Phys 132 2022

Review 2

* **Thurs:** Exam II in class

Covers: Ch 26.5 → 26.6 — Lectures 12 – 19

Ch 27. — HW 5,6

Ch 28

Bring: * Calculator

* Previous 3"x5" single side card
* Second 3"x5" single side card.

Study * 2017 Exam II Q 1→4

* 2018 Exam II Q 1 – 9
* HW, Discussion Probs, Discussion Quizzes
* Class quizzes

Chapter 26.5 – 26.6 (Capacitors)

$Q = C\,\Delta V_c$ $C = \frac{\epsilon_0 A}{d}$ (Parallel Plate)

$U_c = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}C(\Delta V_c)^2$ $C_{eq} = C_1 + C_2$ (parallel)

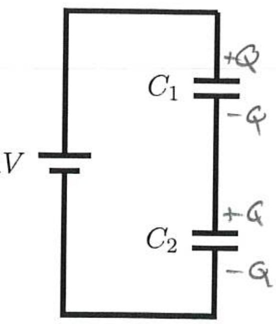
$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$ (series)

Quiz 1 80%

[redacted]

125 Capacitors in Series: Energy

Two capacitors are connected in series. Determine an expression for ~~or~~ the energy stored in each capacitor, for the case where $C_2 = 2C_1$



Answer: The charge on each capacitor is the same. So for capacitor 1

$$U_1 = \frac{1}{2}\frac{Q^2}{C_1}$$

For capacitor 2

$$U_2 = \frac{1}{2}\frac{Q^2}{C_2}$$

We just need the charge. This comes from

$$Q = C_{eq}\Delta V$$

and

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C_1} + \frac{1}{2C_1} = \frac{2+1}{2C_1} \Rightarrow C_{eq} = \frac{2}{3}C_1$$

$$Q = \frac{2}{3}C_1\Delta V$$

Then

$$U_1 = \frac{1}{2}\left(\frac{2}{3}C_1\Delta V\right)^2\frac{1}{C_1} = \frac{1}{2}\frac{4}{9}\frac{C_1^2\Delta V^2}{C_1} = \frac{2}{9}\frac{\Delta V^2}{C_1}$$

$$U_2 = \frac{1}{2}\left(\frac{2}{3}C_1\Delta V\right)^2\frac{1}{C_2} = \frac{1}{2}\frac{4}{9}\frac{C_1^2\Delta V^2}{2C_1} = \frac{1}{9}\frac{\Delta V^2}{C_1}$$

Chapter 27

$J = \frac{\Delta Q}{\Delta t}$ $R = \rho \frac{L}{A}$ $I = \frac{\Delta V}{R}$

$\Delta V = IR$

$P = I \Delta V$

Example: Quiz 2 70% ~ 100%

126 Electrons in a circuit

A $220\,\Omega$ resistor is connected to a $9.0\,\text{V}$ battery.

a) Determine the number of electrons that flow past any point in the circuit in $30\,\text{s}$.

b) Determine the amount of energy needed to push a single electron through the resistor.

Answer: a) $I = \frac{\Delta Q}{\Delta t}$ would give $\Delta Q = I\,\Delta t$

Then let N be the number of electrons

$\Delta Q = Ne \Rightarrow N = \frac{\Delta Q}{e}$

Now $I = \Delta V / R = \frac{9.0\,\text{V}}{220\,\Omega} = 0.041\,\text{A}$

$\Delta Q = 0.041\,\text{A} \times 30\,\text{s} = 1.2\,\text{C}$

$N = \frac{1.2\,\text{C}}{1.6 \times 10^{-19}\,\text{C}} = 7.7 \times 10^{18}$ electrons

b) $\Delta U = q\,\Delta V \Rightarrow \Delta U = e\,\Delta V$

$= 1.6 \times 10^{-19}\,\text{C} \times 9.0\,\text{V}$

$\Delta U = 1.4 \times 10^{-18}\,\text{J}$

Chapter 28

$P = I \Delta V$

$\Delta V = I R_{eq}$

series: $R_{eq} = R_1 + R_2 + R_3 + R_4 \dots + R_N$

parallel: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}$

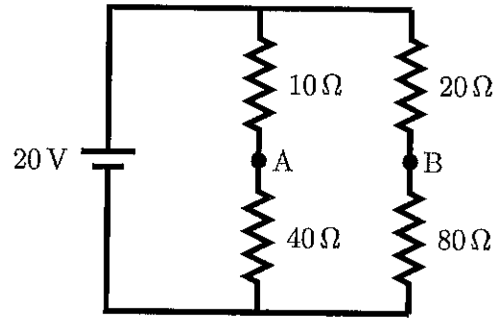
Example: Quiz 3 ~40% ~90%

127 Resistors in series and parallel, 2

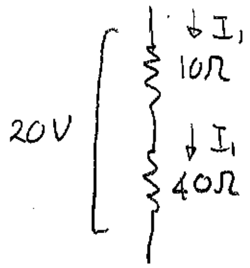
a) Determine the currents through and voltages across each resistor in the illustrated circuit.

b) Determine the potential difference between points A and B.

(132S22)



Answer: a) The potential difference across each arm is 20V



$\Delta V = I_1 R_{eq}$ $\qquad$ $R_{eq} = 10\Omega + 40\Omega = 50\Omega$

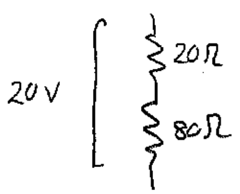
$20V = I_1 50\Omega$

$\Rightarrow I_1 = 0.40\,A$

This is the current in the 10Ω and 40Ω resistors. Then for each

$\Delta V = I_1 R \Rightarrow \Delta V = 0.40A\ R$

Then for the other arm.



$\Delta V = I R_{eq}$ $\qquad$ $R_{eq} = 20\Omega + 80\Omega = 100\Omega$

$20V = I\ 100\Omega \Rightarrow I = 0.20A$

Resistor	I	ΔV
10Ω	0.40A	4.0V
40Ω	0.40A	16V
20Ω	0.20A	4.0V
80Ω	0.20A	16V

We get the individual voltages via $\Delta V = IR = 0.20A\ R$.

b) The potential at A is the same as B. So potential difference between these is 0V