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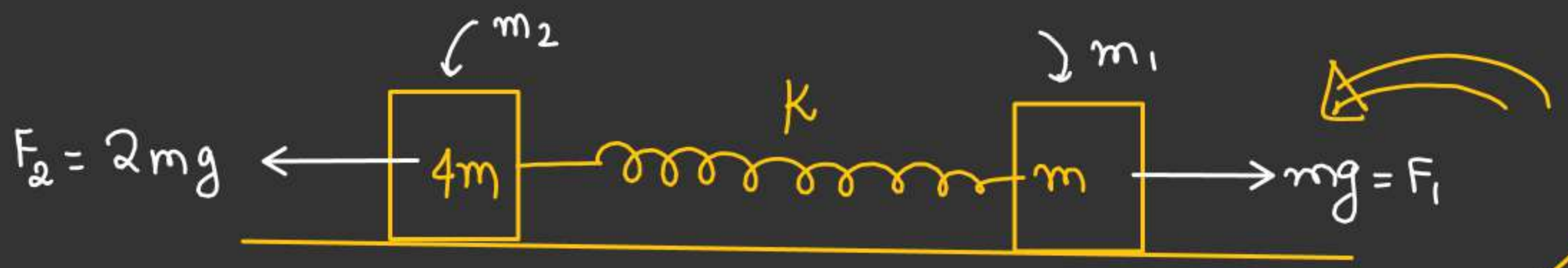
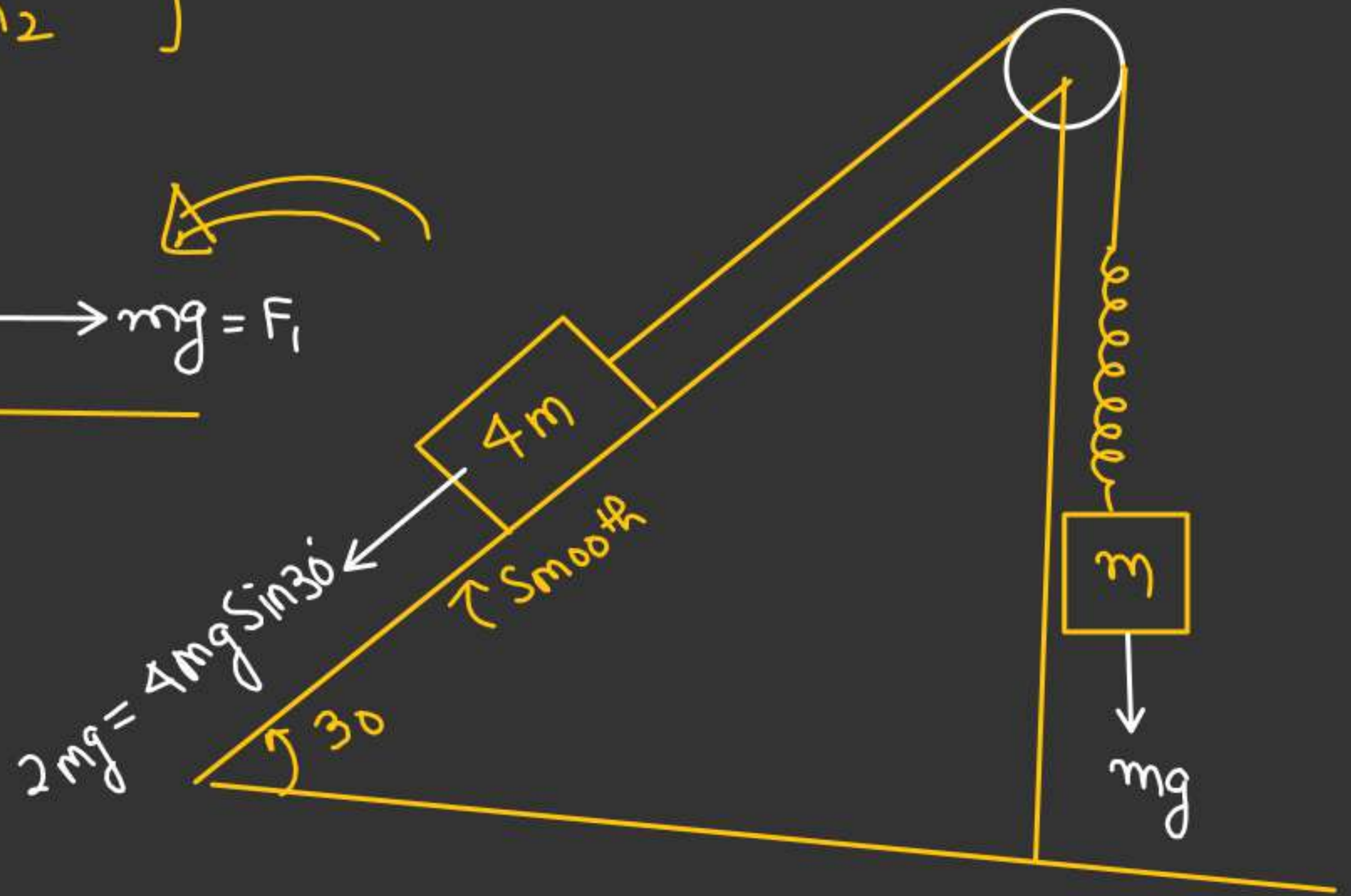
$$x_{max} = \frac{2}{K}\left[\frac{m_1 F_2 + m_2 F_1}{m_1+m_2}\right]$$





$$x_{max} = \frac{2}{K}\left[\frac{(mg)(2mg)+(4m)mg}{5m}\right]$$

$$= \frac{2}{K}\left[\frac{6m^2g}{5m}\right] = \left(\frac{12mg}{5K}\right)$$

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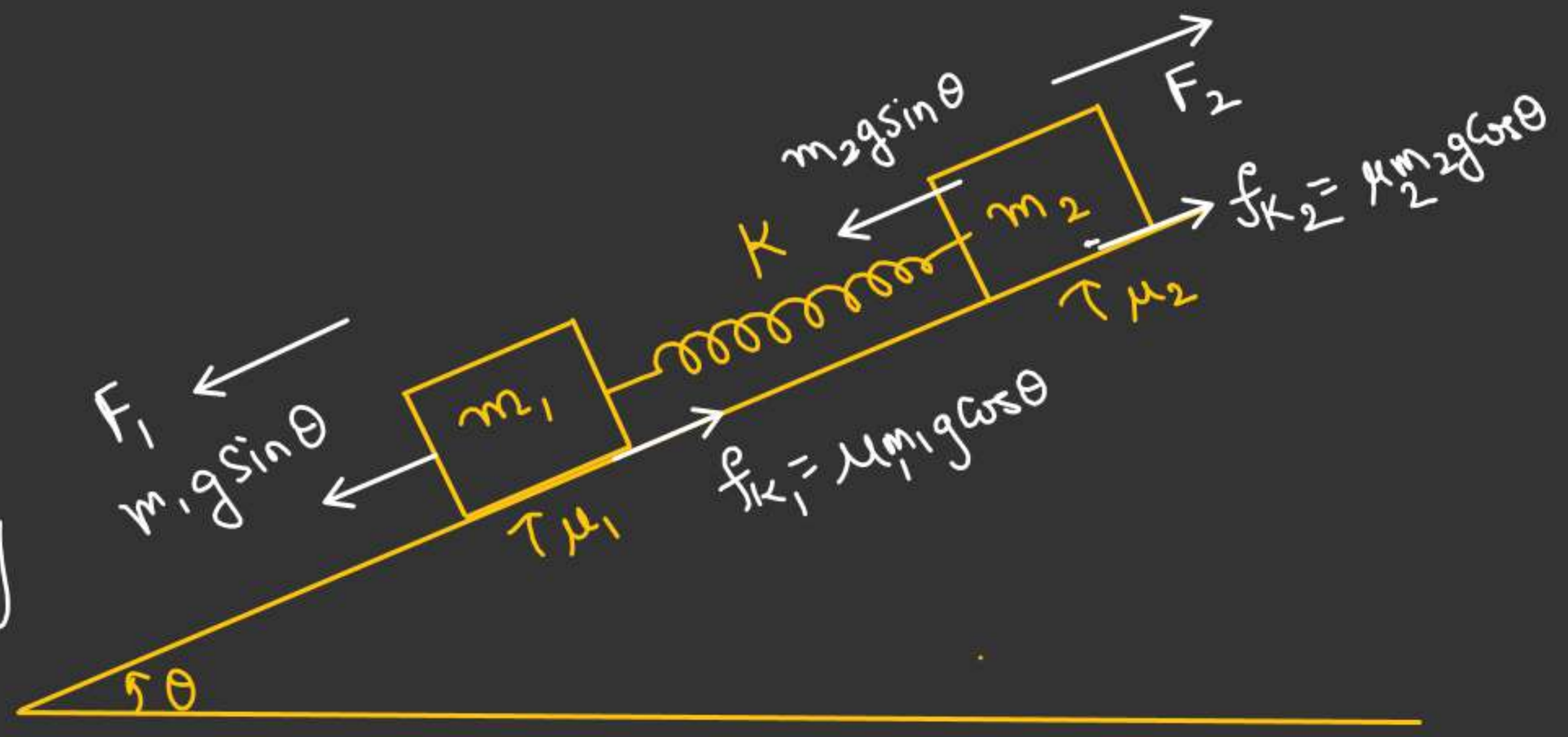
Kinetic friction acting b/w m_1 & m_2

Find x_{max} in the Spring.



$$F_1 = [m_1 g\sin\theta - \mu_1 m_1 g\cos\theta]$$

$$F_2 = [\mu_2 m_2 g\cos\theta - m_2 g\sin\theta]$$

$$x_{max} = \frac{2}{k}\left[\frac{m_2(m_1 g\sin\theta - \mu_1 m_1 g\cos\theta) + m_1(\mu_2 m_2 g\cos\theta - m_2 g\sin\theta)}{m_1+m_2}\right]$$

$$x_{max} = \frac{2}{k}\left[\frac{(\mu_2-\mu_1)\, m_1 m_2 g\cos\theta}{m_1+m_2}\right]$$

① If $\mu_2 > \mu_1$

$x_{max} > 0 \Rightarrow$ elongation.

② If $\mu_2 < \mu_1$

$x_{max} < 0 \Rightarrow$ Compression

③ $\mu_1 = \mu_2 \Rightarrow$ Spring at its Natural length.

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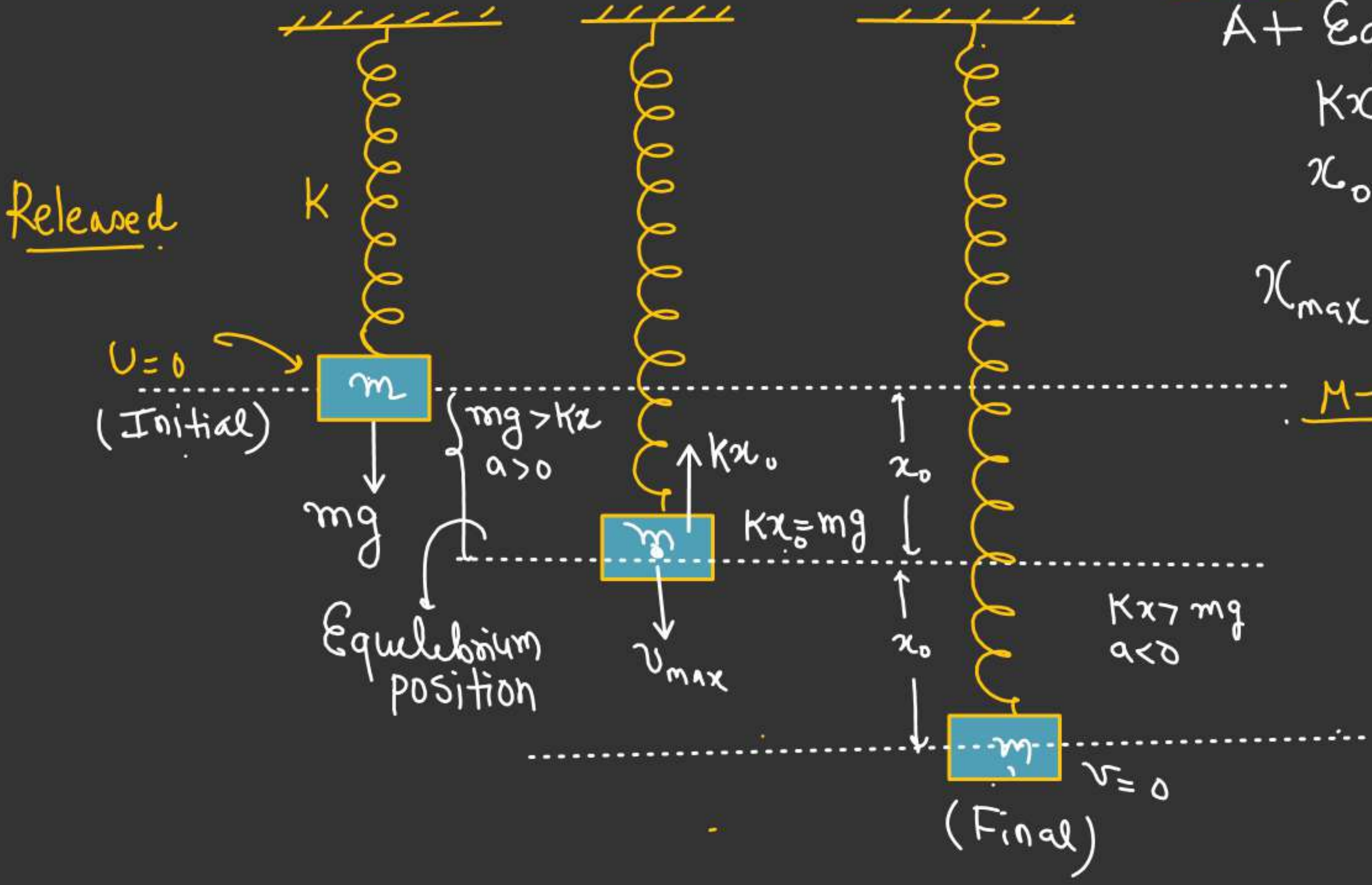
Vertical Spring

Block is released when Spring at its Natural length.



M-1 (Force Method)

At Equlibrium

$$Kx_0 = mg$$

$$x_0 = \frac{mg}{K}$$

$$x_{max} = 2x_0 = \frac{2mg}{K}$$

M-2:- By work-Energy theorem or Energy conservation.

$$U_i + K.E_i = U_f + \cancel{K.E_f}^{\,0}$$

$$0 \qquad 0 \quad = -mg\,x_{max} + \frac{1}{2}Kx_{max}^2$$

$$\left(x_{max} = \frac{2mg}{K} \right)$$

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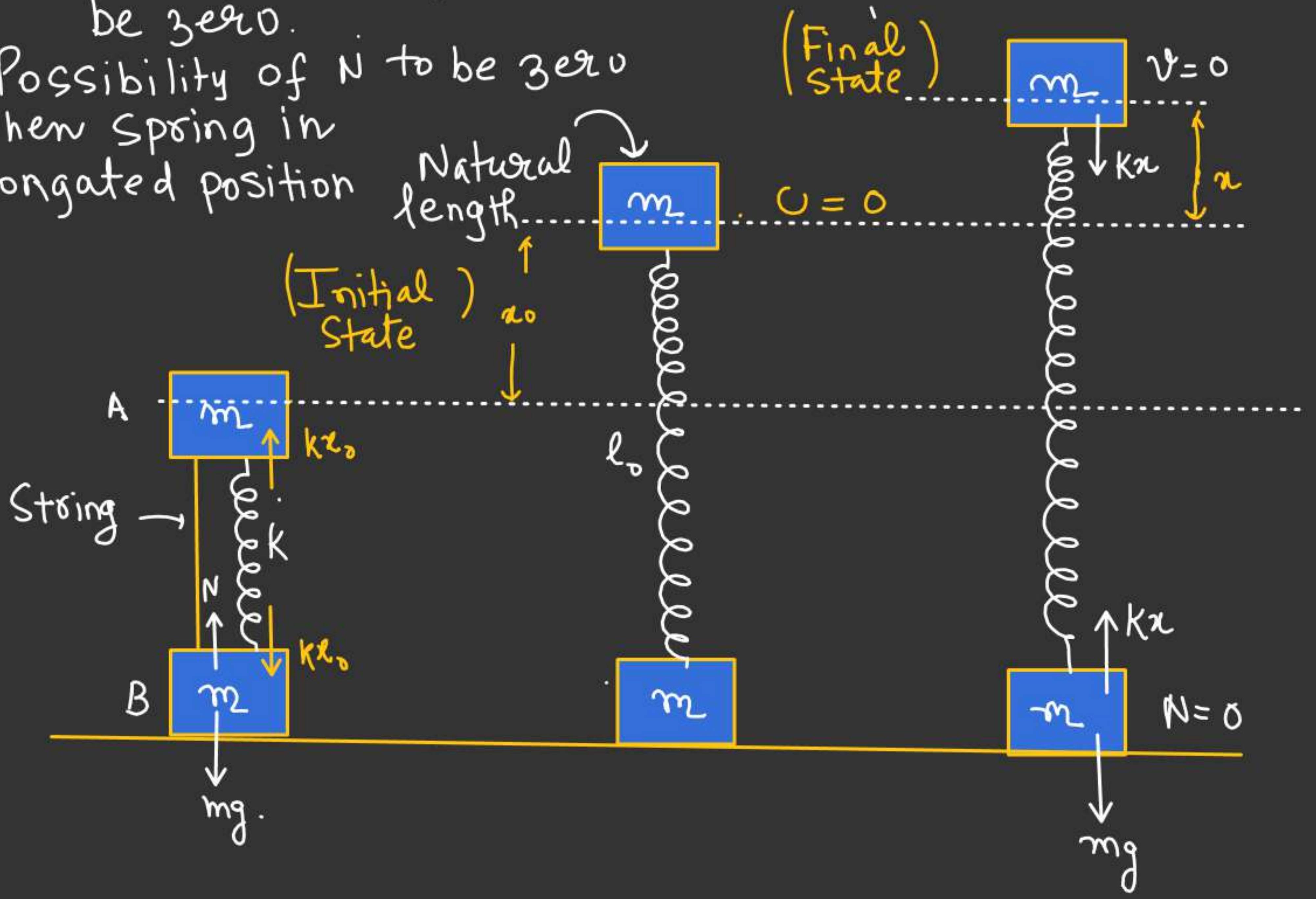
When Spring at Compressed State N of B never be zero.

Possibility of N to be zero when spring in elongated position



Two block tight with a String.
When String is burn find min. initial compression in the Spring so that block B looses Contact with the ground.

Condition for N to be zero

$$Kx \geq Mg.$$

$x \rightarrow$ elongation in the Spring.

$$Kx = mg \Rightarrow x = \frac{mg}{K}$$

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Energy Conservation.

$$U_i + K.E_i = U_f + K.E_f$$ ✓

$$-mgx_0 + \frac{1}{2}Kx_0^2 + 0 = mgx + \frac{1}{2}Kx^2 + 0$$

$$-mgx_0 + \frac{1}{2}Kx_0^2 = mg\left(\frac{mg}{K}\right) + \frac{1}{2}K\left(\frac{mg}{K}\right)^2$$

$$\frac{Kx_0^2}{2} - mgx_0 = \frac{m^2g^2}{K} + \frac{m^2g^2}{2K}$$

$$\frac{K}{2}x_0^2 - mgx_0 - \frac{3m^2g^2}{2K} = 0$$

$$x_0^2 - \frac{2mg}{K}x_0 - \frac{3m^2g^2}{2K} \times \frac{2}{K} = 0$$

$$x_0^2 - \frac{2mg}{K}x_0 - 3\frac{m^2g^2}{K^2} = 0.$$

$$x_0 = \frac{\frac{2mg}{K} \pm \sqrt{\frac{4m^2g^2}{K^2} + \frac{12m^2g^2}{K^2}}}{2}$$

$$x_0 = \frac{1}{2}\left(\frac{2mg}{K} \pm \frac{4mg}{K}\right)$$

+ve Root

$$x_0 = \frac{1}{2}\left(\frac{6mg}{K}\right)$$

$$\boxed{x_0 = \frac{3mg}{K}}$$ ✓

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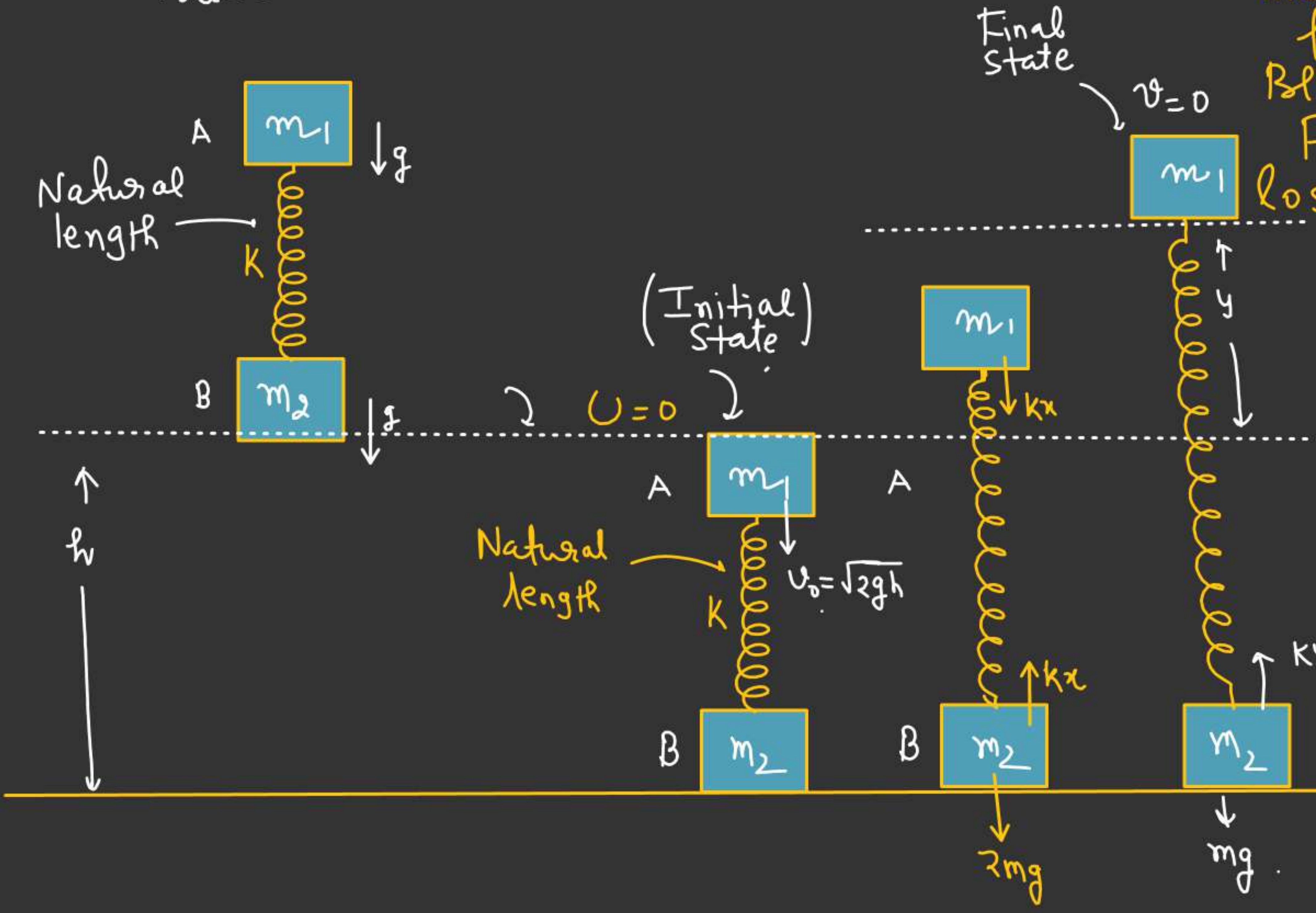
$a_{rel} = 0$.

$v_{rel} = 0$



The whole System released from rest at height h. Block B Stick to the ground. Find h_{min} so that block B losses contact from the ground.

For Block to loose contact.

$$ky \geq m_2 g$$

In limiting condition

$$ky = m_2 g$$

$$y = \left(\frac{m_2 g}{k}\right)$$

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$v_0 = \sqrt{2gh}$

Energy Conservation from initial state to final state.

$$\frac{1}{2} m_1 v_0^2 = m_1 g y + \frac{1}{2} K y^2$$

$$\frac{m_1}{2} \times (2g\underset{(h_{min})}{h}) = m_1 g \left(\frac{m_2 g}{K}\right) + \frac{1}{2} K \left(\frac{m_2 g}{K}\right)^2$$

$$m_1 g h_{min} = \left(\frac{m_1 m_2 g^2}{K} + \frac{m_2^2 g^2}{2K}\right)$$

$$\cancel{m_1 g}\, h_{min} = \frac{\cancel{m_1} m_2 g^{\cancel{2}}}{K}\left(1 + \frac{m_2}{2m_1}\right)$$

$$h_{min} = \frac{m_2 g}{K}\left(1 + \frac{m_2}{2m_1}\right)$$

$$\boxed{h_{min} = \frac{m_2 g}{K}\left(1 + \frac{m_2}{2m_1}\right)}$$