Wednesday, March 2, 2016	**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) Consider the circuit shown below. Provide correct Kirchoff's law equations for the following:

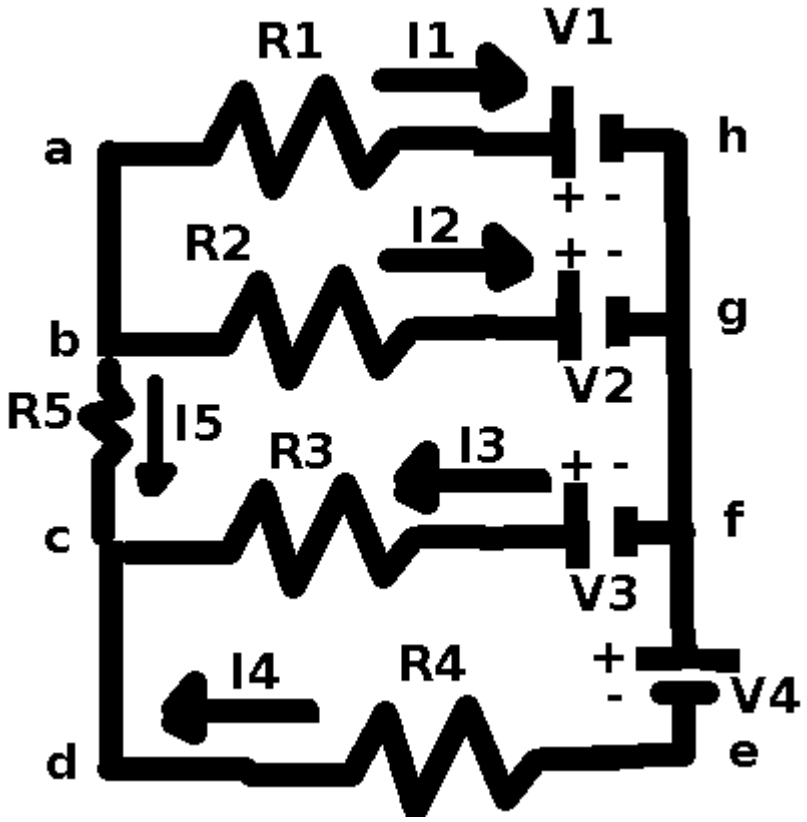
Loop (abgha):_____

Loop (bcfgb):_____

Loop (cdefc):_____

@b: _____

@c: _____



Suppose the following values exist:
resistances: R1=1Ω, R2=2Ω, R3=4Ω, R4=4Ω R5=5Ω
Potentials: V1=10V,V2=20V,V3=30V,V4=40 V

If the solutions for the currents are:
I1=1.06A, I2=-3.94A,I3=1.81A,I4=-10.78A,I5=1.81A

Calculate the total power radiated by the circuit

What is the interpretation of the result provided for current I4?

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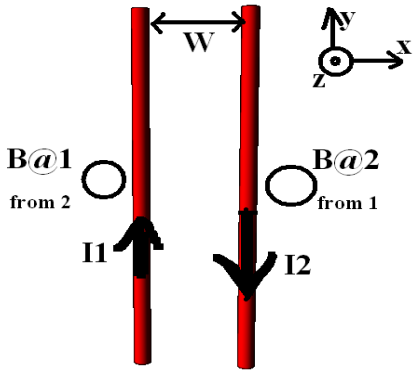
(2) Two long wires each of length L are separated by a distance w carry currents I1 and I2 in the directions shown. Note that x and y are in the plane of the wire while z comes out of the page.



(a) In the circles provided, show the direction of the magnetic fields, B@1 from 2 and B@2 from 1.

(b) Sketch, and label, force on wire 1 (F1) and the force on wire 2 (F2) on the diagram.

(c) Showing complete details, calculate the magnitude of the magnetic field at wire 2 (due to the current in wire 1). Your answer is in terms of I1, and W.

(d) Calculate the magnitude of the force per unit length on wire 2 in terms of I1, I2, W and a constant.

(e) Suppose I1=1 A, I2=2 A, and W=1m. Provide a numerical result (with the correct unit vector direction, and correct SI units) for the force per unit length on wire 2.

(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. Your answer should include sketches as needed.

(a) Calculate the electric field between the plates of the parallel plate capacitor in terms of σ and ε_0.

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

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

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

(e) 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 .

(f) 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) Note: in your answers below, be sure to include correct SI units.
Resistor 1 has a resistivity $\rho_1=5\ \Omega m$ and a length L=0.1 m. Resistor 2 has a resistivity $\rho_2=10\ \Omega m$ and a length L=0.2 m. Both resistors have a cross sectional area $A=0.1\ m^2$.

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

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

Capacitor 1 has area $A=0.1m^2$ and a plate separation $d_1=0.1m$. Capacitor 2 has an area $A=0.1m^2$ and a plate separation $d_2=0.2m$.

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

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

(e) Suppose that a resistor $R=1x10^6\ \Omega$ is placed in series with a capacitor C=33 μf. Calculate the time constant of this RC circuit.