INTRO TO CH1 : PHYSICAL QUANTITIES & UNITS

Physical quantity:

Any quantity that can be measured and has units.

Is further divided into:

1. Base Quantities: those that can't be simplified further
2. Derived Quantities: can be expressed using one or more base quantities.

The seven (7) base quantities: quantity (unit)

1. length (m)
2. time (s)
3. temperature (K)
4. mass (kg)
5. amount of substance (mol)
6. current (A)
7. light intensity (cd) → "candela"

Important derived quantities: quantity (base units)

- Area (m^2)
- Density (kgm^{-3})
- Volume (m^3)
- Speed (ms^{-1})
- Acceleration (ms^{-2})
- Force ($kgms^{-2}$)
- Power (kgm^2s^{-3})
- Energy (kgm^2s^{-2})
- Charge (As)
- Voltage ($kgm^2s^{-3}A^{-1}$)
- Resistance ($kgm^2s^{-3}A^{-2}$)
- Specific Heat Capacity ($m^2s^{-2}K^{-1}$)

- Pressure ($kgm^{-1}s^{-2}$)
- Work Done (kgm^2s^{-2})
- Specific Latent Heat (m^2s^{-2})

Example Question:

Given that $F = \frac{Q^2}{4\pi x r^2}$ and $F = \frac{yI^2}{2\pi d}$

where....

F = force, Q = charge, I = current, r = radius, d = distance,

find the base units of $\frac{1}{xy}$.

$$\frac{Q^2}{4\pi x r^2} = \frac{yI^2}{2\pi d}$$

* Remove 4π and 2π since they're dimensionless quantities.

$$\frac{Q^2}{x r^2} = \frac{yI^2}{d}$$

$$\frac{Q^2 d^2}{I^2 r^2} = \frac{xy\, I^2 r^2}{I^2 r^2}$$

$$\frac{I^2 r^2}{Q^2 d} = \frac{1}{xy}$$

* Substitute units in place of quantities

$$\frac{(A)^2 (m)^2}{(As)^2\, m} = \frac{1}{xy}$$

$$\frac{A^2 m^2}{A^2 s^2 m} = \frac{1}{xy}$$

$$\frac{m}{s^2} = \frac{1}{xy}$$

∴, base units of $(xy)^{-1} = ms^{-2}$

Example Question:

In the given equation, find the base units of x

$x = kr^3(P_1 - P_2)\sqrt{\frac{M}{R \cdot T}}$ where...

r = radius, P_1 and P_2 = Pressure, M = Mass per mol, T = temperature,

R = Joules per Kelvin · Mole, K = Dimensionless quantity.

$$x = kr^3(P_1 - P_2)\sqrt{\frac{M}{R \cdot T}}$$

$x = m^3($