Dimension / Units / Conversion

Wednesday, March 27, 2019 9:55 AM

Quantity	Dimension	Unit (SI)	Unit (English)
Mass	M	Kg (kilogram)	lbm / slug
Length	L	m (meter)	ft ← feet
Time	T	s (seconds)	s

Derived Quantities

		SI	English
Area	$= L \times L = L^2$ (length × length)	m^2, mm^2	ft^2, in^2
Volume	$= L \times L \times L = L^3$	$m^3, cm^3, \ldots$	$ft^3, in^3, Yard^3,$
Density	$= \frac{mass}{volume} = \frac{M}{L^3}$	$\frac{kg}{m^3}, \frac{g}{cm^3}$	$\frac{lbm}{ft^3}$
velocity	$= \frac{Length}{time} = \frac{L}{T}$	$\frac{m}{s}, \frac{cm}{s}, \frac{km}{h}$	$\frac{ft}{s}, \frac{in}{s}$
acceleration	$= \frac{change\ in\ velocity}{time} = \frac{L/T}{T} = \frac{L}{T^2}$	$\frac{m}{s^2}, \frac{km}{h^2}$	$\frac{ft}{s^2}, \frac{mile}{h^2}$

Quanility

Force = mass (accelration) $= M\left(\frac{L}{T^2}\right) = \frac{ML}{T^2}$

SI $F \Rightarrow \frac{kg\,m}{s^2} = N$ ← Newton

English System $\frac{slug\,ft}{s^2} = lbf$ ← pounds force

Pressure, $P = F/A = \frac{force}{Area}$ $P = \frac{ML/T^2}{L^2} = \frac{M}{LT^2}$

SI $P = \frac{kg}{ms^2} = Pa$ ← pascal

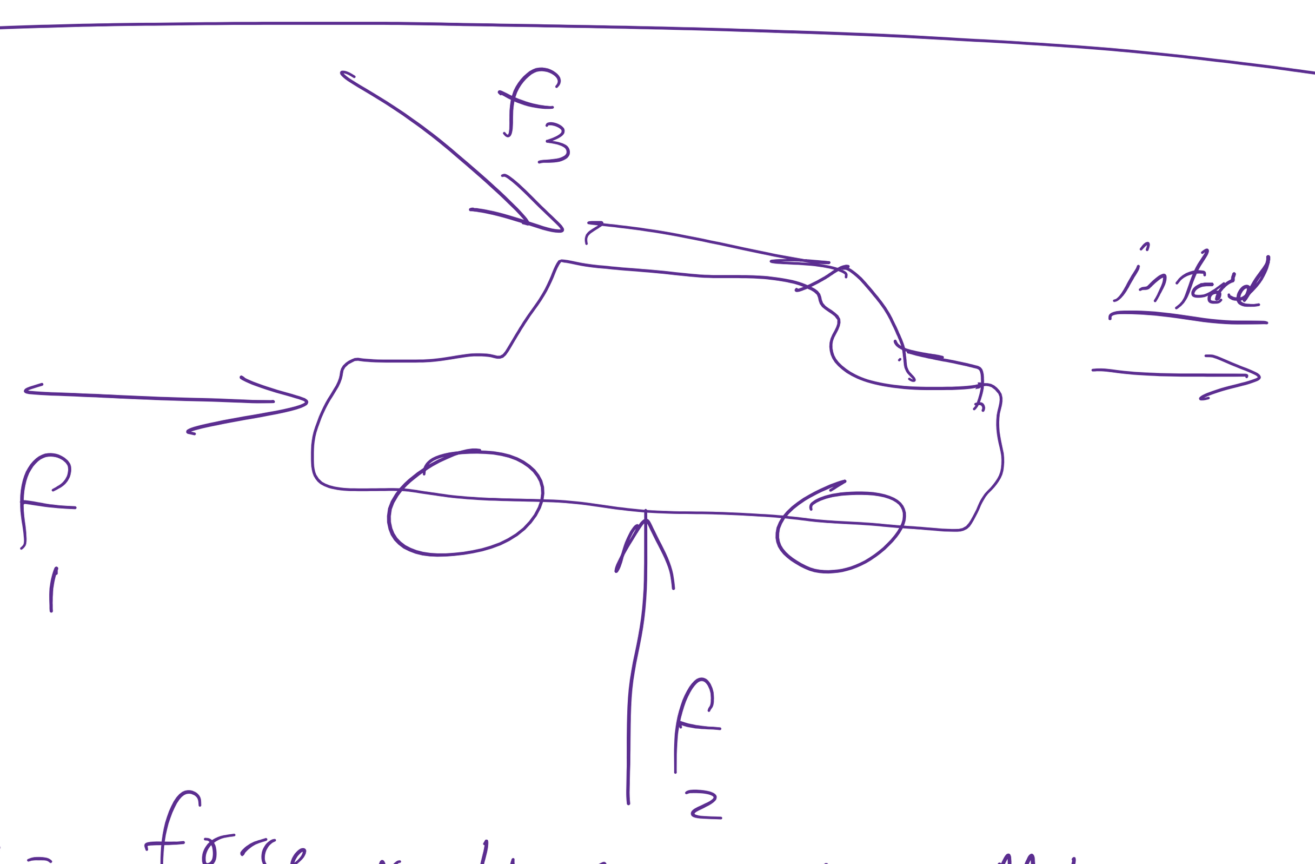
English unit: $\frac{lb}{in^2}$ = Psi Pound per square inch

P = atmospheric pressure = 100,000 Pa $P = F/A$

F = PA = (100,000)(1) = 100,000 N

A = 1 m/s^2

Work



work = force × displacement $= \frac{ML}{T^2} \cdot L = \frac{ML^2}{T^2}$

work SI : $\frac{kg\,m^2}{s^2} = J$ (Joul)

Power = $\frac{Work\ or\ Energy}{time} = \frac{ML^2/T^2}{T} = \frac{ML^2}{T^3}$

SI Power $J/s = W$ watt

Temperture ^oC C ^oF F ^oK K

$F = 1.8C + 32$

$K = C + 273.15$

Unit Conversion

SI Units

		10^2
tetra	T	
Giga	G	10^9
Mega	M	10^6
kilo	K	10^3
Deci	d	10^{-1}
Centi	c	10^{-2}
milli	m	10^{-3}
Micro	μ	10^{-6}
nano	n	10^{-9}
Pico	p	10^{-12}

English $1^{ft} = 12^{in}$, $3^{ft} = 1^{Yard}$

$1^{kg} = 2.28^{lb}$, $1^{mile} = 1.6^{km}$

Dimensinal Analysis

a) $40\ km/h = ??\ m/s$ $\{1\ km = 1000\ m$, $1\ h = 3600\ s\}$

$40 \frac{km}{h} \times \frac{1000\ m}{1\ km} \times \frac{1\ h}{3600\ s} = 11.11\ \frac{m}{s}$

You should put it down, allow you to cancel it

b) $9\ km/L \rightarrow ??\ \frac{mile}{galons}$ $\{1\ mile = 1.6\ km$, $1\ gal = 3.785\ L\}$

$9 \frac{km}{L} \times \frac{1\ mile}{1.6\ km} \times \frac{3.785\ L}{1\ gal} = 21.17\ \frac{mils}{gal}$

c) $554\ m^4/(day \cdot kg) = ??\ cm^4/(min \cdot g)$

$\{1\ m = 100\ cm$, $1\ day = 24\frac{h}{day} \times 60\frac{min}{h} = 1440\ min$, $1\ kg = 1000\ g\}$

$554 \frac{m^4}{day \cdot kg} \times \left[\frac{100\ cm}{1\ m}\right]^4 \times \frac{1\ day}{1440\ min} \times \frac{1\ kg}{1000\ g} = 38,472\ \frac{cm^4}{min \cdot g}$

d) $38.1\ \frac{ft}{s} = ??\ \frac{m}{s}$ → $\{1\ ft = 0.3048\ m\}$

e) $921\ kg/m^3 = ??\ lbm/ft^3$ → $\{1\ kg = 2.28\ lbm\}$

f) $42\ ft^2/h = ??\ cm^2/s$ $\{1\ ft = 30.48\ cm$, $1\ h = 3600\ s\}$