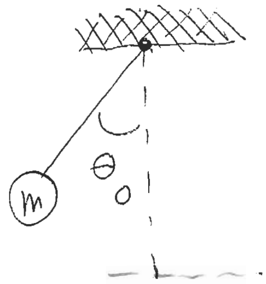
A pendulum consists of a a mass m suspended from the ceiling by a string of negligible mass with length L. The pendulum is pulled back an angle Θ_0 from the vertical. Find an expression for the centripetal acceleration of the mass as a function of θ.



$$ME_i = mg(L - L\cos\theta_0)$$

$$ME_f = mg(L - L\cos\theta) + \tfrac{1}{2}mv^2$$

$$\tfrac{1}{2}mv^2 = mgL - mgL\cos\theta_0 - mgL + mgL\cos\theta = mgL(\cos\theta - \cos\theta_0)$$

$$v^2 = 2gL(\cos\theta - \cos\theta_0)$$

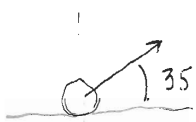
$$\boxed{a = \frac{v^2}{L} = 2g(\cos\theta - \cos\theta_0)}$$

A constant force F acts on a particle of mass m. Assuming the particle is initially at rest, find an expression for the instantaneous power delivered by the force at time t.

$$v = v_0 + at = \frac{F}{m}t$$

$$P = Fv = \boxed{\frac{F^2}{m}t}$$

A golf ball (m = 46.0 g) is struck with a force that makes an angle of 35 degrees to the horizontal. The ball lands 240 m away on a flat fairway. If the golf club and ball are in contact for 8.00 ms, what is the average force of impact?



$$0 = v_0\sin\theta\, t - \tfrac{1}{2}gt^2$$

$$\Rightarrow \tfrac{1}{2}gt = v_0\sin\theta$$

$$t = \frac{2v_0\sin\theta}{g}$$

$$R = v_0\cos\theta\, 2v_0\sin\theta / g = \frac{2v_0^2}{g}\cos\theta\sin\theta$$

So $$\boxed{v_0 = \left(\frac{Rg}{2\cos\theta\sin\theta}\right)^{1/2}} = 50.02\ \text{m/s}$$

$$\frac{\Delta p}{t} = F = \boxed{\frac{m\left[\frac{Rg}{2\cos\theta\sin\theta}\right]^{1/2}}{t}} = \boxed{288\ \text{N}}$$

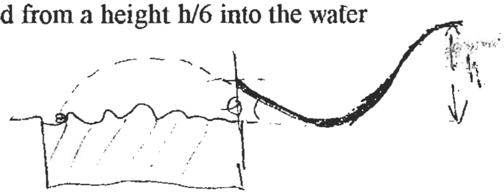
Through a bizarre set of circumstances, you find yourself trapped on a frictionless ice-covered lake holding an M-16 assault rifle. You have 20 rounds. The distance to the nearest land is 800 meters. The mass of each bullet is 3.3 g with a muzzle velocity of 995 m/s. Describe your strategy for reaching land and estimate how long the trip will take.

$MV = 20\,mv$

$V = \frac{20\,mv}{M}$

$t = \frac{D}{V} = \frac{800\,M}{20\,mv} = \frac{40 \quad 80}{3.3\times10^{-3} \quad 995} =$

A child slides without friction from a height h along a curve water slide. She is launched from a height h/6 into the water at an angle $\theta = 30$ degrees.



a) What maximum height does the child reach after leaving the slide:

$mgh = \frac{1}{2}mv^2 + mg\,h/6 \Rightarrow \frac{mgh5}{6} = \frac{1}{2}mv^2$

$v = \left(\frac{5gh}{3}\right)^{1/2}$

$v^2 = v_0^2 - 2g\Delta x \qquad \frac{5gh}{3}\sin^2 30 = 2g\Delta x$

$\Delta x = \frac{5h}{6}\left(\frac{1}{4}\right)$

So max height $= \frac{5h}{24} + \frac{h}{6} = \frac{3h}{8}$

b) At what horizontal distance from thelaunch point does she hit the water?

$0 = \frac{h}{6} + v_0 \sin\theta\, t - \frac{1}{2}gt^2 \leftarrow$ find t..

$R = (v_0\cos\theta)\,t$

quadratic.. so not nec, but doable

$\rightarrow R = \left(\frac{5}{4\sqrt{3}} + \frac{\sqrt{15}}{4}\right)h = 1.69\,h$

$t = \frac{\left(\frac{1}{2}\sqrt{3} + \frac{1}{6}\sqrt{15}\right)\sqrt{h}}{\sqrt{g}} = 1.51\sqrt{h/g}$