Name _____ **Date** _____

West Islip Technology Department **Period** _____

Introduction to Energy

- ***Work*** is force applied over a distance. It is expressed in units such as foot-pounds (ft.-lb) or inch-pounds (in.-lb).
    - The formula for work is: ***F x D = Work***. In the formula, **F** is the ***force*** in pounds, and **D** is the ***distance*** in feet.
        - Example: If a 10-pound weight is lifted one foot, the work accomplished equals ***10 foot-pounds***.
            - 10 lb. x 1 ft. = 10 ft. lb
- ***Power (P)*** is the amount of work done based on a time period such as seconds or minutes. Power is the time rate of doing work.
    - The formula for power is:

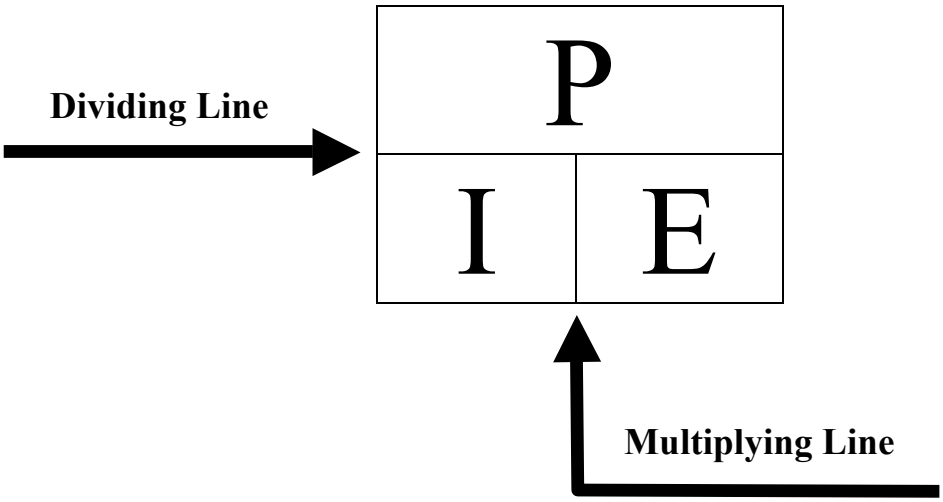
$$\text{Power} = \frac{\text{Work}}{\text{Time}}$$

    - Continuing with the example from above, if a 10 pound weight was moved one foot in ½ (.5) second, the power expended would equal ***20*** foot-pounds per second.

$$\text{20 ft.-lb/second} = \frac{\text{10 ft.-lb}}{\text{.5 second}}$$

- ***Horsepower (hp)*** is used for stating mechanical power. Electrical machines such as motors are rated in horsepower.
    - ***One horsepower (hp)*** is defined as a work rate of 550 ft.-lb/second. In addition, 33,000 ft.-lb/minute equals one horsepower.
- The unit of power is the ***watt (W)***. It was named in honor of James Watt, who is credited with the invention of the steam engine.
    - The formula for electrical power is: ***P (watts) x E (volts) x I (amperes)***.

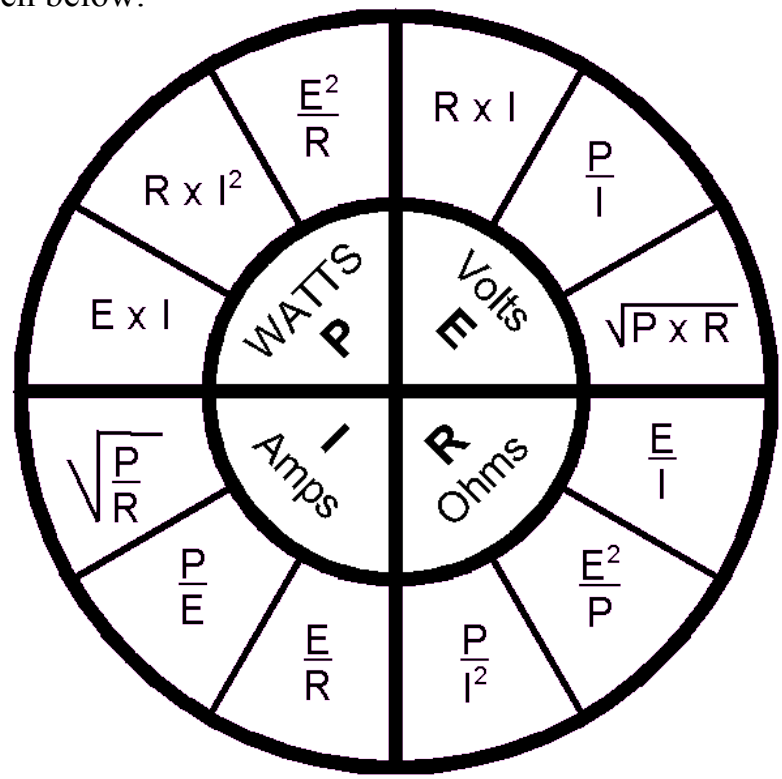
- In order to convert electrical power, in watts, into mechanical power, in horsepower, you can use the following conversion factor.
    - ***746 watts = 1 horsepower***
- The power formula is sometimes called ***Watt's Law***, and it can be arranged algebraically. If two quantities are known, the third unknown can be found using the guide below.



    - Example 1: A circuit with an unknown load has an applied voltage of 120 volts. The measured current is 8 amperes. How much power is consumed?
        - ***P = I x E***
        - ***P = 8 A x 120 V***
        - ***P = 960 W***
    - Example 2: A coffee pot, rated at 200 watts, is connected to a 120 volt source. How much current will this appliance use?
        - ***I = P/E***
        - ***I = 200 W / 120 V***
        - ***I = 1.67 A***

- It is possible to combine ***Ohm's law*** and ***Watt's law*** to produce simple formulas that allow you to solve for current, voltage, resistance, or power if any two of those quantities are unknown.
    - The formulas that relate to Ohm's law and Watt's law can be arranged in a wheel-shaped guide for you to use as a reference. When you look at the guide, you will see two circles, an inner circle, and an outer circle. You will need to use the ***inner circle*** to solve for your unknown quantity, and use the ***outer circle*** to plug in your known quantities.

- The wheel shaped guide that incorporates Ohm's law and Watt's law can be seen below.



- Example 1: Using the guide above, solve the following problem. A circuit has 60 volts and a resistance of 15 ohms. How many amps and watts are involved in this circuit?

  - ***I = E / R***
  - ***I = 60 V / 15 Ω***
  - ***I = 4 A***

  - ***P = E^2 / R***
  - ***P = 60^2 V / 15 Ω***
  - ***P = 240 W***

- Example 2: Using the guide above, solve the following problem. A circuit has 5 amps and 50 watts. How many volts and ohms are involved in this circuit?

  - ***E = P / I***
  - ***E= 50 W / 5 A***
  - ***E = 10 volts***

  - ***R = P / I^2***
  - ***R = 50 W / 5^2 A***
  - ***R = 2 Ω***