Practice Exam #3

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Name: ______________________________

Problem	Grade	Points Possible
1		5
2		5
3		5
4		15
5		15
6		15
Total		60

$$x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$
$$v_x(t) = v_{0x} + a_x t$$
$$v_{fx}^2 = v_{0x}^2 + 2a_x \Delta x$$
$$a_c = \frac{v^2}{r}$$
$$\sum_i \vec{F}_i = m\vec{a} = \frac{d\vec{p}}{dt}$$
$$\vec{p} = m\vec{v}$$
$$\epsilon_0 = 8.85 \times 10^{-12}$$
$$V_b - V_a = -\int_a^b \vec{E} \cdot d\vec{s}$$
$$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$$
$$\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$$
$$\vec{F}_B = q\vec{v} \times \vec{B}$$
$$F_B = qvB\sin(\theta)$$
$$\vec{F}_B = i\vec{L} \times \vec{B}$$
$$\vec{\tau} = \vec{\mu} \times \vec{B}$$
$$\vec{\mu} = Ni\vec{A}$$
$$v = E/B$$
$$U_E = \frac{q^2}{2C} = \frac{1}{2}CV^2$$
$$U_B - \frac{1}{2}Li^2$$
$$\tan(\phi) = \frac{X_L - X_C}{R}$$

$$\vec{F}_q = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$$
$$\vec{E}_q = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\hat{r}$$
$$\vec{F}_q = q\vec{E}$$
$$\vec{p} = q\vec{d}$$
$$\vec{\tau}_p = \vec{p} \times \vec{E}$$
$$U_p = -\vec{p} \cdot \vec{E}$$
$$E_p(z) = \frac{1}{2\pi\epsilon_0}\frac{p}{z^3}$$
$$\Phi_E = q_{enc}/\epsilon_0$$
$$\Phi_E = \oint \vec{E} \cdot d\vec{A}$$
$$\Phi_B = \oint \vec{B} \cdot d\vec{A}$$
$$i = \frac{dq}{dt}$$
$$i = \int J dA$$
$$V = iR$$
$$V = q/C \text{ or } C = q/V$$
$$\tau_C = RC$$
$$\tau_L = L/R$$
$$C = \frac{\epsilon_0 A}{d}$$
$$C_{eq} = C_1 + C_2 + ...$$
$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + ...$$
$$R_{eq} = R_1 + R_2 + ...$$
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + ...$$

$$\vec{B} = \frac{\mu_0 i}{4\pi}\int \frac{d\vec{s} \times \hat{r}}{r^2}$$
$$\oint \vec{B} \cdot d\vec{s} = \mu_0 i_{enc}$$
$$B = \frac{\mu_0 i}{2\pi R}$$
$$B = \frac{\mu_0 i\phi}{4\pi R}$$
$$B = \mu_0 n i$$
$$B = \frac{\mu_0 N i}{2\pi}\frac{1}{r}$$
$$B(z) = \frac{\mu_0 i R^2}{2(R^2 + z^2)^{3/2}}$$
$$\vec{B}(z) = \frac{\mu_0}{2\pi}\frac{\vec{\mu}}{z^3}$$
$$n = N/L$$
$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$
$$L = \frac{N\Phi_B}{i}$$
$$\mathcal{E} = -L\frac{di}{dt}$$
$$\mathcal{E}_{\{1,2\}} = -M\frac{di_{\{2,1\}}}{dt}$$
$$q(t) = Q\cos(\omega t + \phi)$$
$$q(t) = Qe^{-t/2\tau_L}\cos(\omega' t + \phi)$$
$$\omega = \sqrt{1/LC}$$
$$\omega' = \sqrt{\omega^2 - (R/2L)^2}$$
$$I = \mathcal{E}_m/Z$$
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$
$$X_L = \omega_d L$$
$$X_C = 1/\omega_d C$$

Question 1: Power P is transmitted along a cable at a voltage of 1 kV and a current of 500 A. Some of this power is lost during transmission in the resistance R of the wires. If the same power P is transmitted at only 120 V through the same wires, how much more/less power is lost during transmission? Answer in terms of a ratio (P_{120}/R_{1000}).

Question 2: Current is passed through two lightbulbs using a 9 V battery. Rank the following three circumstances in terms of the brightness of the bulbs, with 1 being the brightest. Two configurations may yield the same results.

- ___ Each bulb by itself.
- ___ The two bulbs in series.
- ___ The two bulbs in parallel.

Question 3: A charged particle moves at a very high speed to the right in a magnetic field that points upward. Describe its motion if the particle is

(a) positively charged;

(b) negatively charged;

(c) neutral.

Question 4: A 100-m long copper wire has a diameter of 1 mm.

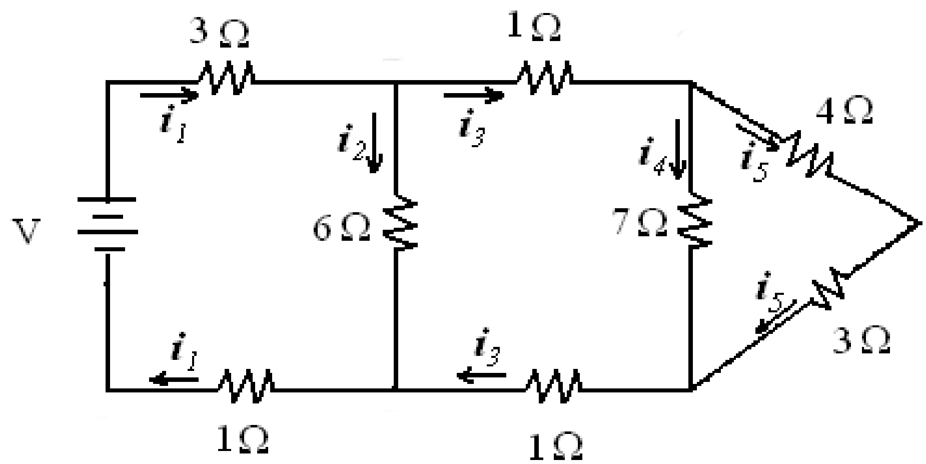
(a) Compute its resistance (look up appropriate constants).

(b) If a current of 1 A passes through the wire for 2 hours, how much energy has been converted to heat?

(c) If the price of electricity is 8 cents/kW-hr, how much money has been lost to heat?

(d) Repeat parts (a) - (c) for a wire of twice the diameter.

Question 5: Find the current through each branch of the circuit below, when $V = 9$ V.



Question 6: An electron moves in a uniform magnetic field $\vec{B}$ with a velocity $\vec{v} = 2000\hat{\jmath}$ m/s. Find the magnetic force on the particle if

(a) $\vec{B} = 4\hat{k}$ T

(b) $\vec{B} = -4\hat{k}$ T

(c) $\vec{B} = 4\hat{\imath}$ T

(d) $\vec{B} = 4\hat{\jmath}$ T