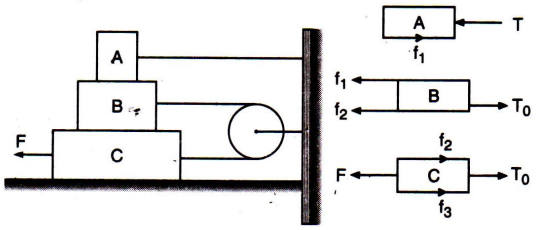
AVIRAL
JEE | NEET | FOUNDATIONS

JEE ADV - PHYSICS
DPP -02

21 JAN 2020

TOPICS :LAWS FO MOTION SOLUTION

1.



If 'C' moves with constant speed

$$a_c = 0$$

$$F - T_0 - f_2 - f_3 = 0$$

$$-f_1 + T_0 - f_2 = 0$$

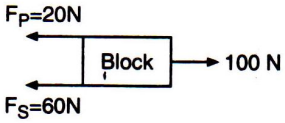
$$T = f_1$$

$$f_1 = \frac{3}{4}g, \quad f_2 = \frac{7}{4}g, \quad f_3 = \frac{15g}{4}$$

Solving, $F = 8g$ N

2. If they move with common acceleration then,

$$a = \frac{100}{40+10} = 2\ \text{m/s}^2$$



Pseudo force on block = $10 \times 2 = 20$ N

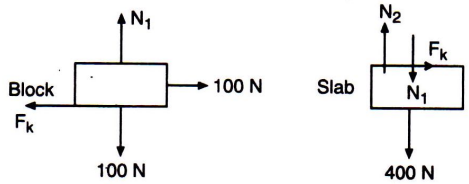
Net force = $100 - 20 = 80$ N

$$f_{s\max} = \mu_s \times 10 \times 10 = 60\ \text{N}$$

$\because$ 80 N > 60 N

there will be relative motion.

Now, FBD of block and slab will be



$\therefore \quad 100 - f_k = 10a_1$ $\qquad f_k = 40a_2$

$100 - 0.4 \times 10 \times 10 = 10a_1$ $\qquad 0.4 \times 10 \times 10 = 40a_2$

$\therefore \quad a_1 = 6\ \text{m/s}^2$ $\qquad \therefore \quad a_2 = 1\ \text{m/s}^2$

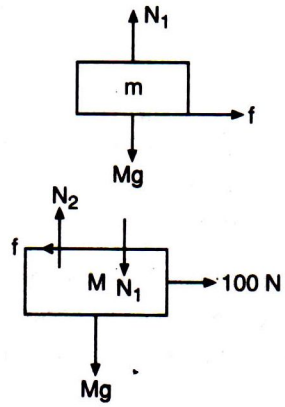
3. Let both move with same acceleration.

$$F - f = Ma$$

$$f = ma$$

From Eqs. (i) and (ii)

$$F = (m+M)f$$



when f is maximum,

$$F = \mu(m+M)g$$

For slipping to start

$$F > \mu(m+M)g$$

Now, $\quad a_1 = \dfrac{F - \mu mg}{M}$

and $\quad a_2 = \mu g$

$\therefore \quad a_r = a_1 - a_2 = \dfrac{F - \mu(m+M)g}{M}$

$\therefore \quad L = \dfrac{1}{2}a_r t^2$

$\therefore \quad t = \sqrt{\dfrac{2L}{a_r}} = \sqrt{\dfrac{2ML}{F - \mu(m+M)g}}$

4. (a) as $N_A = N_B$

Now $\mu_A N_A + \mu_B N_B = Mg$

$N_A[\mu_A + \mu_B] = Mg$

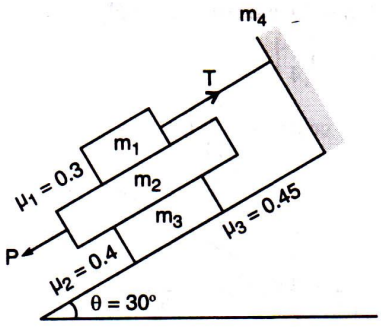
$N_A = \dfrac{Mg}{\mu_A + \mu_B}$

(b) $f_A = \mu_A N_A$

Now percent of weight supported by it is

$= \dfrac{\mu_A N_A}{Mg} \times 100$

5.

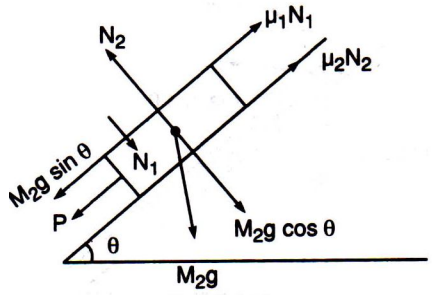


F.B.D. of m_2

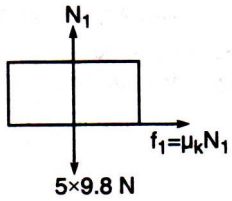
$P + M_2 g \sin\theta = \mu_1 N_1 + \mu_2 N_2$

$P + M_2 g \sin\theta = \mu_1 M_1 g \cos\theta + \mu_2 g \cos\theta (M_1 + M_2)$

By solving this equation, we get value of P.

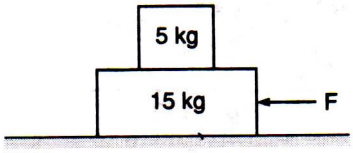


6. For upper block

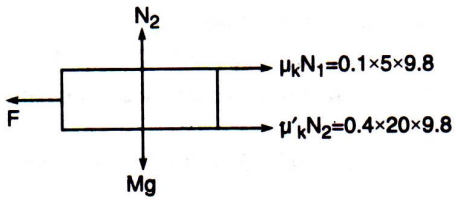


$f_1 = 5 \times a_1$

$a_1 = 0.98$ m/sec^2



For lower block



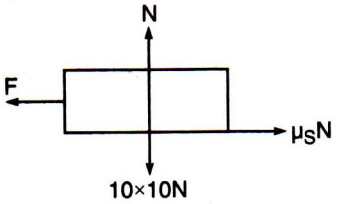
$F - \mu_k N_1 - \mu_k N_2 = M \times a_2$

$F - 0.1 \times 5 \times 9.8 - 0.4 \times 20 \times 9.8 = 15 \times a_2$ ... (i)

[Value of $F = \dfrac{3}{10} \times 5 \times 4.9 + \dfrac{5}{10} \times 20 \times 4.9$]

By putting this value of F in equation (i), we get a_2

7. (a) F.B.D. of block



$F_{max} = \mu_S N$

(b) F.B.D. of bracket

$2F - F = M \times a$