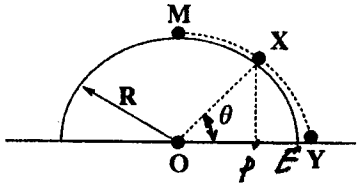
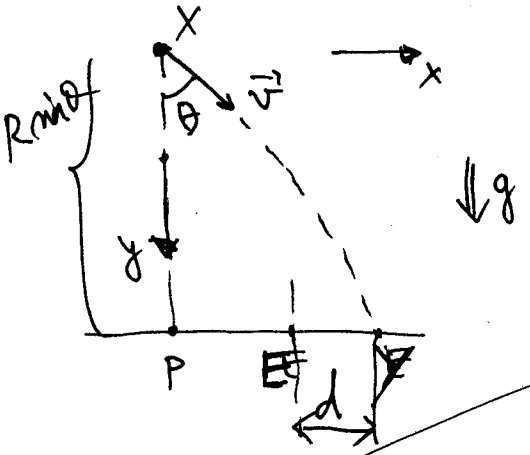
4.

May 2000



$d = |EY|$

We know $v^2\big|_X = 2gR(1-\sin\theta)$; $\sin\theta = \frac{2}{3}$



with the origin of co-ordinate frame set at pt. X

$$\Rightarrow \begin{cases} x = (v\sin\theta)\,t \\ y = (v\cos\theta)\,t + \frac{g}{2}t^2 \end{cases}$$

Body hits the ground at Y, where

$y = R\sin\theta$

express t from "x" equation and subst. into y.

$$\Rightarrow R\sin\theta = x\cdot\frac{\cos\theta}{\sin\theta} + \frac{g}{2}\cdot\frac{x^2}{v^2\sin^2\theta}$$

We found v^2, $\sin\theta$ in previous steps (see class notes)

$$\rightarrow R\cdot\frac{2}{3} = x\cdot\frac{\sqrt{5}}{2} + \frac{x^2}{R}\cdot\frac{27}{16}$$

$$\rightarrow 81x^2 + 24\sqrt{5}Rx - 32R^2 = 0$$

$$x_{\pm} = \frac{-4R(\sqrt{5} \pm \sqrt{23})}{27}$$

We expect $x > 0$, therefore we pick only x_+

$$d = R\cos\theta + x_- - R = R\left\{\frac{\sqrt{5}}{3} - 1 + \frac{(\sqrt{23}-\sqrt{5})4}{27}\right\} \approx 0.12R$$

Ugly ....