The World Communicates

The period and the frequency are related through a reciprocal relationship

$$f = \frac{1}{T} \text{ or } T = \frac{1}{f}$$

The speed of velocity of wave propagation is how fast the wave transfers energy away from a source

$$v = f\lambda$$

Relationship between the displacement and time of constant frequency waves with varying amplitude is described by the equation:

$$y = n \sin ft$$

y = displacement of the wave
n = amplitude of the wave
f = frequency of the wave
t = time

The inverse square law as applied to electromagnetic waves and distance from their source is

$$I \propto \frac{1}{d^2}$$

$$I_1 d_1^2 = I_2 d_2^2$$

The relationship between speed, wavelength and angles of incidence and refraction is known as *Snell's Law*, and can be expressed mathematically as:

$$\frac{\sin i}{\sin r} = \frac{v1}{v2} = {}_{\text{medium 1}}N_{\text{medium 2}}$$

A number of other factors can also be determined using refractive indices

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$$

Energy of a wave can be calculated using

$$E = hf$$

where h is Planck's constant

Electrical Energy in the Home

If a force of magnitude F acts on a charge, q, placed in an electric field, then the magnitude of the electric field strength, E, is given by

$$E = \frac{F}{q} \text{ or } F = qE$$

The S.I. unit of electric field strength is *newton coulomb*$^{-1}$ ($N\,C^{-1}$).
The *direction* of the electric field strength is the direction of the force that acts on a positive charge placed in the field.

Consider a charge, q, which moves between two points in an electric field. If the change in the electric potential energy of the charge is W, then the potential difference between the points, V, is given by

$$V = \frac{W}{q} \text{ or } W = qV$$

When a current, I, passes through a resistor, electric potential energy is dissipated, so there will be a potential drop, V, across the resistor. The resistance, R, of a resistor is

$$R = \frac{V}{I}$$

Ohm's Law: The potential drop across a resistor is proportional to the current passing through the resistor: $V \propto I$. It only applies to resistors with constant resistance, that is, to resistors whose resistance is the same no matter what current is passing through them. For such resistors, Ohm's Law can be written as $V = IR$.

If two conductors differ only in area of *cross-section*, the conductor with the greater area of cross-section will have the lesser resistance. The resistance, R, of a wire is inversely proportional to the area of cross-section, A:

$$R \propto \frac{1}{A}$$

Total *current* through the power supply equals the sum of the currents through the different parts of the *parallel* circuit.

$$I_{\text{total}} = I_1 + I_2 + I_3 \ldots$$

Voltage in a *series* circuit is given by adding the drops in potential different across the different resistances loads in a circuit.

$$\mathrm{V_{ps}} = \mathrm{V_1} + \mathrm{V_2} + \mathrm{V_3} \ldots$$

If resistors, with resistances R_1, R_2 … R_n are connected in *parallel* to a power supply, the combination is equivalent to a single resistor of resistance R_{parallel}, where:

$$\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$$

Power is the rate at which energy is transformed from one form to another

$$P = \frac{E}{t}$$

$$E = VIt$$

$$P = VI$$

$$P = I^2R$$

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

$$Q = It$$

$$W = Pt = IVt$$

Moving About

$$v = \frac{s}{t}$$

$$a = \frac{\Delta v}{\Delta t}$$

$$a = \frac{v - u}{t}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$2s = ut + vt$$

$$F = ma$$

$$W = Fs$$

$$E_K = \frac{1}{2}mv^2$$

$$Ft = mv - mu$$

$$I = Ft$$

$$p = mv$$

$$F = \frac{\Delta p}{\Delta t}$$

Law of Conservation of Momentum

$$m_1u_1 + m_2u_2 + \ldots = m_1v_1 + m_2v_2 + \ldots$$

The Cosmic Engine

$F = \frac{mv - mu}{t}$

$F_G = G\frac{m_1 m_2}{d_2}$

$I_1 {d_1}^2 = I_2 {d_2}^2$

$v = \frac{2\pi r}{T}$

$F_C = \frac{mv^2}{r}$

$\frac{r^3}{T^2} = k$, where k the constant stays the same for each planetary system

$\frac{{r_1}^3}{{T_1}^2} = \frac{{r_2}^3}{{T_2}^2}$

Kepler's Third Law

$\frac{r^3}{T^2} = \frac{Gm}{4\pi^2}$