Answer on Question 52044, Physics, Mechanics | Kinematics | Dynamics

Question:

Which of the following equations is not dimensionally consistent? The symbols have their usual meaning:

a) $s = ut - gt^2$

b) $Ft = mv - m_0$

c) $-kx + F_0 sin(\omega t) = ma$

d) $\omega^2 = \omega_0^2 + \alpha\theta$

Solution:

Let's check the dimensions. If the dimensions on both side of the equation is equal, the equation is dimensionally consistent:

a) $[m] = \left[\frac{m}{s}\right] \cdot [s] - \left[\frac{m}{s^2}\right] \cdot [s^2]$,

$[m] = [m]$

Therefore, this equation is dimensionally consistent.

b) $\left[kg \cdot \frac{m}{s^2}\right] \cdot [s] = [kg] \cdot \left[\frac{m}{s}\right] - [kg]$,

$\left[kg \cdot \frac{m}{s}\right] \neq [kg] \cdot \left[\frac{m}{s}\right] - [kg]$.

Therefore, this equation is not dimensionally consistent.

c) $-\left[\frac{kg \cdot \frac{m}{s^2}}{m}\right] \cdot [m] = \left[kg \cdot \frac{m}{s^2}\right] \cdot sin\left[\frac{rd}{s} \cdot s\right] = [kg] \cdot \left[\frac{m}{s^2}\right]$,

$-\left[kg \cdot \frac{m}{s^2}\right] = \left[kg \cdot \frac{m}{s^2}\right] \cdot sin[rd] = \left[kg \cdot \frac{m}{s^2}\right]$,

$\left[kg \cdot \frac{m}{s^2}\right] = \left[kg \cdot \frac{m}{s^2}\right]$.

Therefore, this equation is dimensionally consistent.

d) $\left[\frac{rd^2}{s^2}\right] = \left[\frac{rd^2}{s^2}\right] + \left[\frac{rd}{s^2}\right] \cdot [rd]$,

$$\left[\frac{rd^2}{s^2}\right] = \left[\frac{rd^2}{s^2}\right] + \left[\frac{rd^2}{s^2}\right],$$

$$\left[\frac{rd^2}{s^2}\right] = \left[\frac{rd^2}{s^2}\right].$$

Therefore, this equation is dimensionally consistent.

So, the equation b) $Ft = mv - m_0$ is not dimensionally consistent.

Answer:

b) $Ft = mv - m_0$.