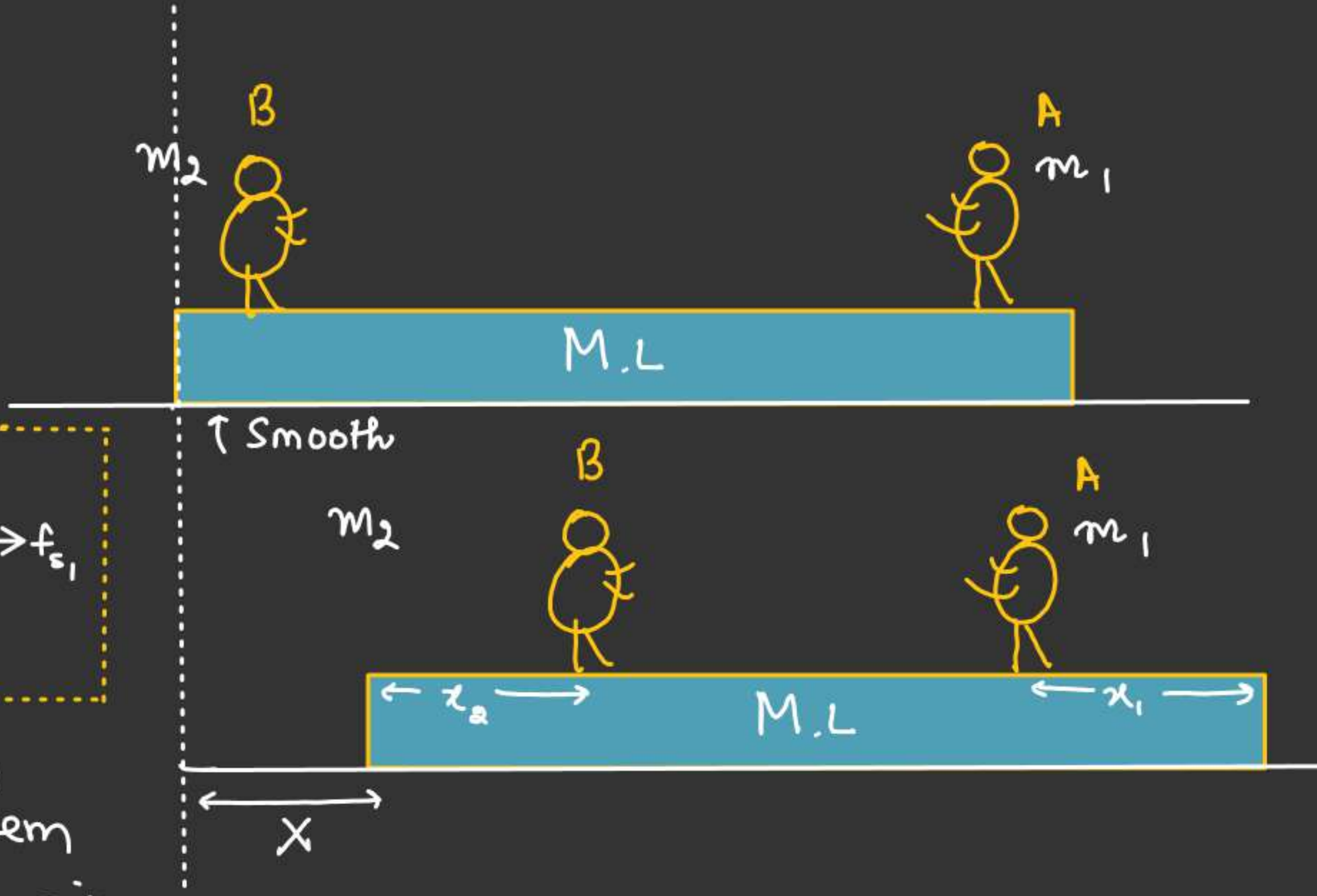
Nishant Jindal

MOTION OF COM

Case $[\Delta X_{com} = 0]$

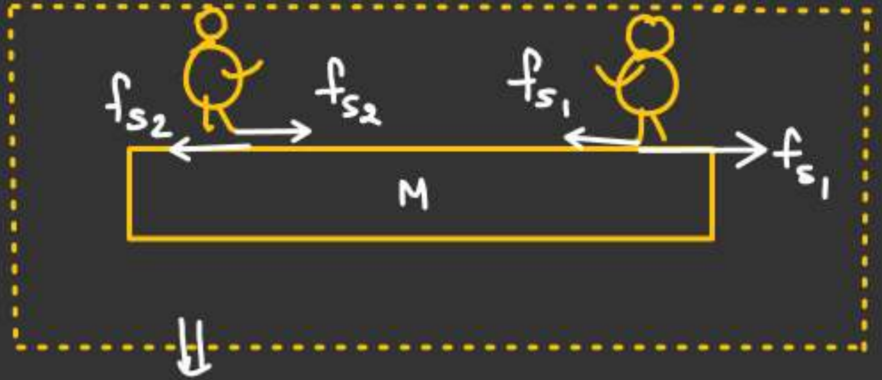
Two Men + Plank System

x_1 & x_2 be the displacement of person A and B w.r.t plank. then displacement of plank= ??



Note:-

↳ While using $\Delta X_{com} = 0$ all the displacements must be w.r.t earth



⇓

· Taking both the men and plank as system net external force in x-direction is zero

⇒ Since $(V_{com})_i = 0$.

$(\Delta X_{com})_i = 0$.

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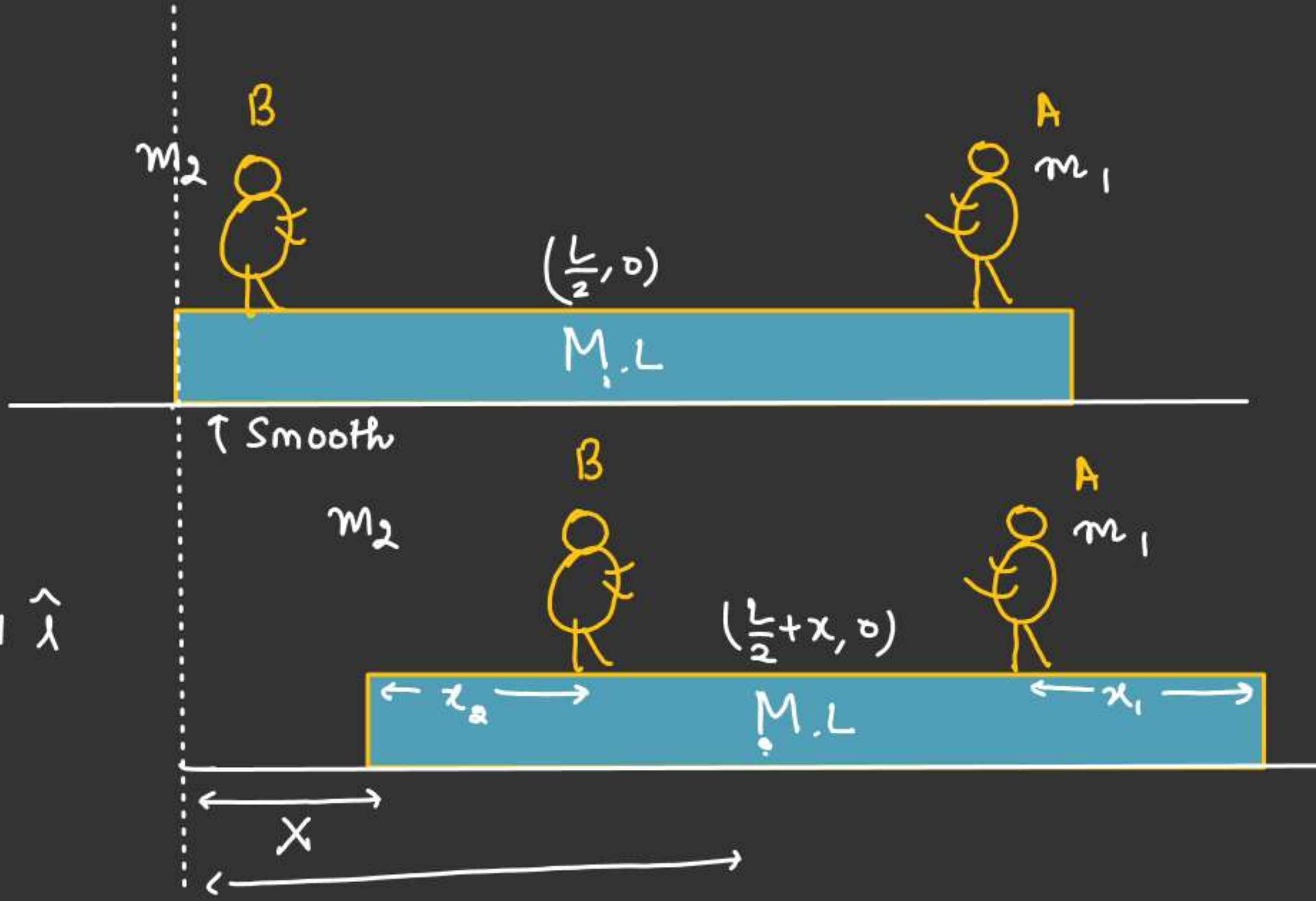
Case $[\Delta X_{com} = 0]$

$$\vec{X}_{A/E} = \vec{X}_{A/plank} + \vec{X}_{plank/E}$$

Displacement of A w.r.t earth $= -x_1\hat{i} + X\hat{i}$
$= (X - x_1)\hat{i}$

$$\vec{X}_{B/E} = \vec{X}_{B/plank} + \vec{X}_{plank/E}$$
$$= x_2\hat{i} + x\hat{i} \qquad \Delta\vec{x}_{plank} = x\,\hat{i}$$
$$= (x_2 + x)\hat{i}$$



$$0 = \Delta X_{com} = \frac{m_1 x_{A/E} + m_2(x_{B/E}) + Mx}{m_1 + m_2}$$

$$0 = m_1(X - x_1) + m_2(x + x_2) + Mx \Rightarrow \boxed{x = \frac{m_1 x_1 - m_2 x_2}{m_1 + m_2 + M}}$$

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Case $[\Delta X_{com} = 0]$

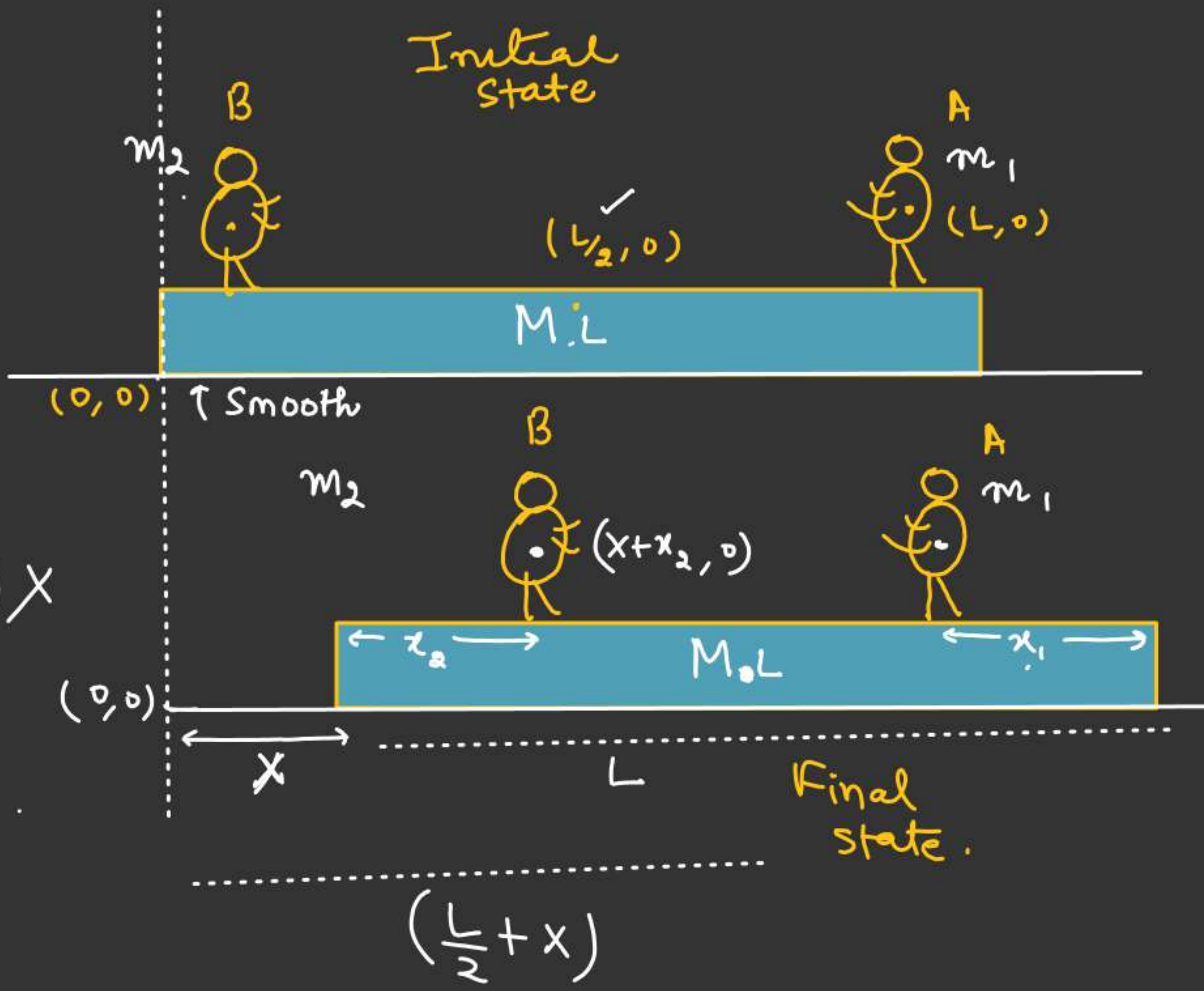
M-2 ✓

$$(X_{com})_i = (X_{com})_f$$

$$\frac{m_2(0) + m_1 L + M(L/2)}{m_1 + m_2 + M} = \frac{m_2(X + x_2) + m_1(L - x_1 + X) + M\left(\frac{L}{2} + X\right)}{(m_1 + m_2 + M)}$$

$$\cancel{m_1 L} = (m_2 x_2 - m_1 x_1) + (m_2 + m_1 + M)X + \cancel{m_1 L}$$

$$X = \left(\frac{m_1 x_1 - m_2 x_2}{m_1 + m_2 + M}\right) ✓$$



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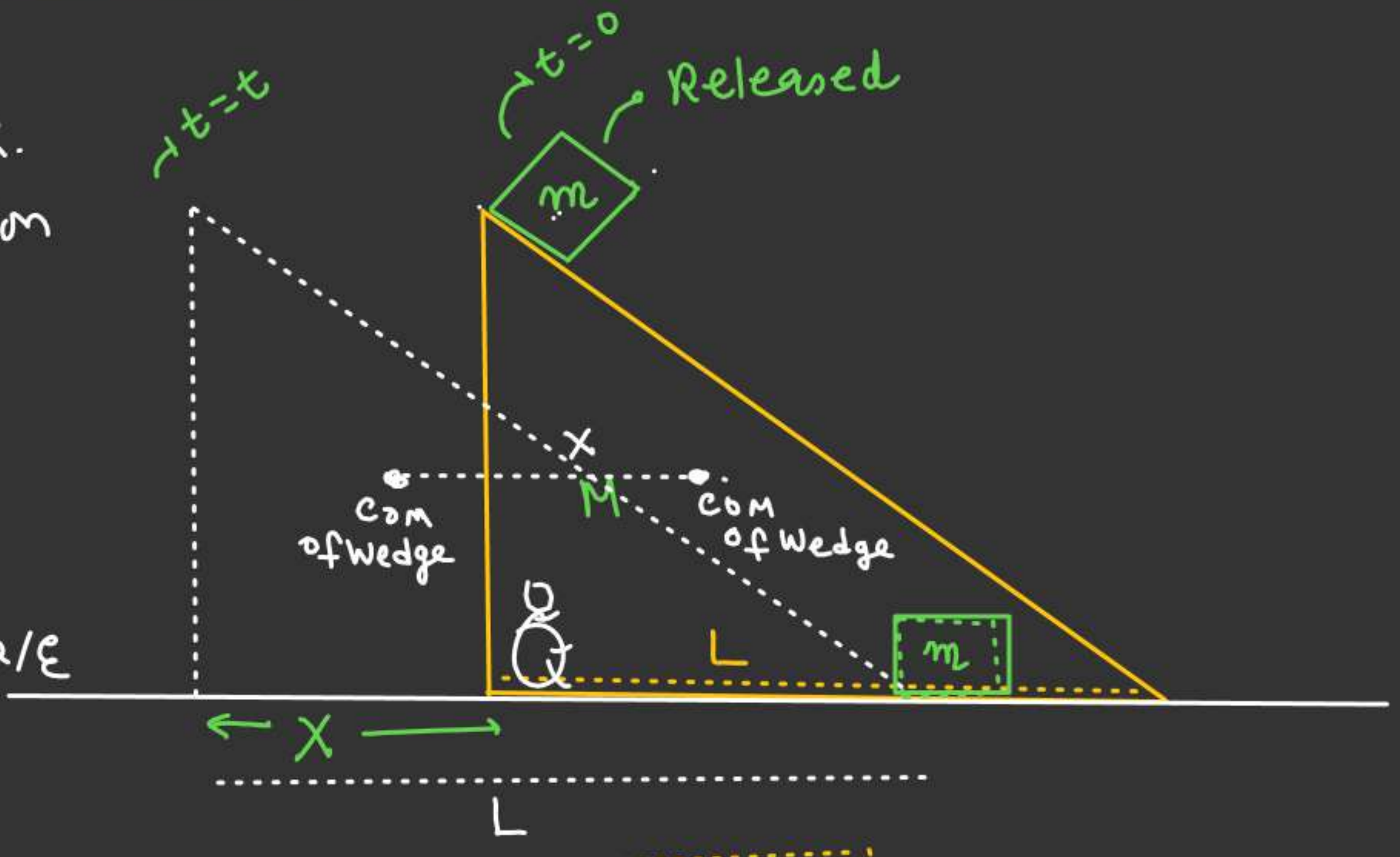
MOTION OF COM

Case $[\Delta X_{com} = 0]$

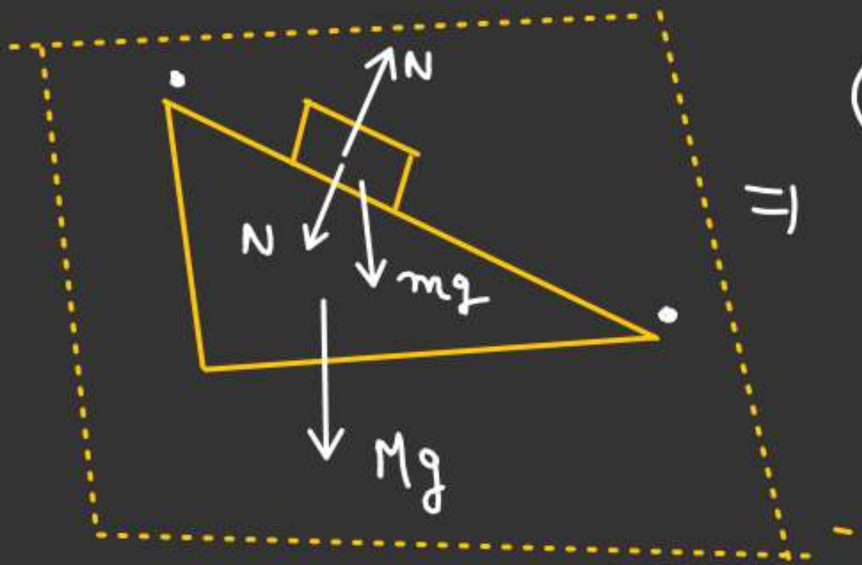
All the contact surfaces are smooth. Block is released from the position shown in the fig. Find displacement of wedge when block just reach the ground.



$$\overrightarrow{X}_{block/E} = \overrightarrow{X}_{block/wedge} + \overrightarrow{X}_{wedge/E}$$

$$= (L\hat{i} - X\hat{i})$$

$$= (L - X)\hat{i}$$



$$(F_{ext})_x = 0 \Rightarrow (\Delta X_{com})_x = 0$$

$$\Delta X_{com} = 0$$

$$\frac{m(\Delta\overrightarrow{X}_{block/E}) + M(\Delta\overrightarrow{X}_{wedge/E})}{m+M} = 0$$

$$m(L-x)\hat{i} + MX\hat{i} = 0 \Rightarrow \boxed{X = -\frac{mL}{M+m}\hat{i}}$$

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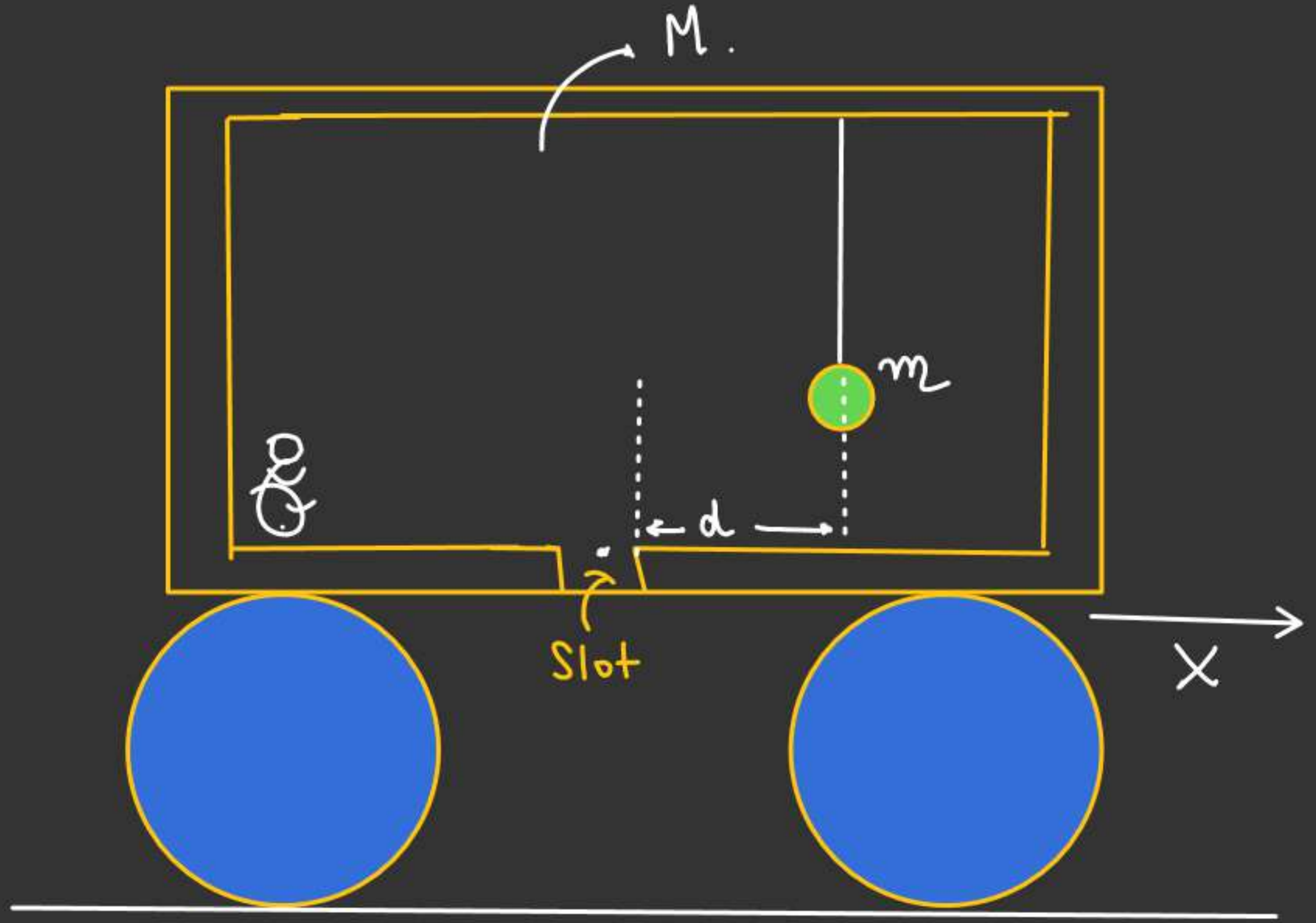
MOTION OF COM

Case $[\Delta X_{com} = 0]$

\# String breakes and ball of mass finally drop in the slot. Find displacement of trolley.



$$\Delta X_{com} = 0. \qquad (F_{ext})_x = 0.$$

$$(V_{com})_i = 0.$$

$$\vec{X}_{ball/E} = \vec{X}_{ball/trolley} + \vec{X}_{trolley/E}$$

$$= -d\hat{i} + X\hat{i}$$

$$= (X-d)\hat{i}.$$

$$\Delta \vec{X}_{com} = 0$$

$$\frac{MX\hat{i} + m(X-d)\hat{i}}{(M+m)} = 0$$

$$X(M+m) = md.$$

$$X = \left(\frac{md}{M+m}\right) \checkmark$$

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MOTION OF COM

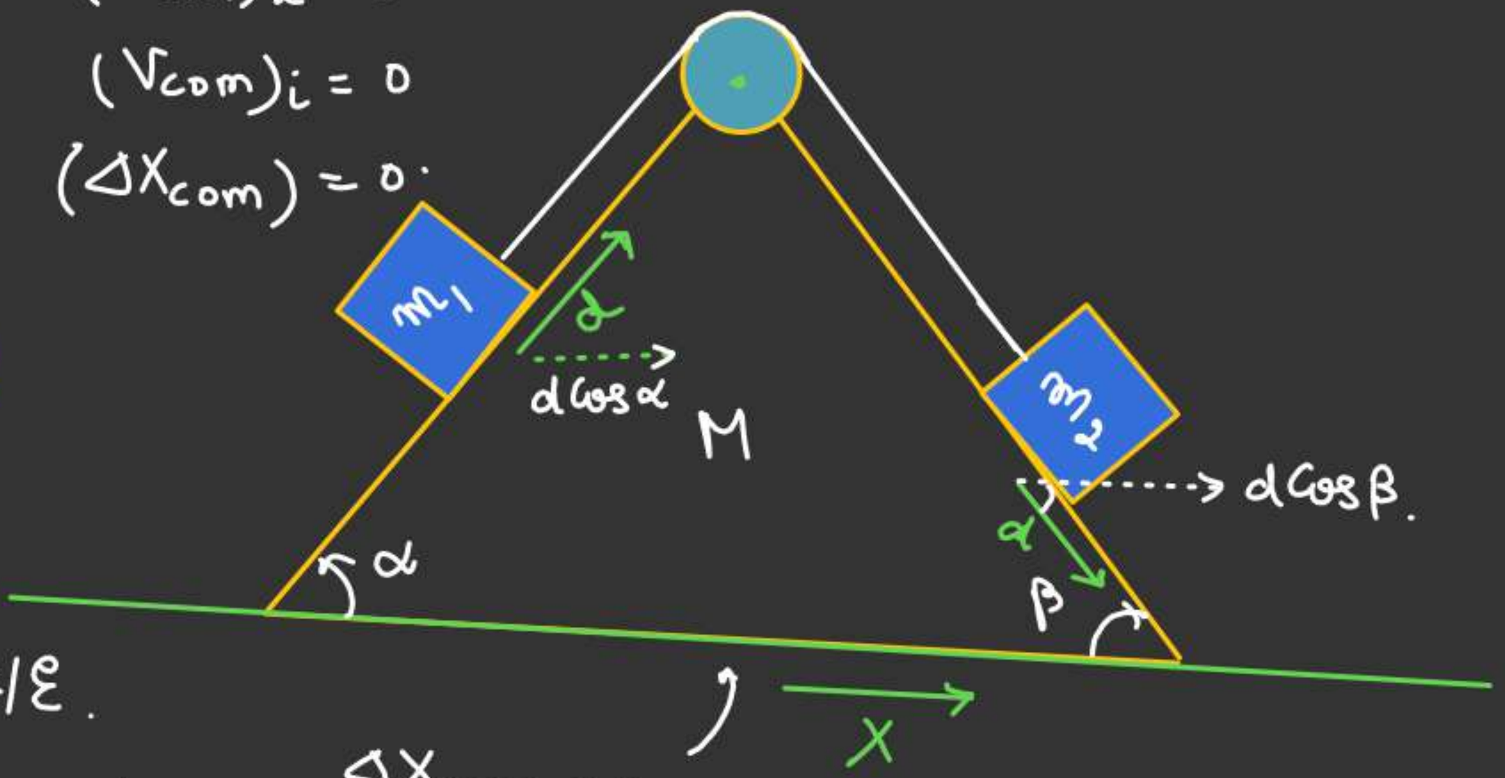
Case $[\Delta X_{com} = 0]$

All the contact surfaces are smooth.
System is released from rest.
Find displacement of wedge if d be the displacement of blocks w.r.t wedge

$(F_{ext})_x = 0$

$(V_{com})_i = 0$

$(\Delta X_{com}) = 0.$



Sol^n

$$\vec{X}_{m_1/E} = \vec{X}_{m_1/wedge} + \vec{X}_{wedge/E}$$

$$= (d\cos\alpha)\hat{i} + X\hat{i}$$

$$= (d\cos\alpha + X)\hat{i}$$

$$\vec{X}_{m_2/E} = \vec{X}_{m_2/wedge} + \vec{X}_{wedge/E}$$

$$= d\cos\beta\,\hat{i} + X\hat{i}$$

$$= (d\cos\beta + X)\hat{i}$$

$\Delta X_{com} = 0.$

$$\frac{m_1(d\cos\alpha + X)\hat{i} + m_2(d\cos\beta + X)\hat{i} + MX\hat{i}}{(m_1+m_2+M)} = 0$$

$$(m_1+m_2+M)X = d(m_2\cos\beta - m_1\cos\alpha)$$

$$\boxed{X = \frac{(m_2\cos\beta - m_1\cos\alpha)d}{m_1+m_2+M}}$$

MOTION OF COM

Case [$\Delta X_{com} = 0$]

Find $X = ??$