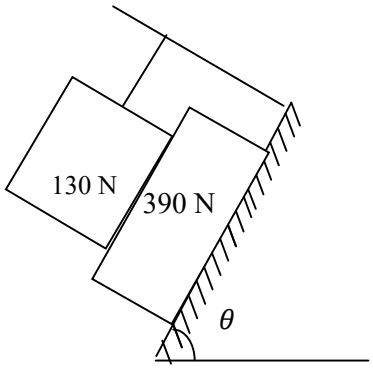
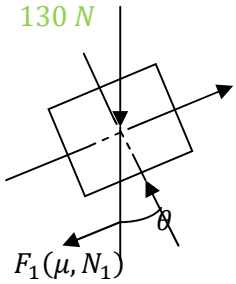
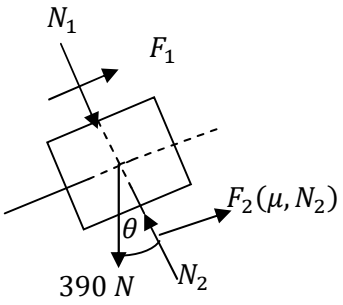


Solution:



FBD of upper ladder



FBD of lower ladder

Considering upper block

Resolving the force along the plane,

$$T - 130 \sin\theta - F_1 = 0$$

$$T = 130 \sin\theta + \frac{1}{3} N_1 \longrightarrow (1)$$

Resolving the force normal to the plane,

$$N_1 = 130 \cos\theta \longrightarrow (2)$$

Substitute (2) in (1)

$$T = 130 \sin\theta + \left(\frac{1}{3} \times 130 \cos\theta\right)$$

$$T - 130 \sin\theta + 43.33 \cos\theta \rightarrow (3)$$

Considering lower block

Resolving the force along the plane ,

$$F_1 + F_2 - 390 \sin\theta = 0$$

$$\mu N_1 + \mu N_2 = 390 \sin\theta$$

$$\mu(N_1 + N_2) = 390 \sin\theta$$

$$\frac{1}{3}(130 \cos\theta + N_2) = 390 \sin\theta \rightarrow (4)$$

Resolving the force normal to the plane,

$$N_2 - N_1 - 390 \cos\theta = 0$$

$$N_2 = 390 \cos\theta + N_1$$

$$N_2 = 390 \cos\theta + 130 \cos\theta = 520 \cos\theta$$

Sub N_2 in (4)

$$390 \sin\theta = \frac{1}{3}(130 \cos\theta + 520 \cos\theta)$$

$$390 \sin\theta = 216.67 \cos\theta$$

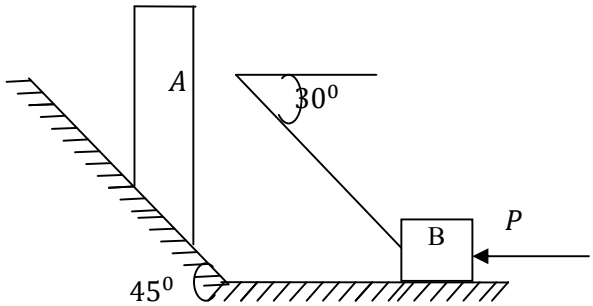
$$\frac{\sin\theta}{\cos\theta} = \frac{216.67}{390}$$

$$\tan\theta = 0.555$$

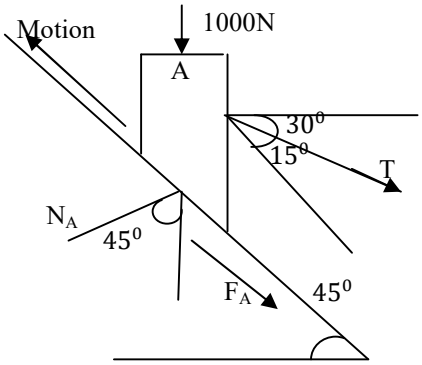
$$\theta = \tan^{-1}(0.555) = 29^0$$

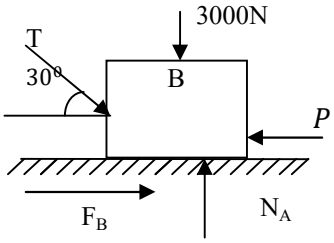
Problem 5:

Block a weighting 1000N rests on a rough inclined plane whose inclination to the horizontal is 45^0. It is connected to another block B, Weighting 3000N rests on a rough horizontal plane by a weightless rigid bar inclined at an angle of 30^0 to the horizontal as required shown in Figure. Find the horizontal force required to be applied to the block B just to move the block A in upward direction. Assume the angle of friction as 15^0 at all surfaces where these is sliding.



Solution:





Given,

$$\phi = 15^0$$

$$\mu = \tan\phi = \tan 15^0 = 0.268$$

Let T=tension in the rod

Considering Freebody diagram of block A

Resolve the forces along the plane and equate to zero.

$$T\cos 15^0 + F_A + 1000\sin 45^0 = 0$$

$$0.966T + \mu N_A = -1000\sin 45^0$$

$$0.966T + 0.268N_A = -707.1 \rightarrow (1)$$

Resolve the forces normal to the plane and equate to zero

$$N_A - 1000\cos 45^0 + T\sin 15^0 = 0$$