1995 (6)

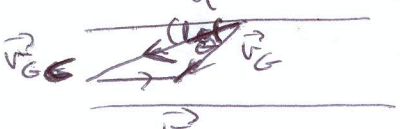
To Return as required. : $\vec{v}_G = -(v\cos\theta\,\vec{i} + v\sin\theta\,\vec{j})$

$\vec{v}_G = -\left(v\frac{3}{5}\vec{i} + v\frac{4}{5}\vec{j}\right)$

$\vec{v}_C = q\vec{i} = \frac{45}{100}\vec{i}$.

Let v be speed travelled along this path. But $|\vec{v}_{GC}| = p = \frac{3}{5}$

$\vec{v}_{GC} = -\frac{3}{5}\cos\alpha\,\vec{i} - \frac{3}{5}\sin\alpha\,\vec{j}$.



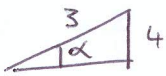
$\vec{v}_G = \vec{v}_{GC} + \vec{v}_C$

$\Rightarrow -\frac{3}{5}v\vec{i} - \frac{4}{5}v\vec{j} = -\frac{3}{5}\cos\alpha\,\vec{i} - \frac{3}{5}\sin\alpha\,\vec{j} + \frac{45}{100}\vec{i}$.

$\vec{i} \Rightarrow -\frac{3}{5}v = -\frac{3}{5}\cos\alpha + \frac{45}{100}$ (1)

$\vec{j} \Rightarrow -\frac{4}{5}v = -\frac{3}{5}\sin\alpha$ (2)

Solve

$\therefore$ (2) $\Rightarrow \frac{4v}{3} = \sin\alpha \Rightarrow$  Pythag $\Rightarrow$  $\Rightarrow \cos\alpha = \frac{\sqrt{9-16v^2}}{3}$

$\therefore$ (1) $\Rightarrow -\frac{3}{5}v = -\frac{3}{5}\left(\frac{\sqrt{9-16v^2}}{3}\right) + \frac{45}{100}$

$\times\left(-\frac{5}{3}\right) \Rightarrow v = \frac{\sqrt{9-16v^2}}{3} - .75$

$\Rightarrow v + .75 = \frac{\sqrt{9-16v^2}}{3}$

$\Rightarrow 3v + 2.25 = \sqrt{9-16v^2}$

$()^2 \Rightarrow (3v+2.25)^2 = 9-16v^2$

$\Rightarrow 9v^2 + 13.5v + 5.0625 = 9 - 16v^2$

$\Rightarrow 25v^2 + 13.5v + (5.0625 - 9)$

$\Rightarrow 25v^2 + 13.5v - 3.9375 = 0$

$\div 25 \Rightarrow v^2 + .54v - .1575 = 0$

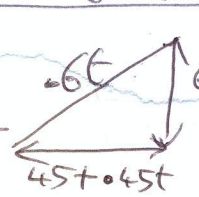
$\therefore v = \frac{-.54 \pm \sqrt{(.54)^2 - 4(1)(-.1575)}}{2(1)} = \frac{-.54 \pm \sqrt{.2916 + .63}}{2} = \frac{-.54 \pm \sqrt{.9216}}{2}$

$\Rightarrow v = \frac{-.54 \pm .96}{2} \Rightarrow v = \frac{.42}{2}$ (or neg) $\Rightarrow v = .21$.

$\therefore$ Time $= \frac{\text{dist along path}}{\text{speed along path}} = \frac{.75}{.21} = 357.14$ seconds

Note: Marks a(i) 15 a(ii) 10 b(i) 15 b(ii) 10 Average mark was 35/50 as hardly anyone got b(i) out but most people got rest out!

b(ii) Alternative: Let t be time to Return



ASA $(.6t)^2 = (60)^2 + (.45t+45)^2$

$\Rightarrow .36t^2 = 3600 + .2025t^2 + 40.5t + 2025$

$\Rightarrow .1575t^2 - 40.5t - 5625 = 0$

$\Rightarrow t = 357.14$ secs (SHORT!)