

Physics 161

Lecture 22 Summary

Electric Currents and Resistance

November 16, 2017

# Lecture 22: learning objectives

You will be able to define average and instantaneous current.

You will be able to discuss the concept of an **electrical circuit**.

You will be able to define **electrical resistance** and relate resistance to **resistivity**.

You will be able to state the relationships between electrical power, current, potential difference and resistance.

# Electric current

## Average current:

The amount of charge that flows through an area, in a given time interval.

$$I_{\text{ave}} = \frac{\Delta Q}{\Delta t}$$

## Instantaneous current:

The limit of the average current as the time interval goes to zero.

$$I = \lim_{\Delta t \rightarrow 0} I_{\text{ave}} = \lim_{\Delta t \rightarrow 0} \frac{\Delta Q}{\Delta t}$$

## Circuit:

Closed loop around which current circulates.

# Resistance

Resistance:  $R$  :

The ratio of the potential difference across an element of a circuit to the current through that element.

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

Ohm's law:

The potential difference,  $\Delta V$ , across an element of a circuit is equal to the product of the resistance,  $R$ , and the current,  $I$ , through that element.

$$\Delta V = IR$$

Elements that obey this relation are called "Ohmic".

# Electrical energy and power

Power = Energy per second = Voltage \* charge/second:  
The product of the potential difference across an element of a circuit and the current through that element.

$$P = I\Delta V$$

This is the rate at which energy is transferred to some element in a circuit, such as a resistor or a lightbulb.

$$P = I^2 R$$

$$P = \frac{(\Delta V)^2}{R}$$