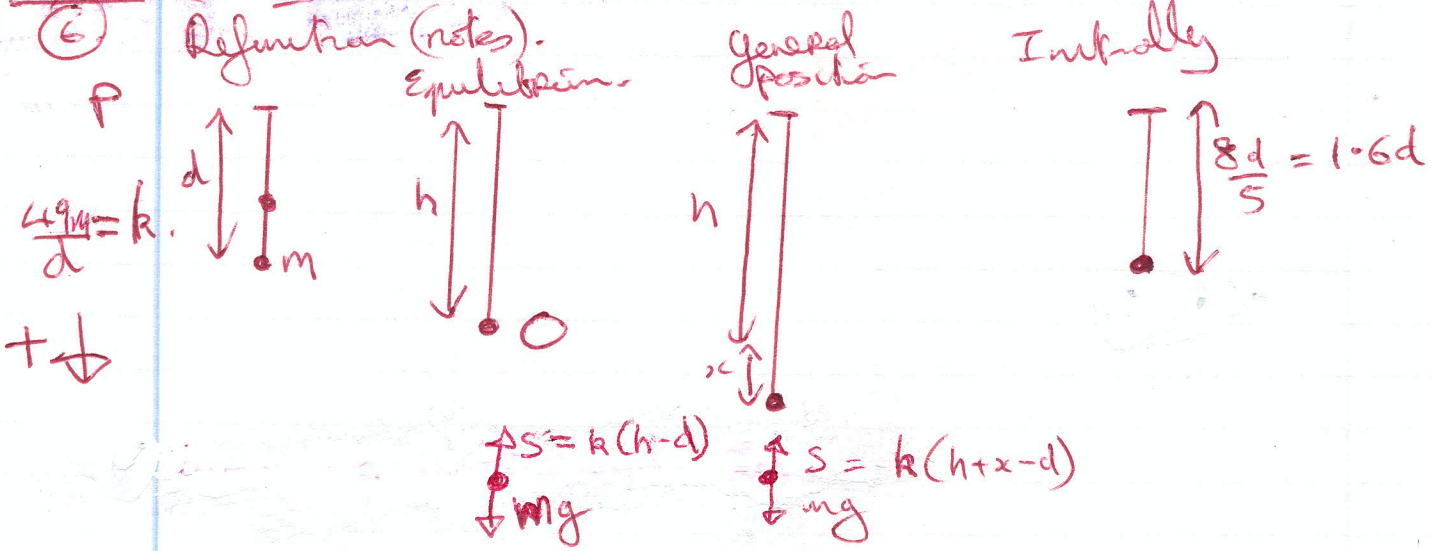
1987. [SHM]

(6)

Refuntion (notes).



(i) Just find position of point of equilibrium: let it be h m below P

$$S = k(h-d) = \frac{49m}{d}(h-d)$$

Nett force = 0 $\Rightarrow -\frac{49m}{d}(h-d) + mg = 0.$

$\Rightarrow -\frac{49h}{d} + 49 + g = 0.$

$\Rightarrow h = \frac{d}{49}(49+g) = d\left(\frac{58.8}{49}\right) = 1.2d.$

$\Rightarrow$ **$h = 1.2d$**

Consider forces at typical position x below P.

$$S = k(h+x-d) = \frac{49m}{d}(1.2d + x - d) = \frac{49m}{d}(.2d+x)$$

$\therefore$ NII $\Rightarrow$ $\vec{S} + \vec{w} = ma \Rightarrow -\frac{49m}{d}(.2d+x) + m(9.8) = ma.$

$\Rightarrow -9.8 - \frac{49}{d}x + 9.8 =$

$\Rightarrow -\frac{49}{d}x = \text{accel}$

$\Rightarrow$ SHM about point O, with **$\omega = 7/\sqrt{d}$**

Initially dist from P $= \frac{8d}{5}$ and speed $= 0$.

$\therefore$ $v = 0$, when $x = 1.6d - 1.2d = .4d.$

$\Rightarrow$ A mplitude **$A = .4d$**

(ii) STRING goes slack when particle d metres from P.

$\Rightarrow$ **$x = -.2d$**

Time for this $x = A\cos\omega t$ (Because starting at extreme)

$\Rightarrow -.2d = .4d\cos\frac{7}{\sqrt{d}}t$

$\Rightarrow -\frac{1}{2} = \cos\frac{7}{\sqrt{d}}t.$

$\Rightarrow t = \frac{\sqrt{d}}{7}\cos^{-1}\left(-\frac{1}{2}\right). = \frac{\sqrt{d}}{7}\left(\frac{2\pi}{3}\right) = \frac{2\pi\sqrt{d}}{21}.$

$t = \frac{2\pi\sqrt{d}}{21}$