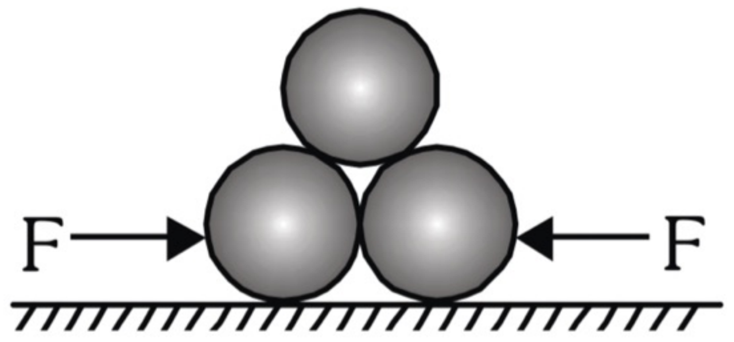
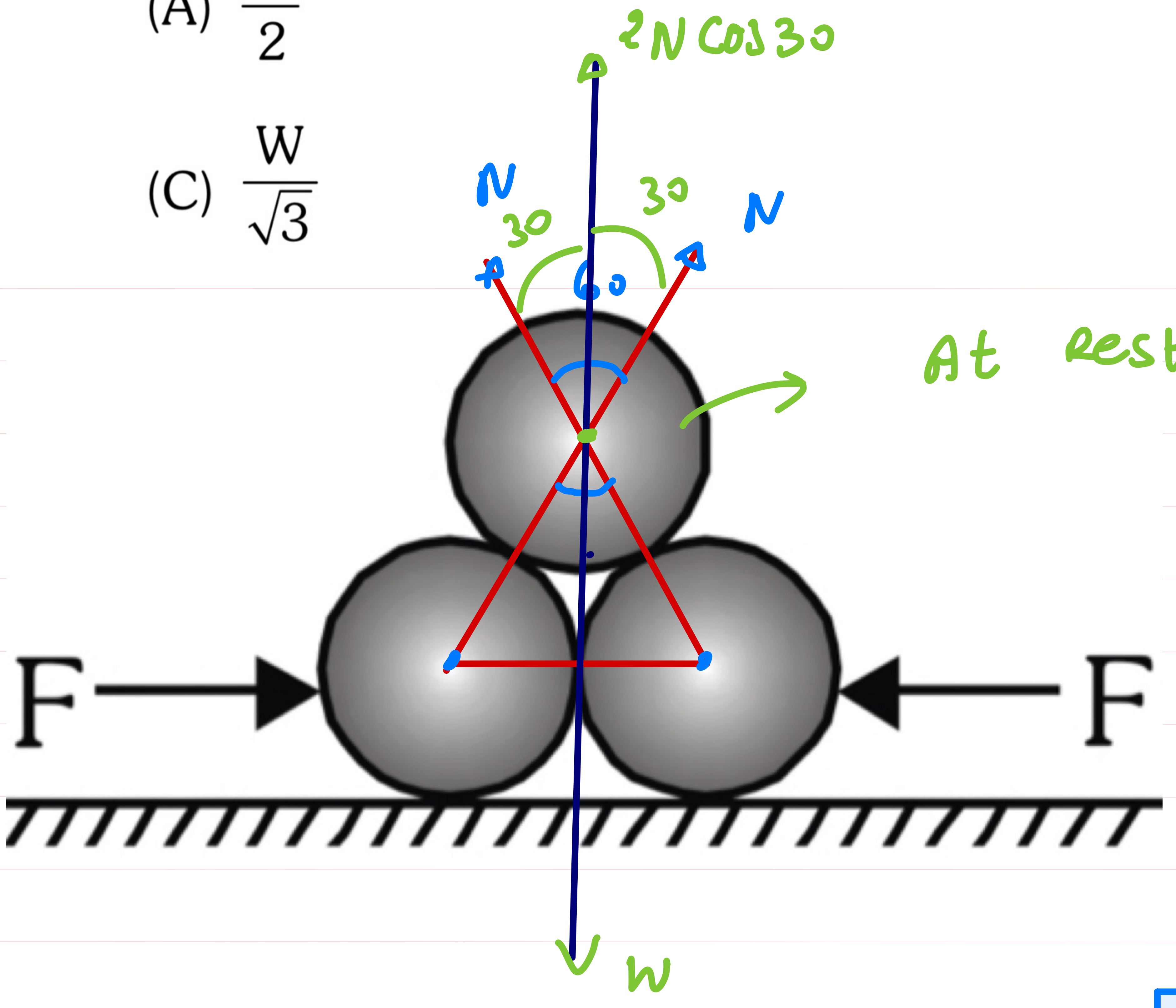
6. Two smooth cylindrical bars weighing W each lie next to each other in contact. A similar third bar is placed over the two bars as shown in figure. Neglecting friction, the minimum horizontal force on each lower bar necessary to keep them together is-

(A) $\frac{W}{2}$ (B) W

(C) $\frac{W}{\sqrt{3}}$ (D) $\frac{W}{2\sqrt{3}}$





At rest $\Sigma F_y = 0$

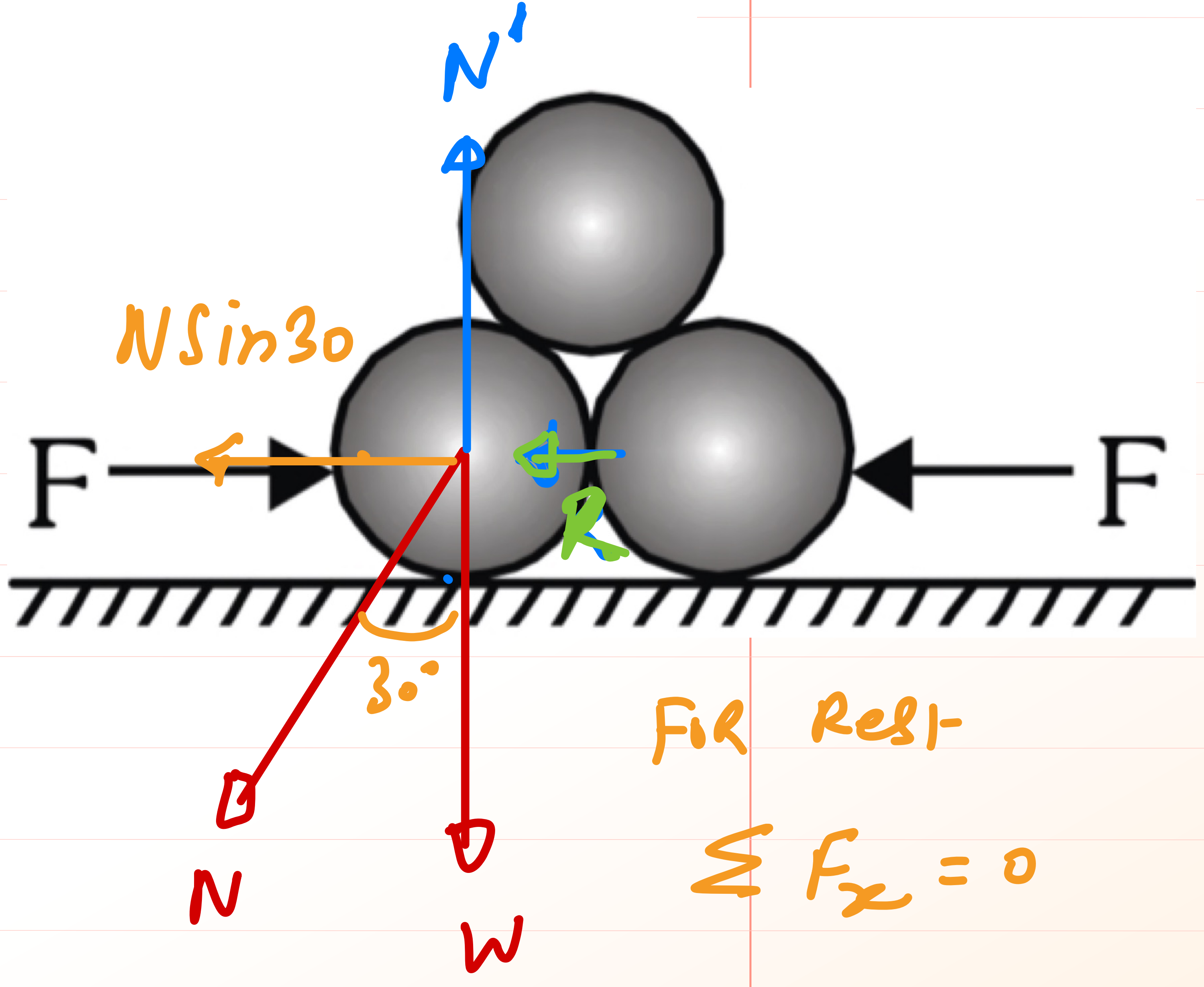
$2N\cos 30 = W$

$N = \frac{W}{\sqrt{3}}$

For $F \to$ min. R must be 0

$$\boxed{F_{min} = \frac{W}{2\sqrt{3}}}$$

Ans



For Rest $\Sigma F_x = 0$

$F - R - N\sin 30 = 0$

$F = R + N\sin 30$

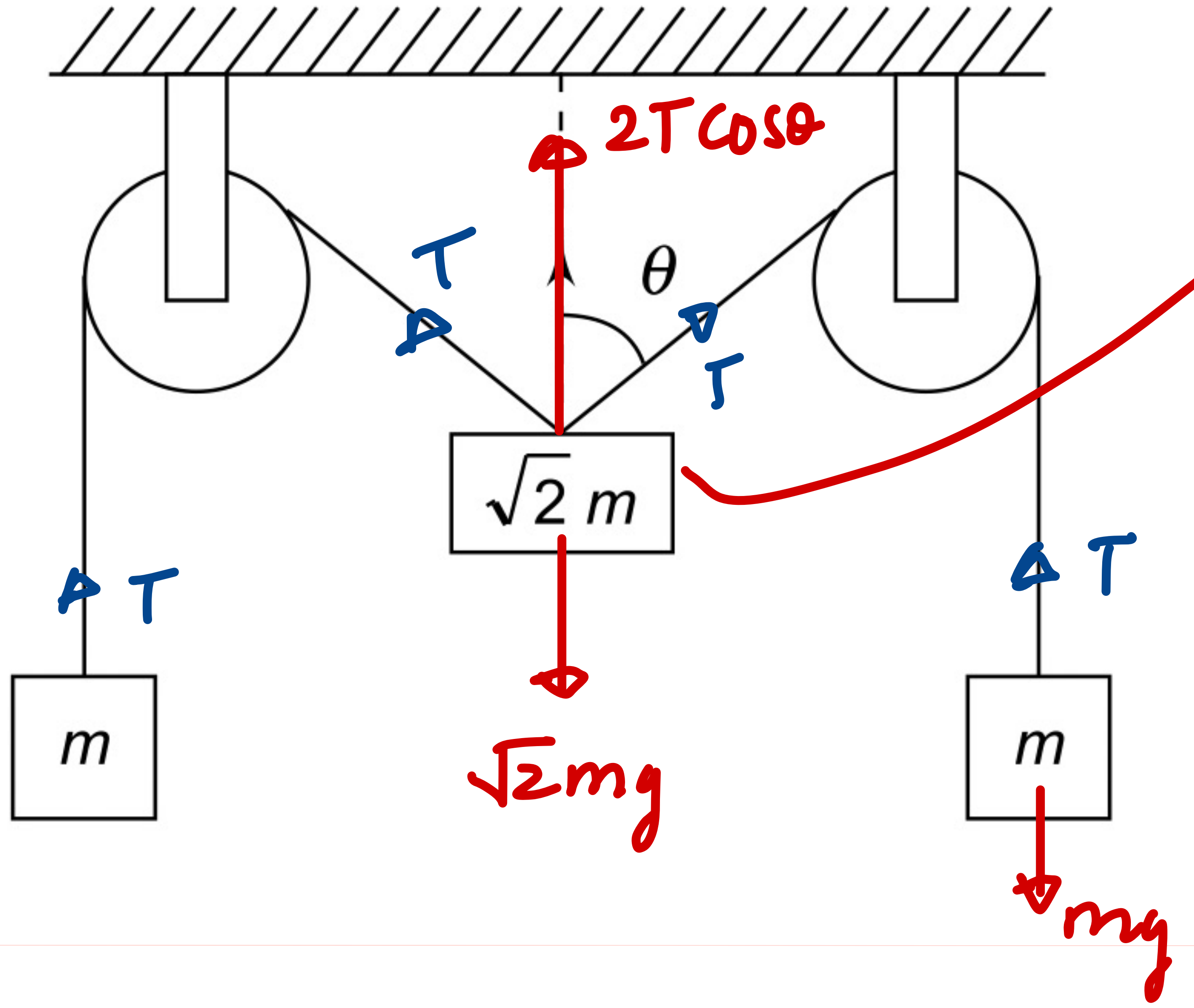
$F = R + \frac{W}{2\sqrt{3}}$

Ex

The pulleys and strings shown in Fig. are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be

(a) 0° (b) 30°
(c) 45° (d) 60°

IIT, 2001



$T = mg$

at Rest

$2T\cos\theta = \sqrt{2}\, mg$

$2(\cancel{mg})\cos\theta = \sqrt{2}\,\cancel{mg}$

$\cos\theta = \frac{\sqrt{2}}{2}$

$\cos\theta = \frac{1}{\sqrt{2}} \Rightarrow \boxed{\theta = 45^\circ}$ Ans

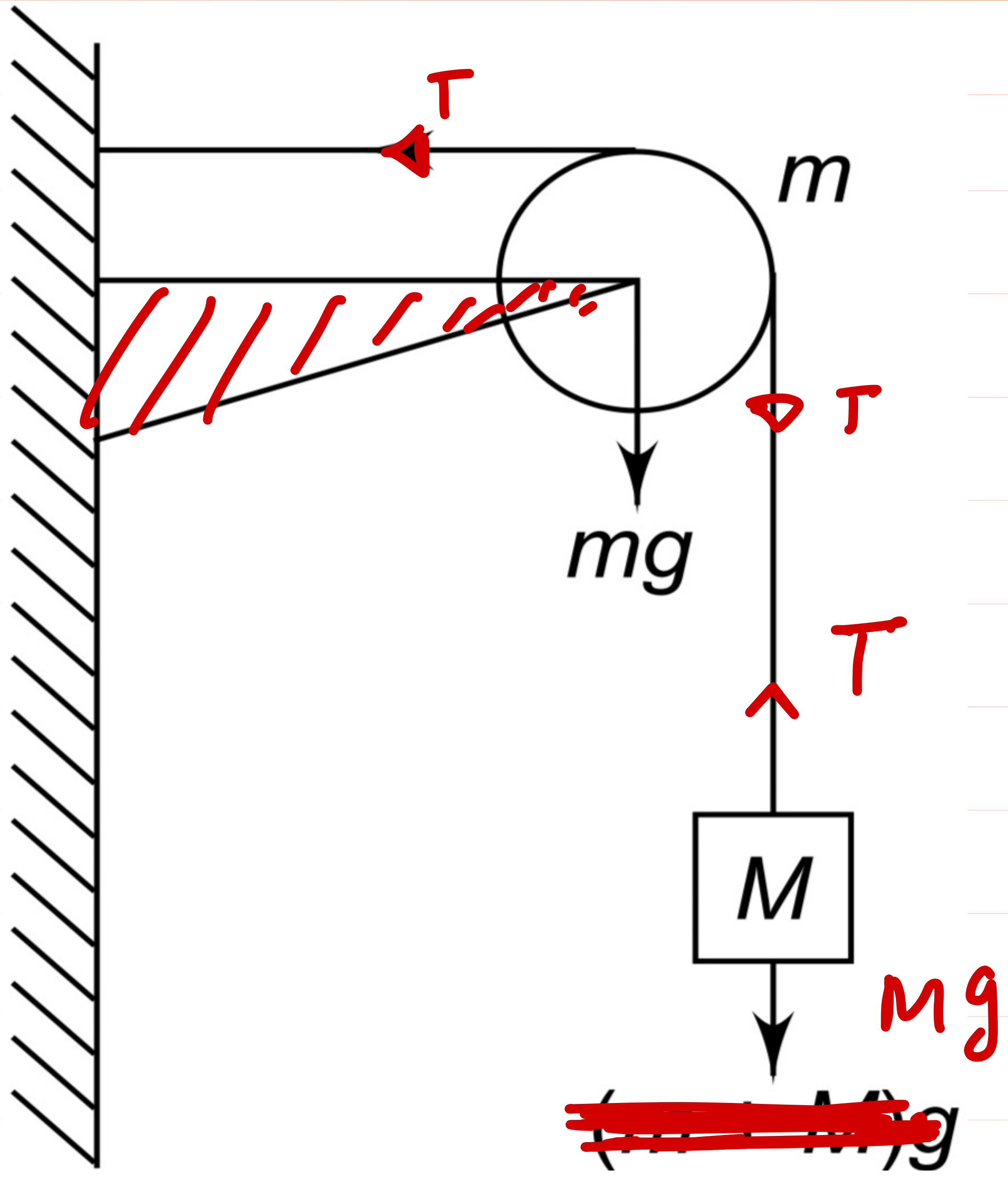
Ex A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown Fig. ~~[illegible]~~5. The force on the pulley by the clamp is given by

(a) $\sqrt{2}\ Mg$

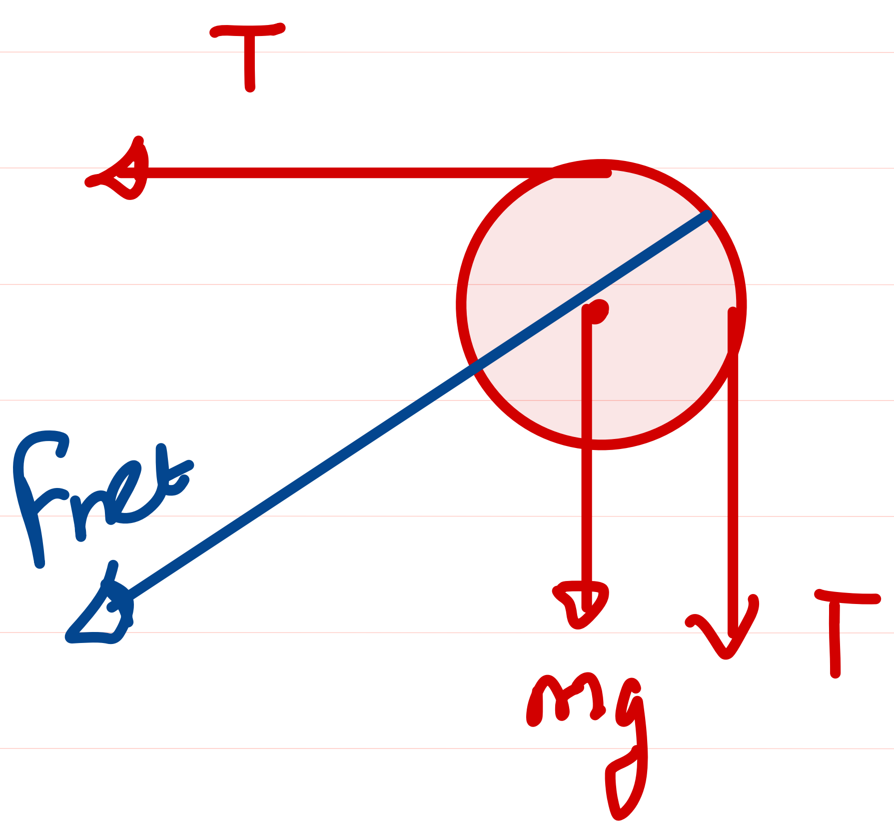
(b) $\sqrt{2}\ mg$

(c) $\sqrt{(M+m)^2+m^2}\ g$

(d) ✓ $\sqrt{(M+m)^2+M^2}\ g$



$T = Mg$



Fnet Force on pulley

$$F_{net} = \sqrt{T^2 + (T+mg)^2}$$

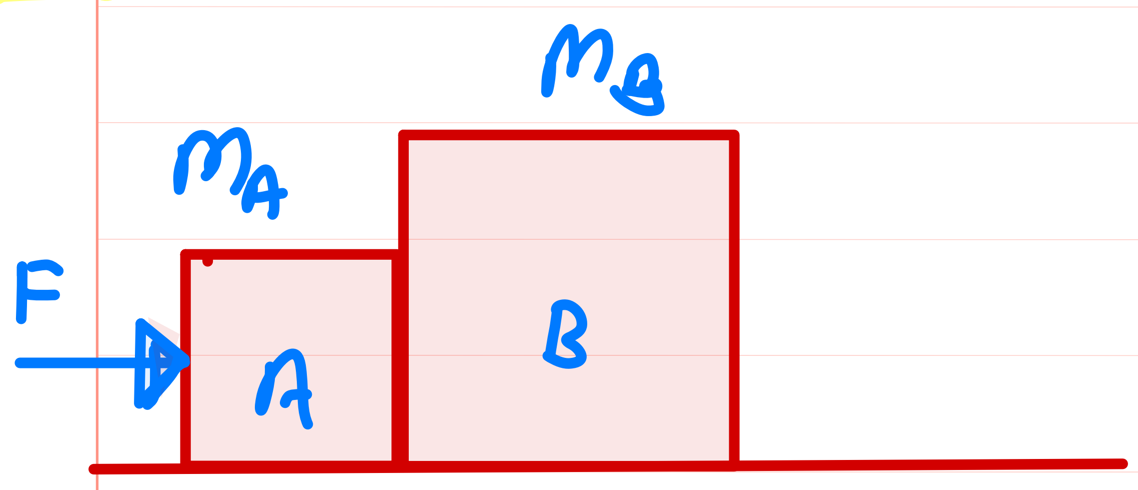
$$= \sqrt{(Mg)^2 + (Mg+mg)^2}$$

$$F_{net} = g\sqrt{M^2 + (M+m)^2}$$

(Motion of Accelerated Bodies)

① When Bodies in contact :→

Ex-1



Smooth surface

Find (i) Acc. of blocks

(ii) Contact Force b/w blocks

(i)

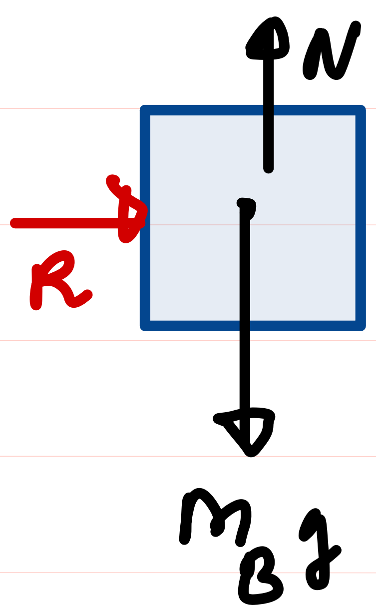
$$\Sigma F_x = M_T \cdot a$$

$$F = (M_A + M_B)\, a$$

$$\boxed{a = \frac{F}{M_A + M_B}}$$

Ans

(ii) F.B.D of B

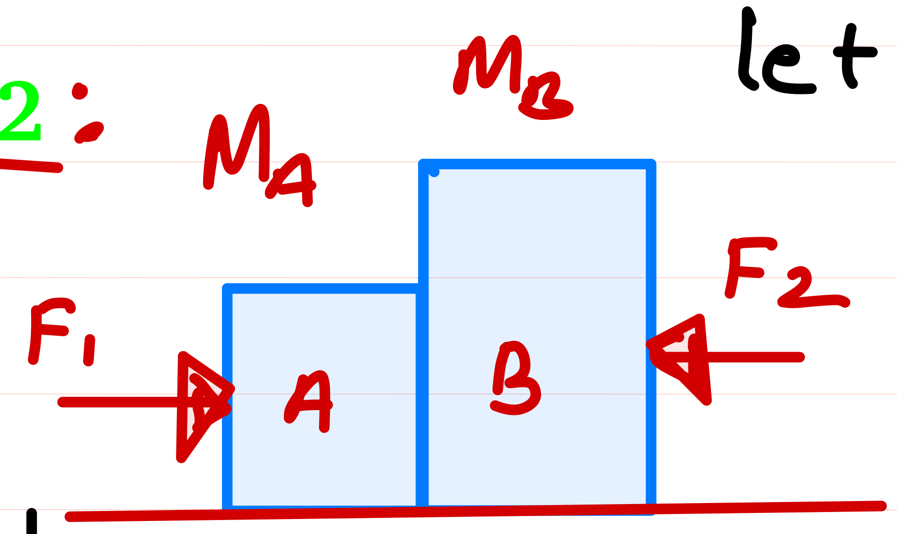


$$F_x = m_B a$$

$$\boxed{R = m_B F / (m_A + m_B)}$$

Ans

Ex-2 :



let $F_1 > F_2$

Smooth surface

Find (i) Acc. of blocks

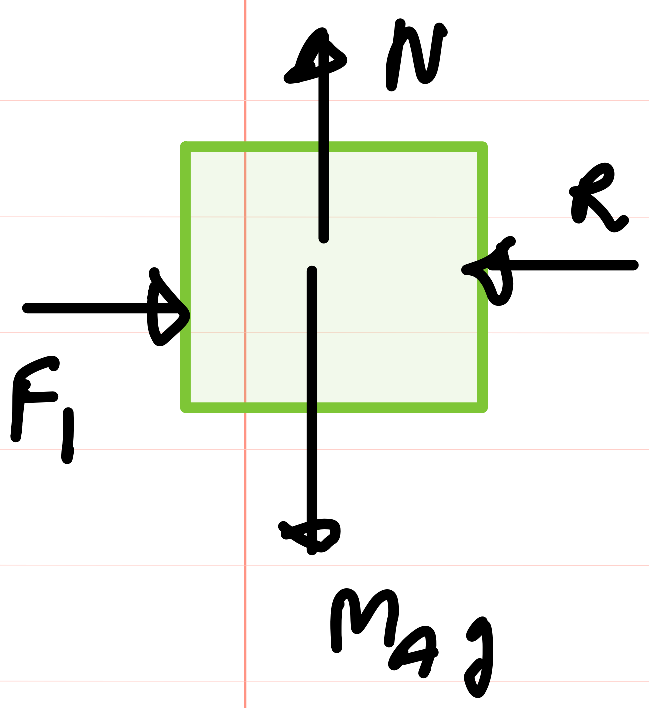
(ii) contact force b/w blocks

(i)

$$a = \frac{\Sigma (F_{net})_x}{M_{Total}}$$

$$\boxed{a = \frac{F_1 - F_2}{M_A + M_B}}$$

(ii) F.B.D of A



$$(F_{net})_x = m_A a$$

$$F_1 - R = m_A a$$

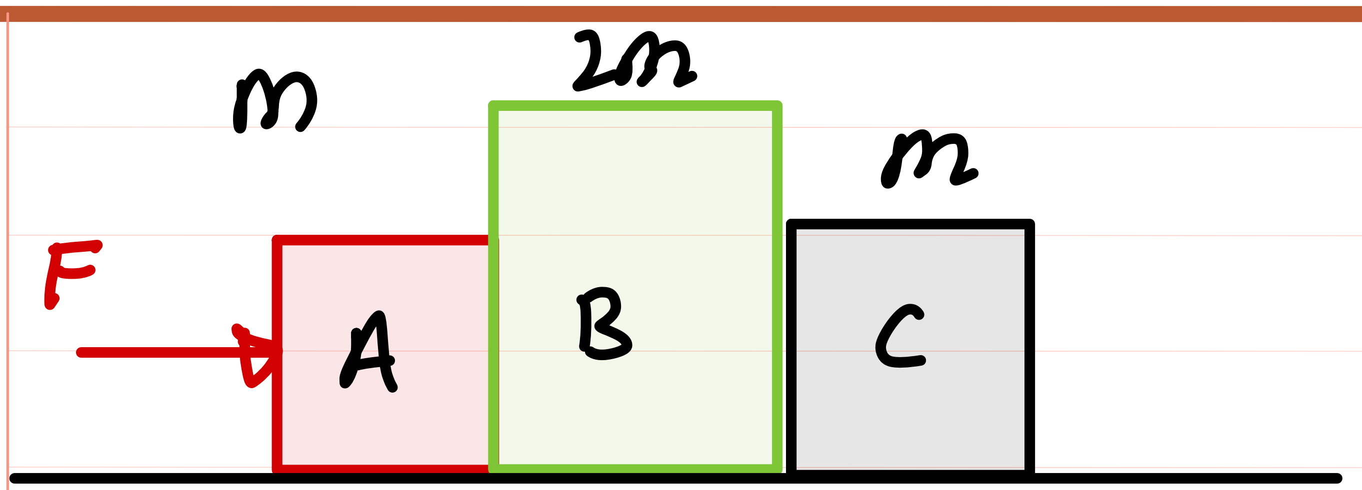
$$R = F_1 - m_A a$$

$$= F_1 - \frac{m_A (F_1 - F_2)}{m_A + m_B}$$

$$\boxed{R = \frac{m_A F_2 + m_B F_1}{m_A + m_B}}$$

Ans

Ex-3



Find (i) acc. of each block

(ii) contact force b/w AB and BC

(i)

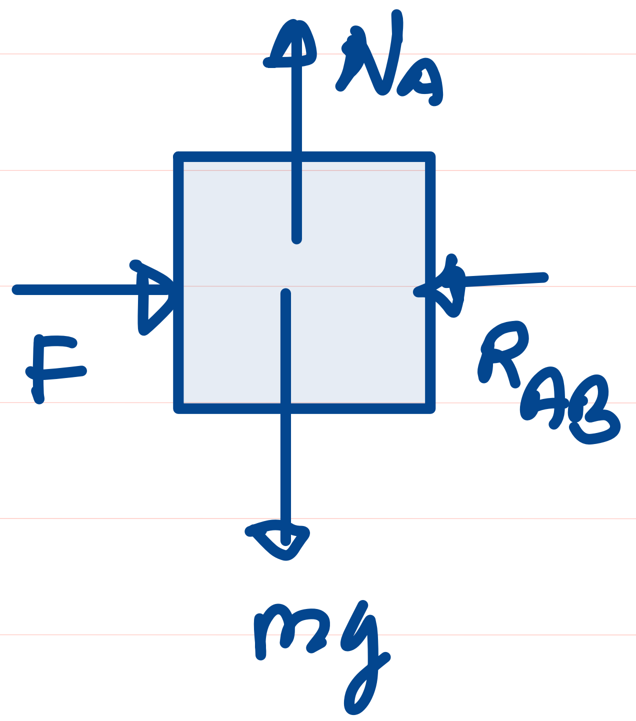
$$a = \frac{F_{net}}{M_{Total}}$$

$$a = \frac{F}{m+2m+m}$$

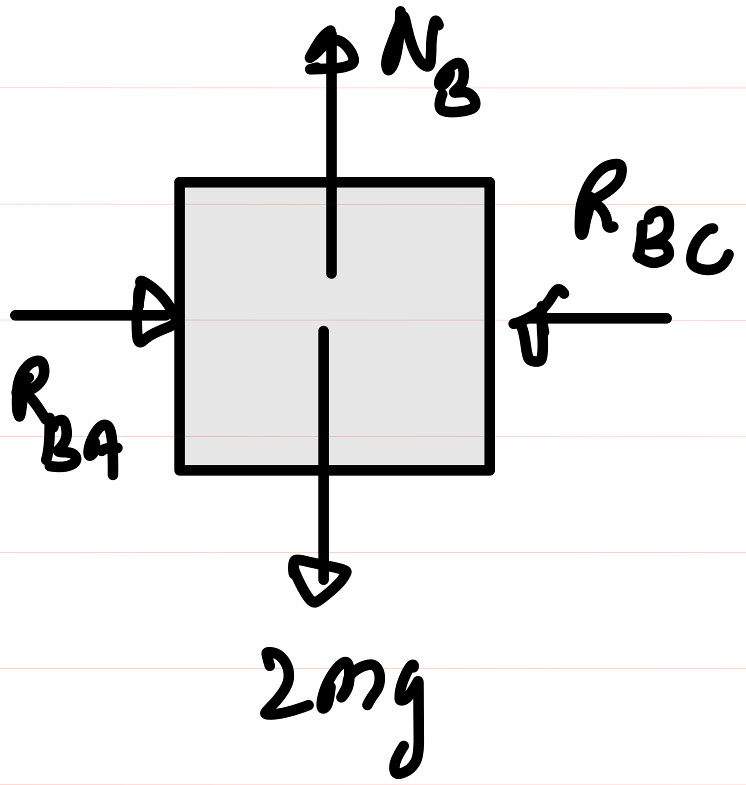
$$\boxed{a = \frac{F}{4m}}$$ Ans

(ii)

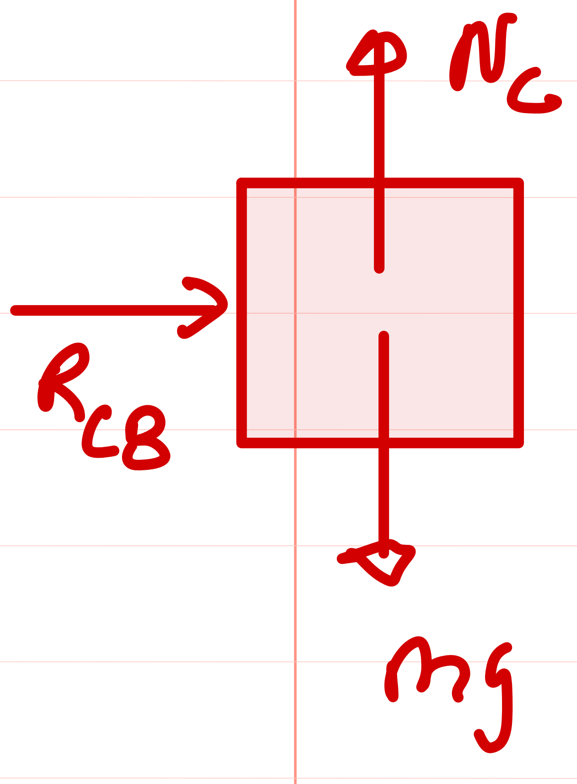
F.B.D of A



F.B.D of B



F.B.D of C



$$F - R_{AB} = ma$$

$$F - ma = R_{AB}$$

$$R_{AB} = F - \frac{mF}{4m}$$

$$\boxed{R_{AB} = \frac{3F}{4}}$$

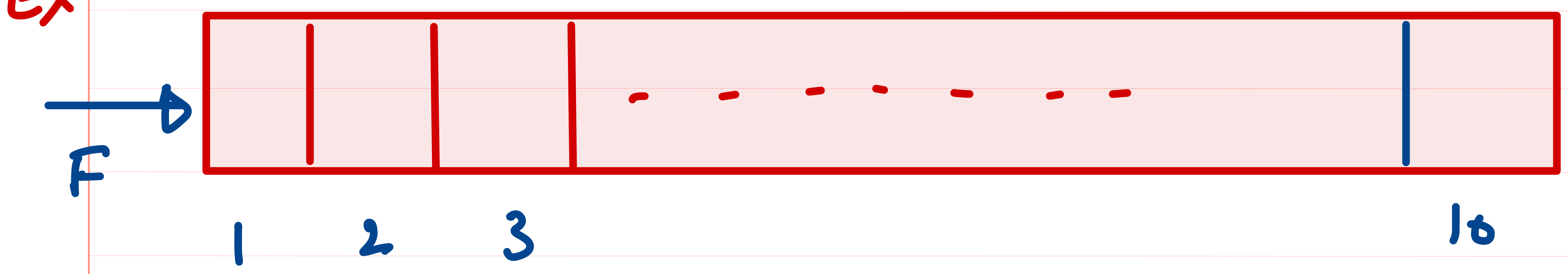
Ans

$$R_{CB} = ma$$

$$= \frac{mF}{4m}$$

$$\boxed{R_{BC} = \frac{F}{4}}$$ Ans

Ex



10 - Identical Blocks of mass m each

Find (i) Acc. of each block

(2) Contact Force b/w 5th and 6th block

(1) $a = \dfrac{F}{10m}$

(2) $R_{56} = 5m \times a$

$= 5m \times \dfrac{F}{10m}$

$R_{AB} = F/2$

(3) $R_{67} = 4m \times a$

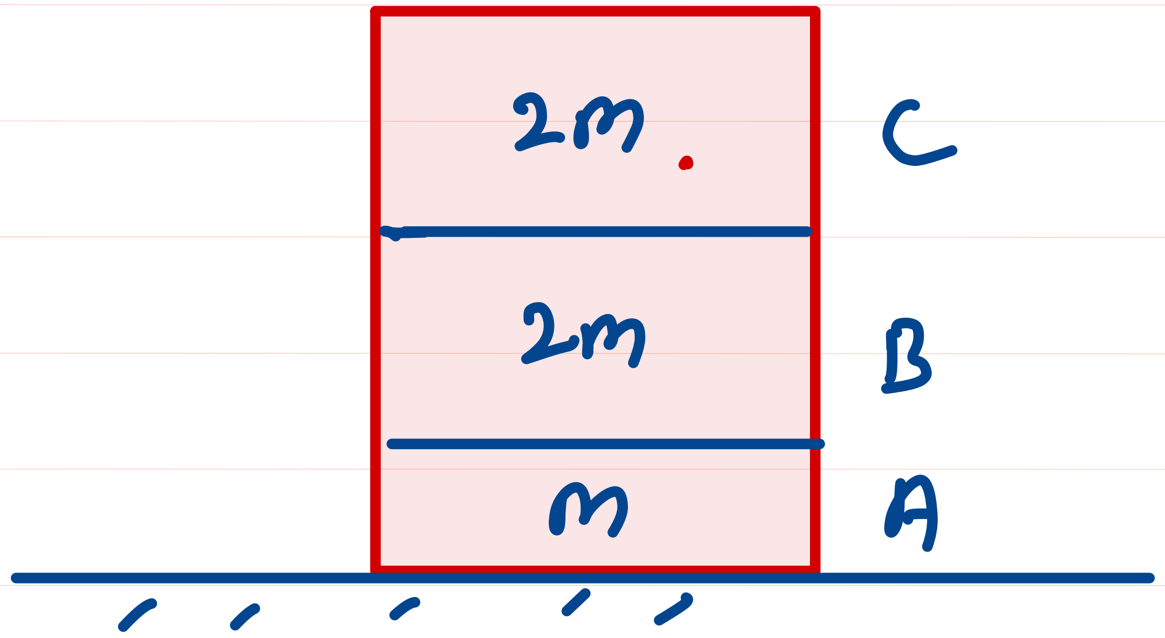
$= 4m \dfrac{F}{10m}$

$R_{67} = \dfrac{2}{5} F$

(4) $R_{34} = 7m \times a$

$R_{34} = \dfrac{7F}{10}$

Blocks in contact in vertical plane



Contact force b/w (Acc. due to gravity = g)

(i) A & B

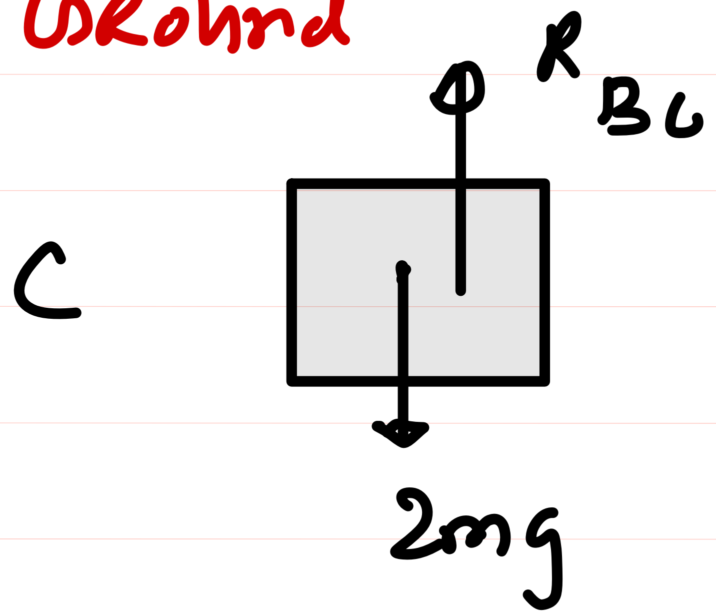
(ii) B & C

(iii) A & Ground

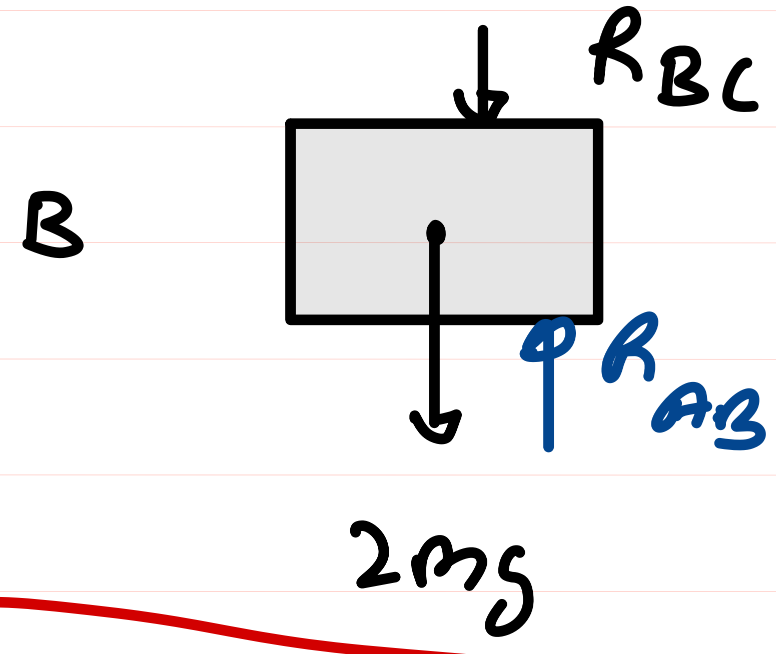
(i) A & B = 4mg

(ii) B & C = 2mg

(iii) A & GR = 5mg

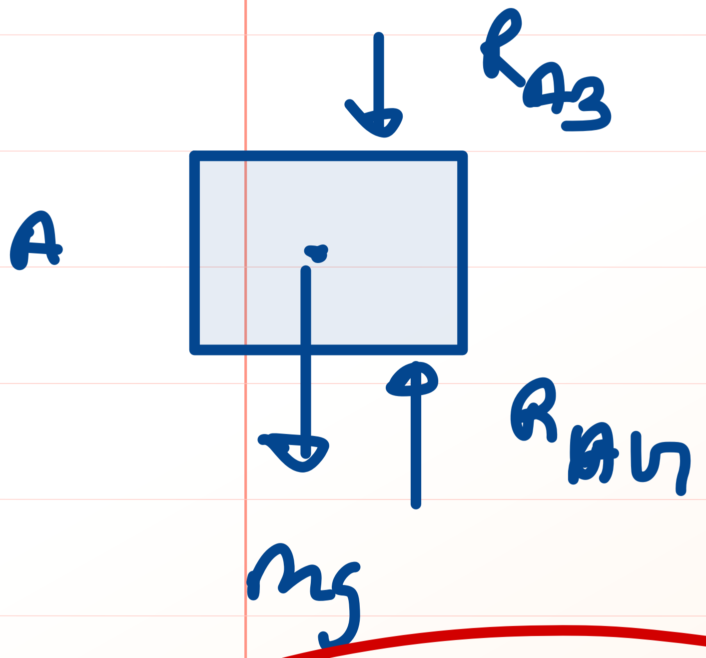


$R_{BC} = 2mg$



$R_{AB} = 2mg + R_{BC}$

$R_{AB} = 4mg$



$R_{AG} = R_{AB} + mg$

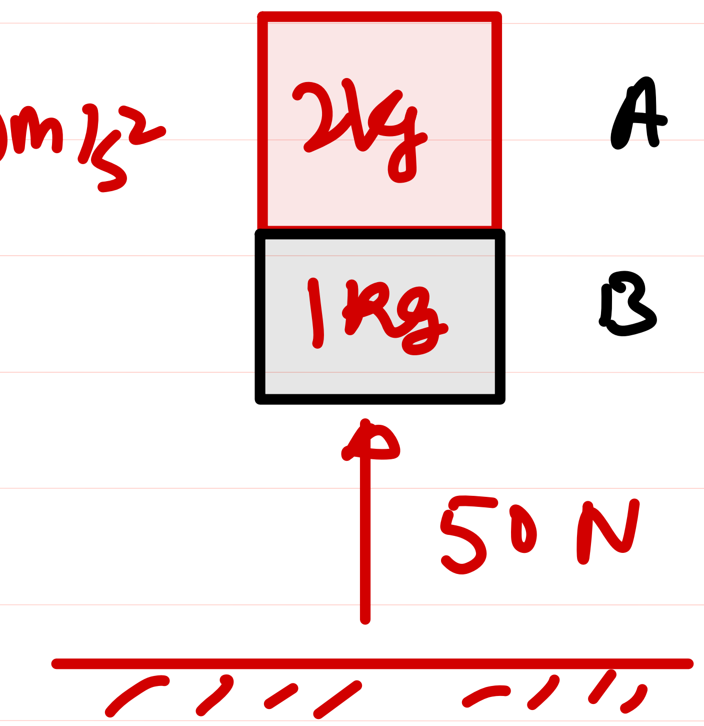
$R_{AG} = 5mg$

Ex

Find (i) acc. of blocks

(ii) Contact force b/w them

$g = 10\, m/s^2$

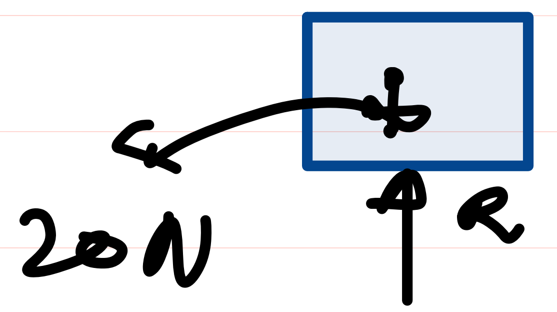


(i) $a = \dfrac{F_{net}}{M_{total}}$

$= \dfrac{50 - 30}{3}$

$$\boxed{a = \frac{20}{3}\, m/s^2}$$

(ii)



2kg

$R - 20 = 2 \times a$

$R = 20 + 2 \times \dfrac{20}{3}$

$$\boxed{R = \frac{100}{3}\, N}$$

Ans