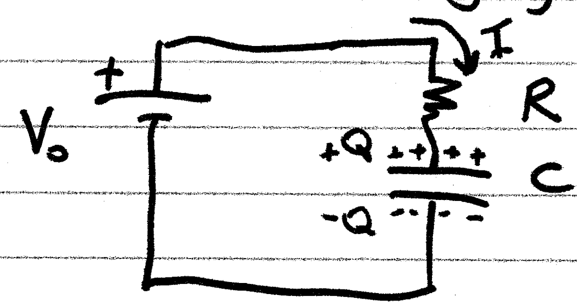
Phys 1402   2014-09-25

Exam 1: Tue 9/30

- I will provide the posted Eqn Sheet.
- Covers chap 15-18
- Review all HW questions
- Review all Prelab Practice
- Review Summer 2014 Exam 1.

HW 2 #22 : Charging Capacitor



$$V_0 = V_R + V_C$$

$$I = \frac{V_R}{R} \qquad Q = CV_C$$

$$I = I_0 e^{-t/\tau}$$

$$\tau = RC$$

Initially: $Q = 0$ so $V_C = 0$ and $V_R = V_0$

So the current starts at $I_0 = \frac{V_0}{R}$

Finally: $I = 0$ so $V_R = 0$ and $V_C = V_0$

So, the capacitor charges to

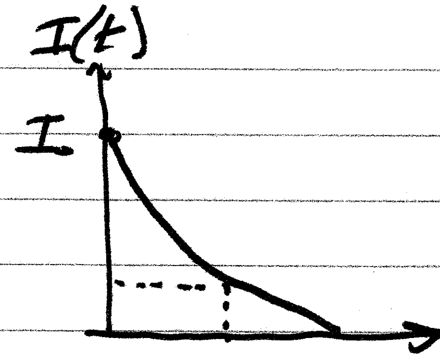
$$Q_0 = CV_0 = (6.00 \times 10^{-6}\,\text{F})(35.0\,\text{V})$$

($\mu \rightarrow 10^{-6}$)

②

ⓐ $t = 10.0\ s$ $\quad \tau = RC$

$$I = I_0 e^{-t/\tau}$$



$$I_0 = \frac{V_0}{R} = \frac{(35.0\ V)}{(9\times10^6\ \Omega)}$$

(10^6 ← M)

Step-by-step: $-t/\tau$, press e^x, mult by I_0

HW2 #5

$Q = I\Delta t$ = charge capacity in C or A·h
Note 1 C = 1 A·s

Energy = V·Q $\qquad P = IV$

Ex: $V = 9.0\ V$ $\qquad Q = 15\ A\cdot h$

$$\text{Energy} = (9.0\ V)\cdot(15\ A\cdot h) = 135\ \underbrace{V\cdot A}_{W}\cdot h$$
$$= 135\ W\cdot h = 0.135\ kWh$$

A capacitor is hooked to a 6.0 V battery and its charge is 3 mC. If the same cap is hooked to a 12.0 V batt, what is the capacitance? $\quad V_c = Q/C \qquad Q = V_c C$

(A) 4 mF (B) 2 mF (c) 0.5 mF (d) 0.25 mF

Note: Before, $C = 3\ mC / 6\ V = 0.5\ mF$

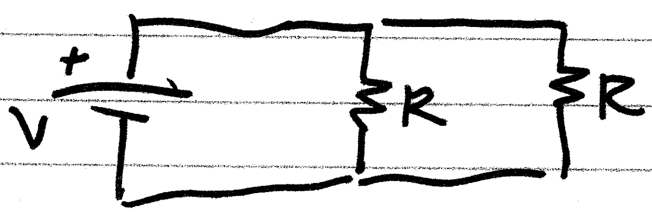
③

If you double the current going thru a resistor, what happens to R?

$$V = IR$$

(Ans: R doesn't change)

Multiple equiv. R in parallel:



Each $I = V/R$

Total $I_{tot} = NI$ (N = # resistors)

Equiv Resistance $R_{eq} = \frac{V}{I_{tot}} = \frac{V}{NI} = \frac{R}{N}$

Ex: Three $60\,\Omega$ in parallel $R_{eq} = 20\,\Omega$

④

HW 2 #23 Charging Capacitor

$$V = V_0 \left(1 - e^{-t/\tau}\right) \qquad \tau = RC$$

V @ time t (V); Equilibrium Voltage (V_0)

$$-\frac{V}{V_0} = -1 + e^{-t/\tau}$$

$$1 - \frac{V}{V_0} = e^{-t/\tau}$$

← plug #'s in $\sim = 1 - V/V_0$

$$\ln(\sim) = -t/\tau$$

← solve for τ

Plug τ into $\tau = RC$

Strategy:

1) Solve for $e^{-t/\tau}$
2) Plug in known values
3) Take ln() if necessary
4) Finish solving.

(5)

A capacitor is discharging.

@ $t=0$, $V = 60$ V } Cut in half twice.

@ $t = 8$ s, $V = 15$ V

What is V @ $t = 4$ s?

What is τ?

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

$$(15\text{ V}) = (60\text{ V}) e^{-t/\tau}$$

$$0.25 = e^{-t/\tau}$$

$$\ln(0.25) = -t/\tau = -1.386$$

$$\tau = -t/-1.386$$

Plug in $t = (8\text{ s})$ $\quad \tau = 5.77$ s