NYU Phys I

2018-11-8

- ULS: Chaikin
  11-9 726 Bway
  Rm 1067 3 PM
- Q. S.
- Rolling down the plane
- Angular momentum
  velocity
  acceleration
- Moment of inertia
- Rolling w/o slipping

v a

ω α

$$K.E. = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2$$

$I \equiv$ moment of inertia

$$[I] = kg\ m^2$$

$$I = \sum m R^2$$

$$= \sum m R^2$$

~~$\tau = \int \rho R^2 dV$~~ $I = \int \rho R^2 dV$

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

↑ displacement ↖ mass relation

$\tau \propto f$

$\tau = R \times F$

$N \parallel \vec{R} \Rightarrow \sin\theta = 0$

$mg\,R = 0 \Rightarrow$ no torque

Angular Momentum

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

$\vec{p} = m\vec{v}$

$\tau = Rf = I\alpha$

$F = ma = mg\sin\theta - f$

$a = \alpha R$

Rolling w/o Slipping

$\Delta\theta = 2\pi$

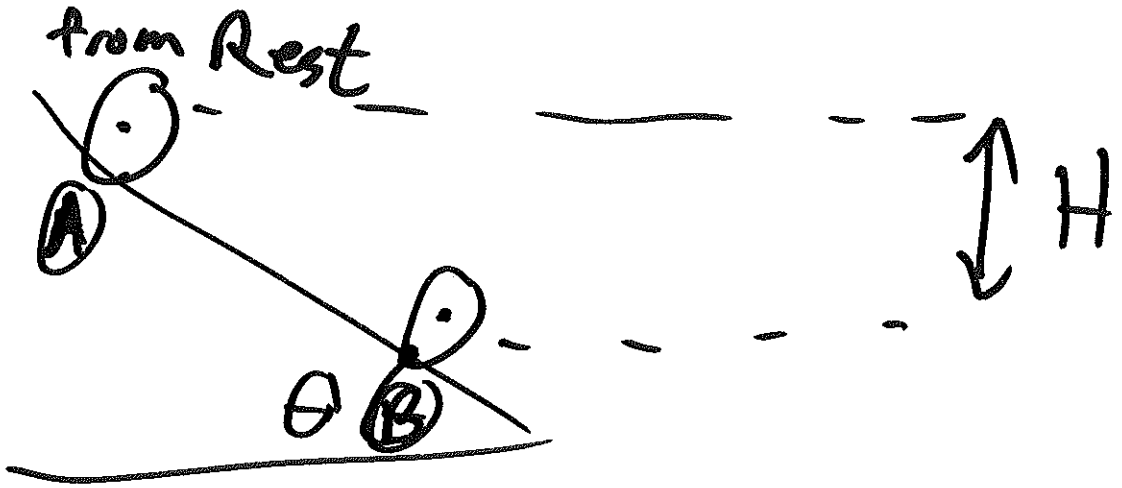
$\Delta x = 2\pi R$

$$\frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T} = \omega$$

$$\boxed{\begin{aligned} v &= \omega R \\ a &= \alpha R \end{aligned}}$$

$$\frac{\Delta x}{\Delta t} = \frac{2\pi R}{T} = v$$

Kinematic Statement



(A) $PE = 0$ $K_{trans} = 0$ $K_{rot} = 0$

(B) $PH = -mgH$ $K_{trans} = \frac{1}{2}mv^2$ $K_{rot} = \frac{1}{2}I\omega^2$

$\sum E = 0$

$$\Rightarrow mgH = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$v = \omega R$$

$\tau = RF = I\alpha$ ①

$F = ma = mg\sin\theta - f$ ③

$a = \alpha R$ ②

$\Rightarrow$ ① $f = \dfrac{I\alpha}{R} = \dfrac{Ia}{R^2}$

② $\alpha = \dfrac{a}{R}$

③ $ma = mg\sin\theta - \dfrac{Ia}{R^2}$

$$ma = mg\sin\theta - \frac{Ia}{R^2}$$

$$ma + \frac{Ia}{R^2} = mg\sin\theta$$

$$am\left(1 + \frac{I}{mR^2}\right) = mg\sin\theta$$

$$a = \frac{g\sin\theta}{1 + \frac{I}{mR^2}} = \frac{g\sin\theta}{1 + \text{☺}}$$

Linear	Rotational
m	I
v	ω
a	α
$F = ma$	$\tau = I\alpha$
$\vec{p} = m\vec{v}$	$\vec{L} = I\vec{\omega}$
$\frac{1}{2}mv^2$	$\frac{1}{2}I\omega^2$

$p = mv$

$\uparrow$

$m \leq 16lb$