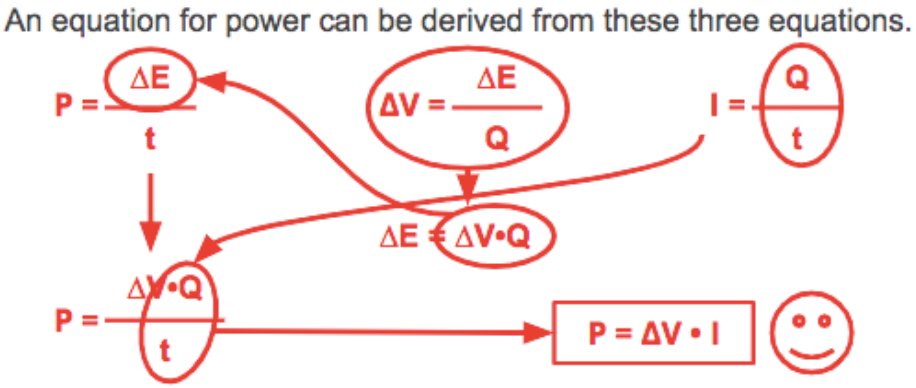
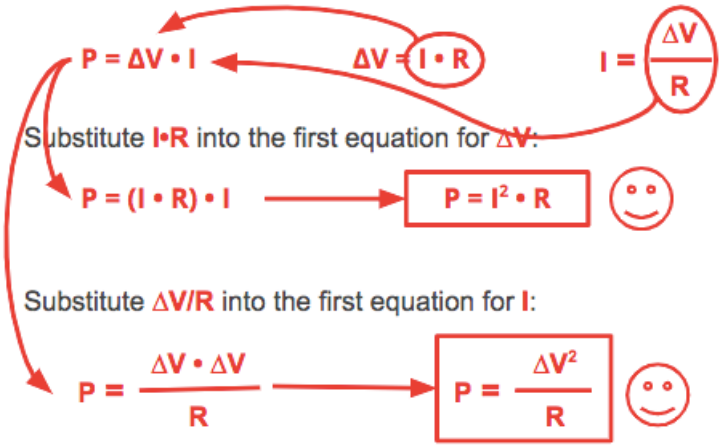
Electric Power - Revisited
Lesson Notes

Learning Outcomes
- What are the mathematical equations for the power in electric circuits?
- How do you use those equations?

Electric Power - Review
Electric power refers to the rate at which work is done by the energy source upon the charge OR
… the rate at which energy is delivered to the load.



Derivation of Power Equations
Additional equations for power can be derived by combining …



The Power Equations
We now have three equations for power. How and when does one use them?
Eq'n #1: **P = I•ΔV** Eq'n #2: **P = I²•R** Eq'n #3: **P = ΔV² / R**

These equations are often used in problems involving the computation of power (**P**) from known values of electric potential difference (**ΔV**), current (**I**), and resistance (**R**).

Known: ΔV, I ⇒ Use Equation 1
Known: I, R ⇒ Use Equation 2
Known: ΔV, R ⇒ Use Equation 3

Thiknk Conceptually!!!! (Always!!!)

When using ANY mathematical formula in Physics, it is important that you never divorce the concepts from the math.

Question: Compare the current of two bulbs - a 60-Watt bulb and a 120-Watt bulb - when placed in their own household circuit.

Wrong Path: Using $P = I^2 \cdot R$, the I^2 value for the 120-W bulb must be twice as much. Thus the I in the 120-W bulb is 1.41 X larger.

60-Watt Bulb:

$P = \Delta V \cdot I$

$60\ W = (120\ V) \cdot I$

$I = (60) / (120) = \mathbf{0.50\ A}$

120-Watt Bulb:

$P = \Delta V \cdot I$

$120\ W = (120\ V) \cdot I$

$I = (120) / (120) = \mathbf{1.0\ A}$

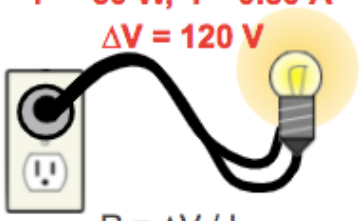
Answer: The 60-Watt bulb draws ½ the current as the 120-Watt bulb.

Looking Deeper at 60-W vs. 120-W Bulbs

Consider the 60-W and 120-W bulbs plugged into a 120-V outlet (US outlet).

P = 60 W, I = 0.50 A

ΔV = 120 V



$R = \Delta V / I$

$R = (120\ V) / (0.50\ A)$

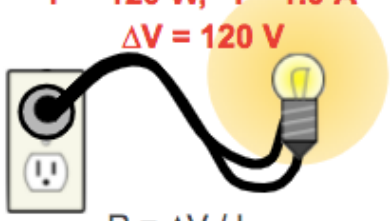
$\mathbf{R = 240\ \Omega}$

$P = \Delta V^2 / R = \mathbf{60\ W}$

$P = I^2 \cdot R = \mathbf{60\ W}$

P = 120 W, I = 1.0 A

ΔV = 120 V



$R = \Delta V / I$

$R = (120\ V) / (1.0\ A)$

$\mathbf{R = 120\ \Omega}$

$P = \Delta V^2 / R = \mathbf{120\ W}$

$P = I^2 \cdot R = \mathbf{120\ W}$

$$P = \Delta V \cdot I$$

$$P = I^2 \cdot R$$

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