

Laws of Motion

For only inclined plane

$A = g \sin \theta$ $N = mg \cos \theta$

for relative slipping (when block & plane move)

$A = g \tan \theta$ $N = Mg / \cos \theta$

① first law = Law of Inertia ^{net moment} of inertia

④ Monkey - problems

② second law

$\vec{P} = \frac{d\vec{p}}{dt}$ $F_{av} = \frac{\Delta \vec{p}}{\Delta t}$

$T_{breaking} = m(g + a_{max})$

- when monkey climbs up the rope

$t_{min} = \sqrt{\frac{2l}{g + a_{max}}}$ $\tan \theta = \frac{A}{g}$

pendulum in lift

- Momentum: $\vec{P} = m\vec{v}$

⇒ Liquid - Jet

① after striking wall, jet splashed

$F_{jet} = -\rho A V^2$
 $F_{wall} = +\rho A V^2$

$\frac{m}{dt} \rightarrow \rho A V$ ^{mass of liquid flow/time}
 $\frac{V}{dt} \rightarrow AV$ ^{rate of flow}

- throughout chapter using mostly system boundary tech. No relative slipping

③ Lami's theory

$\frac{F_1}{\sin \alpha} = \frac{F_2}{\sin \beta} = \frac{F_3}{\sin \gamma}$

② Liquid jet bounces back

$F_{jet} = -2\rho A V^2$
 $F_{wall} = +2\rho A V^2$

⑥ Impulse

- suddenly changing linear momentum.

→ Impulsive force

③ Liquid jet strikes obliquely.

$F_{jet} = -2\rho A V^2 \cos \theta$

$F_{imp} = \frac{dp}{dt}$

- रस्सी दोड़ती की tension दोड़ती

$a = g \sin \theta$ $mg \cos \theta = N$

a) collision of ball with Gd.

Impulse: $m(v_1 + v_2)$

Av. impulsive force: $\frac{\Delta p}{\Delta t}$

③ Lift problems

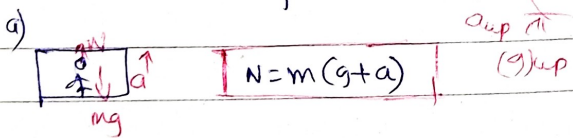
$N = mg$

Reading of weighing machine = True wt.

- can not determine the direction of object, (Velocity determines).

$v_1 = \sqrt{2gh_1}$

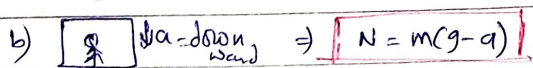
$v_2 = \sqrt{2gh_2}$



b) perfectly elastic collision.

Impulse $\Rightarrow 2mv$

av. impulsive force: $\frac{2mv}{\Delta t}$



c) Free fall $\Rightarrow N = 0$

c) oblique elastic collision.

Impulse: $2mv \cos \theta$

Av. impulsive force: $\frac{2mv \cos \theta}{\Delta t}$

- जबी inclined force की वजह से $N = Mg \cos \theta$

$N = mg \cos \theta$ $A = g \sin \theta$ $N = mg \cos \theta$ $A = g \tan \theta$

⑦ Bullet - plate

① $\Delta p = 2 \text{ mV}$.

② $F_{av} = \frac{\Delta p}{\Delta t} = \frac{2 \text{ mV}}{\Delta t}$

③ $F_{total} = 2 \text{ mV}$.

$\frac{N}{t}$

④ $2 \text{ mV} = mg$

⑧ tension trick

$$W = F \cdot s \cdot \cos \theta$$

$$P = F \cdot v \cdot \cos \theta$$

for tension force and Normal force.

$$\Sigma W = 0$$

$$\Sigma P = 0$$

— NO energy store.

Collision

In one dimension.

① perfectly elastic collision.

② Inelastic collision.

③ perfectly inelastic collision.

① Inelastic collision.

→ F_{net} is zero

→ momentum is conserved.

$$P_i = P_f$$

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

1) coeff. of restitution.

$$e = \frac{v_2 - v_1}{u_1 - u_2}$$

separation

approach

⇒ when v_1 & v_2 not given in question.

then use formula.

$$v_1 = \frac{(m_1 - em_2)u_1 + (1+e)m_2 u_2}{m_1 + m_2}$$

$$v_2 = \frac{(1+e)m_1 u_1 + (m_2 - em_1)u_2}{m_1 + m_2}$$

2) loss in K.E: $\Delta K_f = K_i - K_f$

$$\Delta K = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2 (1 - e^2)$$

② perfectly elastic collision

$$(K.E)_{final} = (K.E)_{initial}$$

1) K.E. transfer during head on elastic collision

$$\frac{\Delta K}{K} = 1 - \left[\frac{m_1 - m_2}{m_1 + m_2} \right]^2 = \frac{4 m_1 m_2}{(m_1 + m_2)^2}$$

$e = 1 \Rightarrow$ perfectly elastic
 $e = 0 \Rightarrow$ perfectly inelastic
 $0 < e < 1 \Rightarrow$ inelastic

③ perfectly inelastic collision

$$P_i = P_f$$

$$m_1 u_1 + m_2 u_2 = (m_1 + m_2) V$$

$$V = \frac{m_1 u_1 + m_2 u_2}{m_1 + m_2}$$

$$\text{Heat} = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2$$

$$\Delta K = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2$$

4) max. elongation & compression in spring

— same as perfectly inelastic collision

$$V_{common} = \frac{m_1 u_1 + m_2 u_2}{m_1 + m_2}$$

$$\frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2 = \frac{1}{2} k x^2$$

⑤ Bouncing of Ball

$$v_n = e^n v_0$$

$$v_0 = \sqrt{2gh_0}$$

$$h_n = e^{2n} h_0$$

$$\text{Total dist} : h_0 \left(\frac{1+e^2}{1-e^2} \right)$$

$$\text{Total time} : \left[\frac{1+e}{1-e} \right] \sqrt{\frac{2h_0}{g}}$$

inelastic collision here mass ~~mix~~ added
 and in perfectly elastic here v_1 transfer
 another body or part.