

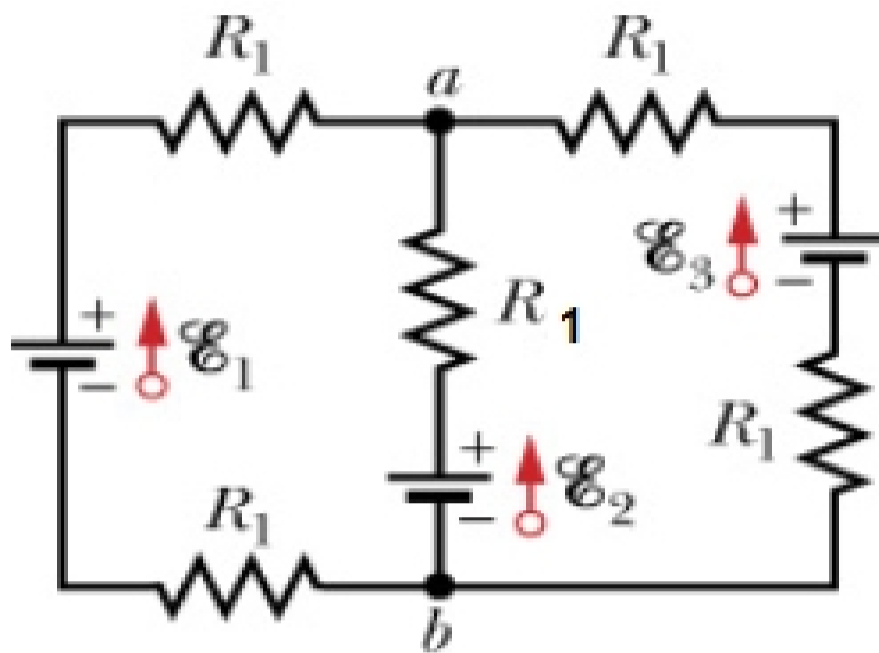
Exam 2

Closed book exam. A calculator is allowed, as is one 8.5×11" sheet of paper with your own written notes. Please show all work leading to your answer to receive full credit. Numerical answers should be calculated to at least 2 significant digits. Exam is worth 100 points, 25% of your total grade.

UF Honor Code: "On my honor, I have neither given nor received unauthorized aid in doing this exam."

Sphere: $S = 4\pi r^2$		$V = \frac{4}{3}\pi r^3$	$\pi = 3.1415927$	$e = 1.6022 \times 10^{-19} \text{ C}$	$g = 9.8 \text{ m/s}^2$
$1 \mu\text{C} = 10^{-6} \text{ C}$	$1 \mu\text{F} = 10^{-6} \text{ F}$	$1 \text{ pF} = 10^{-12} \text{ F}$	$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$		
$K = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 / \text{C}^2$	$\epsilon_0 = 8.8542 \times 10^{-12} \text{ C}^2 / \text{N m}^2$	$c = 3.0 \times 10^8 \text{ m/s}$			
$k = \frac{K}{c^2} = \frac{\mu_0}{4\pi} = 10^{-7} \text{ T} \cdot \text{m} / \text{A}$	$\mu_0 = 4\pi k = 1.257 \times 10^{-6} \text{ T} \cdot \text{m} / \text{A}$	$\mu_0 \epsilon_0 = \frac{1}{c^2}$			
$\mathbf{F} = K \frac{q_1 q_2}{r^2} \hat{\mathbf{r}}_{12}$	$\mathbf{E} = \frac{\mathbf{F}}{q_0}$	$\Phi_E = \oint_S \mathbf{E} \cdot d\mathbf{A} = \frac{q_{\text{enc}}}{\epsilon_0}$	$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$		
$\mathbf{E} = -\nabla V$	$V = \frac{U}{q_0}$	$W = -\Delta U = \int_C \mathbf{F} \cdot d\mathbf{s}$	$\Delta V = -\int_C \mathbf{E} \cdot d\mathbf{s}$		
$\Delta V = \frac{q}{C}$	$\Delta V = -L \frac{di}{dt}$	$i = \frac{dq}{dt}$	$C_{\text{eff}} = C_1 + C_2$	$\frac{1}{C_{\text{eff}}} = \frac{1}{C_1} + \frac{1}{C_2}$	
$R = \rho \frac{L}{A}$	$\tau_{RC} = RC$	$\tau_{LR} = \frac{L}{R}$	$R_{\text{eff}} = R_1 + R_2$	$\frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2}$	
$\Delta V = iR$	$P = Vi = i^2 R = \frac{V^2}{R}$	$U = \frac{Q^2}{2C}$	$U = \frac{1}{2} Li^2$	$\omega = 2\pi f = \frac{1}{\sqrt{LC}}$	
$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}$	$t = \gamma t_0$	$L = \frac{L_0}{\gamma}$	$x' = \gamma(x \pm vt)$	$y' = y$	
			$t' = \gamma(t \pm vx/c^2)$	$z' = z$	
$u'_x = \frac{u_x \pm v}{1 \pm \frac{vu_x}{c^2}}$	$u'_y = \frac{u_y}{\gamma \left(1 \pm \frac{vu_x}{c^2}\right)}$	$E = \gamma mc^2$	$E_K = (\gamma - 1) mc^2$		
$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$	$\mathbf{F} = i \mathbf{L} \times \mathbf{B}$	$\mathbf{p} = \gamma m \mathbf{u}$	$\mathbf{F} = d\mathbf{p} / dt$	$m^2 c^4 = E^2 - p^2 c^2$	
$d\mathbf{B} = \frac{\mu_0}{4\pi} \frac{i d\mathbf{s} \times \mathbf{r}}{r^3}$	$\oint_C \mathbf{B} \cdot d\mathbf{s} = \mu_0 i_{\text{enc}}$	$B_{\text{wire}} = \frac{\mu_0 i}{2\pi r}$	$B_{\text{arc}} = \frac{\mu_0 i}{4\pi R} \Phi$	$p = qBr$	
$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$	$\boldsymbol{\mu} = Ni\mathbf{A}$	$\boldsymbol{\tau} = \boldsymbol{\mu} \times \mathbf{B}$	$U = -\boldsymbol{\mu} \cdot \mathbf{B}$	$F_z = \mu_z \frac{dB_z}{dz}$	
$\Phi_B = \int_S \mathbf{B} \cdot d\mathbf{A}$	$\epsilon = -N \frac{d\Phi_B}{dt}$	$L = N \frac{\Phi_B}{i}$	$u = \frac{\epsilon_0 E ^2}{2} + \frac{ B ^2}{2\mu_0}$		
$\mathbf{a} \cdot \mathbf{b} = a_x b_x + a_y b_y + a_z b_z$	$\mathbf{a} \times \mathbf{b} = (a_y b_z - b_y a_z) \mathbf{x} - (a_x b_z - b_x a_z) \mathbf{y} + (a_x b_y - b_x a_y) \mathbf{z}$				

1. [8 points] In the circuit shown, the resistance $R_1 = 12\Omega$. The battery voltages are identical: $\mathcal{E}_1 = \mathcal{E}_2 = \mathcal{E}_3 = 1\text{ V}$. What is the current (in amps) flowing through the middle branch from a to b ?



2. [6 points] A capacitor of capacitance $C = 2 \times 10^{-10}$ F contains a charge q on one of its plates (and $-q$ on the other). It is connected in to a resistor of resistance $R = 200\Omega$ such that it forms a closed circuit. How much time must elapse so that the charge on the capacitor is reduced to only 10% of its starting value?

3. [6 points] A stationary flat conductor carries a constant current $i > 0$ in the direction from top to bottom ($-\hat{y}$) in the presence of a magnetic field \mathbf{B} that points into plane the paper ($-\hat{z}$). If the electrons that make up the current are not allowed to leave the conductor, and the magnitude of their drift velocity is v_d , indicate the direction and determine the magnitude of any electric field created inside the conductor.

