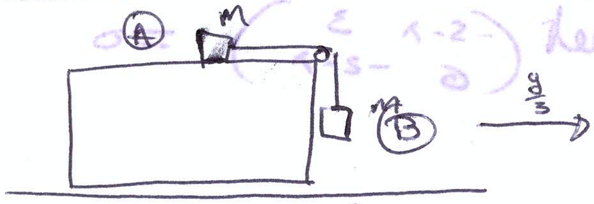
HLC 1991 (multibody Systems)



(i) Mass: (A) m

Forces: R (up), T (right), mg (down)

Accel: f (right), $\frac{g}{3}$ (right)

NII:

$\updownarrow$ $R - mg = 0$, $R = mg$ ①

$\leftrightarrow$ $T = m\left(f + \frac{g}{3}\right)$ ②

(B) m

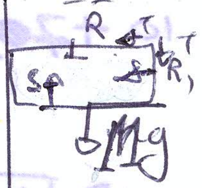
Forces: T (up), R_1 (right), mg (down)

Accel: $\frac{g}{3}$ (right), f (down)

$\updownarrow$ $-T + mg = mf$ ③

$\leftrightarrow$ $R_1 = m\left(\frac{g}{3}\right)$ ④

M Block



Accel: $\frac{g}{3}$ (right)

(not needed)

$\updownarrow$ $R - S - Mg = 0$

$\leftrightarrow$ $P + R_1 = M\left(\frac{g}{3}\right)$

① $\Rightarrow R = mg$

④ $\Rightarrow$ $\boxed{R_1 = mg}$

② and ③ $\Rightarrow$ $-m\left(f + \frac{g}{3}\right) + mg = mf$

$\Rightarrow -mf - \frac{mg}{3} + mg = mf \Rightarrow 2f = \frac{2g}{3} \Rightarrow f = \frac{g}{3}$

$\therefore T = m\left(\frac{g}{3} + \frac{g}{3}\right) \Rightarrow \boxed{T = \frac{2mg}{3}}$

Resultant forces on (A) $T = \frac{2mg}{3}$ N

Resultant forces on (B) $R_1 = \frac{mg}{3}$ N

(ii) Mass: (A) m

Forces: μR (left), R (up), T (right), mg (down)

Accel: $\frac{g}{3}$ (right) — for particles to remain at rest relative to block

NII:

$\updownarrow$ $R = mg$ ①

$\leftrightarrow$ $T - \mu R = \frac{mg}{3}$ ②

(B) m

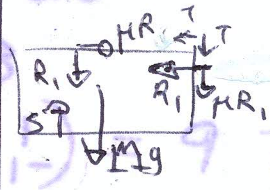
Forces: μR_1 (up), T (up), R_1 (right), mg (down)

Accel: $\frac{g}{3}$ (right)

③ $\updownarrow$ $-T - \mu R_1 + mg = 0$

④ $\leftrightarrow$ $R_1 = \frac{mg}{3}$

M Block



Not Needed

Solve for μ:

①, ② $\Rightarrow$ $T - \mu mg = \frac{mg}{3}$

③, ④ $\Rightarrow$ $-T - \mu\frac{mg}{3} + mg = 0$

$\Rightarrow$ $T = \mu mg + \frac{mg}{3}$, $T = mg - \mu\frac{mg}{3}$

$\Rightarrow \mu mg + \frac{mg}{3} = mg - \mu\frac{mg}{3}$

$\Rightarrow \mu\frac{4mg}{3} = \frac{2mg}{3}$

$\Rightarrow \mu = \frac{1}{2}$