$K_i + U_i + W_{other} = K_f + U_f$ $\quad a_c = \frac{v^2}{R}$ $\quad$ force at bottom of bowl $\Sigma F = n - mg = ma_c$

$n = mg + \frac{mv^2}{R}$

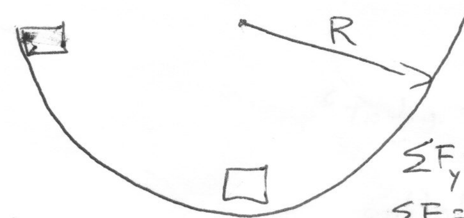
>

$W = \Sigma F \cdot d\cos\theta$

$F \Delta t = \text{impulse} = m\Delta v = \Delta p$ $\quad K = \frac{1}{2}mv^2 = mgy$

$K_f - K_i = E_{dissipated}$

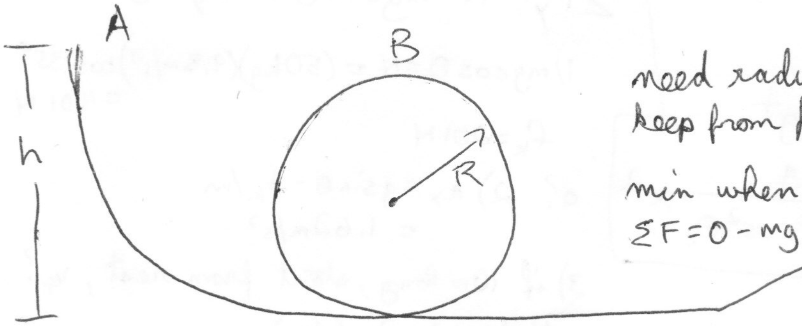
$v = \sqrt{2gR}$



$mgR = \frac{1}{2}mv_f^2$

$\Sigma F_y = N - (2mg) = 0$

$\Sigma F = 0$ at collision



need radial a to keep from falling

min when $n = 0$ at B

$\Sigma F = 0 - mg = ma_c = \frac{mv^2}{R}$

$U_A - U_B = K_B = \frac{1}{2}mv_b^2$

$mgh - mg(2R) \geq \frac{1}{2}mgR$

$\rightarrow h - (2R) \geq \frac{1}{2}R$

$h = \frac{5}{2}R$

Rotation Kinematics

$\omega_z = \frac{d\theta}{dt}$

$\alpha_z = \frac{d\omega}{dt}$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$ (const α)

$\theta - \theta_0 = \frac{1}{2}(\omega + \omega_0)t$

$\omega = \omega_0 + \alpha t$

$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

Linear vs. angular

$I = mr^2$

$K = \frac{1}{2}I\omega^2$

∥ axis

$I_p = I_{cm} + Md^2$

$\tau = Fl$

$\vec{\tau} = \vec{r} \times \vec{F}$

$\tau = I\alpha$

$K = \frac{1}{2}Mv_{cm}^2 + \frac{1}{2}I_{cm}\omega^2$

$\vec{F}_{ext} = M\vec{a}_{cm}$

$\tau = I_{cm}\alpha$

roll w/o slip $\Rightarrow v_{cm} = R\omega$

$W = \int_{\theta_1}^{\theta_2} \tau_z \, d\theta$

$W = \tau(\theta_2 - \theta_1)$

$W_{tot} = \frac{1}{2}I\omega_2^2 - \frac{1}{2}I\omega_1^2$

$P = \tau\omega$

$\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}$

$\vec{L} = I\vec{\omega}$

$\vec{\tau} = \frac{d\vec{L}}{dt}$

Waves

$y(x,t) = A\cos 2\pi f\left(\frac{x}{v} - t\right)$

$= A\cos 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right) = A\cos(kx - \omega t)$ $\left[k = \frac{2\pi}{\lambda}, \omega = 2\pi f\right]$

$\frac{\partial^2 y(x,t)}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y(x,t)}{\partial t^2}$, $v = \sqrt{\frac{F}{\mu}}$

$P_{av} = \frac{1}{2}\sqrt{\mu F}(\omega^2 A^2)$

Periodic Motion

$f = T^{-1}$ $\quad T = f^{-1}$

$\omega = 2\pi f = \frac{2\pi}{T}$

SHM

$F_x = -kx$

$a_x = \frac{F_x}{m} = -\frac{kx}{m}$

$\omega = \sqrt{\frac{k}{m}}$

$f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$T = 2\pi\sqrt{\frac{m}{k}}$

$x = A\cos(\omega t + \phi)$

$E = \frac{1}{2}mv_x^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2 = \text{const}$

∠SHM

$\omega = \sqrt{\frac{K}{I}}$ $\quad f = \frac{1}{2\pi}\sqrt{\frac{K}{I}}$

der simple pendulum

$\omega = \sqrt{\frac{g}{L}}$ $\quad f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$

$T = \frac{2\pi}{\omega} = \frac{1}{f} = 2\pi\sqrt{\frac{L}{g}}$

das pendulum physiklen

$\omega = \sqrt{\frac{mgd}{I}}$ $\quad T = 2\pi\sqrt{\frac{I}{mgd}}$

Resonance

$A = \frac{F_{max}}{\sqrt{(k - m\omega_d^2)^2 + b^2\omega_d^2}}$