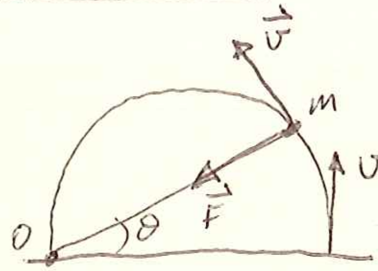
PROB. 12-74



$r = r_0 \cos\theta, \quad r^2\dot{\theta} = h = \text{CONSTANT}$

SHOW $v = \dfrac{v_0}{\cos^2\theta}$

$$v = \sqrt{v_r^2 + v_\theta^2}$$

$$r^2\dot{\theta} = r v_\theta = r_0 v_{\theta,0} = r_0 v_0$$

$$v_\theta = \frac{r_0 v_0}{r} = \frac{r_0 v_0}{r_0 \cos\theta} = \frac{v_0}{\cos\theta}$$

$$v_r = \frac{dr}{dt} = \frac{dr}{d\theta}\cdot\frac{d\theta}{dt} = \frac{dr}{d\theta}\cdot\dot{\theta}$$

$$\frac{dr}{d\theta} = -r_0 \sin\theta,$$

$$\dot{\theta} = \frac{r_0 v_0}{r^2} = \frac{r_0 v_0}{(r_0\cos\theta)^2} = \frac{v_0}{r_0\cos^2\theta}$$

$$v_r = (-r_0\sin\theta)\left(\frac{v_0}{r_0\cos^2\theta}\right) = -\frac{v_0\sin\theta}{\cos^2\theta}$$

$$v = \sqrt{\left[-\frac{v_0\sin\theta}{\cos^2\theta}\right]^2 + \left[\frac{v_0}{\cos\theta}\right]^2}$$

$$v = v_0\sqrt{\frac{\sin^2\theta}{\cos^4\theta} + \frac{1}{\cos^2\theta}} = v_0\sqrt{\frac{\sin^2\theta + \cos^2\theta}{\cos^4\theta}}$$

$$\boxed{v = \frac{v_0}{\cos^2\theta}}$$