PHYS 1020: Physics of Energy

Exam 2 Examples

Electricity, Generators, and Transmission of Electricity

Equations

$$V = IR \qquad P = IV \qquad P = I^2R$$

$$R_{Total} = R_1 + R_2 + R_3 + \cdots \qquad \frac{1}{R_{Total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots \qquad \frac{N_P}{N_S} = \frac{V_P}{V_S}$$

Questions

1. A current of 12 A runs through a copper wire with a resistance of 20 ohms ($20\ \Omega$). What voltage is driving this current?

2. A common toaster uses the resistance of filaments to produce heat and toast bread. A particular toaster has a resistance of 50 Ω. If plugged into a 120-V voltage, what would be the current going through the toaster?

3. How much power is lost through the toaster? Interpret this number.

4. If you have a 64-Ω resistor, a 16-Ω resistor, a 24-Ω resistor, and an 80-Ω resistor connected in **series**, what is the total resistance?

5. If you have a 64-Ω resistor, a 16-Ω resistor, a 24-Ω resistor, and an 80-Ω resistor connected in **parallel**, what is the total resistance?

6. To decrease the electric current, we increase the voltage using a step-up transformer. If a voltage of 4,000 V is sent through a transformer where the size of the secondary coil is quadruple the size of the primary coil, what will be the output voltage?

7. A step-down transformer has 200 loops in the primary coil and 40 loops in the secondary coil. If the input voltage is 4,000 V, what is the output voltage?

Renewable Power

Equations

$$v = \lambda f \qquad c = v_{light} = 300{,}000{,}000\ m/s$$

$$E = hf \qquad h = 6.626 * 10^{-34} J \cdot s = 4.136 * 10^{-15}\ eV \cdot s$$

$P = 0.000283 D^2 v^3\ kW$ (D in meters, v in m/s) $\quad P = 0.00000236 D^2 v^3\ kW$ (D in feet, v in mph)

$$Energy\ Density = \frac{PE}{m} = gh \qquad P = Energy\ Density * Flow\ Rate * efficiency$$

Questions

1. A particular sound wave has a frequency of 440 Hz and a distance of 0.77 m between waves. What is the speed of this sound wave?

2. A photon of yellow light has a wavelength of 570 nm. What is the wave's frequency?

3. How much energy is in a photon of yellow light?

4. What is the power output of a windmill with a diameter of 20 feet when the wind is blowing at 30 mph?

5. What is the power output of a hydroelectric dam with a head of 200 m if the water is flowing at a rate of 500 kg/s and is running at 35% efficiency?