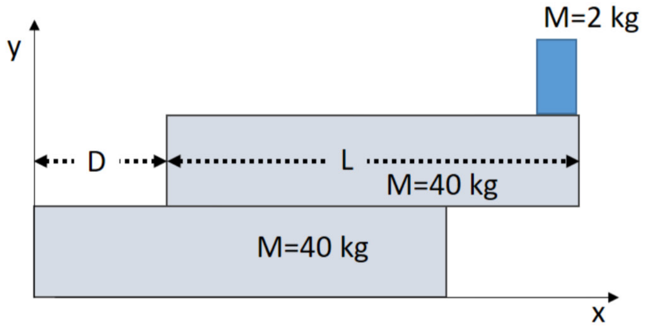
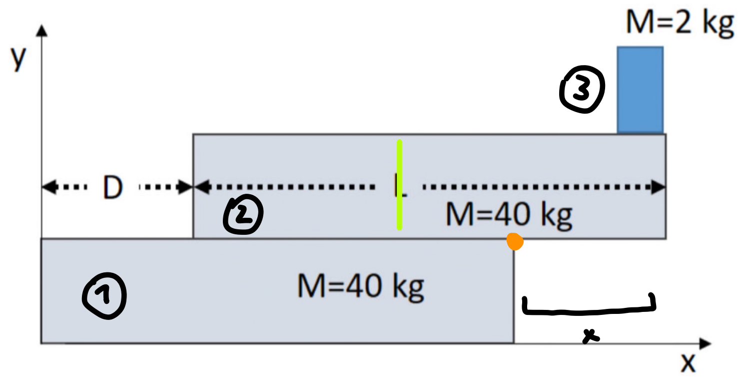
B. The equilibrium game

Find the maximum displacement D to which you can move the top slab (length L) with respect to the bottom one before the top slab will tip-top down. The blue body (M=2 kg) is at one edge of the top sla
(take it with a negligible size with respect to L).





$m_1 = 40\,Kg$

$m_2 = 40\,Kg$

$m_3 = 2\,Kg$

LET'S SUPPOSE THAT ① = ②, THAT IS

$L_1 = L_2$

IF WE WANT TO FIND X WE KNOW THAT

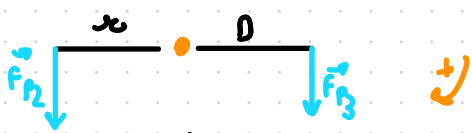
$D + L_2 = L_1 + x$; THAT IS

$x = D$

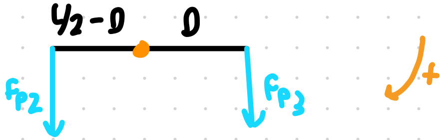
THE CENTER OF MASS OF ② IS LOCATED ON THE GREEN ON THE X-HALF OF ②.(L/2) F_{P_2} WILL BE EQUAL TO m_2 MULTIPLY THE GRAVITATIONAL ACCELERATION, THAT IS

$$F_{P_2} = m_2\, g$$

IF WE CONSIDER THE FULCRUS AS THE TOP RIGTH CORNER OF ① WE CAN SUMMARIZE THE SITUATION AS FOLLOWS:



TO FIND THE VALUE OF x WE KNOW THAT THE WEIGTH FORCE OF ② IS APPLIED ON THE X-AXIS-LINE OF ② THAT IS ON $L/2$ SO WE KNOW THAT $x + D = L/2$ THAT IS $x = L/2 - D$



TO BE IN EQUILIBRIUM WE MUST HAVE

(CHOOSE THE CLOCKWISE ROTATION AS THE POSITIVE ONE)

$$F_{P3} \cdot D - F_{P2}\left(L/2 - D\right) = 0 \quad \text{THAT IS}$$

$$m_3 g D - m_2 g \left(\frac{L}{2} - D\right) = 0$$

$$m_3 g D = m_2 g \left(\frac{L}{2} - D\right)$$

WE CAN MULTIPLY BOTH SIDE OF THE EQUATION BY $\frac{1}{g}$

$$m_3 D = m_2 \left(\frac{L}{2} - D\right)$$

$$m_3 D = m_2 \frac{L}{2} - m_2 D$$

$$D\left(m_3 + m_2\right) = m_2 L/2$$

$$D = \frac{m_2 L}{2\left(m_3 + m_2\right)}$$

- IF $D > \dfrac{m_2 L}{2(m_3 + m_2)}$ THERE WILL BE A CLOCKWISE ROTATION OF 2
- IF $D < \dfrac{m_2 L}{2(m_3 + m_2)}$ THERE WILL BE A COUNTER-CLOCKWISE ROTATION OF 2