Dimensional Analysis

S.No.	Physical Quantity	Formula	Dimensional Formula
1	Speed/velocity(v)	$\frac{distance}{time}$	M^0LT^{-1}
2	Acceleration(a)	$\frac{velocity}{time}$	M^0LT^{-2}
3	Force(F)/ tension	ma	MLT^{-2}
4	Linear momentum(p)	mv	MLT^{-1}
5	Impulse	F x t	MLT^{-1}
6	Pressure/stress	$\frac{Force}{area}$	$ML^{-1}T^{-2}$
7	Work	F x s	ML^2T^{-2}
8	Energy	Work	ML^2T^{-2}
9	Power	$\frac{Work}{time}$	ML^2T^{-3}
10	Surface tension	$\frac{force}{length}$	ML^0T^{-2}
11	Coefficient of elasticity	$\frac{stress}{strain}$	$ML^{-1}T^{-2}$
12	Moment of inertia(I)	Mr^2	ML^2T^0
13	Coefficient of viscosity	$\frac{F \times r}{A \times v}$	$ML^{-1}T^{-1}$
14	Angular velocity(ω)	$\frac{angle}{time}$	$M^0L^0T^{-1}$
15	Angular acceleration(α)	$\frac{angular\ velocity}{time}$	$M^0L^0T^{-2}$
16	Frequency	$\frac{1}{time}$	$M^0L^0T^{-1}$
17	Planck's constant	$\frac{energy}{frequency}$	ML^2T^{-1}
18	Velocity gradient	$\frac{velocity}{distance}$	$M^0L^0T^{-1}$
19	Torque	Iω	ML^2T^{-2}
20	Angular momentum	Iα	ML^2T^{-1}
21	Density	Mass/length	ML^{-3}

Uses of dimensional equations

1. Checking the correctness of various formulae and equations
2. Derivation of formulae
3. Conversion of one system of units into another

Limitations of dimensional analysis

1. It gives no information about the dimensionless constants in the formula.
2. We can't derive the formulae containing trigonometrical functions, log functions which have no dimensions
3. The method of dimensions can't be used to find the exact form of relation.
4. No information whether the quantity is scalar or vector.

Checking the correctness of various formulae and equations

METHOD (STEPS)

1. Write the L.H.S of the equal and write the dimensions of the physical quantities
2. Write the R.H.S of the equal and write the dimensions of the physical quantities
3. Check whether L.H.S=R.H.S
4. If L.H.S = R.H.S then equation is correct otherwise not

e.g. :Check whether the equation is correct or not $\frac{1}{2}mv^2 = mgh$

Answer: 1. L.H.S = $\frac{1}{2}mv^2$ = $[M][LT^{-1}]^2$ = $[ML^2T^{-2}]$

2. R.H.S = mgh = $[M][LT^{-2}][L]$ = $[ML^2T^{-2}]$

3. L.H.S=R.H.S

4. Equation is correct

Practice Questions

Check the correctness of the following equations:

1. $E=mc^2$
2. $v = \sqrt{\frac{2GM}{R}}$
3. $h = \frac{2\sigma cos\theta}{r^2 dg}$
4. $F = 6\pi\eta rv$