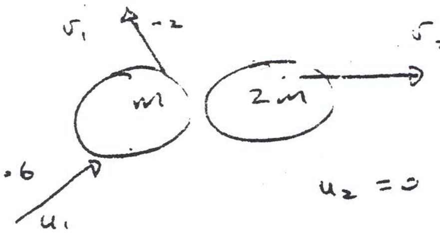
1984 Laws (notes.)



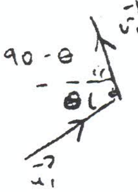
NB watch the minus

i) "A moves at Right angles to ..."

$\vec{u_1} = .6\cos\theta\,\vec{i} + .6\sin\theta\,\vec{j}$.

$\vec{v_1} = -.2\cos(90-\theta)\,\vec{i} + .2\sin(90-\theta)\,\vec{j}$.

$= -.2\sin\theta\,\vec{i} + .2\cos\theta\,\vec{j}$.



Smoothness ⇒ $\vec{j}$ cpt of velocity of A unchanged before and after:

⇒ $.6\sin\theta = .2\cos\theta$

⇒ $\tan\theta = \frac{1}{3}$.

(triangle: hypotenuse $\sqrt{10}$, opposite 1, adjacent 3, angle θ)

⇒ A moves in direction E $\tan^{-1}\frac{1}{3}$ N.

ii) Find e: NLR ($\vec{i}$ direction)

$v_2 - v_1 = -e(u_2 - u_1)$

NB $-(-.2\sin\theta)$

$x + .2\sin\theta = -e(0 - .6\cos\theta)$

$x + .2\frac{1}{\sqrt{10}} = e\ .6\left(\frac{3}{\sqrt{10}}\right)$

PCM ($\vec{i}$ direction)

$m(.6\cos\theta) + 2m(0) = m(-.2\sin\theta) + 2m(x)$

⇒ $.6\left(\frac{3}{\sqrt{10}}\right) = -\frac{.2}{\sqrt{10}} + 2x$.

⇒ $\frac{1.8}{\sqrt{10}} + \frac{.2}{\sqrt{10}} = 2x$ ⇒ $\boxed{\frac{1}{\sqrt{10}} = x}$

∴ NLR ⟹ $\frac{+1}{\sqrt{10}} + \frac{.2}{\sqrt{10}} = \frac{1.8}{\sqrt{10}}e$ ⇒ $\frac{1.2}{1.8} = e$ ⇒ $\boxed{e = \frac{2}{3}}$

iii) ΔKE_{total} = KE after − KE before

$= \left[\frac{1}{2}m\left(\frac{-.2}{\sqrt{10}}\right)^2 + \frac{1}{2}2m\left(\frac{1}{\sqrt{10}}\right)^2\right] - \left[\frac{1}{2}m\left(\frac{1.8}{\sqrt{10}}\right)^2 + \frac{1}{2}(2m)(0)\right]$

$= m\left(\left[\frac{.02}{10} + \frac{1}{10}\right] - \left(\frac{3.24}{20}\right)\right)$

$= m\left(\left[\frac{1.02}{10}\right] - \left[\frac{1.62}{10}\right]\right)$

$= m\left[\frac{.6}{10}\right]$

$= .06\,m$ Joules.