L14

23 July 2021 11:05 AM

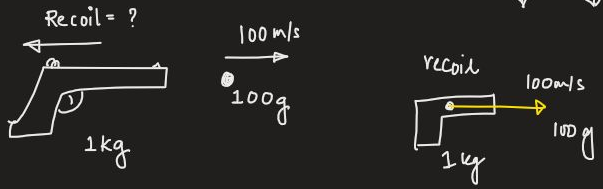
Conservation of Linear MOmentum

$P_f = P_i$ where $P = m \times v$

There should be no external force

The total momentum of an isolated system of interacting particles is conserved.

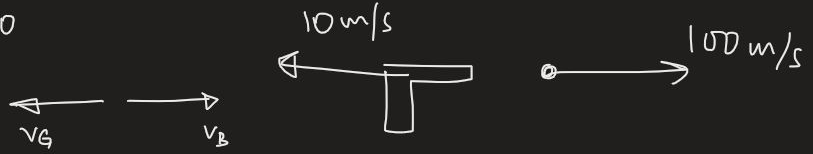
$m_1 a_1 = m_2 a_2$



P_i = Initial momentum of system (Gun + Bullet)

$= M_G \times 0 + M_B \times 0$

$= 0$



$P_f = M_G V_G + M_B V_B$

$= M_G V_G - M_B V_B$ (5.19 Pg 111)

By Conservation of Momentum

$P_f = M_G V_G + M_B V_B$

$= M_G V_G - M_B V_B$ (5.19 Pg 111)

By Conservation of Momentum

$P_i = P_f$

$0 = M_G V_G - M_B V_B$

$0 = 1\,kg\ V_G - \left(\frac{100}{1000}\,kg\right)(100\,m/s)$

$V_G = \frac{1}{10} \times 100\,m/s$

$= 10\,m/s$

"EQUILIBRIUM"

EQUILIBRIUM

Example 5.6 See Fig. 5.8. A mass of 6 kg is suspended by a rope of length 2 m from the ceiling. A force of 50 N in the horizontal direction is applied at the mid-point P of the rope, as shown. What is the angle the rope makes with the vertical in equilibrium? (Take $g = 10\ m\ s^{-2}$). Neglect the mass of the rope.

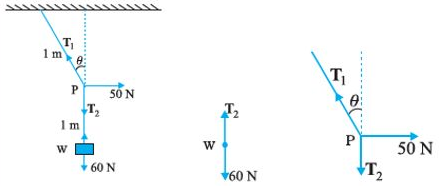
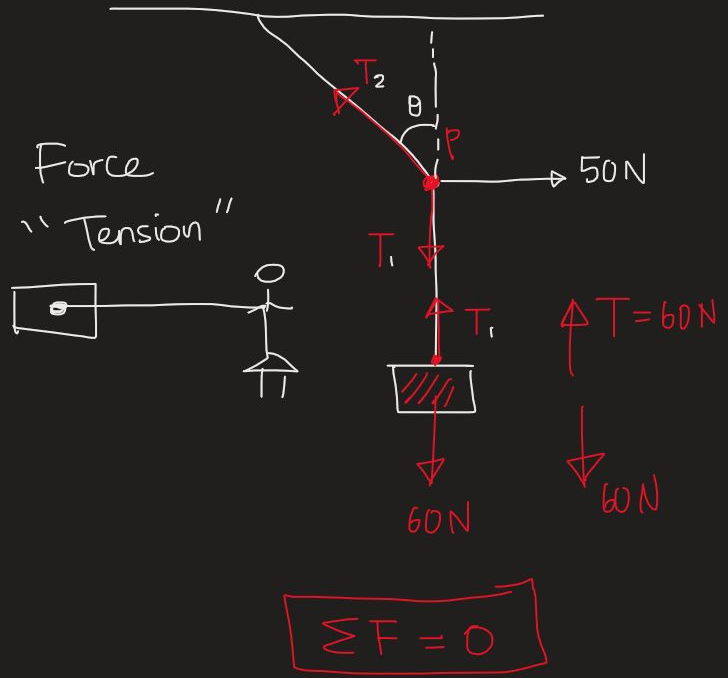


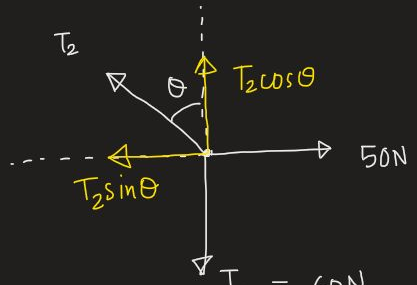
Fig. 5.8

→ " Tension is always away from the body. "

→ " Tension doesn't change if no external force. "



$\Sigma F = 0$



$$\Sigma F_x = 0$$

$$T_2\sin\theta = 50N$$

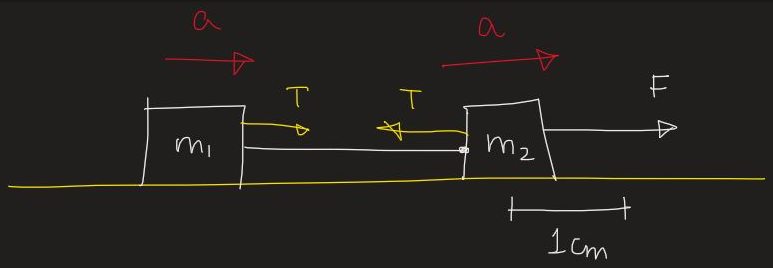
$$\Sigma F_y = 0$$

$$T_2\cos\theta = 60N$$

$$\frac{T_2\sin\theta = 50}{T_2\cos\theta = 60}$$

$$\tan\theta = \frac{5}{6}$$

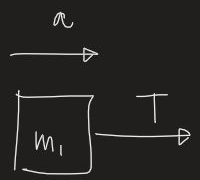
$$\boxed{\theta = \tan^{-1}5/6}$$

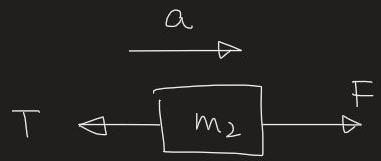


$a = ?$

$T = ?$

CONSTRAINT RELATION → When the acc^n of one body is limited by another body through a string / belt / stick.



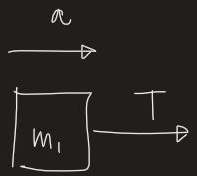


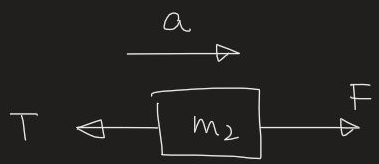
$F = ma$

$$T = m_1 a \quad \text{—— (2)}$$

$\Sigma F = ma$

$$F - T = m_2 a \quad \text{—— (2)}$$





$F = ma$

$T = m_1 a$ — (2)

$\Sigma F = ma$

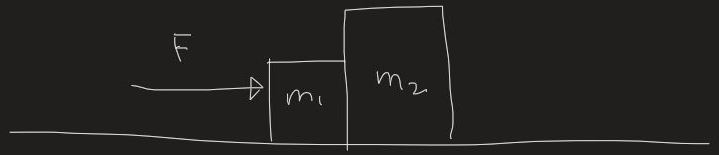
$F - T = m_2 a$ — (2)

$F - m_1 a = m_2 a$

$F = m_1 a + m_2 a$

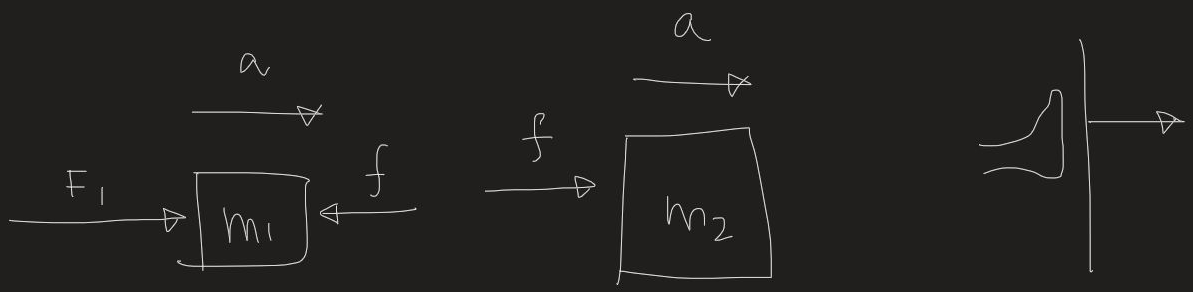
$\frac{F}{m_1 + m_2} = a$

$T = \left(\frac{F m_1}{m_1 + m_2} \right)$



$a = ?$

$f = ?$



$$\Sigma F_x = 0$$

$$F_1 - f = m_1 a \qquad f = m_2 a$$

$$F_1 - m_2 a = m_1 a$$

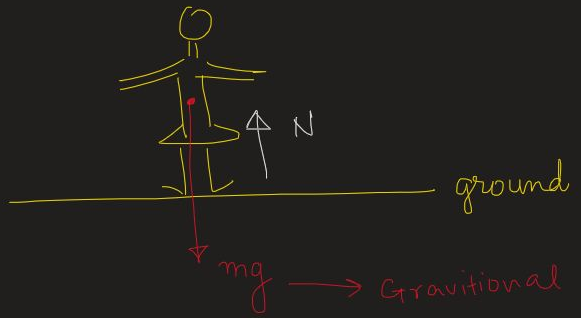
$$a = \frac{F_1}{\quad} \qquad f = m_2 F_1$$

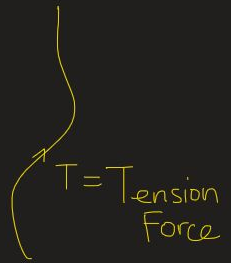
$$F_1 - f = m_1 a \qquad f = m_2 a$$

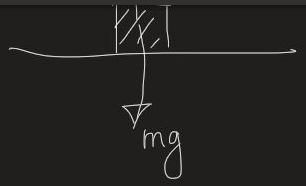
$$F_1 - m_2 a = m_1 a$$

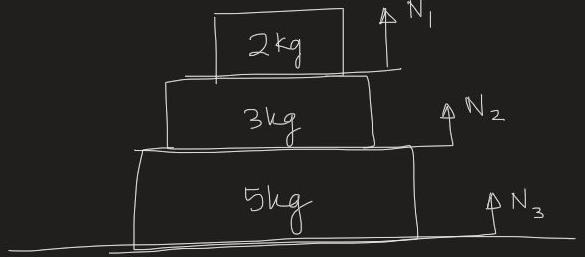
$$a = \frac{F_1}{m_1 + m_2} \qquad f = \frac{m_2 F_1}{m_1 + m_2}$$

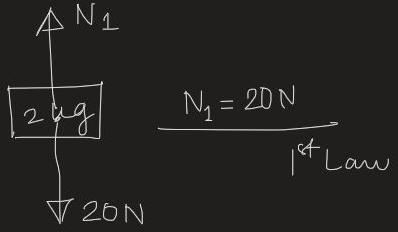
Normal Force

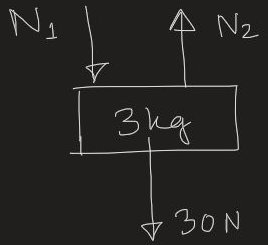






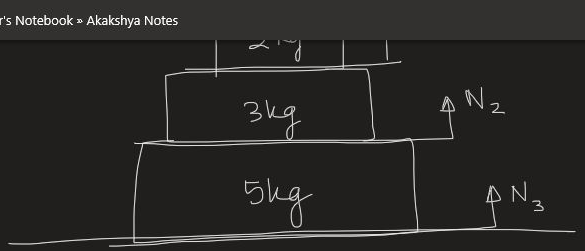






$N_1 + 30 - N_2 = 0$

$N_2 = 50N$?



$N_2 + 50 - N_3 = 0$

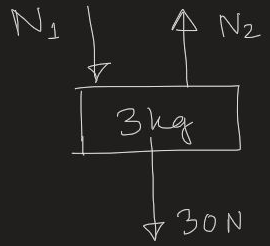
$50 + 50 - N_3 = 0$

$N_3 = 100\,N$

NORMAL FORCE

1st Law

20N



$N_1 + 30 - N_2 = 0$

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