

How to find unknown constants x, y, z etc in a homogeneous Equation?

Q: In the given equation, find value of x, y & z given that the equation is homogeneous?

$$v = \lambda^x P^y \rho^z$$

$v =$ velocity
 $\lambda =$ w. Length
 $P =$ Pressure
 $\rho =$ density

$$m s^{-1} = (m)^x (kg m^{-1} s^{-2})^y (kg m^{-3})^z$$

• Compare (m) from both sides

$$m^1 = (m)^x (m^{-1})^y (m^{-3})^z$$

indices

$$1 = x - y - 3z \rightarrow \textcircled{1}$$

• Compare (s) from both sides

$$s^{-1} = (s^{-2})^y$$

$$-1 = -2y \therefore y = \frac{1}{2}$$

• Compare (kg) from both sides

$$kg^0 = (kg)^y (kg)^z$$

$$0 = y + z \rightarrow \textcircled{2}$$

$$y = \frac{1}{2}, z = -\frac{1}{2}, x = 0$$

Ans:

Ques: $T = L^x g^y$ $T =$ Time
 $L =$ length
 $g =$ acc. due to gravity.
 find x & y ?

$$(s) = (m)^x (ms^{-2})^y$$

compare powers of (s)

$$1 = -2y \therefore y = -\frac{1}{2}$$

compare powers of (m)

$$0 = x + y \therefore x = \frac{1}{2}$$

Ques. ① $F = 6\pi r \eta v$

$F =$ Force $r =$ radius $v =$ velo.

find base units of η ?

$$F = 6\pi r \eta v$$

$$kg m s^{-2} = (m) (\eta) (m s^{-1})$$

$$\text{base unit of } \eta = kg m^{-1} s^{-1}$$

$$\textcircled{2} \frac{V}{t} = (L)^x \left(\frac{P}{r}\right)^y (\eta)^z$$

using your answer from ① find x, y & z ?

$V =$ Volume $t =$ time $L =$ Length

$r =$ radius $P =$ Pressure

$$\frac{m^3}{s} = (m)^x \left(\frac{kg m^{-1} s^{-2}}{m}\right)^y (kg m^{-1} s^{-1})^z$$

$$m^3 s^{-1} = (m)^x (kg m^{-2} s^{-2})^y (kg m^{-1} s^{-1})^z$$

compare (s)

$$-1 = -2y - z \rightarrow \textcircled{1}$$

compare (kg)

$$0 = y + z \rightarrow \textcircled{2}$$

$$y = 1 \quad z = -1$$

compare (m)

$$3 = x - 2y - z \rightarrow \textcircled{3}$$

$$x = 4$$

Q: $I = Sq n v^x$

$I =$ Current (A) find x ?

$S =$ Area (m^2)

$q =$ Charge (A.s)

$v =$ velocity (ms^{-1})

$n =$ number of electrons per unit volume =

$$\frac{\text{number of electrons}}{\text{Volume}} = \frac{1}{m^3} = m^{-3}$$

$$I = S q n v^x$$

$$A = (m^2) (A.s) (m^{-3}) (ms^{-1})^x$$

compare (s)

$$0 = 1 - x$$

$$x = 1$$