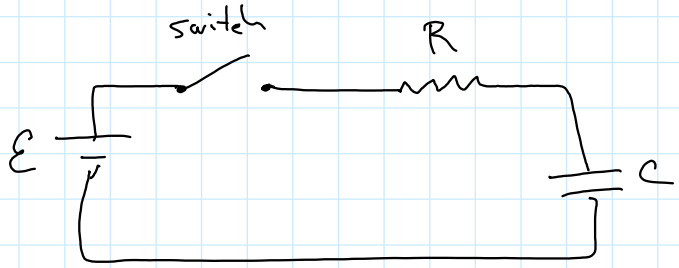
Phy 2B 2/2

Monday, February 2, 2015 9:54 AM

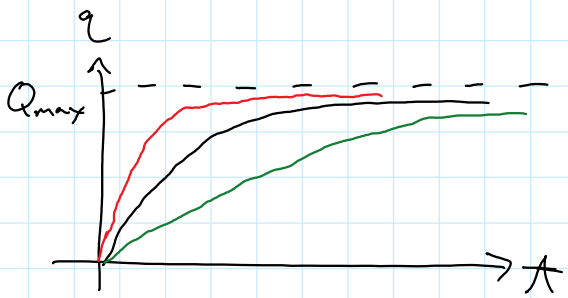
Exam #2 20-5 → ch 21

RC Circuits

Review for Exam



Time to charge capacitor depends on both R and C



Charging Capacitor

$$q(t) = C\mathcal{E}\left(1 - e^{-\frac{t}{RC}}\right)$$

→ 0 at $t = 0$

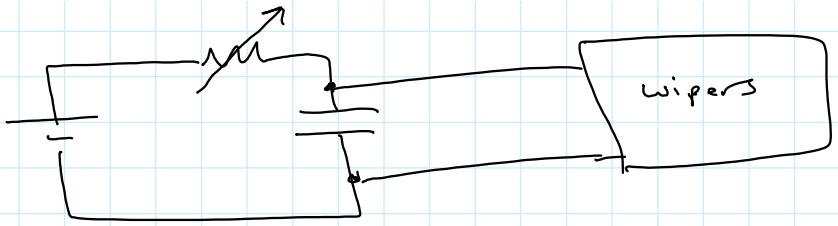
→ $C\mathcal{E}$ (Q_{max}) at $t = \infty$

when $t = RC$ ← $\tau = RC$ time constant

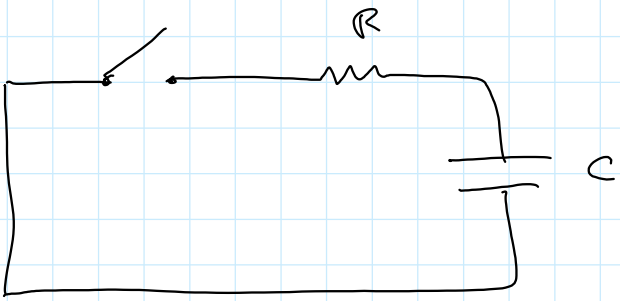
$$q = Q_{max}\left(1 - \frac{1}{e}\right)$$

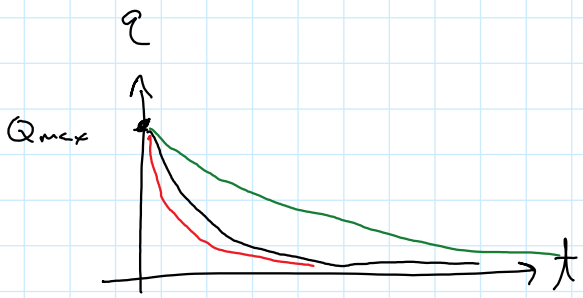
Windshield wipers

variable Resistor



Discharging Capacitor:

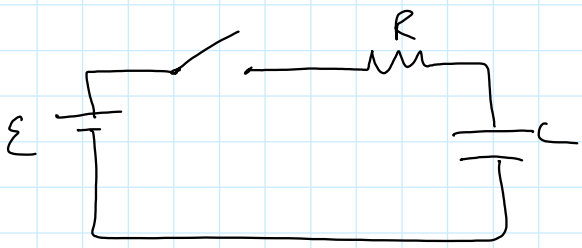




$$q(t) = Q_{max}\, e^{-\frac{t}{\tau}} \qquad \tau = RC$$

How long to get to $\frac{1}{2}$ of its max charge?

We will do a charging cap:



$$q(t) = Q_{max}\left(1 - e^{-\frac{t}{RC}}\right)$$

$q(t) = Q_{max}(1 - e^{\cdot})$

$\frac{Q_{max}}{2} = Q_{max}\left(1 - e^{-\frac{t}{RC}}\right)$ solve for t

$\frac{1}{2} = 1 - e^{-\frac{t}{RC}}$

$e^{-\frac{t}{RC}} = \frac{1}{2}$

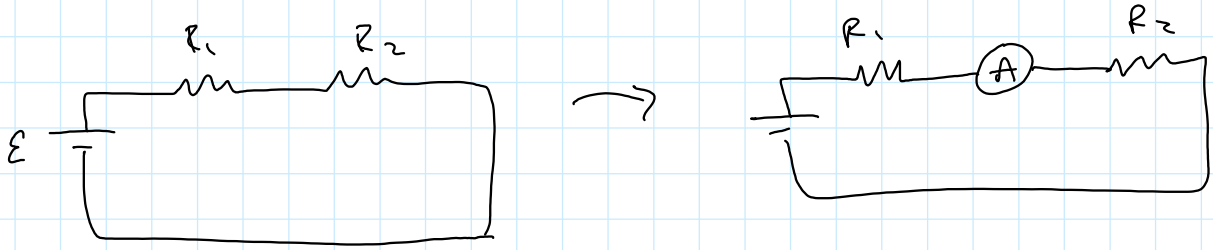
$\ln\left(e^{-\frac{t}{RC}}\right) = \ln\left(\frac{1}{2}\right)$

$-\frac{t}{RC} = \ln\frac{1}{2}$

$t = -RC\ln\frac{1}{2}$

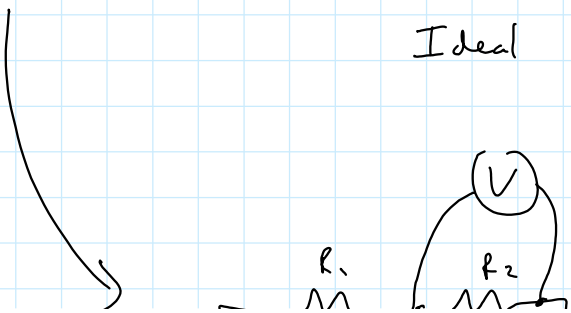
$= RC\ln 2$

Ammeters and Voltmeters

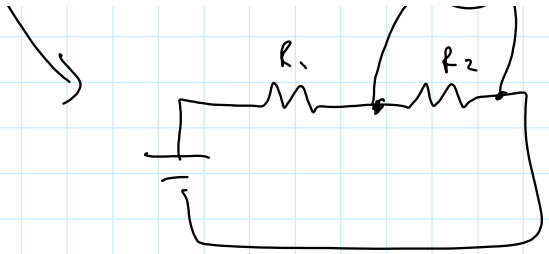


must put in series with the device you are measuring for current

Ideal ammeters have zero Resistance



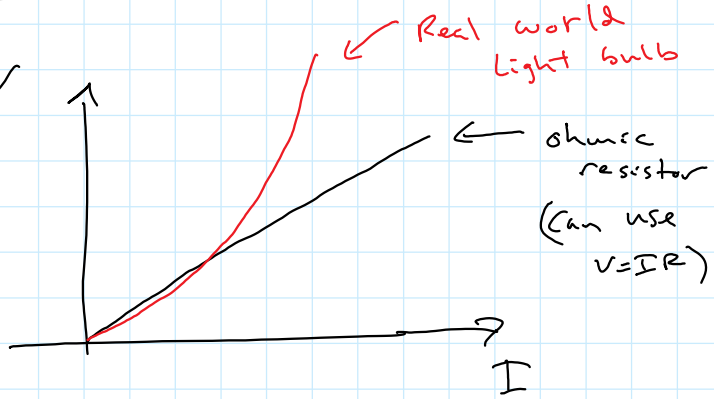
measure voltage



measure voltage in parallel

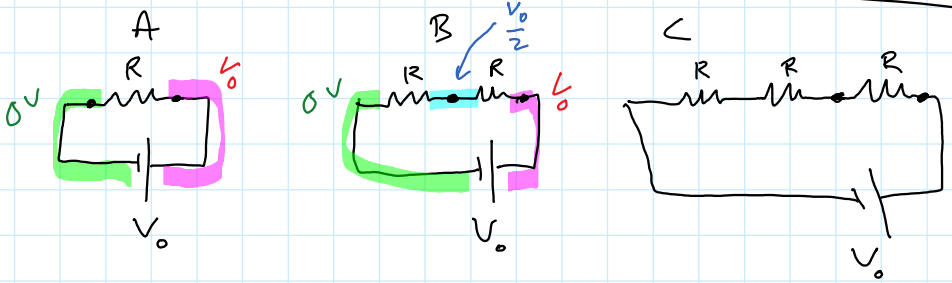
Ideal voltmeter has $R_{int} = \infty$

$V = IR$



Worksheet p. 99

1)



$V_{Nm} = V_0$ $\quad V_{Nm} = \frac{V_0}{2}$ $\quad V_{Nm} = \frac{V_0}{3}$

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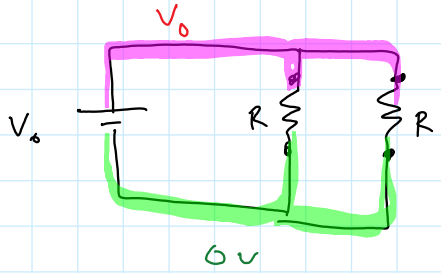
2)



$V_A = V_0 = V_B = V_C$

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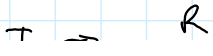
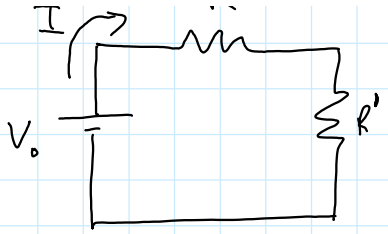
3)





$$I_A < I_B < I_C$$

$$V_A < V_B < V_C$$

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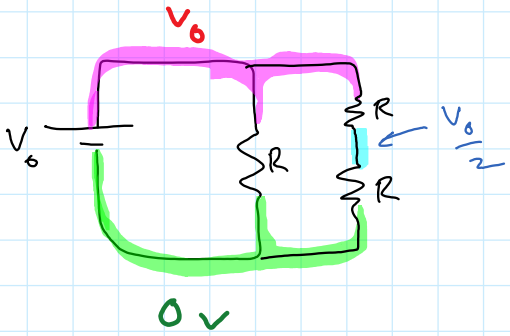
4)



$$V_A = V_0$$

$$V_B = V_0$$

$$V_C = \frac{V_0}{2}$$

Worksheet p. 106

Let $R = 1\ \Omega$

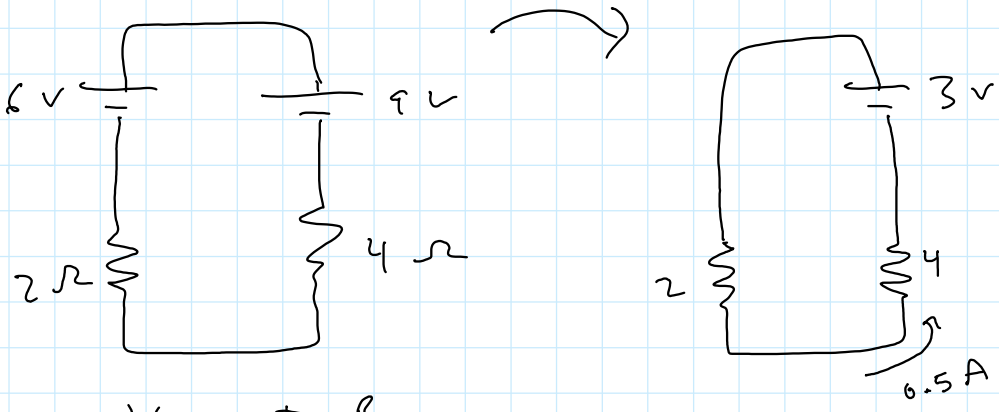
$V = 10\ V$

	(A)	(V)
A	2.5 A	2.5 V
B	5 A	5 V
C	2.86 A	0 V
D	6.67 A	0 V

Ch. 21 #64 b)

Ch. 21 #64

b)



$$V = I R$$

$$(3V) = I\,(6\ \Omega)$$

$$I = \frac{1}{2}\ A$$

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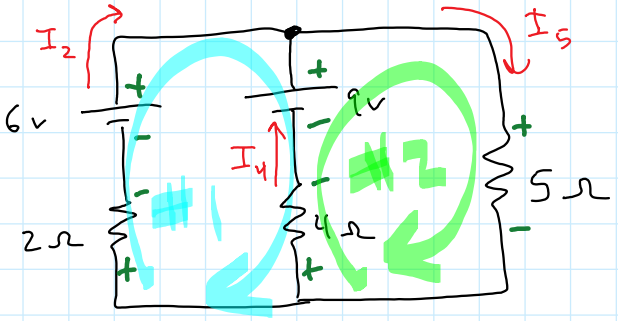
a)



1) pick a direction of I in each branch

2) Mark the high/low potential ends of each device with +/− signs

3) Junction: $\Sigma I_{in} = \Sigma I_{out}$

$$I_2 + I_4 = I_5$$

4) 2 Loop Rules:

Loop #1: $-I_2(2\Omega) + 6V - 9V + I_4(4\Omega) = 0$

Loop #2: $-I_4(4\Omega) + 9V - I_5(5\Omega) = 0$

using PhET simulation gives

$I_2 = 0.24$ A

$I_4 = 0.87$ A

$I_5 = 1.10$ A

directions are correct

Power:

$$P = IV$$

units: watts = W

for resistors:

$$P = IV = I^2R = \frac{V^2}{R}$$

Which has smaller R → 100 W lightbulb or 60 W bulb?