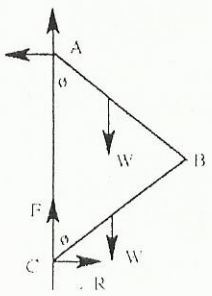
1994

7 (i)



Moments about A for system

$W(0.5\ell \sin\phi) + W(0.5\ell \sin\phi) = R(2\ell \cos\phi)$

$\Rightarrow \quad R = \frac{W \tan\phi}{2}$

Moments about B for rod BC

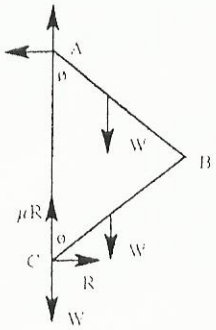
$W(0.5\ell \sin\phi) + R(\ell \cos\phi) = F(\ell \sin\phi)$

$W \tan\phi + 2R = 2F \tan\phi$

$W \tan\phi + W \tan\phi = 2F \tan\phi$

$\Rightarrow \quad F = W$

(ii)



Moments about B for rod BC

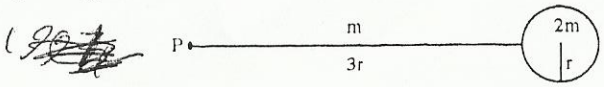
$W(0.5\ell \sin\phi) + W(\ell \sin\phi) + R(\ell \cos\phi) = \mu R(\ell \sin\phi)$

$1.5W \tan\phi + R = \mu R \tan\phi$

$1.5(2R) + R = \mu R \tan\phi$

$\Rightarrow \quad \mu = \frac{4}{\tan\phi}$

8 (i)



1994

I about p $= \frac{4}{3} m\left(\frac{3r}{2}\right)^2 + \frac{1}{2}(2m) r^2 + 2m(4r)^2$

$= 3 m r^2 + m r^2 + 32 m r^2$

$\Rightarrow \quad I = 36 m r^2$

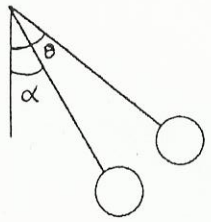
$M h = m(1.5 r) + 2m(4 r)$

$\Rightarrow \quad M h = \frac{19}{2} m r$

Period $T = 2\pi \sqrt{\frac{I}{Mgh}}$

$= 2\pi \sqrt{\frac{72 r}{19 g}}$

(ii)



Gain in kinetic energy = Loss in potential energy

$\frac{1}{2} I \omega^2 = mg(1.5 r)(\cos\alpha - \cos\theta) + 2mg(4 r)(\cos\alpha - \cos\theta)$

$= \frac{19}{2} mgr (\cos\alpha - \cos\theta)$

$\omega^2 = \frac{19 mgr}{36 m r^2} (\cos\alpha - \cos\theta)$

$\Rightarrow \quad \omega^2 = \frac{19 g}{36 r} (\cos\alpha - \cos\theta)$