Mechanics 1 formulae:

Models

model	assumption
particle (dimensions negligable)	mass concentrated at point (weight acts at a single point); resistive forces are negligable
rod (all dimensions but one are negligable)	mass concentrated along line; no thickness; regid
lamina (obj with area but negligable width)	mass distributed across flat surface
uniform body (mass distributed evenly)	mass concentrated at geometric centre of body — centre of mass
light object (small mass)	treated as massless; tension same at both ends of light string
inextensible string (does not stretch under load)	constant acceleration in system
smooth surface	no friction
rough surface	experience resistive force (friction)
wire (rigid)	treated as one dimension
smooth light pully	pully is massless; tension is same on either side of pully
Bead (particle with hole in it)	moves freely across string; if smooth, tension same
Peg (support)	dimensionless & fixed; either smooth or rough
air resistance	negligable
Gravity	assumes same & act down

(Rasha's notes 2023
Best of luck!
You've got it!!! Believe)

- Opposite of tension (breaking) is thrust (force of compression)
- buoyancy → upward force responsible for floating

constant acceleration

- average speed = $\frac{\text{total distance}}{\text{time}}$
- area in acceleration-time graph is $\Delta v = v - u$
- $a = \frac{v-u}{t}$, $s = \frac{(v+u)}{2} \cdot t$
- $v^2 = u^2 + 2as$, $s = ut + \frac{1}{2}at^2$

  $s = vt - \frac{1}{2}at^2$

} suvat

→ accelerate up $-9.8 m/s^2$

down $9.8 m/s^2$

- time between projection & hitting ground → time of flight

  initial s = speed of projection =

vectors

$r = r_0 + v(t)$ — displacement

r_0: position vector (starting)

r: position vector

dynamics of particle moving in straight line

- newton's first law of motion → obj will stay at rest (if at rest) & obj moving with constant velocity will continue doing so unless & until an unbalanced force acts on the object
- object accelerate in same direction of Fnet
- newton's second law of motion → $F = ma$
- system can be treated as whole if they are moving in same straight line
- newton's third law of motion → for every action is an equal & opposite reaction
- in pully its not one system as not straight line motion

Forces & friction

Friction has a max/limiting value

when obj is on point of moving → limiting eq

- $F_{max} = \mu R$ — normal rxn

  (μ = coefficient of friction)

Momentum & impulse

$I = mv - mu$ → $a = \frac{v-u}{t}$

(N·s)

$F = m\left(\frac{v-u}{t}\right)$

$Ft = mv - mu$

$Ft = I$ — newton's third law of motion imp

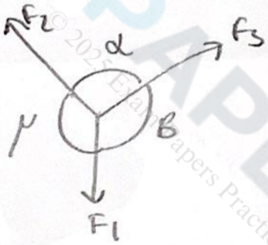
- principle of conservation of momentum:

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Statics of a particle

- if $F_{net} = 0$

  - if you have 3 forces in eq they form closed triangle



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

— lami's theorem

- $F \leq \mu R$

* body is at static eq if → $a = 0$, $F_{net} = 0$, total/resultant moment = 0

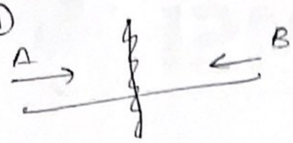
Moment

— turning effect of force (N.m)

all bodies rigid

- $P = |F| \times d$
- eq → Resultant moment = 0
- reaction force always there between pivot & surface
- more downward force → more R
- at point of tilting → no reaction forces (tension = 0 / R = 0)

extra:

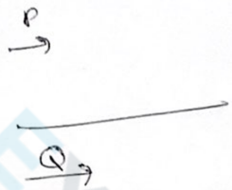
① 

$s_B + s_A = d$

② 

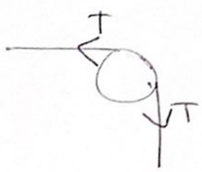
$s_Q - s_P = d$

$s_P - s_Q = d$

③ 

$s_P = s_Q$

(at point of collision & outtaking

- for smootc surfaces, $a = g\sin\theta$ ∴ more inclided → more a
- same string → same tension
- $\tan\alpha > \mu$ → motion
- $\tan\alpha = \mu$ → limitin eq
- $\tan\alpha < \mu$ → eq
- 

→ $R = 2F\cos\frac{\alpha}{2}$

two particle connecte with taut string will move at varying v until string becomes taut they then move at ~~constant~~ same velocity (commone)