

Motion of an Insect in the Rough Bowl.

The insect crawl up the bowl up to a certain height h only till the component of its weight along the bowl is balanced by limiting frictional force.

Let m = mass of the insect, r = radius of the bowl, μ = coefficient of friction for limiting condition at point A

$$R = mg \cos \theta \quad \dots\dots(i) \quad \text{and} \quad F_l = mg \sin \theta \quad \dots\dots(ii)$$

Dividing (ii) by (i)

$$\tan \theta = \frac{F_l}{R} = \mu \quad [\text{As } F_l = \mu R]$$

$$\therefore \frac{\sqrt{r^2 - y^2}}{y} = \mu \text{ or } y = \frac{r}{\sqrt{1 + \mu^2}}$$

$$\text{So} \quad h = r - y = r \left[1 - \frac{1}{\sqrt{1 + \mu^2}} \right], \therefore h = r \left[1 - \frac{1}{\sqrt{1 + \mu^2}} \right]$$

