Wednesday, March 4, 2015	**Physics220: UnTest 02**	Name _____

Instructions: You have a total of 55 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: $k=8.987\text{x}10^{9}\frac{Nm^2}{C^2}:\epsilon_0=8.854\text{x}10^{-12}\frac{C^2}{Nm^2}:\mu_0=4\pi\,\text{x}10^{-7}\frac{Tm}{A}$

(1) Capacitor 1 has area $A=0.1m^2$ and a plate separation $d_1=0.05m$. Capacitor 2 has an area $A=0.1m^2$ and a plate separation $d_2=0.02m$.

(a) if the two capacitors are placed in series, find the equivalent capacitance.

(b) if the two capacitors are placed in parallel, find the equivalent capacitance.

Resistor 1 has a resistivity $\rho_1=100\ \Omega m$ and a length $L=0.05$ m. Resistor 2 has a resistivity $\rho_2=20\ \Omega m$ and a length $L=0.02$ m. Both resistors have a cross sectional area $A=0.1\ m^2$.

(c) If the two resistors are placed in series, find the equivalent resistance.

(d) If the two resistors are placed in parallel, find the equivalent resistance.

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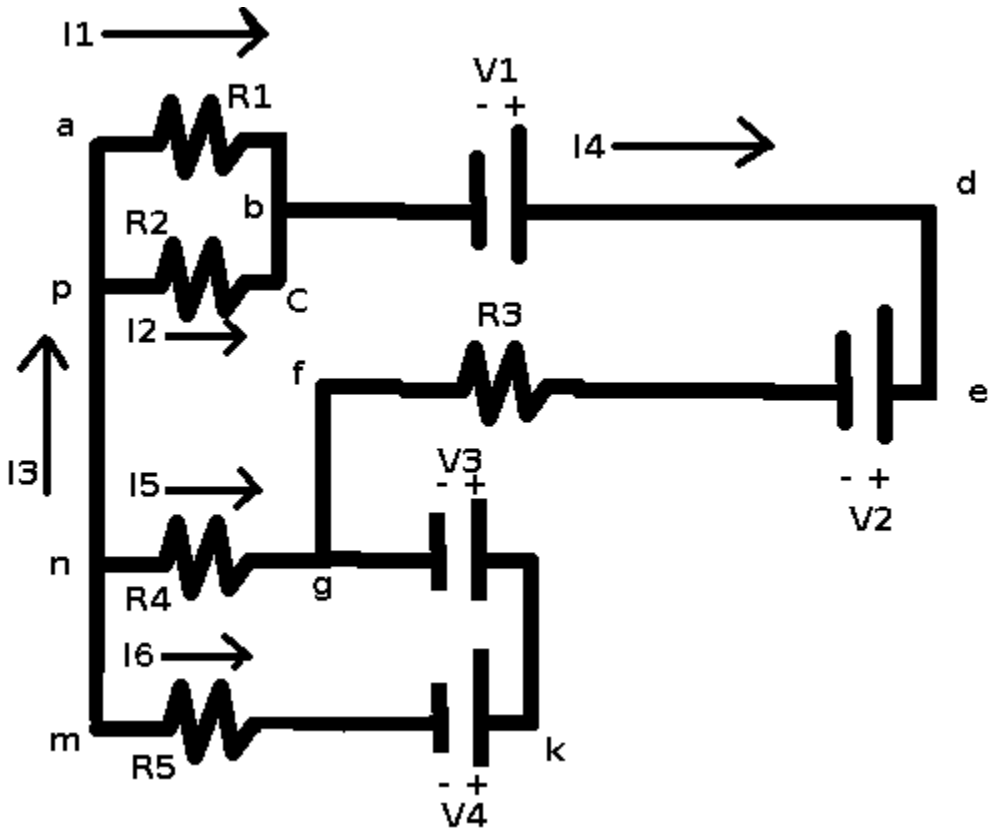
(2) Consider the following circuit. Provide the following Kirchoff's laws equations:
(a) loop (abdefgnpa):
(b) loop (abcpa):
(c) loop (ngkmn):
(d) @ g:
(e) @ p:
(f) @ b:



With R1=1,R2=2,R3=3,R4=4,R5=5,V1=10,V2=20,V3=30,V4=40, the following currents result:
I1=−1.64A:I2=−0.82A:I3=−2.45A:I4=−2.45A:I5=+0.88A:+I6=2.20A

(g) Find power radiated by resistor R5.

(h) What is the interpretation of the result provided for current I2?

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(3) A parallel plate capacitor has one plate of area A located at z=0 and the other plate of area A located at z=d. There is a surface charge $+\sigma$ on the plate at z=0 and $-\sigma$ on the plate at x=d. You may assume that the electric field between the plates is $\vec{E}=\frac{\sigma}{\epsilon_0}\hat{z}$ and zero outside the capacitor.

(a) Calculate the magnitude of the potential difference between the plates.

(b) Calculate the total amount of charge separated, Q in terms of σ and A .

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

(d) A capacitor is charged to a maximum charge Q. Find the total energy (U) stored in the capacitor in terms of E, ϵ_0, A and d .

(e) From your expression for the total stored energy (U) obtained in (d), find an expression for the energy density inside the parallel plate capacitor in terms of ϵ_0 and E .

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(4) 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: $V = ax + b$. Calculate the **vector electric field** in this region of space.