1-8

$|A||B|\cos\theta$ · $v = \frac{dx}{dt}$ $a = \frac{dv}{dt}$ · $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$ · $v(t) = v_0 + at$ · $v_2(x) = v_0^2 + 2a(\Delta x)$ $v^2(x) = v_0^2 + 2a(\Delta x)$

$d = \frac{v_i + v_f}{2} t$ · $v = \frac{v_0 + v}{2}$ $\Delta y = \frac{1}{2}gt^2$ · $v_{y0} = v_0 + at$ $W = F dx$ $F = ma$ · $a = \frac{v^2}{R}$

centripetal: $v = \frac{d}{t} = \frac{2\pi r}{t}$ $a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$ $(t\, v_{0y} t) = 0$ $F_{net} = m + \frac{v^2}{R} = m \times \frac{4\pi^2 R}{T^2}$ $\boxed{\text{Spring}}$: $F = kx$ $\boxed{\text{Satellites}}$: $F_{net} = \frac{M_{sat} \cdot v}{R}$

$v^2 = \frac{G \cdot M_{central}}{R}$ $F_{grav} = \frac{G \cdot M_{sat} \cdot M_{central}}{R^2}$

$\boxed{\text{Tension}}$ $T = mg\cos\theta + ma + m\frac{r^2}{r} + mg$

$= T_g + F + F_c + f_{friction}/N$

$= \frac{2m_1 m_2 g}{m_2 + m_1}$

period $T = \sqrt{\frac{4\pi^2 r^3}{GM}}$

$a = \frac{G M_{central}}{r^2}$ $\frac{T^2}{r^3} = \frac{4\pi}{G \cdot M_{central}}$ earth mass $= 5.97 \times 10^{24}$

$\boxed{\text{Energy}}$ $\Delta KE = \frac{1}{2}mv_B^2 = -\frac{1}{2}mv_A^2 = (F_s)\Delta y$

$PE = \frac{1}{2}kx^2$ $PE_{grav} = mgh$

① linear momentum conservation → elastic → mom + KE ⇒ momentum: $m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$ ②

② rotation → inelastic → energy / mom: $\frac{1}{2}m_1 v_{1i}^2 + \frac{1}{2}m_2 v_{2i}^2 = \frac{1}{2}m_1 v_{1f}^2 + \frac{1}{2}m_2 v_{2f}^2$

$m_1\vec{v}_1 + m_2 v_2 = (m_1 + m_2)\vec{v}_f$

③ vector-cross-product $\bar{A} \times \bar{B} = \bar{C}$ — rhr. $|c| = |A||B|\sin\theta$

④ Angular momentum conserved

$\Sigma\tau = \frac{d\tau}{dt} = 0$

⑤ static equilibrium - $\Sigma F_{x,y} = 0$ · $\Sigma\tau = 0$ · $v = rw$ $a = r\alpha$

| | |
|---|---|
| x, y | $\theta$ |
| v | $\omega$ |
| a | $\alpha$ |
| m | I |
| F | $\tau$ |
| $\frac{1}{2}mv^2$ | $\frac{1}{2}I\omega^2$ |

$v_{escape} = \sqrt{\frac{2GM}{r}}$

$PE_{grav} = \frac{GMm}{r}$

$\frac{dL}{dt} = \vec{\tau}$

$\bar{\omega} = \frac{\Delta\theta}{\Delta t}$ $\vec{\tau} = \vec{r}\vec{F}$ $\vec{L} = \vec{r}\vec{p} = \vec{r}m\vec{v} = I\vec{\omega}$

angular momentum

$v = \omega r$ $I = \int r^2 dm$

$a = \alpha r$ $\tau = rF\sin\theta$

$\bar{\omega} = \frac{1}{2}(\omega_0 + \omega)$

$\omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

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

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

rolling w/o slipping: $v = \omega R$, translate $= \frac{1}{2}Mv^2$; rotate: $\frac{1}{2}I\omega^2$

$\underline{\text{Impulse}}$ $F_{av}\Delta t = m\Delta v$ avg.

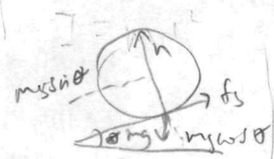
inelastic = just momentum

elastic = momentum + energy $= \frac{1}{2}mv^2$

$p = mv$

moment of inertia

rolling down an incline



$I = \frac{2}{5}mr^2$

$I = \frac{1}{2}MR^2$ $I = MR^2$ $I = \frac{2}{5}MR^2$ $I = \frac{1}{12}ML^2$

$v = m/s$

$a = m/s^2$

$F = N = kg \cdot \frac{m}{s^2} = F$

$k = \frac{N}{m} = \frac{kg}{s^2}$

energy/work $= J = N \cdot m$

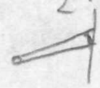
Power $= W = \frac{J}{s}$

linear accel $Ma = \Sigma\vec{F} = -Ma = -mg\sin\theta + f$

ang. accel $I\alpha = \Sigma\vec{\tau} = -Rf = f_s R I\alpha$

$I = \frac{1}{4}MR^2 + \frac{1}{2}ML^2$ $I = \frac{1}{2}MR^2$ $I = \frac{2}{3}MR^2$

$f = \frac{I\alpha}{R} = \frac{Ia}{R^2}$ $\alpha = \frac{a}{R}$



$I = \frac{1}{3}ML^2$

$Ma = Mg\sin\theta - \frac{Ia}{R^2}$

$a = \frac{g\sin\theta}{1 + \frac{I}{MR^2}}$

$I_{total} = I_{cm} + md^2$

d = displacement from center

m = mass

L = total length

energy $= \frac{1}{2}mv^2 + \frac{1}{2}\left[\frac{2}{5}mr^2\right]\left[\frac{v}{r}\right]^2$

$v = \frac{\lambda}{T} = \lambda f$

$\lambda$ = wave speed

$p + \frac{1}{2}\rho v^2 + \rho g y$ = constant

p: pressure, $\rho$: density

$\Delta U = Q + W$

sphere: $v = \sqrt{\frac{10}{7}gh}$ (h: bottom)

$\frac{1}{2}mv^2 = \frac{3}{2}kT$ $k = 1.38 \times 10^{-23}$ J/K