

Physics 121

Trig

$$\begin{aligned}\sin \theta &= o/h \\ \cos \theta &= a/h \\ \tan \theta &= o/a \\ \text{distance} &= 2\pi r (\text{circle}) \\ \text{area} &= \pi r^2 (\text{circle})\end{aligned}$$

Rotations

$$\begin{aligned}\text{Rolling without slipping} \\ x &= \theta r \\ v &= \omega r \\ a &= \alpha r\end{aligned}$$

Kinematics

$$\begin{aligned}v &= \Delta x / \Delta t \\ a &= \Delta v / \Delta t \\ \Delta x &= v_0 t + \frac{1}{2} a t^2 \\ v_f^2 &= v_0^2 + 2a\Delta x \\ g &= 9.8 \text{ m/s}^2\end{aligned}$$

$$X_{cm} = \sum m_i x_i / \sum m_i$$

$$\begin{aligned}\Delta \theta &= \omega_0 t + \frac{1}{2} \alpha t^2 \\ \omega_f^2 &= \omega_0^2 + 2\alpha\Delta\theta \\ \omega &= \Delta\theta / \Delta t \\ \alpha &= \Delta\omega / \Delta t \\ KE &= \frac{1}{2} I \omega^2\end{aligned}$$

$$\begin{aligned}\tau_{net} &= I \alpha \\ \tau &= f(\Delta x) \sin\theta \\ I &= mr^2 \\ l &= I\omega \text{ (Angular momentum)}\end{aligned}$$

Dynamics

$$\begin{aligned}F_{net} &= ma \\ F_g &= Gm_1 m_2 / r^2 \\ F_g &= mg \text{ (near surface of earth)} \\ f_k &= \mu_k F_N \\ f_s &\leq \mu_s F_N \\ a_c &= v^2 / r = \omega^2 r\end{aligned}$$

Springs

$$\begin{aligned}F &= -k\Delta x \\ PE &= \frac{1}{2} k \Delta x^2\end{aligned}$$

Work and Energy

$$\begin{aligned}W &= Fd \cos \theta \\ KE &= \frac{1}{2} m v^2 \\ W_{net} &= \Delta KE \\ W_{nc} &= \Delta KE + \Delta PE \\ PE &= mgh\end{aligned}$$

Constants

$$\begin{aligned}G &= 6.67 \times 10^{-11} \\ M_{earth} &= 5.98 \times 10^{24} \\ R_{earth} &= 6.38 \times 10^6\end{aligned}$$

Impulse and Momentum

$$\begin{aligned}\text{Impulse} &= F t = \Delta p \\ p &= mv\end{aligned}$$

$$\begin{aligned}m_1 v_1 + m_2 v_2 &= (m_1 + m_2) v_f \text{ (Inelastic)} \\ V_{cm} &= \sum m_i v_i / \sum m_i\end{aligned}$$

Elastic Collisions

- 1) Find V_{cm}
- 2) Subtract V_{cm} from each velocity
- 3) Change sign of each velocity
- 4) Add V_{cm} to each velocity