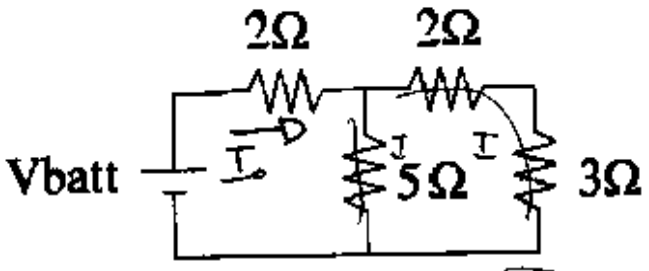
1) Short Answer (50 points)(Show Your Work!)

a) The 3 Ohm resistor is dissipating ¼ Watt of power, what is Vbatt? (5pts)



$P = I^2R$

$\frac{1}{4} = I^2 3$

$I^2 = \frac{1}{12}$

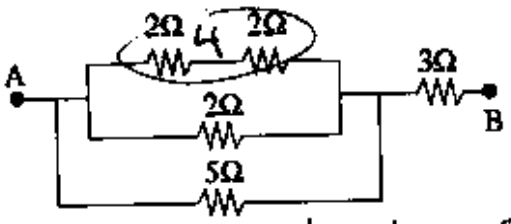
$I = 0.289A$ ✓①

$I_0 = (0.577A)$ Currents same ①

$V_{Batt} = 2(.577A) + 5(.289A) = 2.6V$ ①

Vbatt = 2.6V 2

b) Calculate the resistance between points A and B. (5pts)



$\frac{1}{4} + \frac{1}{2} + \frac{1}{5} = \frac{5}{20} + \frac{10}{20} + \frac{4}{20}$

$= \frac{19}{20}$

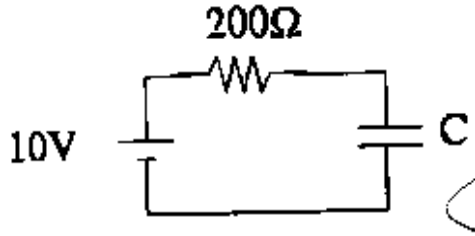
$R_{tot} = 3 + \frac{20}{19}$

3 29/19

$R_{AB} =$ [redacted] Ω 4.05Ω

(3.95Ω if 11 wrong)

c) For C = 10 pf, how fast is energy being stored in the capacitor if the current supplied by the battery is 10mA? (5pts)



$P_{tot} = P_R + P_{cap}$ 2

$P_{cap} = P_{tot}' - P_R'$

$= (10V)(10mA) - (.01)^2 200 = 0.08W$

$P_{CAP} = 0.08W$

1) Short Answer cont'd (Show Your Work!)

d) What is the magnitude of the force on a proton moving at a velocity of 100 m/s if the proton is moving at an angle of 97 degrees with respect to a B field iof strength 10 mT? (5 pts)

$(1.6\times10^{-19}C)(100m/s)(0.01T)(\sin 97^\circ)$ (2)

gen (2)

$|F| = 1.59\times10^{-18}\,N$ (1)

What is the resistance of a copper wire of length 2.1 m, diameter 1.1 mm, and resistivity of 1.69E-8 Ohm-meters. If this is the resistivity at 20 degrees C, what is the resistance at 42 degrees C?

$R = \rho_0 \frac{l}{A} = \frac{(1.69\times10^{-8}\,\Omega m)(2.1m)}{\pi(0.0011m/2)^2} = 0.0373\,\Omega$

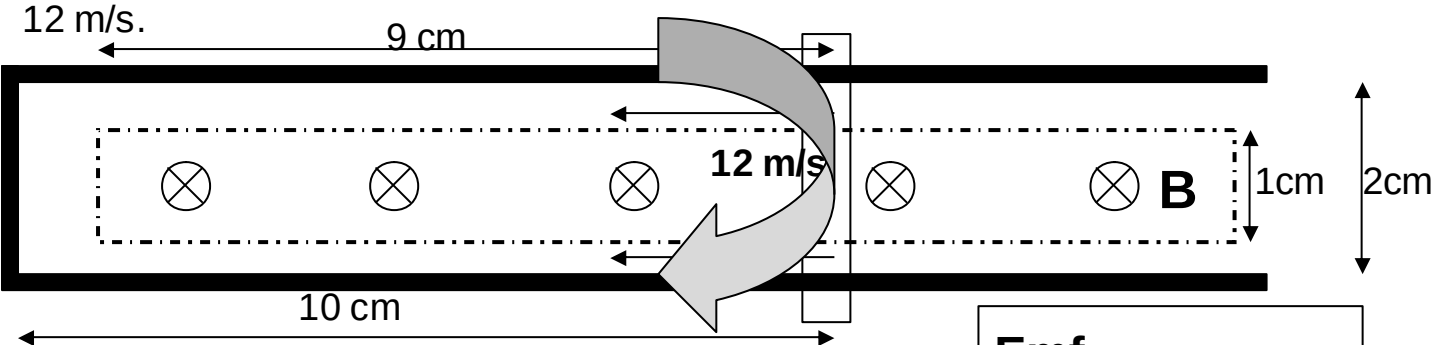
R20 = 0.037 Ω (5)
R42 = 0.041 Ω (5)

$\frac{l}{A}(\rho-\rho_0) = (\rho_0\alpha(T-T_0))\frac{l}{A}$

$R - R_0 = R_0\alpha(T-T_0)$

$R = R_0 + R_0\alpha(T-T_0) = 0.0373\Omega + 0.0373\Omega\left(4.3\times10^{-3}\frac{\Delta}{K}\right)(22^\circ K) = 0.0408\,\Omega$

The B Field inside the dashed area shown below has a magnitude of 0.150T. A conducting bar is moving on conducting rails as shown with a constant velocity of 12 m/s.



f) What is the EMF induced across the bar? (5 pts)

Emf=

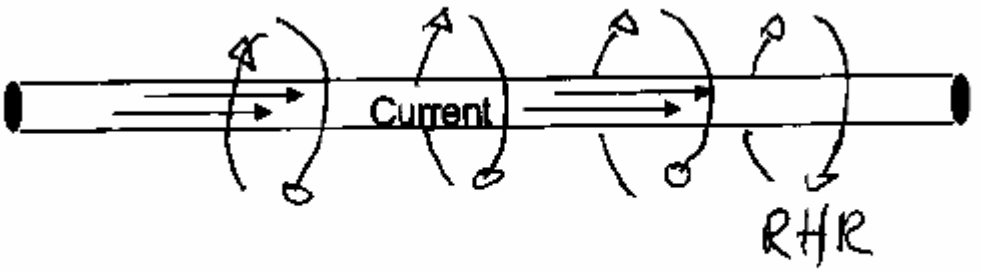
3 $\left(B\frac{\Delta A}{\Delta t}\right) = (0.150T)(0.01m)(12m/s) = 0.018\,V$

g) Indicate the direction current flows due to the induced emf. Explain. (5 pts)

opposes change in B-field

1) Short Answer cont'd (don't forget to justify your answer!)

h) What does the B field around a wire carrying current look like? (2 pts)



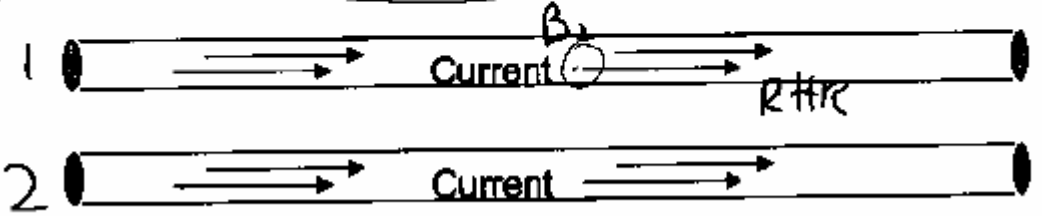
i) How do you make a resistor have a larger resistance? (2 pts)

Increase the Area
Current flows through

Decrease the Area
Current flows through

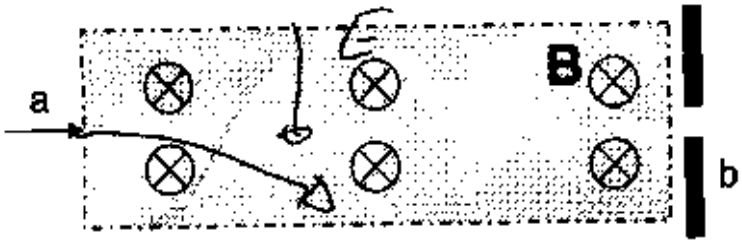
$R = \rho \frac{\ell}{A} \propto \frac{1}{A}$

j) Are the wires below attracted to each other or repelled? (2 pts)



2) Spectroscopy

A B field of magnitude 0.030 T points into the page as shown.



(With the proper choice of an E field, a charged particle can pass straight through the B Field.)

(note: B=0 outside the shaded boxes)

A charged particle, moving in the x direction, is incident on this B field at "a" (as shown). Indicate on the figure how the particle moves in the B field if it has a negative charge. (2 pts)

We want to force the particle to move straight along the x direction in the magnetic field by using an electric field to counteract the force on the particle due to the magnetic field. If the particle is moving at 10,000 m/s and has a charge of -1e, what is the magnitude of the E field needed, and which direction should it point? Is it different for a positively charged particle? (explain) (8 pts)

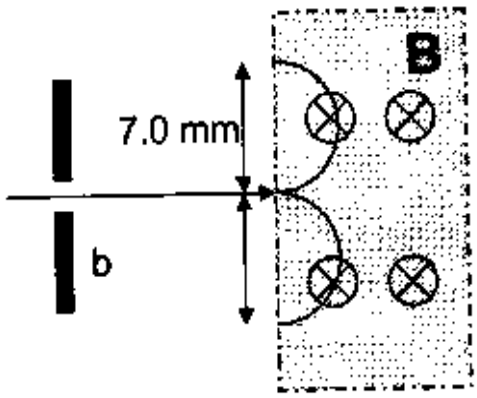
$qE = qvB$

$E = vB = \left(10^4 \frac{m}{s}\right)(0.03\,T)$

$|E| = 300\,N/C$

show direction on figure

same for positive



After the 10,000 m/s negatively (-1e) charged particle passes through the slit at b, it enters another area of magnetic field of magnitude 0.030 T, and the particle moves in a half circle of diameter 7.0 mm. What is the mass of this particle? (10 points)

Mass= 1.68×10^{-27} Kg

$\frac{mv^2}{r} = qvB \qquad m = \frac{qBr}{v} = \frac{(1.6\times10^{-19}C)(0.03T)(.0035)}{10^4}$