FORCE & FRICTION TUTORIAL

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Pg 116 Comprehension

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Pg 143 94, 95, 97

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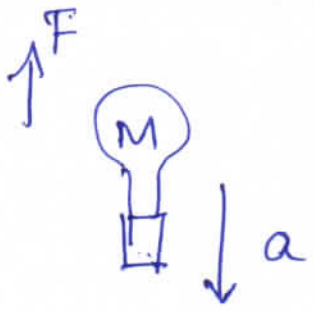
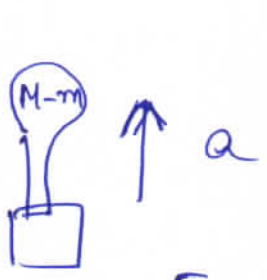
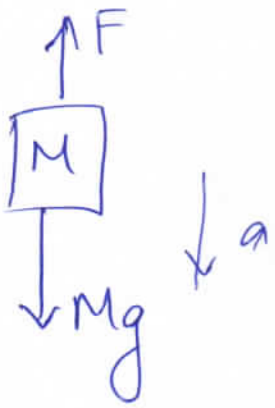
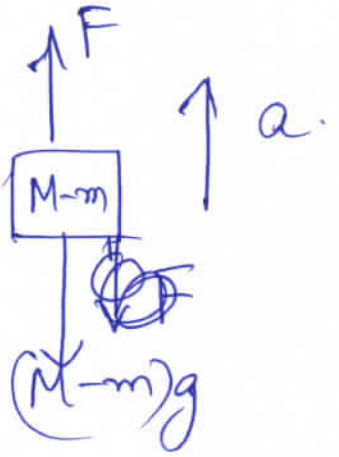
Pg 112

(5)









$Mg - F = Ma.$ $\qquad F - (M-m)g = (M-m)a.$

$Mg - (M-m)g = (2M-m)a.$

$mg = (2M-m)a.$

$m(g+a) = 2Ma$

$m = \dfrac{2Ma}{g+a}.$

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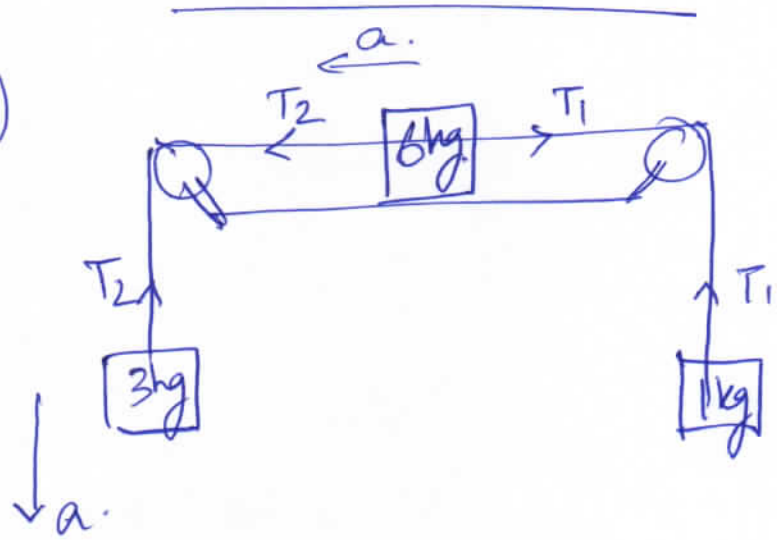
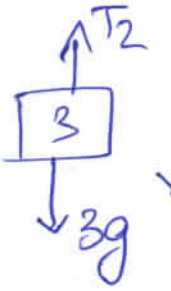
(6)





$3g - T_2 = 3a.$ — ①

$T_1 - 1g = 1a.$ — ②

$T_2 - T_1 = 6a$ — (3)

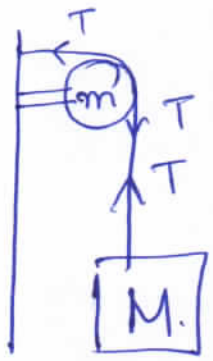
(1) + (2) + (3)

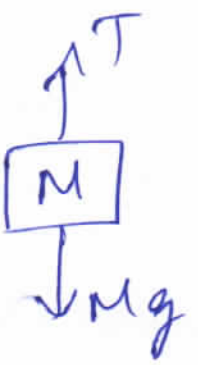
$2g = 10a$

$a = \frac{2g}{10} = 2 m/s^2$

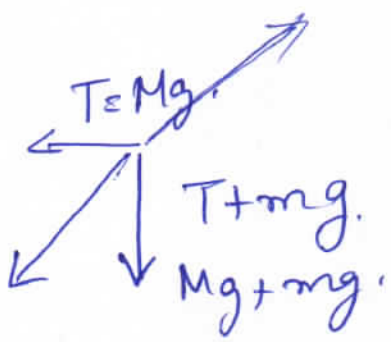
Pg 114

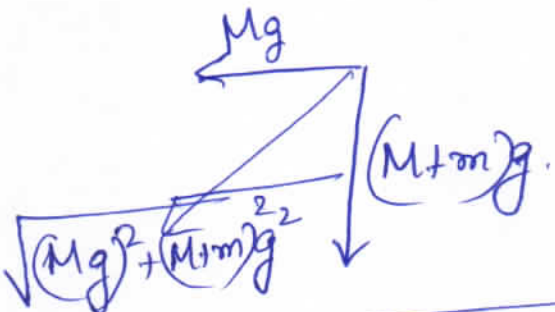
(12)





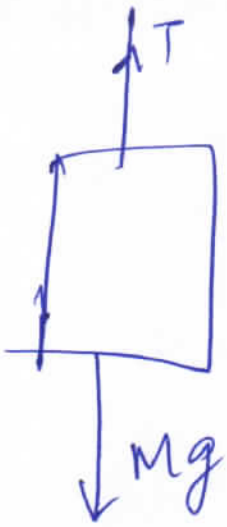
$T = Mg.$





(B) $= \sqrt{M^2 + (M+m)^2}\, g.$

(14)



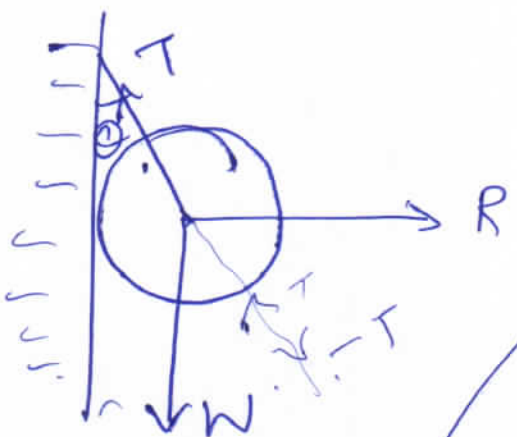
$T = Mg$ ⇊

$a = 0$

$v = \text{const}$.

C, D.

(15)



$T\cos\theta = W$ → (1)

$T\sin\theta = R$ → (2)

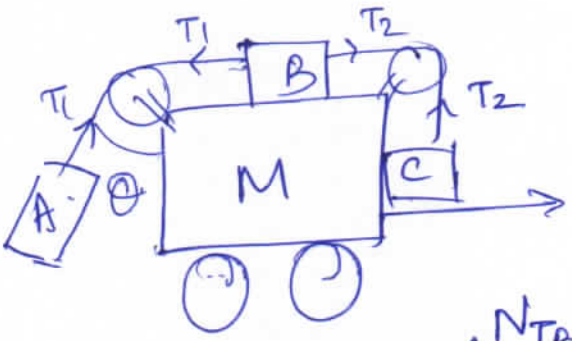
$T^2\cos^2\theta + T^2\sin^2\theta = W^2 + R^2$

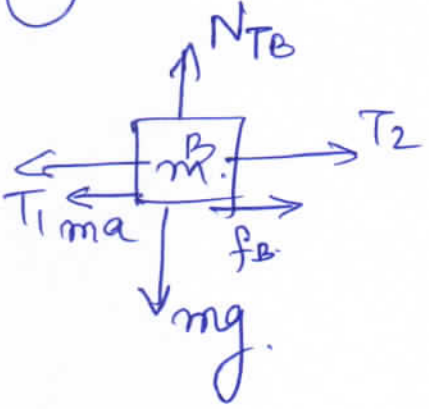
$T^2 = W^2 + R^2$ — (B)

$\tan\theta = \frac{R}{W} \Rightarrow R = W\tan\theta$ — (D)

$\vec{R} + \vec{W} = -\vec{T}$

or $\vec{R} + \vec{W} + \vec{T} = 0$

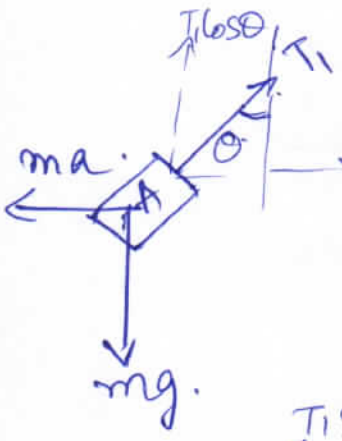




$N_{TB} = mg$ — (2)

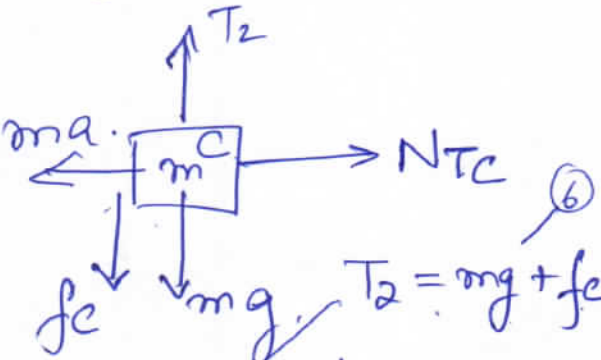
$T_2 + f_B = T_1 + ma$ — (3)

$T_2 + \mu mg = T_1 + ma$.



$T_1 \cos\theta = mg$ — (4)

$T_1 \sin\theta = ma$ — (5)



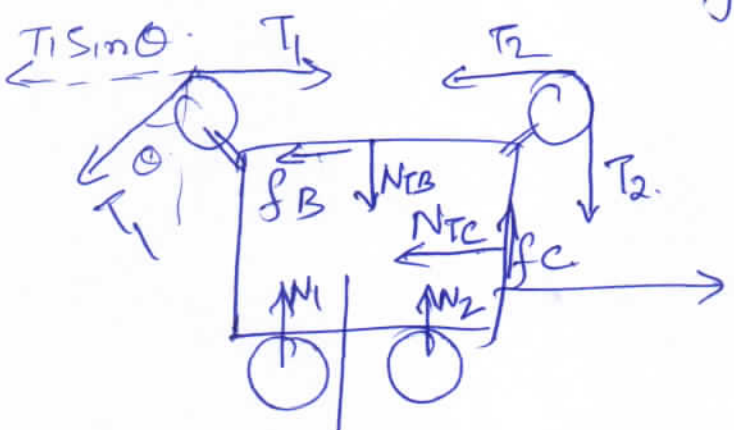
(6)

$T_2 = mg + f_c$

$N_{TC} = ma$

(7)

$T_2 = mg + \mu ma$.



Mg

$F - T_2 + T_1 - N_{TC} - T_1 \sin\theta = Ma$ — (1)

$F + \mu mg - ma - mg - ma = Ma$.

(f_B)

$\frac{F + \mu mg}{(M+3m)} = a$.

(6) & (3).

$$mg + \mu ma + \mu mg = T_1 + ma.$$

$$mg(1+\mu) = T_1 + ma(1-\mu)$$

$$70\left(\frac{11}{7}\right) = T_1 + ma\left(1-\frac{4}{7}\right)$$

$$110 = T_1 + \frac{3ma}{7}$$

$$T_1 = 110 - \frac{3ma}{7} = 110 - 3a$$

$$T_1^2 = 70^2 + (7a)^2 \qquad \text{From (4) \& (5)}.$$

$$(110-3a)^2 = 70^2 + (7a)^2$$

$$a = 7.5\ m/s^2.$$

$$\tan\theta = \frac{a}{g} \qquad \text{from (5)/(4)}$$

$$\theta = \tan^{-1} 0.75 = 37^\circ$$

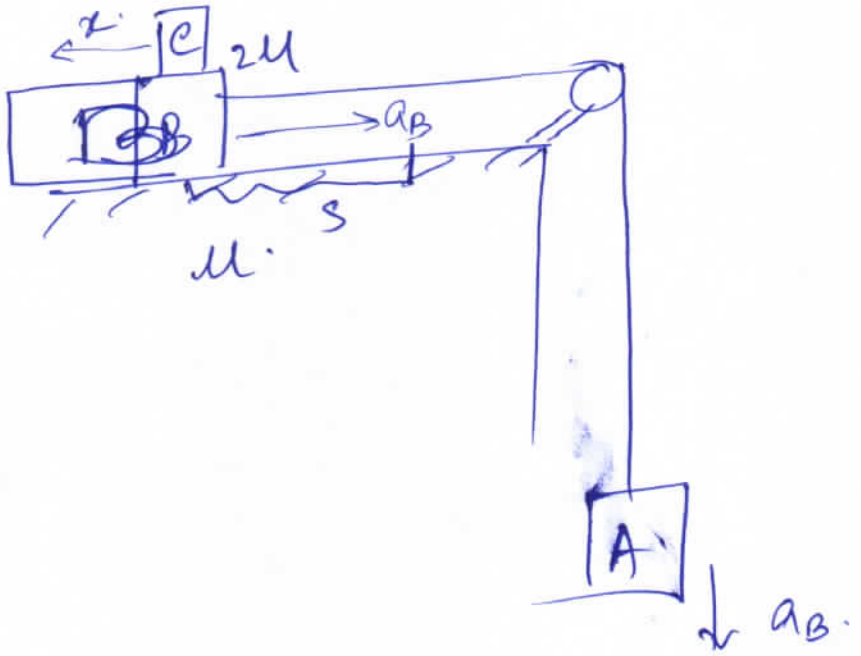
$$F = a(M+3m) + \cancel{4 \times 10}.$$

$$= \frac{30}{4}(21+21) \cancel{+40}$$

$$= \frac{30}{4} \times 42^{21} \cancel{+40} = 315\ N.$$

Pg 122

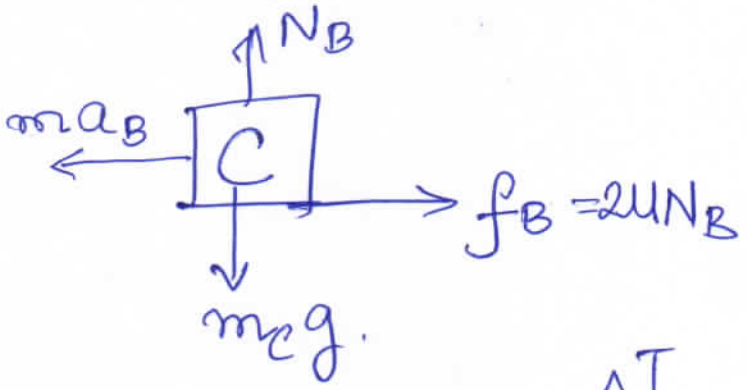
(31)

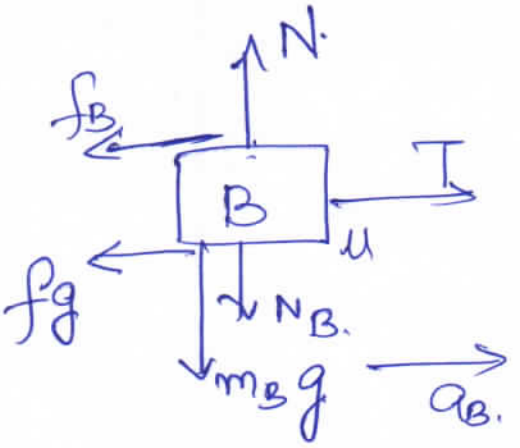


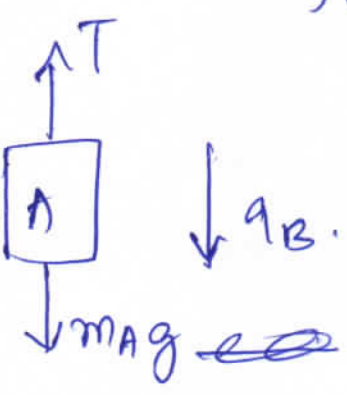
$$S = \frac{1}{2} a_B t^2 \qquad t^2 = \frac{2S}{a_B}$$

$$x = \frac{1}{2} a_{CB} t^2$$

$$= \frac{1}{2} a_{CB} \times \frac{2S}{a_B} = \frac{S\, a_{CB}}{a_B}$$







$$mg - T = ma_B \quad \text{—— (1)}$$

$$f_g = \mu N$$

$$N = N_B + mg$$

$$f_g = \mu(N_B + mg) \quad \text{—— (2)}$$

$$T - f_B - f_g = ma_B$$

$$T - 2\mu N_B - \mu N_B - \mu mg = ma_B$$

$$T - 3\mu N_B - \mu mg = ma_B \quad \text{—— (3)}$$

(1) + (3)

$$mg(1-\mu) - 3\mu N_B = 2ma_B$$

$$mg(1-\mu) - 3\mu mg = 2ma_B$$

$$g(1-4\mu) = 2a_B$$

$$a_B = \frac{g(1-4\mu)}{2}$$

$$\left|(ma_B - f_B)\right| = m_c a_{cB}$$

$$\left(m\frac{g}{2}(1-4\mu) - 2\mu mg\right) = ma_{cB}$$

$$\frac{mg}{2} - 2\mu mg - 2\mu mg.$$

$$\frac{mg}{2}(1 - 8\mu) = m a_{CB}.$$

$$a_{CB} = \frac{g}{2}(1 - 8\mu)$$

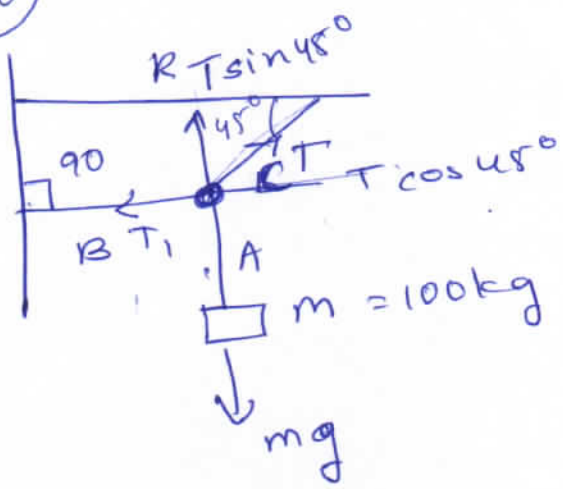
$$x = \frac{S\, a_{CB}}{a_B}$$

$$= \frac{S \frac{g}{2}(1 - 8\mu)}{\frac{g}{2}(1 - 4\mu)}$$

$$= \frac{S(1 - 8\mu)}{(1 - 4\mu)} \checkmark$$

Pg 126

(20)



$mg = T\sin 45^\circ$

$1000 = \frac{T}{\sqrt{2}}$

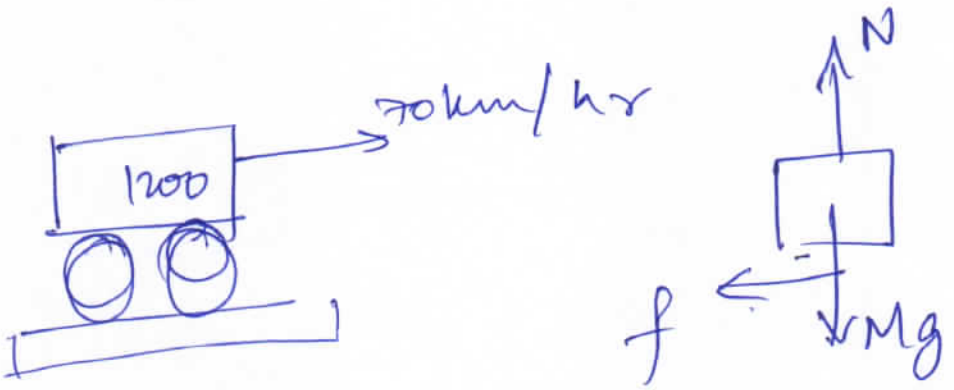
$T = \sqrt{2} \times 1000$

$T_1 = T\cos 45^\circ = 1000\sqrt{2} \times \frac{1}{\sqrt{2}}$

$T_1 = 1000\ N$

Pg 127

(28)



$v^2 - u^2 = 2as.$

$0^2 - \left(70 \times \frac{5}{18}\right)^2 = 2(-\mu g)s$

$s = \frac{\left(70 \times \frac{5}{18}\right)^2}{2\mu g}$

$f = \mu N$

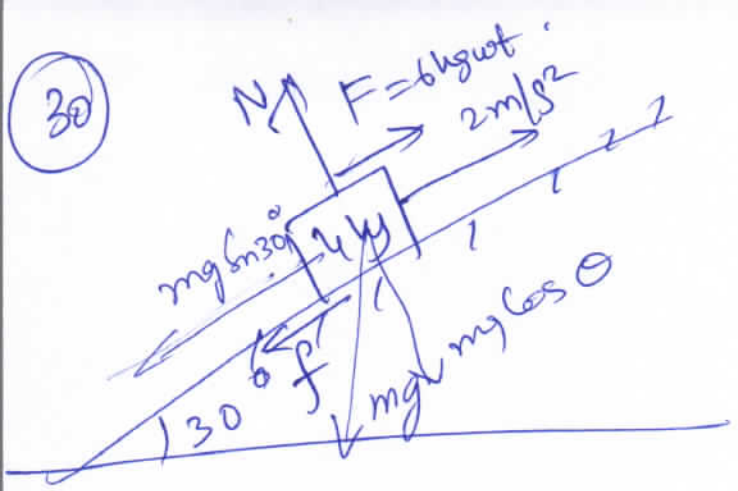
$= \mu Mg.$

$f = Ma.$

$\mu Mg = Ma$

$a = \mu g$

(30)

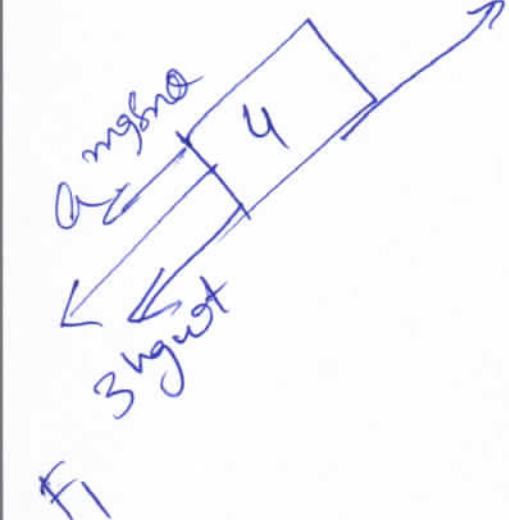


$$F - f - mg\sin\theta = 4 \times 2.$$

$$f = F - mg\sin\theta - 8$$

$$= 6g - 4g \times \frac{1}{2} - 8$$

$$= 4g - 8 = 32$$



& $F_1 + mg\sin\theta - f = 4a.$

$$F + F_1 - 2f = 8 + 4a.$$

$$6g + 3g - 2 \times 32 = 8 + 4a.$$

$$26 = 8 + 4a$$

$$18 = 4a \qquad a = 4.5\ m/s^2$$