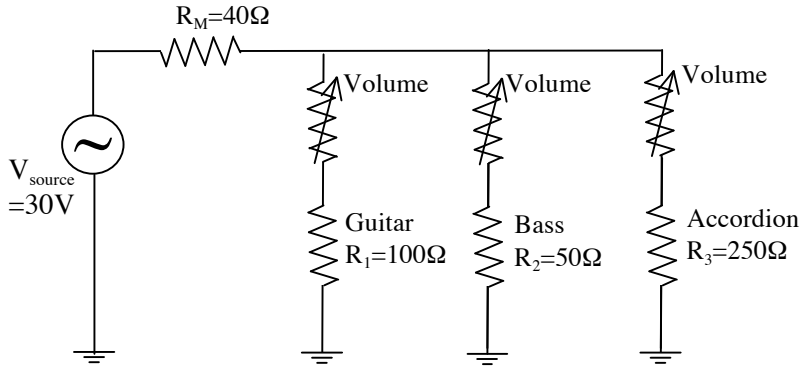
**VB = VCC * R2 / (R1+R2) = 11 * 4 / (8+4) = 44 / 12 = 3.67V**

21. (4 points) What is the value of $I_E$?

**VE = VB – 0.7 = 2.97V**
**IE = VE/RE = 2.97 / 100 = 0.0297A**

~~22. (4 points) If $\beta_{DC}$ = 50, what is $V_C$?~~

23. (10 points) In the following "pseudo-cue-system," three instrument channels are placed in parallel, and each channel has a volume knob (represented by variable resistors).




a) Say the guitar channel's volume knob is "all the way on", i.e. zero resistance, and the other two volume knobs are turned "off," i.e. "infinite" resistance. What is…

…the total current?

…the current that flows through the guitar channel?

…the voltage across the guitar?

**IT = VS / (RM + R1) = 30 / 140 = 0.214 A**

**I1 is the same as IT**

**V1 = I1 * R1 = 0.214 * 100 = 21.4V**

b) Now suppose the bass channel's knob is also turned all the way on….

What is the total current?

What is the current through the guitar channel?

What is the voltage across the guitar?

**R12 = (1/R1 + 1/R2)^(-1) = 100/3 = 33.3 Ohms**

**RT = RM + R12 = 40 + 33.3 = 73.3 Ohms**

**IT = 30V / 73.3 Ohms = 0.409 A Note: greater than in part (a), becase added a current-path**

**I1 = IT * (R12 / R1 ) = .409 * (33.3 / 100) = 0.136 A**

**V1 = I1 * R1 = 13.6 V**

**Extra Credit:**

10. (2 points) Which recording industry pioneer "accidentally" created the first diode, but could not see any practical application of it?

**Thomas Edison**

11. (2 points) How badly would you like to be a laboratory assistant for PHY2250 in Fall '09?