Helpful relationships

Equation 1: (average speed)

$$V_{av} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

Equation 2: (acceleration)

$$a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$$

Equation 3: If acceleration is uniform: (and only if it is uniform!)

$$v_{av} = \frac{v_1 + v_2}{2}$$

The next two equations are derived from Equations 1 - 3.

Equation 4:

$$v_2^2 = v_1^2 + 2a\Delta x$$

Equation 5:

$$\Delta x = v_1\Delta t + \frac{a\Delta t^2}{2}$$

The following two equations relate to circular motion.

Equation 6: (tangential speed)

$$\mathbf{v} = \frac{\mathbf{2\pi R}}{\mathbf{T}}$$

Equation 7: (centripetal acceleration)

$$a_c = \frac{v^2}{R} = \frac{4\pi^2 R}{T^2}$$

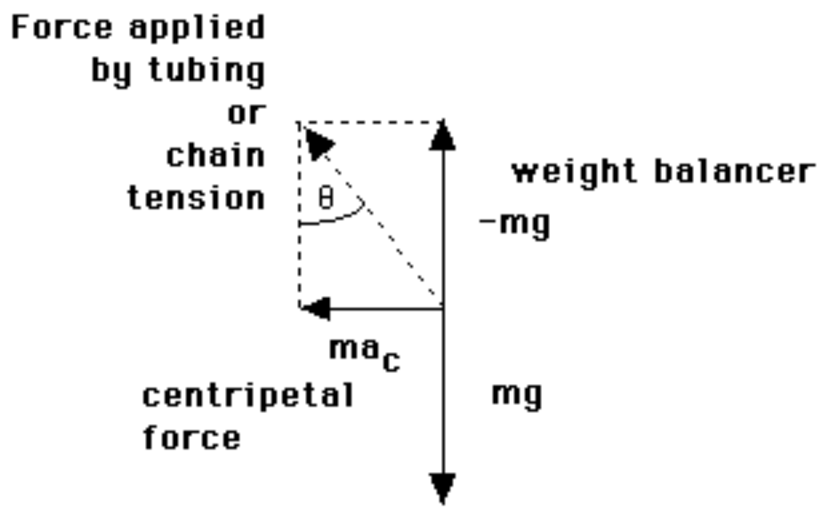
Equations 8: (force)

$$F = ma$$

Equation 9: (impulse)

$$F\Delta t = m\Delta v$$

The following diagram and Equation 7 and 8 are useful in the derivation of Equation 10



$$\frac{F_c}{F_g} = \frac{\frac{mv^2}{R}}{mg} = \tan\theta = \frac{a_c}{g}$$

Equation 10: (centripetal acceleration)

$$a_c = \frac{v^2}{R} = g\tan\theta$$

Equation 11 (work)

a) $W = \vec{F}\Delta\vec{x}$ b) $W = PE = mg\Delta h$

Equation 12: (potential energy)

$$PE = mg\Delta h$$

Equation 13: (kinetic energy)

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

When loss of PE = gain of KE, and if original v is small, the final v can be determined by

Equation 14:

$$v = \sqrt{2g\Delta h}$$

The relationship between revolutions/minute and radians/s can be determined using the following:

$$1 \text{ rev} = 2\pi \text{ radians}$$

Equation 15

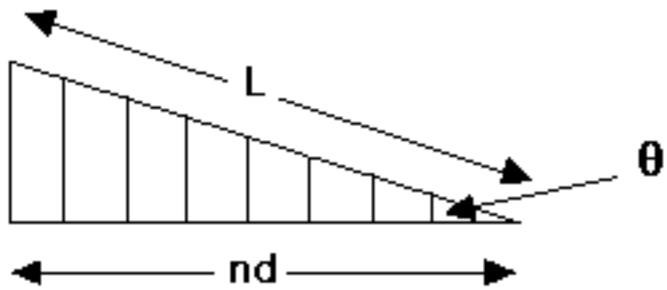
$$\left(\frac{\text{rev}}{\text{min}}\right)\left(\frac{2\pi \text{ rad}}{\text{rev}}\right)\left(\frac{1 \text{ min}}{60 \text{ s}}\right) = \frac{\text{rad}}{\text{s}}$$

Equation 16: (power)

$$P = \frac{\text{Work}}{t} = \frac{mgh}{t}$$

and 1 kWhr = 3.6×10^6 J

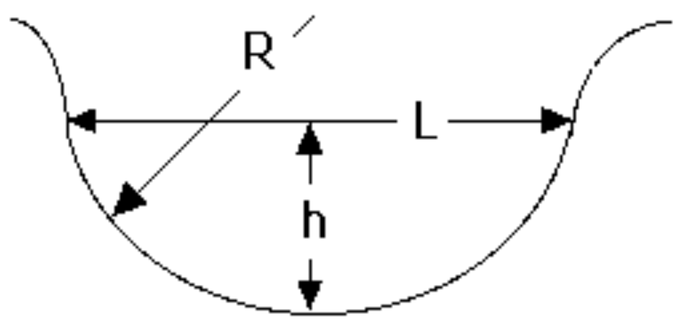
When the distance between parallel crosspieces is known as in the following diagram



Equation 17:

$$L = \frac{nd}{\cos \theta}$$

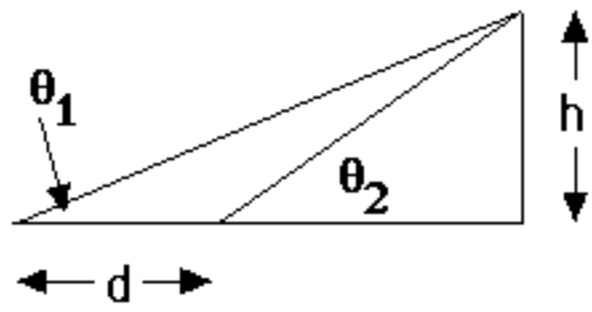
The average radius in the following diagram can be determined using Equation 18.



Equation 18:

$$R = \frac{1}{2}\left(h + \frac{L^2}{4h}\right)$$

"h" in the following diagram can be determined using Equation 19.



Equation 19:

$$h = \left(\frac{\sin\theta_1 \sin\theta_2}{\sin(\theta_2 - \theta_1)}\right)d$$

The flow rate can be determined when the speed, depth, and width are known

Equation 20: Volume/time = (v)(d)(w)

Equation 21: The overall v at an instance can be determined when v_x and v_y are known by using the Pythagorean theorem.

Equation 22:

$$\Delta E = mc\Delta t$$

and for water

$$c = 1\ \frac{\text{cal}}{\text{g °C}} = 4190\ \frac{\text{J}}{\text{kg K}}$$

Equation 23: (coefficient of friction)

$$\mu = \frac{F_f}{F_N}$$

The following four equations are special examples of previously stated equations.

Equation 24: $$v = \frac{2\pi R_a}{T_a} + \frac{2\pi R_b}{T_b}$$

Equation 25: $$h = \frac{1}{2}gt^2$$

Equation 26: $$v_2 = v_1 + gt$$

Equation 27: $$x = v_x t$$

Equation 28: (period of a pendulum)

$$T = 2\pi(l/g)^{1/2}$$