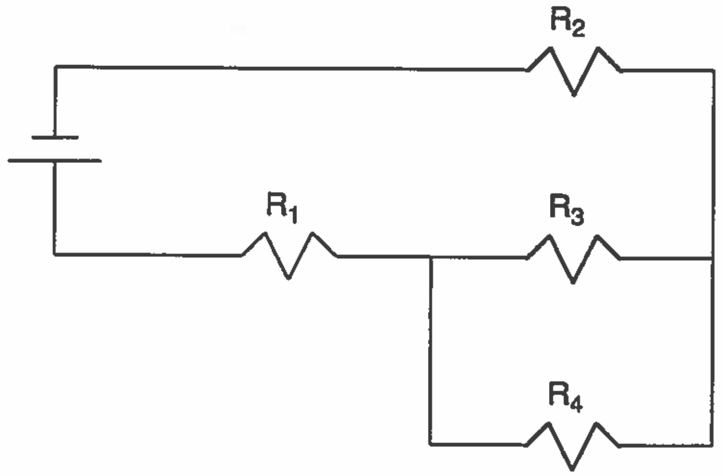
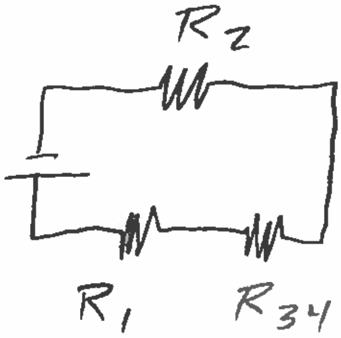
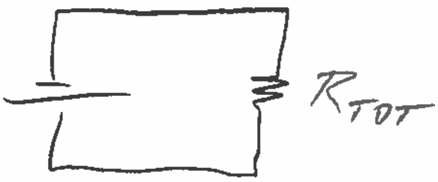
Sp '20
Exam 2B

1. (30 pts) In the circuit below, the battery has an EMF of 18 Volts, and the resistors are R_1 = 1.0 Ohm, R_2 = 2.0 Ohm, R_3 = 3.0 Ohm, and R_4 = 4.0 Ohm.

Find the voltage drop across each of the four resistors.







$$\frac{1}{R_{34}} = \frac{1}{3} + \frac{1}{4}$$

$$\Rightarrow R_{34} = 1.71\ \Omega$$

$$R_{TOT} = R_1 + R_{34} + R_2 = 4.71\ \Omega$$

$I_{TOT} = \frac{[redacted]\ 18}{4.71} =$ [redacted] 3.822 A

$I_1 = I_{34} = I_2 =$ [redacted] 3.822 A

$\Delta V_{34} = I_{34} R_{34} =$ [redacted] 6.5 Volts

$\Delta V_1 = I_1 R_1 =$ [redacted] V	3.8
$\Delta V_2 = I_2 R_2 =$ [redacted] V	7.6
$\Delta V_3 = \Delta V_{34} =$ [redacted] V	6.5
$\Delta V_4 = \Delta V_{34} =$ [redacted] V	6.5

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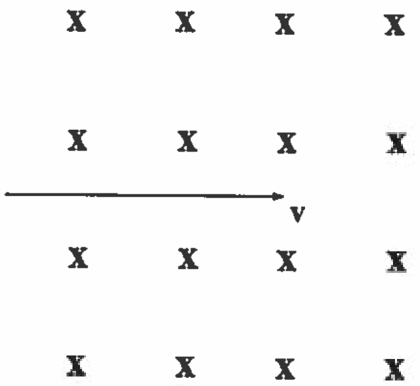
2. (35 pts) A proton is accelerated from rest through a potential difference of 850 Volts. Once the proton achieves its final velocity v, it moves at that velocity into a region of uniform electric field of 560 V/m pointing into the page as shown below.

If the magnitude and direction of the proton's velocity is to remain constant while in this region, what must be the magnitude and direction of the uniform magnetic field in this region?

E = 560 V/m

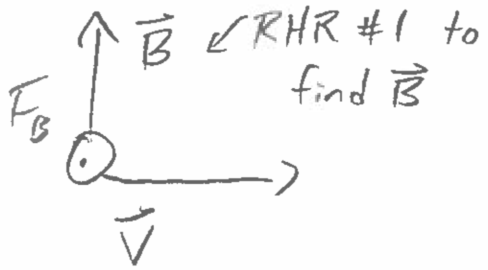


$$W_E = -q\,\Delta V = \Delta K$$

$$-(1.6\times10^{-19})(-850) = \tfrac{1}{2}(1.67\times10^{-27})v^2$$

$$v = 4.036\times10^{5}\ \text{m/s}$$

For straight path, F_B must point ⊙ since F_E points ⊗ for + charge



F_B must $= F_E$

$$qvB = qE$$

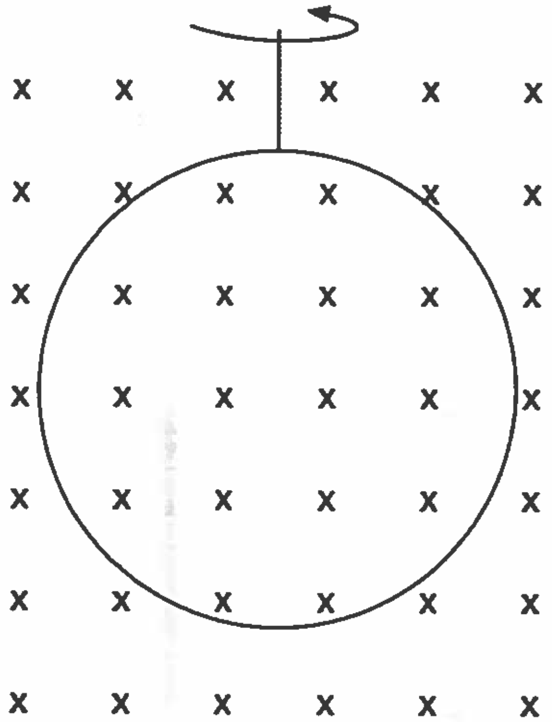
$$B = \frac{E}{v} = \frac{560}{4.036\times10^{5}}$$

$$\boxed{B = 1.4\times10^{-3}\ \text{T},\ \uparrow}$$

Sp '10 Exam 2B

3. (35 pts) A circular wire with 468 turns, a resistance of 1.33 Ohms, and a radius of 13.5 cm is located within a uniform magnetic field of 78.0 μT pointing into the page. Initially, the plane of the loop is in the plane of the page as shown.

The loop begins to rotate at a constant speed so that the left side comes out of the page toward you and the right side goes into the page. After 0.250 seconds, the loop has rotated 90.0°. During this time interval, what is the magnitude and direction of the average induced current observed in the loop?



$$\varepsilon_{ind} = N \frac{\Delta \Phi_B}{\Delta t}$$

$$= \frac{NBA\, \Delta\cos\theta}{\Delta t}$$

$$= \frac{(468)(78\times10^{-6})\pi(.135)^2(1-0)}{.250}$$

$$= \boxed{8.36\times10^{-3}\ \text{Volts}}$$

$$I_{ind} = \varepsilon_{ind}/R = \boxed{6.29\times10^{-3}\ A}$$

$\Phi_B = \otimes, \downarrow \Rightarrow B_{ind} = \otimes \Rightarrow$ $\boxed{I_{ind} = \text{clockwis}}$