Chapter 20 Summary

Essential Concepts and Formulas



Electromotive Force and Current

The maximum potential difference V is called the electromotive force emf V/ (not not a force as the name implies) Flow of charge is called C electric current, I • Measured in C/s =S Ampere 2 Types of currents: $\xi = emf$ Direct (DC) and Alternating (AC)

Ohm's Law

- Analagous to water V = IRflowing in a hose. In water, great pressure $\frac{V}{-} = R$ means larger water flow In electricity, greater voltage means larger current volt R=resistance Resistor: device that ampere offers resistance Used to control current and voltage levels
- $= ohm(\Omega)$

Resistance and Resistivity

Like in a hose, resistance relates to length and area $R = \rho$ Rho is proportionality constant known as resistivity of material Rho is inherent property of material, like density Like density, changes with temperature

Electric Power

Definition: When charge flows from A to B in a circuit, leading to current I and voltage V, the electric power is P=IV

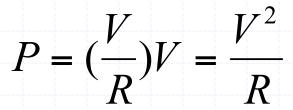
Unit: Watt (W)

 Substituting other expressions for I and V, we obtain equivalent expressions for power $P = \frac{(Vq)V}{Vt} = \frac{Vq}{Vt}V = IV$

 $P = I(IR) = I^2R$

P = IV

VWork VTime



Alternating Current

- Similar to DC current, but voltage and current oscillate
- Equations are basically analogous to dc equations
- rms=root mean square.
 Obtained by dividing peak value by sqrt(2)

Eqns aren't as important as concept of <u>oscillation</u>

$$V = V_0 \sin 2\pi ft$$

$$I = \frac{V_0}{R} \sin 2\pi ft = I_0 \sin 2\pi ft$$

$$P = I_0 V_0 \sin^2 2\pi ft$$

$$\overline{P} = \frac{1}{2} I_0 V = \left(\frac{I_0}{\sqrt{2}}\right) \left(\frac{V_0}{\sqrt{2}}\right) = I_{rms} V_{rms}$$

$$\overline{P} = I_{rms} V_{rms}$$

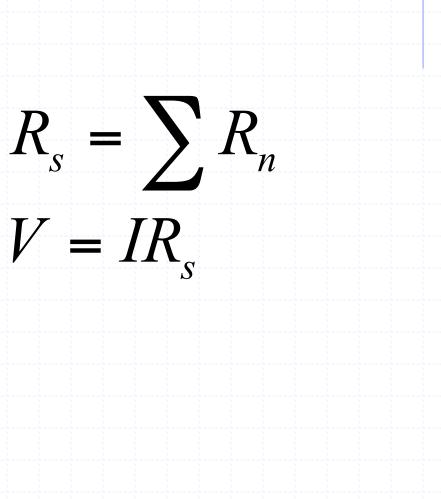
$$\overline{P} = I^2_{rms} R$$

$$\overline{P} = \frac{V_r^2}{R}$$

Series Wiring

If devices are in series, the current is the same everywhere in the circuit

- Equivalent resistance is sum of individual resistors (R_s>R_n)
- You can still find power delivered to the resistors.
- In general, total power delivered is equal to power delivered to equivalent resistance



Parallel Wiring

 If devices are in parallel, the voltage is the same across each branch

Equivalent Resistance R_p<R_n R

 $I = V \frac{1}{R}$

- In general, total power is equal to power delivered to equivalent resistor
- Smallest resistance has largest impact (if one equals 0, short out occurs)

Circuits Wired Partially in Both

- Strategy: Break it up into series/parallel parts
- Deal with isolated resistors, find equivalent resistance
- Slowly, keep adding one more part at a time, so slowly eliminating resistors
- Once again, easiest way is to break the circuit into manageable parts

Internal Resistance and Kirchhoff's Rule

Internal resistance: resistance of the battery depends on the current; the terminal voltage (delivered to the circuit) is the emf of the battery minus the internal resistance

 Junction rule: Current into a junction equals current out of a junction (conservation of charge)

Loop Rule: For a closed-circuit loop, the total of all the potential drops is the same as the total of all the potential rises (conservation of energy)

Measurement of Current and Voltage

Ammeter: Measures current at some point in the circuit. Probes must be inserted in series with the circuit. Meter should have a negligible resistance.

Voltmeter: Measures the voltage between two points. Probes must be inserted in parallel with the circuit. Meter should have a negligible resistance.

Capacitors in Series and in Parallel

 $C_p = \sum C_n$

As with resistors, there are equivalent capacitance when multiple capacitors in series

Capacitors in series all have the same amount of charge on each plate of the capacitor

 Capacitors in parallel are charged to the same voltage

