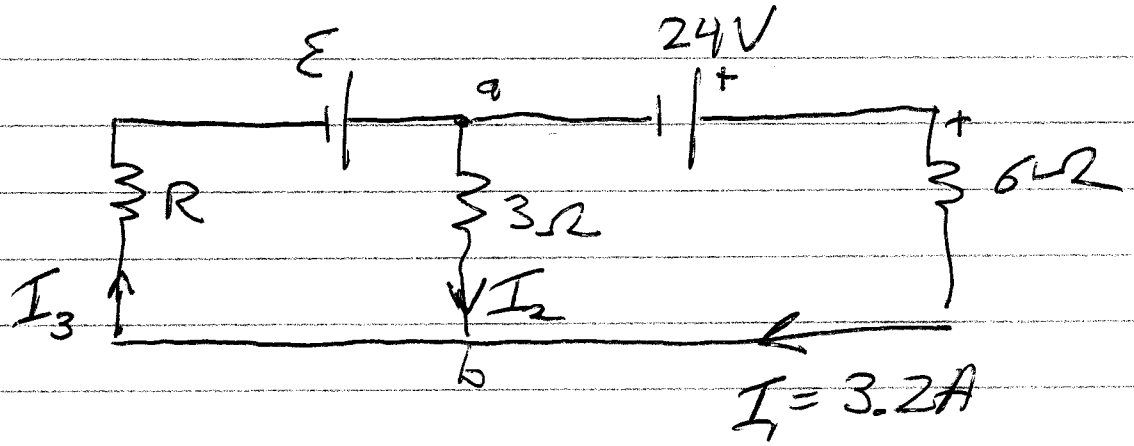
Phys 2426 2015-09-24 Lec 9

Exam 1 Tue 9/29
Practice test (Last Year's Exam) posted.
tinyurl.com/spirkocak

Topics:
- Electrostatics, charge, E-field
- Elec Potential (V), relation to E
- Batteries & Capacitors
- DC current & Ohm's Law
- Complex DC Circuits
  - Equivalent R
  - Kirchoff's Laws
  - Meters for V, I, R
- RC Circuits

(2)



Current: $I_3 = I_2 + (3.2\ A)$

Loops: Out: $\mathcal{E} - I_3 R + 24 - I_1 6 = 0$

Left: $\mathcal{E} - I_3 R - I_2 3 = 0$

$(\mathcal{E} - I_3 R) = -24 + I_1 \cdot 6 = I_2 3$

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w/o Kirchoff: $V_6 = 6 \cdot 3.2 = (19.2\ V)$

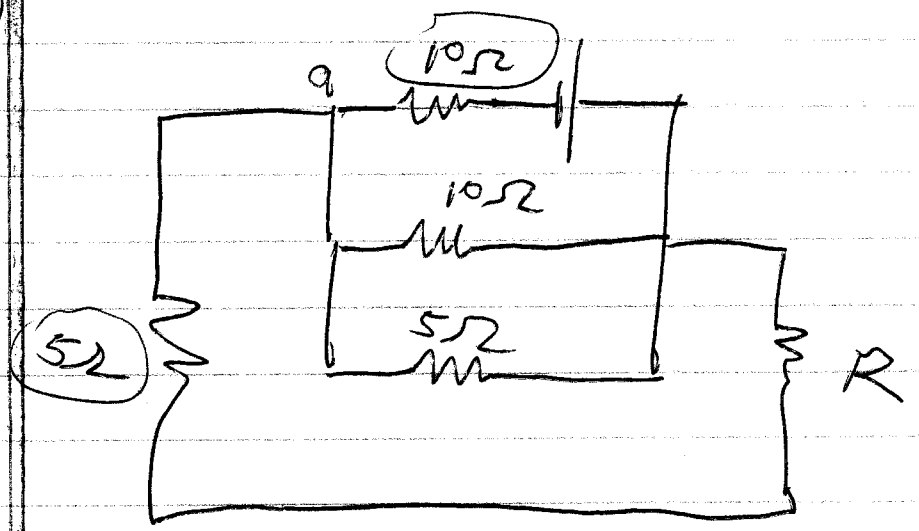
$a \to b \qquad \Delta V = +24\ V - 19.2\ V$

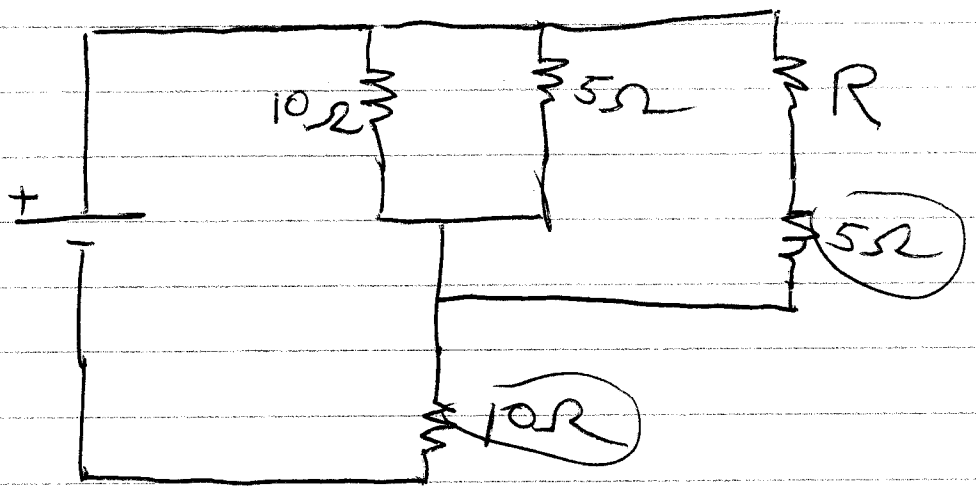
$= 4.8\ V$

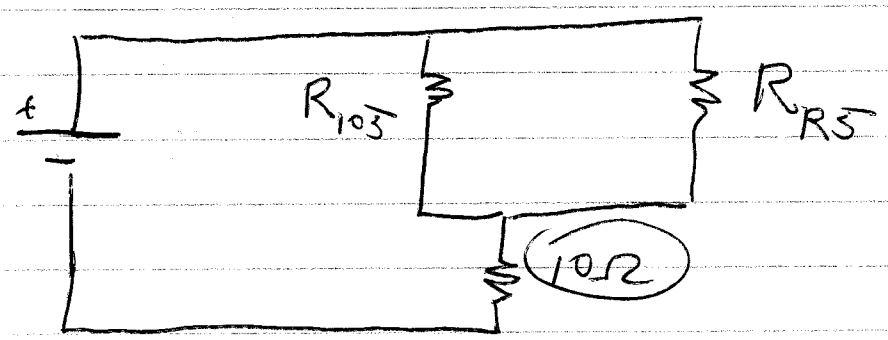
b is 4.8v higher than a

$I_2 = (4.8v)/(3\Omega) = 1.6\ A \qquad b \to a$

(3)







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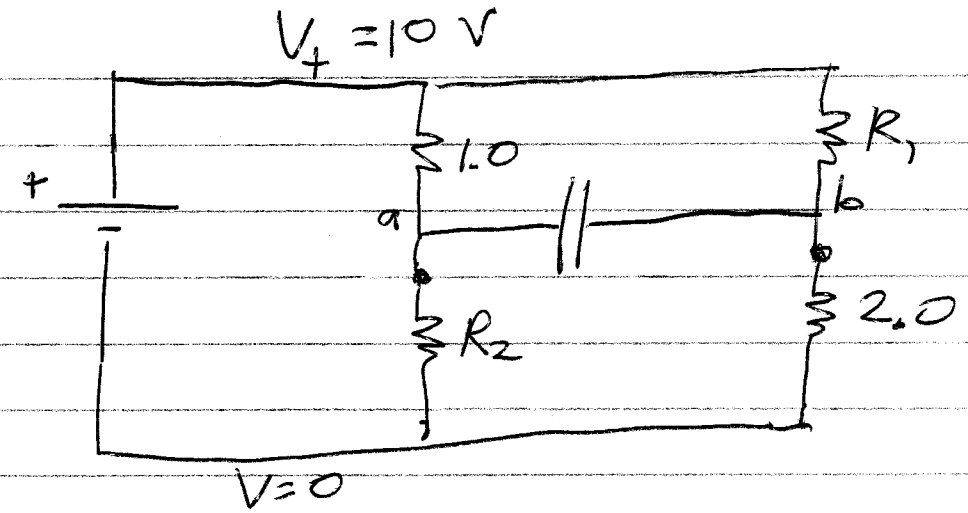


$Q = CV \qquad V = \text{const} \qquad I = 0$

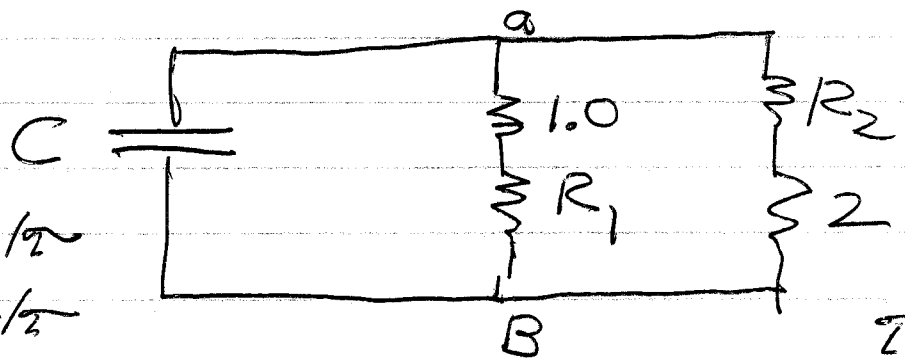
$$I_2 = \frac{10}{1+R_2} \qquad V_2 = IR_2$$

$$V_a = V_2$$

$$I_1 = \frac{10}{R_1+2} \qquad V_B = 2I_1$$

$$V_C = V_a - V_b$$

(b)



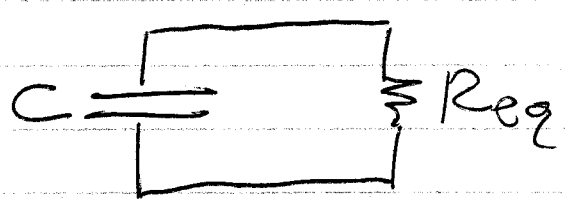
$\tau = RC$

$$V = V_0 e^{-t/\tau}$$

$$\frac{V}{V_0} = e^{-t/\tau}$$

$$\frac{1}{6} = e^{-t/\tau}$$

$$\ln\left(\frac{1}{6}\right) = \frac{-t}{\tau}$$



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After 3 time constants, how much charge is left in a discharging cap?

$$Q = Q_0 e^{-t/\tau}$$

$$\frac{Q}{Q_0} = e^{-t/\tau}$$

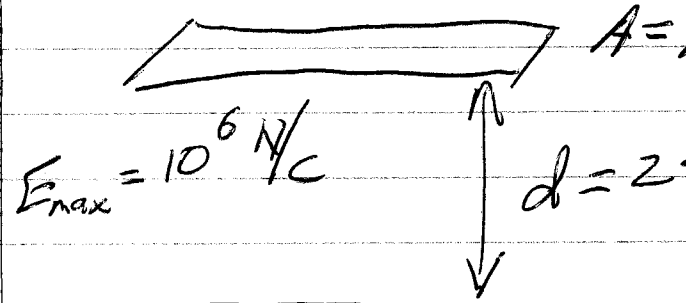
Answer, as worded $= e^{-3\tau/\tau} = e^{-3}$

$= 0.0498$

$= 5\%$

$\tau = RC$

Thunderstorm as a parallel plate cap:



$E = 4\pi k \sigma$

$k = 9\times10^9 \frac{N m^2}{C^2}$

$\sigma = E/(4\pi k) = 8.84\times10^{-6} \frac{C}{m^2}$

$Q = \sigma A = \sigma(9\times10^6 m^2) = 80\ C$

This is +80 C on ground, −80 C in cloud.

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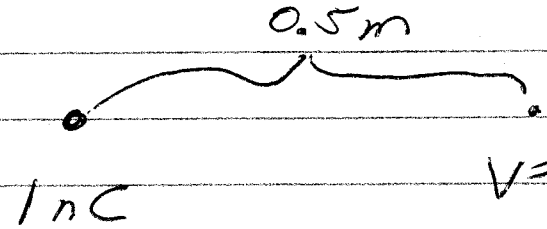

$$V = \frac{kq}{r} = \frac{(9\times10^{9})(1\times10^{-9})}{0.5}$$

$$= 18 \text{ V}$$

1.0 nC spread out on a ring w/ radius 0.5 m. What is V @ center?

$$V = \int \frac{k\,dq}{r}$$

$$= \frac{k}{r}\int dq$$

$$= \frac{kq}{r} = (18 \text{ V})$$