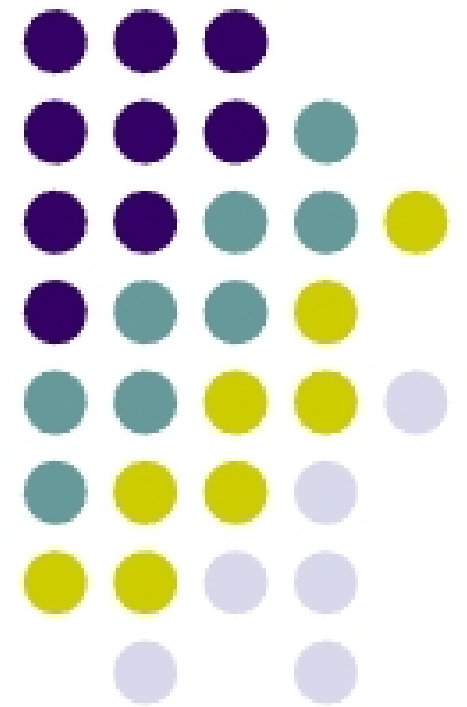


Chapter 33

Alternating Current (AC)

R, L, C in AC circuits



AC, the description

- A DC power source, like the one from a battery, provides a potential difference (a voltage) that does not change its polarity with respect to a reference point (often the ground)
- An AC power source is sinusoidal voltage source which is described as



$$D_V = D_{V_{max}} \sin(\omega t)$$

Here

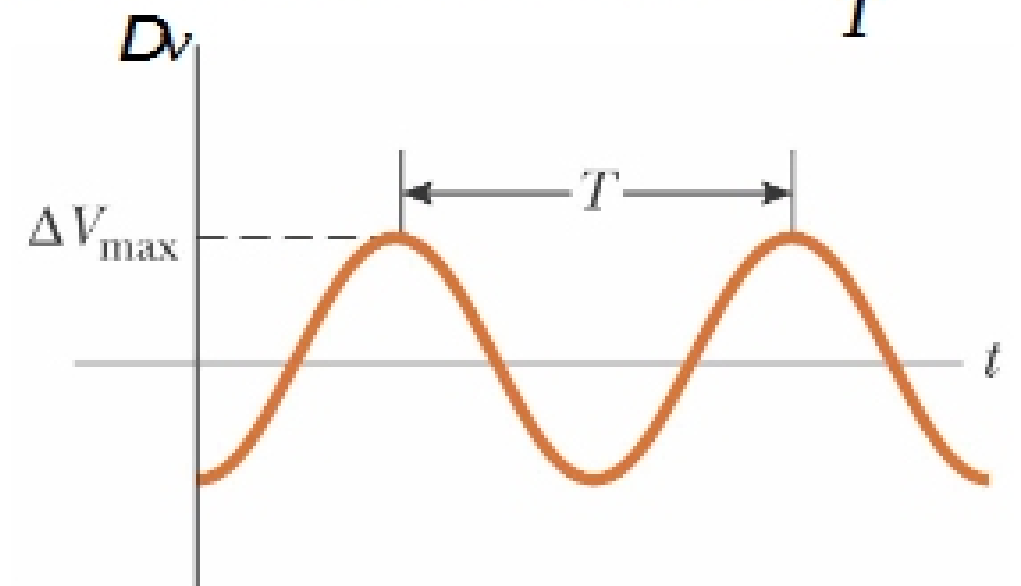
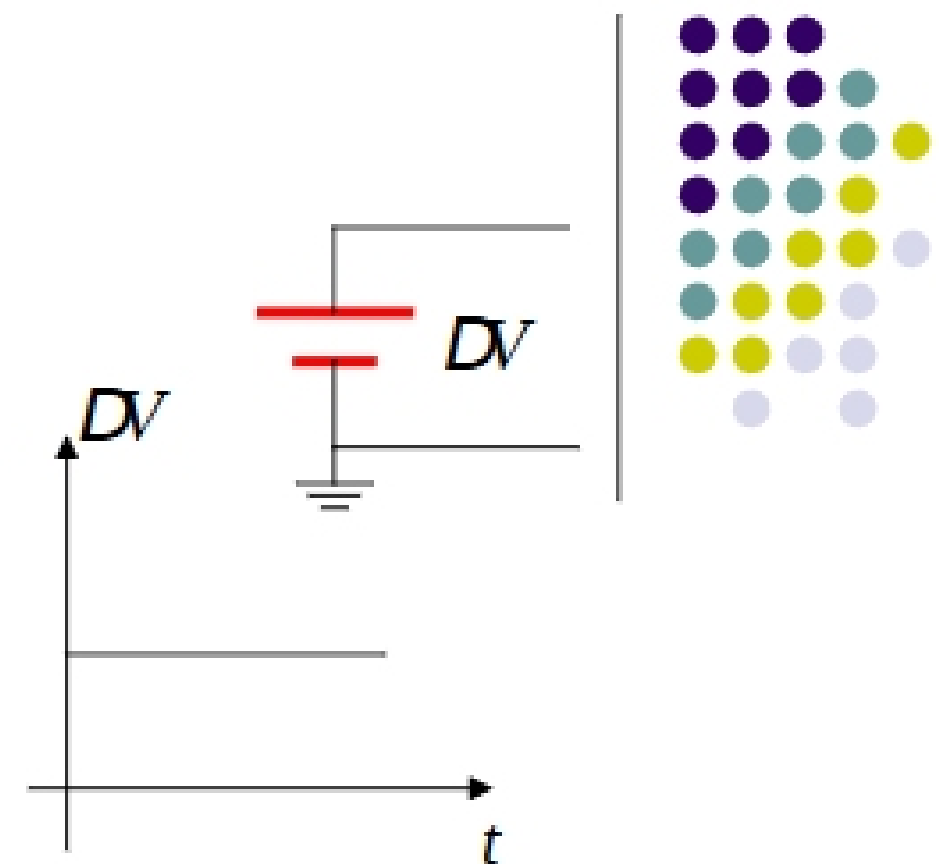
D_V is the instantaneous voltage with respect to a reference (often not the ground).

$D_{V_{max}}$ is the maximum voltage or amplitude.

ω is the angular frequency, related to frequency f and period T as $\omega = 2\pi f = \frac{2\pi}{T}$

Symbol in a circuit diagram:  or 

The US AC system is 110V/60Hz.
 Many European and Asian countries use 220V/50Hz.



Resistors in an AC Circuit, Ohm's Law

The voltage over the resistor:

$$\Delta v_R = \Delta v = \Delta V_{\max} \sin(\omega t)$$

Apply Ohm's Law, the current through the resistor:

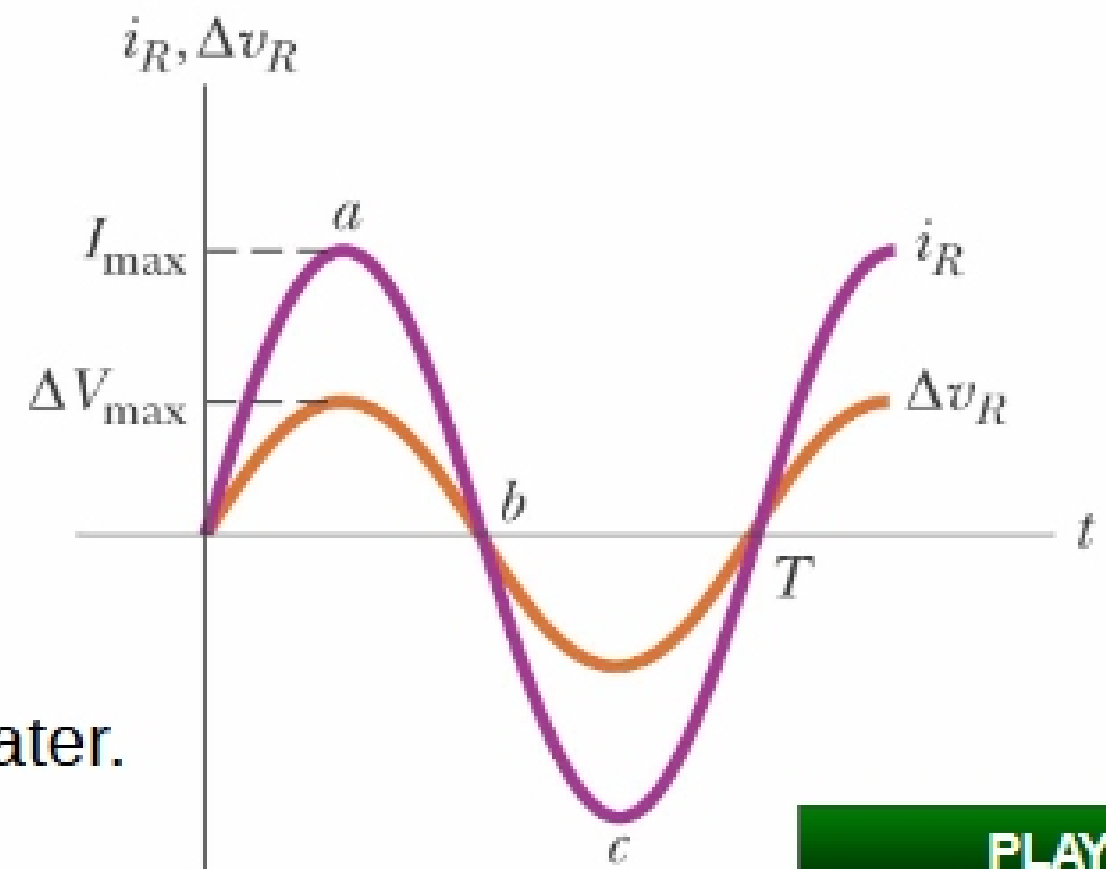
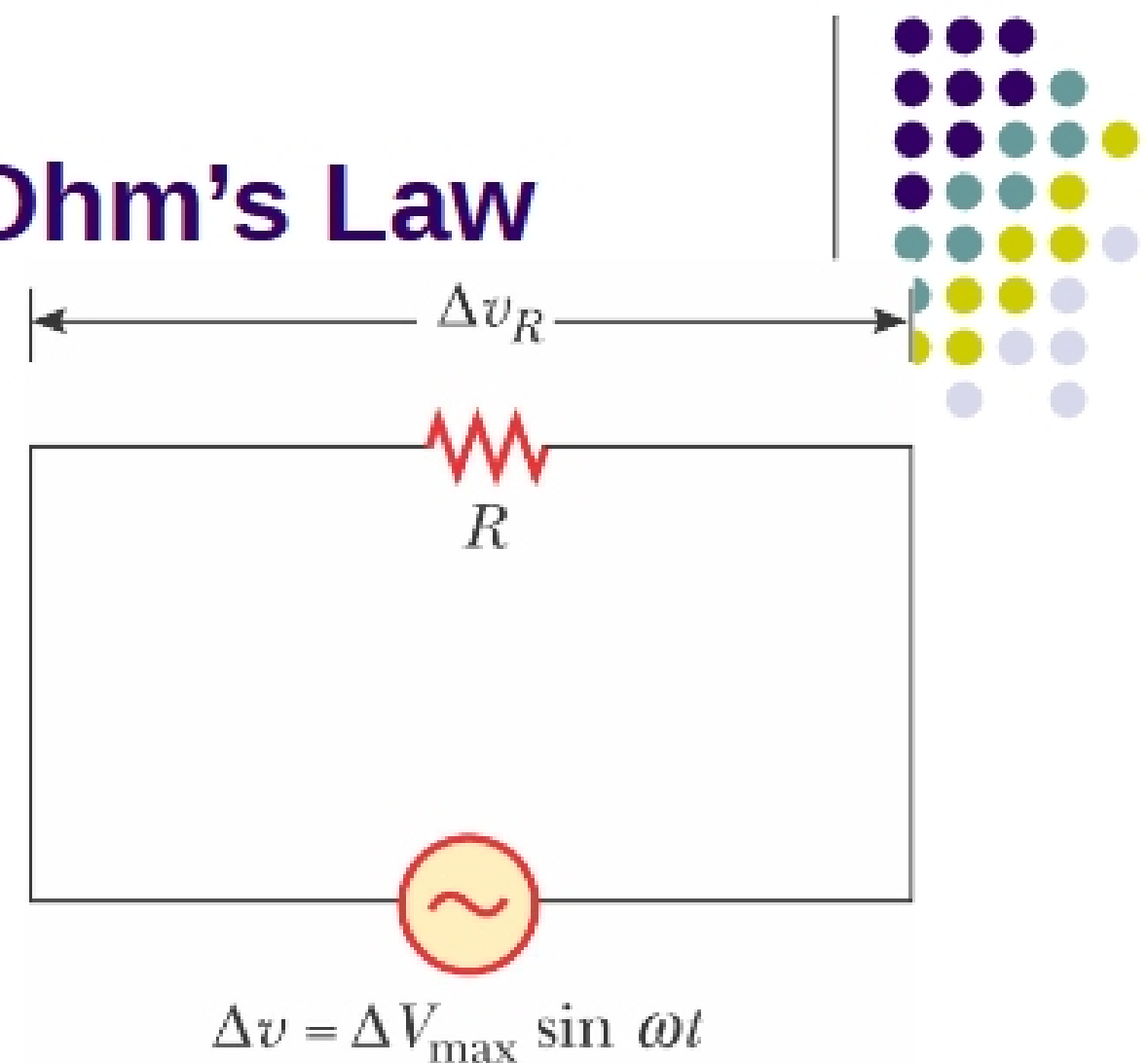
$$i_R = \frac{\Delta v_R}{R} = \frac{\Delta V_{\max}}{R} \sin(\omega t) \quad \text{?} \quad I_{\max} \sin(\omega t)$$

The current is also a sinusoidal function of time t . The current through and the voltage over the resistor are **in phase**: both reach their maximum and minimum values at the same time.

The power consumed by the resistor is

$$P_R = \Delta v_R \quad \text{?} \quad = \frac{\Delta v_R^2}{R} = i_R^2 R = \frac{\Delta V_{\max}^2}{R} \sin^2(\omega t)$$

We will come back to the power discussion later.



PLAY
ACTIVE FIGURE