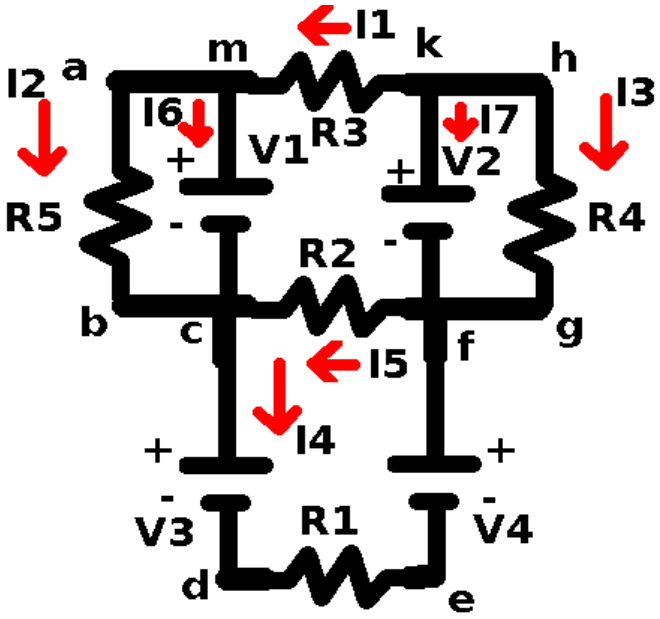
Friday, February 25, 2022	**Physics220: UnTest 02**	Name _____

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: $k=8.987\times10^{9}\frac{Nm^2}{C^2}$: $\epsilon_0=8.854\times10^{-12}\frac{C^2}{Nm^2}$: $\mu_0=4\pi\times10^{-7}\frac{Tm}{A}$

[1] Consider the circuit shown above. Write the Kirchoff's laws equations that result from the following:



(a) loop (abcma):_____ (b) loop(mcfkm):_____

(c) loop (kfghk): _____ (d) loop (cdefc): _____

(e) @c: _____ (f)@f: _____ (g) @k:_____

If the components have the following values:
R1=1Ω, R2=2Ω, R3=3Ω, R4=4Ω and R5=5Ω
V1=10V, V2=20V, V3=30V, V4=40V

The following currents result:
I1=7.1 A, I2=2.0 A, I3=5.0 , I4=-1.4 A, I5=5.7 A, I6=-9.1A, I7=2.1 A

(h) Calculate the power radiated by resistor R1.

(i) What is the interpretation of the value provided for current I6?

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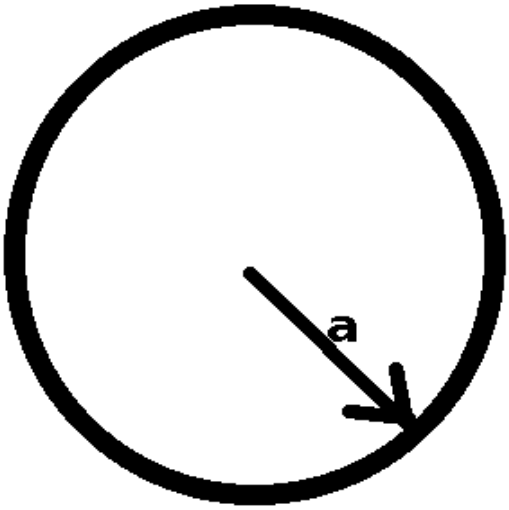
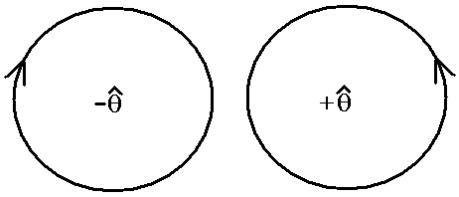


[2] A wire of radius a carries a **uniform** current density given by $\vec{J}=-|\vec{J}|\hat{z}$ which is directed into the page. The wire carries a total current I.

(a) Which direction does the magnetic field circulate around the wire? (circle the correct answer below).



(b) Calculate the magnitude of the current density, $|\vec{J}|$ in terms of I and a.

(c) Showing complete details, including sketches as necessary, calculate the vector magnetic field outside the wire in terms of I, and the radius vector r.

(d) Showing complete details, including sketches as necessary, calculate the vector magnetic field inside the wire in terms of I, a and the radius vector r.

(e) Suppose I=10 A and a=0.1m. Find the magnitude of the magnetic field at the surface of the wire with correct SI units.

[3] A particle of mass m and charge q is accelerated through a potential difference V and then injected into a uniform magnetic field.

(a) The kinetic energy the particle has after acceleration is given by (in terms of V and q) is given by:

_____

(b) the velocity of the particle is given by (in terms of V, m and q):

_____

(c) if the velocity is given by $\vec{v}=u\hat{x}$ and the magnetic field is given by $\vec{B}=B\hat{z}$, the direction of the magnetic force on the particle (assuming a positive charge) is given by:

_____

(d) The radius of orbit of the particle is given by:

_____

Provide numerical results for the case that $m=1x10^{-6}$ kg, q=1 μC , $V=1x10^{6}$ V and B=10 T for a, b,c, and d with correct SI units.

[4]

(a) If R_1 has a resistance of 10 Ω and resistor R_2 has a resistance of 100 Ω, calculate the resistance of the two resistors when connected in series.

(b) If R_1 has a resistance of 10 Ω and resistor R_2 has a resistance of 100 Ω, calculate the resistance of the two resistors when connected in parallel.

(c) If C_1 has a capacitance of 5μf and C_2 has a capacitance of 8μf, calculate the capacitance of the two capacitors when they are connected in series.

(d) If C_1 has a capacitance of 5μf and C_2 has a capacitance of 8μf, calculate the capacitance of the two capacitors when they are connected in parallel.

(e) Calculate the RC time constant when a resistor ($R=4x10^6$ Ω) is connected in series with a capacitor (C=4 μf).

(f) In a series RC circuit , if the capacitor has an initial charge separation Q_0 , how long (in seconds) will it take until the charge is reduced to $Q_0/2$ if the resistor is $R=4x10^6$ Ω and the capacitor is C=4 μf