Wednesday, March 1, 2017	**Physics250: UnTest 02**	Name _____

Instructions: You have a total of 50 minutes to complete this test.
Answer each question completely showing complete details.
For complete credit you must include correct SI units with numerical answers.

Time Start_____ Time finish _____pledged _____

Constants: $k=8.987x10^{9}\frac{Nm^2}{C^2}:\epsilon_0=8.854x10^{-12}\frac{C^2}{Nm^2}:\mu_0=4\pi x10^{-7}\frac{Tm}{A}:\mu=1x10^{-6}$

[1] A wire has a length L=5 m and is carrying a current towards the +x direction of 7 A.

(a)Calculate the magnitude of the magnetic field at a distance of 0.1 m from the wire.

(b) Suppose that the same wire, with the same current is subjected to an external magnetic field in the -y direction of strength B=0.1 T. Calculate the total vector force on the wire (do not forget the direction; $\hat{x},\hat{y}$, or $\hat{z}$).

(c) In a region of space, it is observed that the electric potential varies as:

$$V=b+\frac{1}{2}az^2 \quad .$$

Calculate the vector electric field in this region of space.

[2] A parallel plate capacitor has plates of area A and separation d. On the plate located at the x=0, a surface charge density +σ exists while on the plate located at x=d, a surface charge density -σ exists. Answer the following assuming that this can be regarded as an ideal capacitor.

(a) Starting from Gauss's Law, show (showing complete details) how to calculate the vector electric field within the capacitor in terms of σ, ε_0 and $\hat{x}$.

(b) Calculate the **magnitude** of the potential difference between the two plates in terms of σ, ε_0 and d.

(c) Calculate the capacitance of the capacitor in terms of ε_0 , A and d.

(d) Calculate the total energy stored on the capacitor in terms of C and V.

(e) Calculate the energy density in terms of ϵ_0 and E.

(f) Suppose a capacitor (C=1μf) has potential difference of 100V. Find the total stored electrostatic energy with correct SI units.

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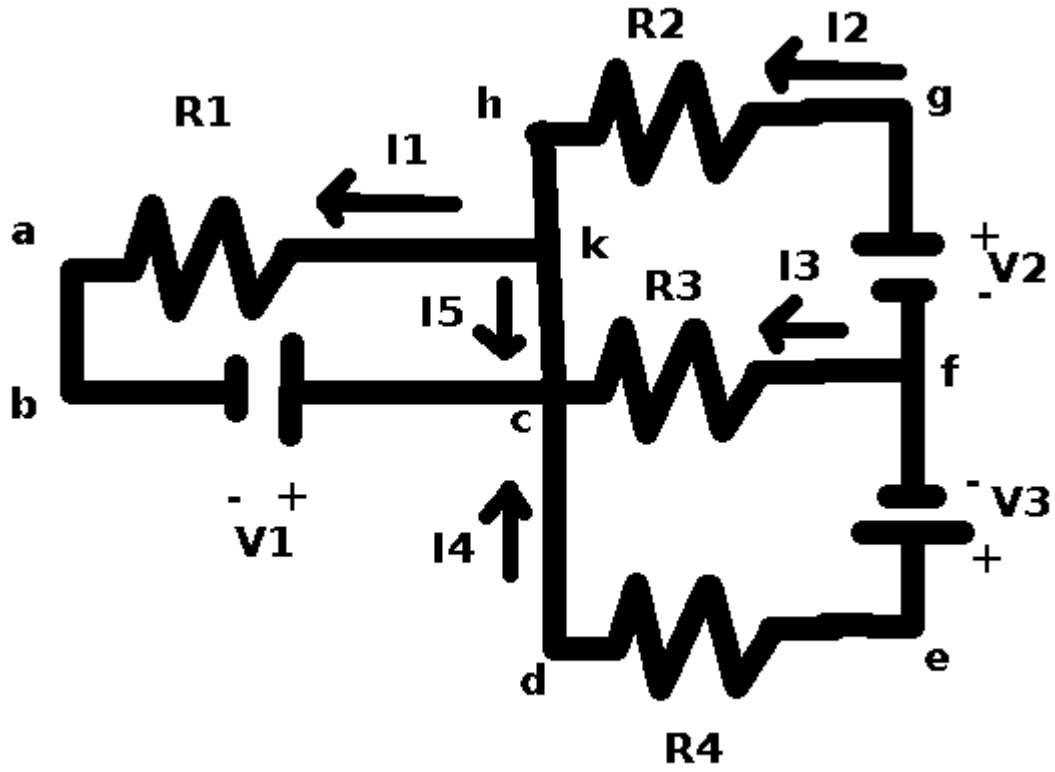

[3] Consider the circuit shown above. Write the Kirchoff's laws equations that result from the following:
Loop (abcka) _____
Loop (cdefc):_____
Loop (cfghkc):_____
@c: _____
@f: _____
Suppose with the following values:
V1=10V : V2=20V : V3=30V : R1=1Ω : R2=2Ω : R3=3Ω : R4=4Ω, the following currents resulted: I1=10A, I2=1.92A, I3=-5.38A, I4=3.46A, and I5=-8.08 A.
Calculate the total power radiated with correct SI units.

P=_____
What is the interpretation of the value provided for current I5?

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[4] A capacitor has a plate area of .5 m^2 and a plate separation of 0.1 m.
(a) Calculate the capacitance of this capacitor.

(b) If C_1 has a capacitance of 1μf and C_2 has a capacitance of 5 μf. ,calculate the capacitance of the two capacitors when they are connected in series.

(c) If C_1 has a capacitance of 1μf and C_2 has a capacitance of 5 μf. ,calculate the capacitance of the two capacitors when they are connected in parallel.

A has a resistivity of 20 Ωm. A resistor from this material is 0.1 m long and has a cross sectional area of 0.1 m^2.
(d) Calculate the resistance of this resistor.

(e) If R_1 has a resistance of 100 Ω and resistor R_2 has a resistance of 50 Ω, calculate the resistance of the two resistors when connected in series.

(f) If R_1 has a resistance of 100 Ω and resistor R_2 has a resistance of 50 Ω, calculate the resistance of the two resistors when connected in parallel.

(g) Calculate the RC time constant when a resistor ($R=1x10^5$ Ω) is connected in series with a capacitor (C=3 μf).