97

Laws. (10)

1976

$\vec{v_1} = 0\vec{i} + b\vec{j}$.
$= 0\vec{i} + a\vec{j}$.

$\vec{v_2} = x\vec{i}$.

$e = \frac{1}{2}$.

$\vec{u_1} = a\vec{i} + b\vec{j}$.

$\vec{u_2} = \vec{0}$.

When $\tan 45 = \frac{b}{a}$.

$\Rightarrow a = b$.

and $\sqrt{a^2 + b^2} = u$

$\Rightarrow \sqrt{u^2 + a^2} = u$

$\Rightarrow \sqrt{2a^2} = u$.

$\Rightarrow \sqrt{2}\, a = u$.

$\Rightarrow \boxed{a = \frac{u}{\sqrt{2}}}$.

Remember:

$\vec{v} \perp \vec{u_2} \Rightarrow$.

$\vec{v} = a\vec{i} + b\vec{j}$.

PCM $\Longleftrightarrow$: $m(a) + \ell(0) = m(0) + \ell(x)$.

NLR $\Longleftrightarrow$: $v_2 - v_1 = -e(u_2 - u_1)$

$x - 0 = -\frac{1}{2}(0 - a)$

$\Rightarrow x = \frac{1}{2}a$.

$\Rightarrow x = \frac{1}{2}\left(\frac{u}{\sqrt{2}}\right) \Rightarrow x = \frac{u}{2\sqrt{2}}$ (15)

PCM $\Rightarrow$.

$m a = \ell x$

$m \frac{u}{\sqrt{2}} = \ell \frac{u}{2\sqrt{2}}$

$\Rightarrow m = \frac{1}{2}\ell$

$\Rightarrow \boxed{2m = \ell}$ (10)

Loss in KE:

KE After ($\Longleftrightarrow$): $\frac{1}{2} m (0)^2 + \frac{1}{2} \ell (x)^2 = \frac{1}{2} 2m \left(\frac{u}{2\sqrt{2}}\right)^2$

$= \frac{m u^2}{8}$

KE Before ($\Longleftrightarrow$): $\frac{1}{2} m a^2 + \frac{1}{2} \ell 0^2$

$= \frac{1}{2} m \left(\frac{u}{\sqrt{2}}\right)^2$

$= \frac{\frac{1}{2} m u^2}{2}$

$= \frac{m u^2}{4}$

$\therefore \Delta KE = \frac{m u^2}{8} - \frac{m u^2}{4} = -\frac{m u^2}{8}$.

Total Original KE $= \frac{1}{2} m (a^2 + b^2) + \frac{1}{2} \ell (0)^2$

$= \frac{1}{2} m u^2$

$\therefore$ Fractional KE Loss $= \frac{\frac{m u^2}{8}}{\frac{1}{2} m u^2} = \frac{1}{4}$. (15)