International System of Units (SI)

Basic SI units:

Meter	Second	Kilogram
m	s	kg

$F = ma$

Force, Newton

$$1N = 1\frac{kg \cdot m}{s^2}$$

$W = Fd$

$E_{kin} = \frac{mv^2}{2}$

Work & Energy, Joule

$$1J = 1N \cdot m = 1\frac{kg \cdot m^2}{s^2}$$

$P = \frac{F}{A}$

Pressure, Pascal

$$1Pa = 1\frac{N}{m^2} = 1\frac{kg}{m \cdot s^2}$$

$Power = \frac{\Delta W}{\Delta t}$

Power, Watt

$$1W = 1\frac{J}{s} = 1\frac{kg \cdot m^2}{s^3}$$

Homework

Consider a marine animal living deep under water where the resources are scarce. It needs to move around to get those, and to do it in an efficient manner. One way to characterize this efficiency is by calculating Power-to-Mass ratio for this animal (also called power-to-weight ratio in engineering).

a) *Use dimensional analysis* to obtain the formula for the Power-to-Mass ratio of a marine animal that needs to move around at speed v. Assume that this quantity may, in principle, depend on:

- density of water ρ, (measured in kg/m^3)
- size of the animal L (in m).
- Speed v (in m/s)

b) Based on your result (a), do you expect a small or a large fish to dominate the deep see? Why?

c) A giant squid is mostly drifting in deep water to save energy. But when in danger, it can propel itself rather fast, about 10 m/s. From your result (b) estimate the power required for such bursts. The length of the squid is L=10m, its mass M=200kg.