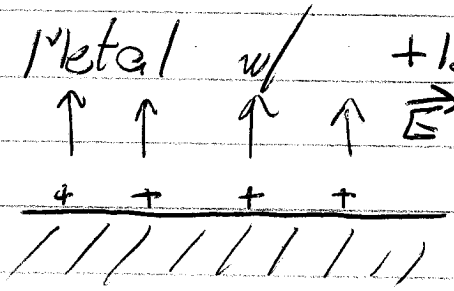
Phys 1402 2017-07-13

~~Exam~~ Quiz 1 #16

Metal w/ $+1.5\ \mu C/m^2$ on surface.



$E = 2\pi k\sigma$

or

$E = 4\pi k\sigma$

σ = charge per area

"$2\pi k\sigma$" has E split above & below surface.
But here, there is metal below w/ $E = 0$.
Must use "$4\pi k\sigma$" version.

$$E = 4\pi k\sigma = 4\pi\left(9\times10^{9}\ \frac{Nm^2}{C^2}\right)\left(1.5\times10^{-6}\ \frac{C}{m^3}\right)$$

$$= 1.7\times10^{5}\ N/C$$

$$= 170000\ N/C$$

Ways to calculate E:

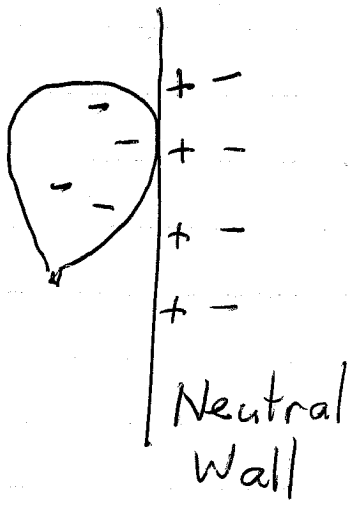
Point $E = \frac{kq}{r^2}$ $\quad |E| = \frac{\Delta V}{\Delta x}$

Line $E = \frac{2k\lambda}{r}$

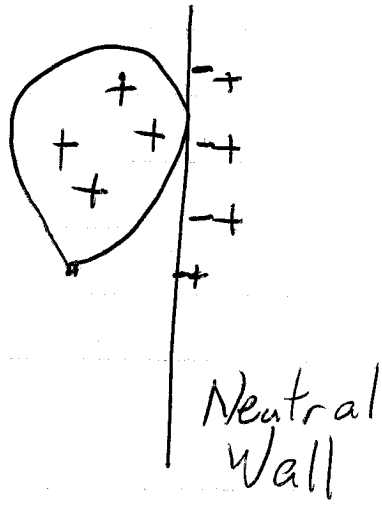
Surface $E = \begin{cases} 2\pi k\sigma \\ 4\pi k\sigma \end{cases}$

② Quiz 1 #11

Negative Balloon

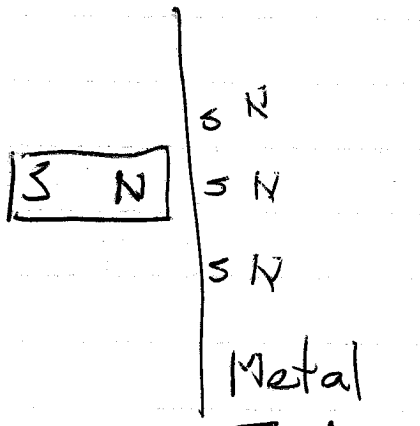


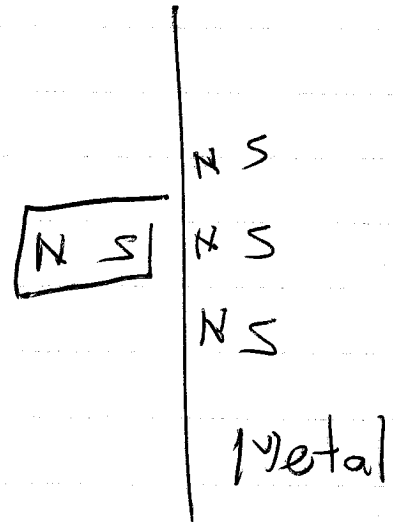
Positive Balloon



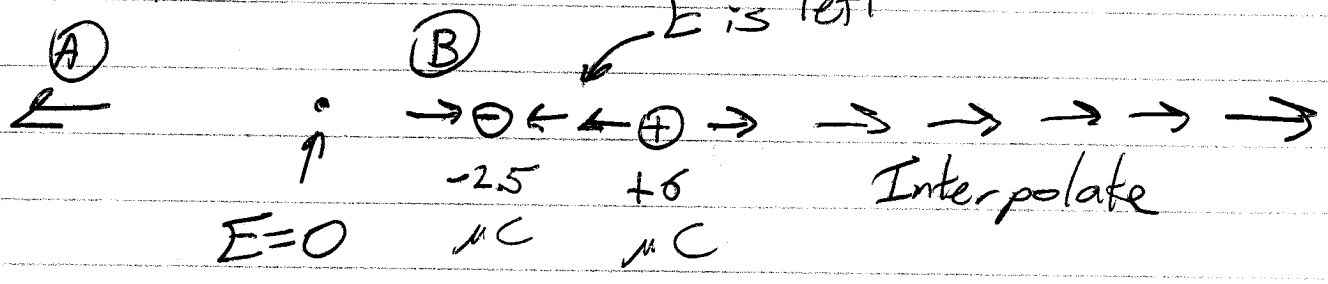
Wall gets polarized by charged balloon.

Compare Magnet & refrigerator





Quiz 1 #22

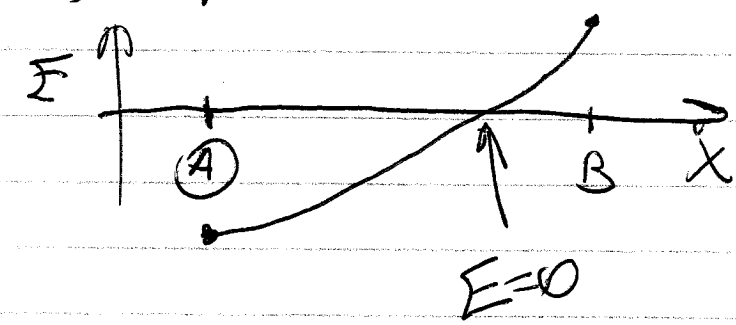


Total $Q = +6 - 2.5 = +3.5\ \mu C$

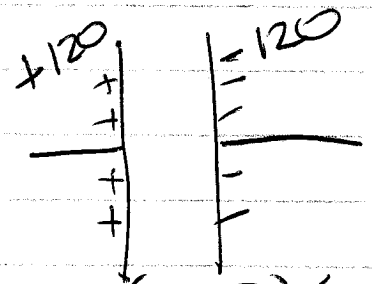
"Far away" the charges "look like" a single $+3.5\ \mu C$ charge. So far away, $\vec{E}$ points away.

~~Some~~

At (A), $\vec{E}$ points away from total $+3.5\ \mu C$
At (B), $\vec{E}$ points toward $-2.5\ \mu C$



#19

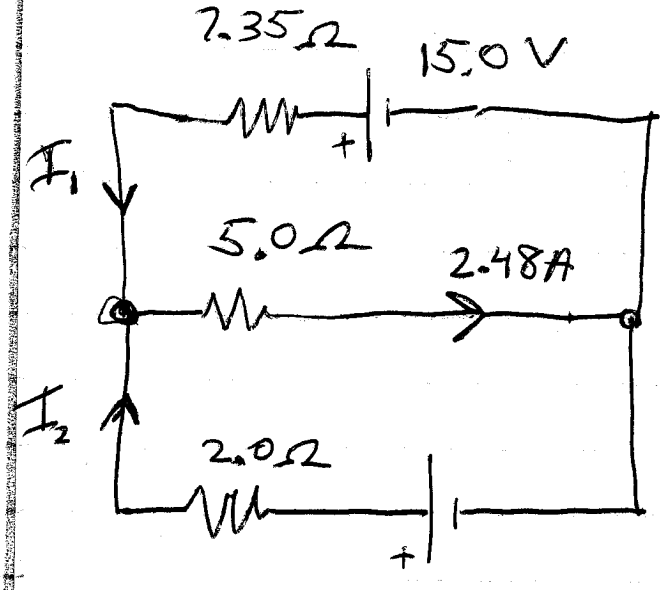


total = 0

#20 $\frac{1}{2}CV^2 = \frac{1}{2}(15\ \mu F)(8\ V)^2$
$= 480\ \mu J$

#18 $Q = CV = (15\ \mu F)(8.0\ V)$
$= 120\ \mu C$

④



For 5Ω resistor:

$V = IR = (2.48A)(5.0\Omega)$
$= 12.4\ V$

Voltage of 7.35 Ω ↓

The top segment has total ΔV of $15.0v + V_7$
It's in parallel w/ middle segment $12.4\ V$

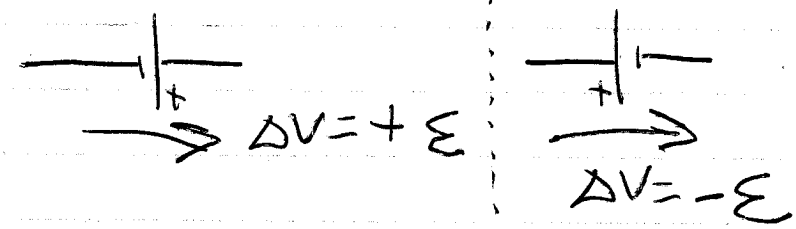
Therefore $V_7 = -2.6\ V$

Same thing by Kirchoff: Top Loop, CCW

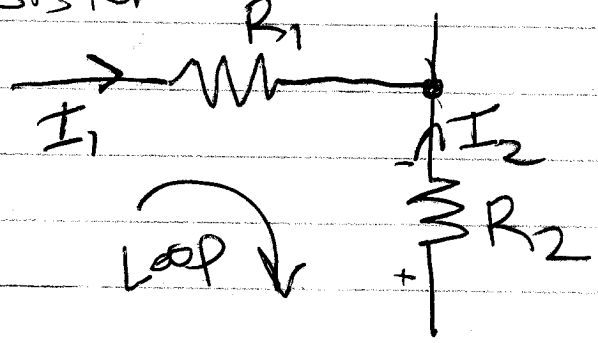
$$+(15.0v) - (7.35\Omega)I_1 - (12.4v) = 0$$

$$15 - 12.4 = 7.35\ I_1$$
$$2.6 = 7.35\ I_1$$
$$I_1 = 2.6/7.35 = 0.354\ A$$

• Batt



- Resistor



$$\Delta V = \cdots - I_1 R_1 + I_2 R_2 \cdots = 0$$

Loop with I_1 — Loop against I_2

Solve for I_2 in example

$$I_1 + I_2 = 2.48\ A$$

$$(0.354A) + I_2 = 2.48\ A$$

$$I_2 = 2.13\ A$$

Lower Loop - CW

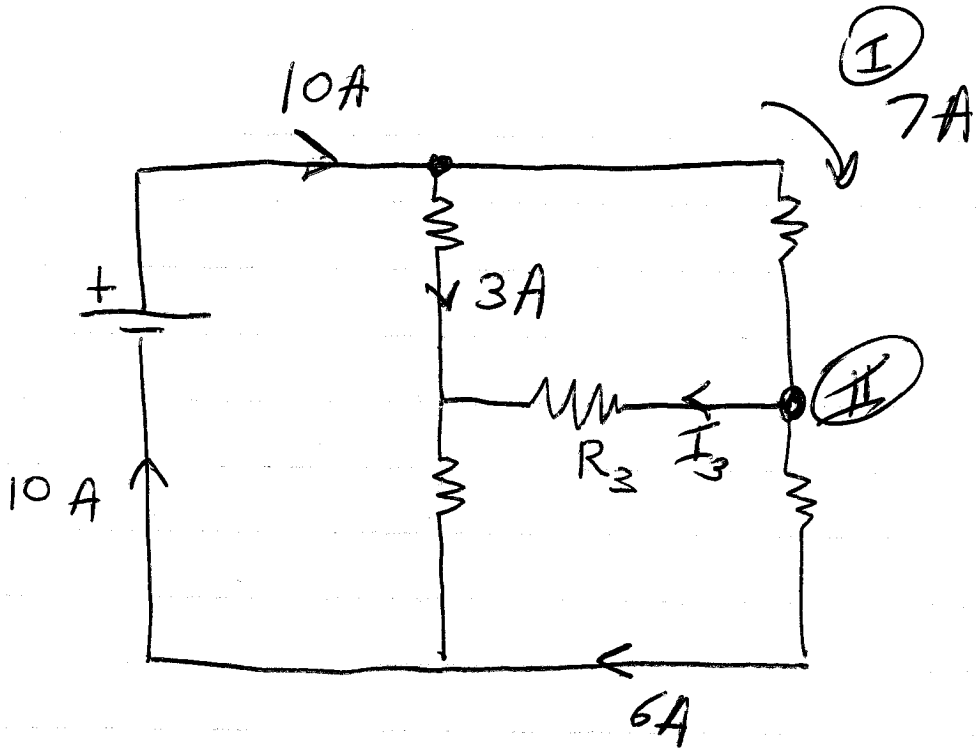
$$+\mathcal{E} - (2.13\ A)(2.0\ \Omega) - 12.4\ V = 0$$

$$\mathcal{E} - (4.26\ V) - 12.4\ V = 0$$

$$\mathcal{E} - 16.7\ V = 0$$

$$\mathcal{E} = 16.7\ V$$

(6)



Current in R_3?

- 0 A
- 1 A
- 2 A
- 3 A

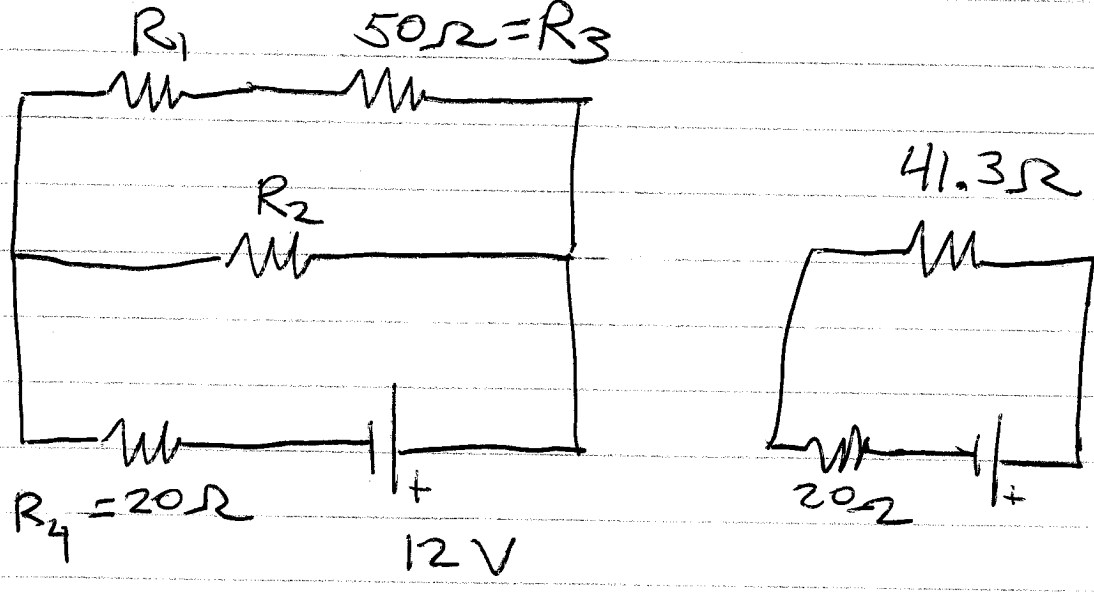
$$10A = \text{(I)} + 3A$$

(I) 7A is going all the way across the top.

(II) 7A splits and 1A goes to R_3

$$7A = 6A + I_3$$

(7)



What	V	I	R	P
R_1			38Ω	
R_2	8.09		78Ω	
R_3			50Ω	
R_4		0.196	20Ω	
Overall	12.0V	$\frac{12}{61.3} = 0.196$	61.3	
R_{13}	8.09		88Ω	
R_{123}	8.09	0.196	41.3Ω	
~~R_{1234}~~				

↖ "same" current in series

$$R_{123} = \left(\frac{1}{88} + \frac{1}{78}\right)^{-1} = 41.3\,\Omega$$

$$R_{overall} = 41.3 + 20 = 61.3\,\Omega$$