College Prep Physics II – Video Lecture Notes – Chapter 19
Video Lecture #3
Finding the cost to power light bulbs and Defining Kilowatt Hour

$\$0.12$

Example Problem: 3 Light Bulbs; P_f = 15 watts; P_i = 60 watts; ΔV = 120 V; $\frac{\$0.12}{kW \cdot hr}$

$\frac{3hr}{day}$ (Bulbs are powered for this much time)

(yes, there are 24 hours in a day, however, the light bulbs are not on 24 hours each day.)

(A standard household circuit in the United States has a potential difference of 120 V.)

$\Delta P = P_f - P_i = 15 - 65 = -50\,watts \Rightarrow \|\Delta P\| = 50\,watts$

$\Delta V = IR \Rightarrow R = \frac{\Delta V}{I} = \frac{120}{I} = ?????$ (we don't know the current.)

$P = \frac{\Delta V^2}{R} \Rightarrow R = \frac{\Delta V^2}{P} = \frac{120^2}{15} = \boxed{960\Omega}$

Power saved by three bulbs: $P_{saved} = 3 \times 50 = 150\,watts \times \frac{1kW}{1000watts} = 0.15kW$

$0.15kW \times \frac{3hr}{day} = \frac{0.45kW \cdot hr}{day} \Rightarrow \left(\frac{0.45kW \cdot hr}{day}\right)\left(\frac{\$0.12}{kW \cdot hr}\right)\left(\frac{365.242days}{1year}\right) = \frac{\$19.723}{year}$

$\$108 \times \frac{1year}{\$19.723} = 5.4758 \approx \boxed{5.5\,years}$

What is a KiloWatt Hour?

$(kW \cdot hr)\left(\frac{1000W}{1kW}\right)\left(\frac{3600s}{1hr}\right) = 3{,}600{,}000W \cdot s = 3{,}600{,}000\frac{J}{s} \cdot s = 3{,}600{,}000s = 3.6MJ$

$1kW \cdot hr = 3.6MJ$ (you will not be given this as a conversion, you must derive it, every time.)