(iii) $F = F_m$

The block is in impending motion, i.e the block just start to move towards left.

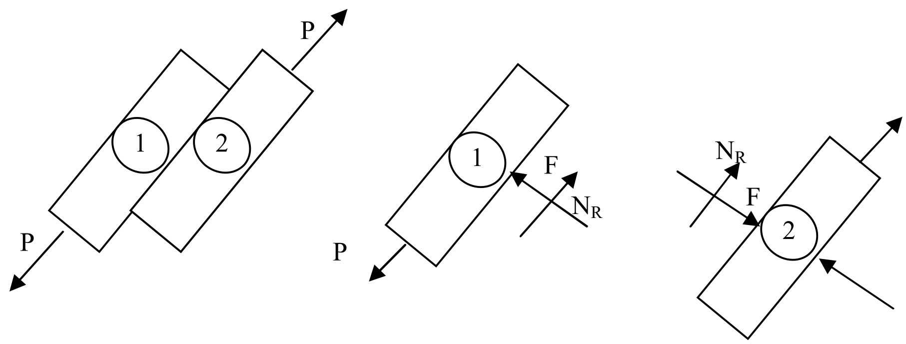
$$\sum H = 0 \qquad F = P\cos\theta$$

$$\sum V = 0 \qquad N_R = W + P\sin\theta$$

(iv) $F > F_m$

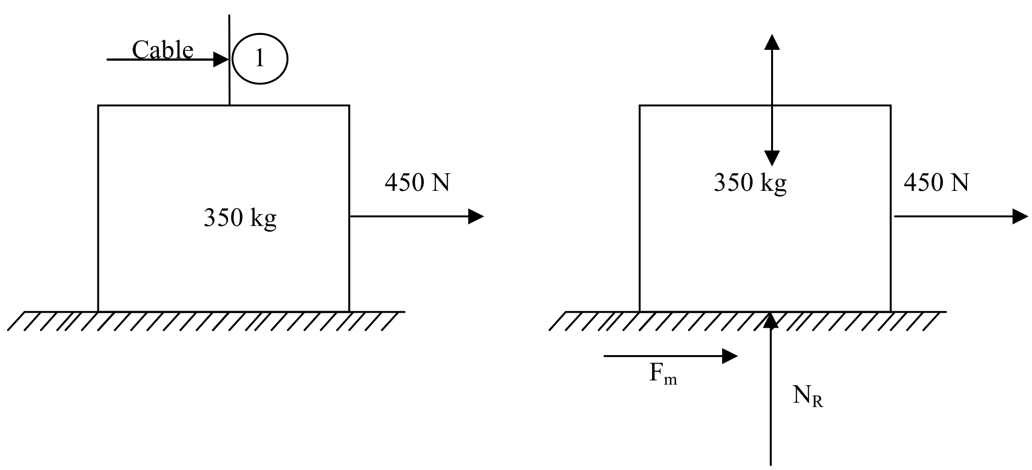
The body is in motion; the body is not in equilibrium condition. Hence both equations of equilibrium cannot be used and $F_m = \mu_N$ cannot be applied.

Important points



Problem 1:

A man can pull horizontally with a force of 450N. A mass of 350kg is resting on a horizontal surface for which the coefficient of friction is 0.20. The vertical cable of a crane is attached to the top of the block as shown in Figure. what will be the tension in the cable if the man is just able to start the block to right.



Solution:

Given

$\mu = 0.2$; mass =350kg =350×9.8=3430 N

External force P=450 N towards right conditions of equilibrium.

$\sum H = 0 \qquad 450 - F_m = 0$

$F_m = 450$ N

$\sum V = 0$, $\qquad N_R + T - 3430 = 0$

$N_R = 3430 - T$

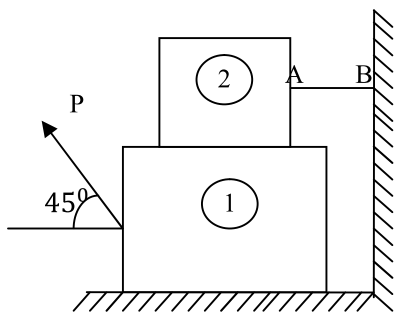
w.k.t

$F_m = \mu N_R$

450=0.2(3430-T) ∴ T=1180N

Problem 2:

Block(2) rests on a block(1) and is attached by a horizontal rope AB to the wall as shown in Figure what force P is necessary to cause motion of block(1) to impend? The coefficient of friction between the blocks is ¼ and between the floor and block(1) is $\frac{1}{3}$. Mass of blocks(1) and (2) are 14kg and 9kg respectively.

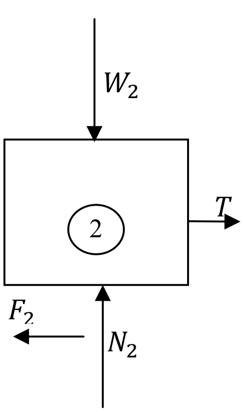


Solution :

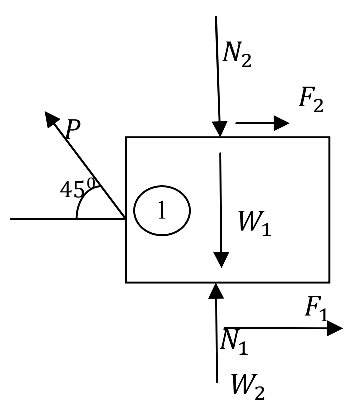
$$W_1 = 14\text{kg} = 14 \times 9.8 = 137.2\text{N}$$

$$W_2 = 9\text{kg} = 9 \times 9.8 = 88.2\text{N}$$

$$\mu_1 = \frac{1}{3} ; \mu_2 = \frac{1}{4}$$



FBD of block (2)



FBD of block (1)

Consider block(2)

$$\sum H = 0 \quad T - F_2 = 0$$

$$T - (\mu_2 . N_2) = 0$$

$$T - \left(\frac{1}{4} - N_2\right) = 0 \rightarrow (1)$$

$$\sum V = 0$$

$$N_2 - 88.2 = 0$$

$$N_2 = 88.2N$$

Sub N_2 in (1)

$$T=22.05N \text{ (or) } F_2 = 22.05N$$

Consider block (1)

$$\sum H = 0$$

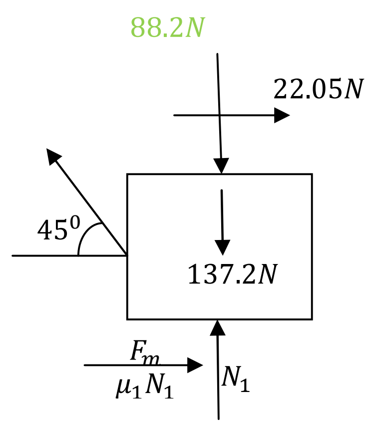
$$F_1 + F_2 - P\cos 45 = 0$$

$$22.05 + (0.333 \times N_1) = P\cos 45 \rightarrow (2)$$

$$\sum V = 0$$

$$N_1 + N_2 - W_1 + P\sin\theta = 0$$

$$N_1 - 88.20 - 137.2 + P\sin 45 = 0$$



$$P\sin 45 = 225.4 - N_1 \rightarrow (3)$$

$$\frac{(3)}{(2)} \Longrightarrow \frac{P\sin 45}{P\cos 45} = \frac{225.4 - N_1}{22.05 + 0.333N_1}$$

$$\tan 45 = \frac{225.4 - N_1}{22.05 + (0.333 \times N_1)}$$

Solving this we get

$$N_1 = 152.55\ N$$

Sub N_1 in (2)