Power is the amount of energy that is consumed or produced over time.

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

Where P is in Watts (W), energy is in Joules (J) and time is in s (s).

Power can also be alternative expressed as the following relationship.

$W = E = \vec{F} \cdot \vec{d}$

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

$P = \frac{\left(\vec{F} \cdot \vec{d}\right)}{\Delta t}$

$P = \vec{F} \cdot \frac{\vec{d}}{\Delta t}$

$P = \vec{F} \cdot \vec{v}$

$\boxed{P = \vec{F} \cdot \vec{v}}$ or $\boxed{P = F \cdot v}$ if F and v are collinear

Efficiency

$$\boxed{\%\ \text{Efficiency} = \frac{\text{E}_{\text{out}}}{\text{E}_{\text{in}}} \times 100}$$

Where E_{out} is the **actual** useful energy output of a machine or device, in Joules (J)

E_{in} is the total **consumed** energy of a machine or device, in Joules (J)

Example 1: Determine the amount of power required to drag a 50kg sled at a speed of 5m/s, if the coefficient of friction is 0.2.

Example 2: A 3000kg SUV accelerates up a hill from 20m/s to 30 m/s. If the hill has a 20% grade and the SUV accelerates over a distance of 50m determine

a) How long it takes to get up to speed
b) The height increase over the time period
c) The initial gravitational and kinetic energy
d) The gravitational and kinetic energy at the end of the work period
e) The total work done
f) The power
g) The amount of chemical potential energy required to accelerate the SUV up to speed if the engine is only 15% efficient