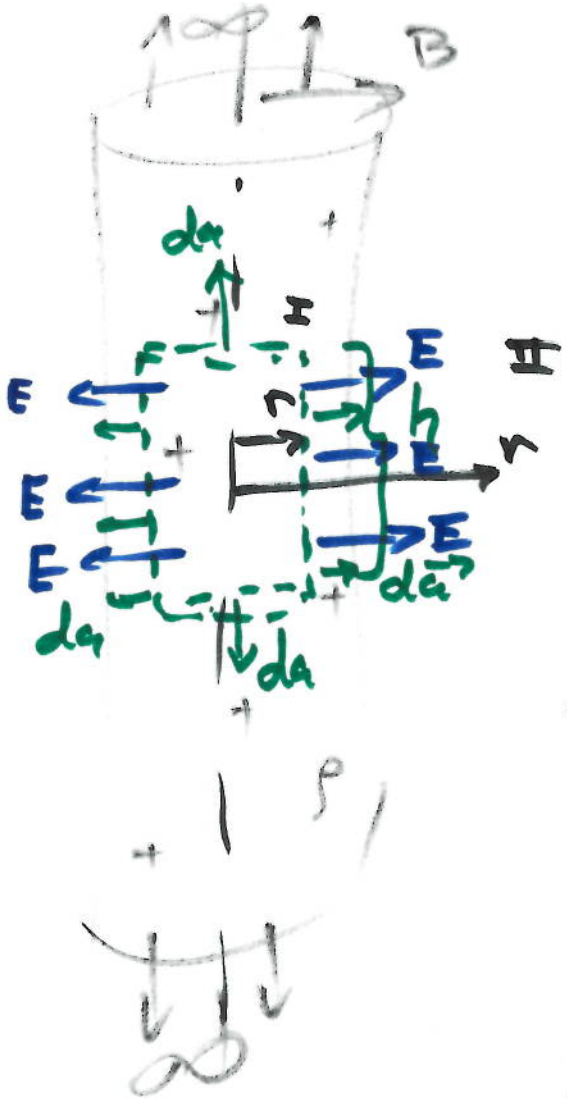
Exam 1 Review



$E(r)$

$(=)$ inside $r < B$

$$\oint \vec{E} \cdot \vec{da} = \frac{Q_{in}}{\epsilon_0}$$

$$\int_{side} E\,da + \int_{ends} E\,da \cos 90^\circ = \frac{Q_{in}}{\epsilon_0}$$

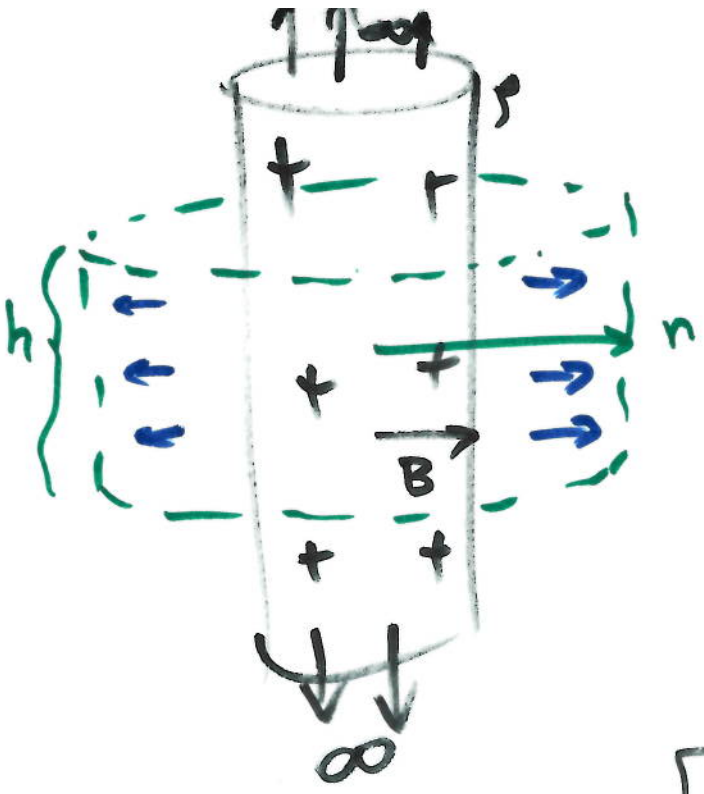
$$E \int_{side} da = \frac{Q_{in}}{\epsilon_0}$$

$$E \underbrace{2\pi r h}_{side} = \frac{\rho \pi r^2 h}{\epsilon_0}$$

$$\boxed{E = \frac{\rho r}{2\epsilon_0}} \quad (\text{inside } r < B)$$

ρ = charge / volume

$\rho \cdot V = Q$



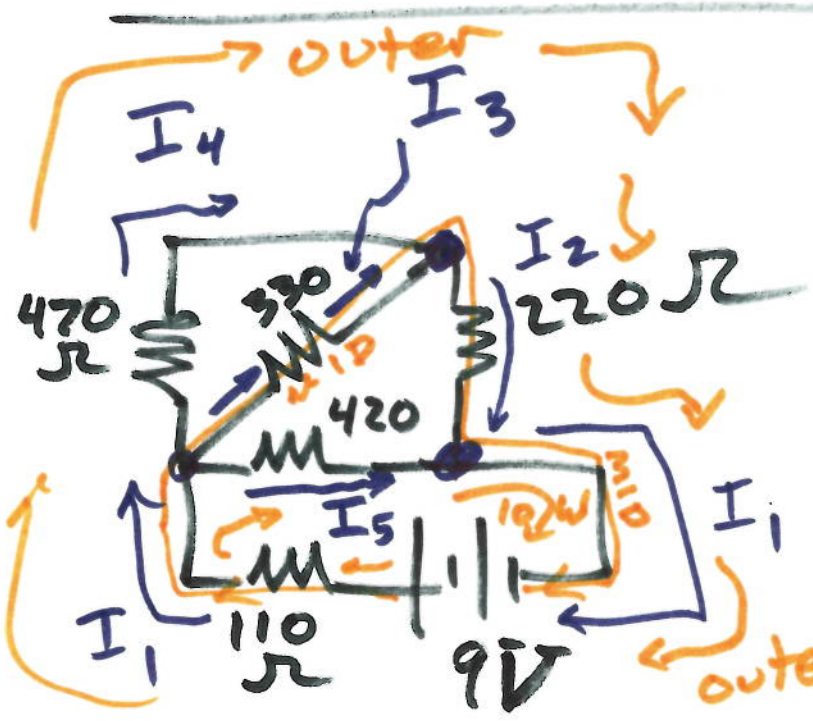
$$\oint \vec{E}\cdot d\vec{a} = \frac{Q_{in}}{\epsilon_0}$$

$$\int_{side} E\,dq = \rho\frac{V}{\epsilon_0}$$

$$E\int dq =$$

$$E\,2\pi r h = \rho\frac{\pi B^2 h}{\epsilon_0}$$

$$\boxed{E = \rho\frac{B^2}{2\epsilon_0 r}} \quad (r > B \text{ outside})$$



Find I through each R.

$$\Sigma I_{in} = \Sigma I_{out}$$

$$I_1 = I_3 + I_4 + I_5$$

$$I_3 + I_4 = I_2$$

$$I_5 + I_2 = I_1$$

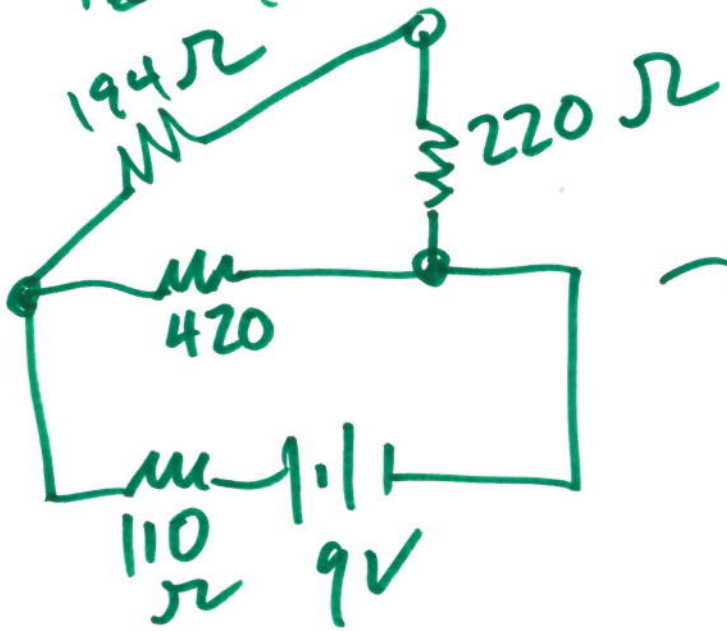
lower: $9V - 110\Omega\, I_1 - 420\Omega\, I_5 = 0$

outer: $9V - 110\Omega\, I_1 - 470\, I_4 - 220\, I_2 = 0$

MID: $9V - I_1 110\Omega - 330\Omega I_3 - 220\Omega I_2 = 0$

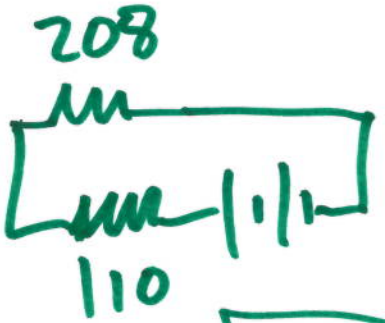
470 and 330 are in parallel

$$R_{\parallel} = \frac{330 \cdot 470}{330 + 470}\,\Omega = 194\,\Omega$$



194
+220
414

Parallel
$R_{par} = \frac{420 \cdot 414}{420 + 414}$



$V = IR$

$$I_1 = \frac{V}{R} = \frac{9V}{318\Omega} = 0.0283A$$

$I_1 = 0.0283A$

lower: Plug I_1 get I_5

$$9V - 110\Omega(0.0283A) - 420 I_5 = 0$$

$$9 - 3.11 = 420 I_5$$

$I_5 = 0.0140A$

$$I_5 + I_2 = I_1$$

$$0.0140 + I_2 = 0.0283.$$

$I_2 = 0.0143$

To get I_4 use outer loop equ.

$$9V - \underbrace{110(0.0283)}_{3.11} - 470 I_4 - \underbrace{220(0.0143)}_{3.15} = 0$$

$$2.74 = 470 I_4$$

$I_4 = 5.83 \times 10^{-3} A$

$I_3 + I_4 = I_2$ To get I_3.

$$I_3 = I_2 - I_4$$

$$= 0.0143 - 0.00583$$

$I_3 = 8.47 \times 10^{-3} A$

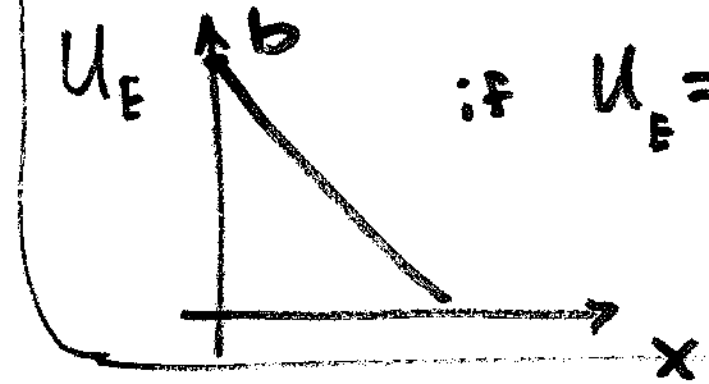
$$E_x = -\frac{dV}{dx}\hat{x} \simeq -\frac{\Delta V}{\Delta x}\hat{x} \qquad E_x = -\frac{\partial V}{\partial x}$$

$V=2$ $V=1$ $V=0$

$x=0$ 1 2

$$\vec{F} = q'\vec{E}$$

$$F_x = -\frac{dU}{dx}\hat{x}$$



if $U_E = -kx + b$ find F_E

$$F_{E_x} = -(-k) = +k$$

$$\int \vec{F}\cdot d\vec{x} = \Delta U \qquad -\int \vec{E}\cdot d\vec{x} = \Delta V$$

(#2) Given: $E_x = a + bx$

what is ΔV from $x=0$ to $x=1$?

$$-\int_0^1 (a+bx)\,dx = \Delta V$$

$$-\int_0^1 (a+bx)\,dx = -\left[ax + \frac{bx^2}{2}\right]_0^1$$

$$-\left[\underbrace{\left(a+\frac{b}{2}\right)}_{\text{eval at } x=1} - \underbrace{(0+0)}_{\text{eval at } x=0}\right]$$

$$\boxed{-a + -\frac{b}{2} = \Delta V}$$