Physical Science: Tesla Coil Connections

Introduction to Matter
States of Matter

Plasmas

1. "Plasma is the state of matter that does not have a definite shape or volume and whose particles have broken apart."
2. Properties
    a. Plasmas conduct electric current, while gasses do not.
        i. Electric and magnetic fields affect plasmas but do not affect gases.
        ii. Strong magnets are used to form a magnetic "bottle" to contain very hot plasmas that would destroy any other container.
    b. Natural plasmas
        i. Lightning
        ii. fire
        iii. Aurora borealis
    c. Artificial plasmas
        i. In fluorescent lights
        ii. Plasma balls

Work, Machines, and Energy
Energy and Energy Resources

Electrical Energy

1. "Electrical energy is the energy of moving electrons."
    a. Electrons
        i. Negatively charged particles of atoms
        ii. Energy created by moving electrons is used to do work
    b. Electrical energy can be both potential and kinetic energy
2. Light energy
    a. Vibrations of electrically charged particles
    b. Cause energy to be transmitted
    c. Do not cause other particles to vibrate
    d. Can be transmitted through a vacuum

Work, Machines, and Energy
The energy of waves

The nature of Waves;

1. “A wave is any disturbance that transmits energy through matter or space.”
2. Waves carry energy
3. Some waves transfer energy through the vibration of the particles (atoms or molecules) in a medium
    a. A medium is a substance through which a wave can travel.
    b. A medium can be a solid, liquid, or a gas
    c. Waves that require a medium are called mechanical waves
4. Some waves can transfer energy without traveling through a medium
    a. Visible light and microwaves are examples
    b. Waves that do not require a medium are called electromagnetic waves
        i. Light from the sun
        ii. Electromagnetic waves travel faster through empty space

Properties of Waves;

1. Amplitude
2. Wavelength
3. Frequency
    a. The number of waves produced in a given amount of time
    b. Hertz: 1 hertz = 1 wave per second (1 Hz = 1/s)
4. Wave speed
    a. Speed at which a wave travels
    b. Velocity = lambda times frequency ($v = \lambda \times f$)
5. Resonance
    a. Standing Waves form a stationary pattern in which portions of the wave are at the rest position due to total destructive interference and other portions have a large amplitude due to constructive interference
    b. The frequencies at which standing waves are produced are called resonant frequencies.
        i. When an object vibrating at or near the resonant frequency of a second object causes the second object to vibrate
        ii. A resonating object absorbs energy from the vibrating object and therefore vibrates, too.

Work, Machines, and Energy
Introduction to Electricity

a. Conduction - Electrons are transferred from one object to another by direct contact.
    i. "In a Tesla coil, confining the electrical energy to the conductors and preventing its leakage over their supports or to the ambient air in the form of electrical discharges always occurs when the electric surface density reaches a certain value.
    ii. Tesla attempted to prevent these discharges for his specific experimental purposes, but many people since have been enthusiastic to create these discharges which may be termed as "man-made lightning"." [Barton B. Anderson; The Classic Tesla Coil, A Dual-Tuned Resonant Transformer. pg 1]
b. Induction
    i. Occurs when charges in an uncharged object are rearranged without direct contact with a charged object
    ii. "The secondary is an air-core coil with many more turns as compared to the primary coil. The oscillating energy from the primary coil and capacitor induces the secondary coil by way of electromagnetic induction or commonly referred to as an electromagnetic field. [Ibid, pg 2]
    iii. Typically, 10 - 25% of the electromagnetic field interacts with the secondary coil.
        1. This fraction is known as the coupling coefficient (k), and is a ratio of how much of the source electromagnetic field is coupled to a destination (secondary coil).
        2. The coupling coefficient is purely a function of the geometry's and relative placement of the primary and secondary coils." [Ibid, pg 2]
c. Conductors
d. Insulators
e. Static electricity
f. Electric discharge
g. Lightning
h. Electric current
i. Voltage
j. Resistance
k. Ohm's law
l. Electric Power
m. Measuring electrical energy
n. Electric circuits
    i. Series
    ii. Parallel