DIMENSIONS

Dimensions as a tool in physics denotes the physical nature of a quantity. Dimensions show the way in which derived quantities are related to basic (or fundamental) quantities. If a quantity has no dimension then it has no unit.

The following units have dimensions as follows

|  |  |  |  |
| --- | --- | --- | --- |
| Unit | Dimension |  |  |
| Length | L |  |  |
| Mass | M |  |  |
| Time | T |  |  |
| Current | I |  |  |

The following can be proven from the

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Area |  |  |  |  |
| Volume |  |  |  |  |
| Density |  |  |  |  |
| Speed |  |  |  |  |
| Velocity |  |  |  |  |
| Acceleration |  |  |  |  |
| Force |  |  |  |  |
| Impulse |  |  |  |  |
| Momentum |  |  |  |  |
| Surface Tension |  |  |  |  |
| Pressure |  |  |  |  |
| Energy |  |  |  |  |
| Gravitational Constant |  |  |  |  |

DIMENSIONAL PRINCIPLE

This is a procedure by which the dimensional uniformity of any equation may be checked. For an equation to be dimensionally uniform or consistent, the dimension on the left hand side has to be equal to the dimension on the right hand side. For example, if, it means that the dimension of A must be equal to the dimension of B and C respectively.

QUESTIONS

1. The period (T) of an oscillation is related to the mass (m), length (l) and the acceleration due to gravity (g). Using the principle of dimension, derive the formula for the period of an oscillation.

Therefore,

Since the dimension of mass is M, the dimension of length is L, the dimension of period is T and the dimension of acceleration (due to gravity) is

Dimensionally,

On equating, since the dimensional principle states that the dimension of the left hand side has to be equal to the dimension of the right

Therefore

Therefore,

1. Experiment shows the frictional force (F) of a body moving in the air depends on its velocity (v) of its motion, density of the air through which it travels and the cross-sectional area of the body.

If

Here, x, y and z are integers and k is a constant. Find the values of x, y and z.

Solution

The dimension of density, is. The dimension of velocity, the dimension of area is. The dimension of force is.

Dimensionally, is expressed as

Therefore

And the equation

Is then expressed as

1. A sphere of mass 100g and radius (r) of 2cm falls vertically through air of densityat a place where the acceleration due to gravity (g) is and attains a steady velocity (v) of. If the retarding force on the sphere is given as

And k is a dimensionless constant. Use the dimensional method to find the values of x, y, z and k

Solution

Dimensionally,

From the question,

But

Therefore,

1. The velocity (v) of a wave setup by plucking a stretched string is found to depend on the tension (T) in the string, its length (l) and its mass (m) and is given by

Here, k is a constant and x, y and z are unknown numbers.

Find the values of x, y, and z.

1. Experiment has shown that the viscous force (F) on a spherical body of radius (r) with an angular velocity through a liquid of viscosity. The formula expressed as

Find a, b and c

1. The velocity v of the wave set-up by plucking a stretched string is found to depend on the tension T in the string, its length l, and its mass m, and is given by the equation where x, y and z are unknown numbers. Find x, y and z

Answer:

1. Use dimensional analysis to determine the value of y in the relation , where T is the period of vibration, a is the radius and p is the density and is the surface tension

Answer,

1. What are the dimensions of torque and pressure respectively
2. Which unit is equivalent to Answer: Pa
3. What is the internationally agreed system of units
4. What is the unit of thermal conductivity?
5. The product of pressure and volume has the same unit as???

USES OF DIMENSIONS

To find the unit of a given physical quantity in a given system of units

To find dimensions of physical constants or coefficients

To convert a physical quantity from one system of units to another