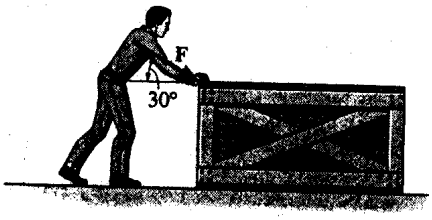
Homework #2 Solutions

13-18. The man pushes on the 60-lb crate with a force **F**. The force is always directed down at 30° from the horizontal as shown, and its magnitude is increased until the crate begins to slide. Determine the crate's initial acceleration if the static coefficient of friction is $\mu_s = 0.6$ and the kinetic coefficient of friction is $\mu_k = 0.3$.

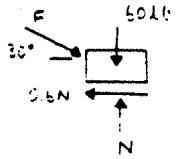


Force to produce motion :

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad F\cos 30° - 0.6N = 0$

$+\uparrow \Sigma F_y = 0; \quad N - 60 - F\sin 30° = 0$

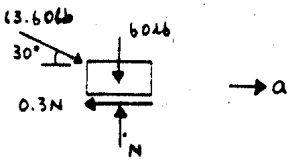
$N = 91.80 \text{ lb} \quad F = 63.60 \text{ lb}$



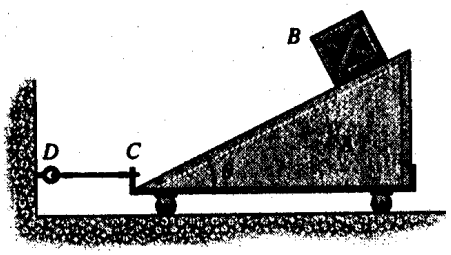
Since $N = 91.80$ lb,

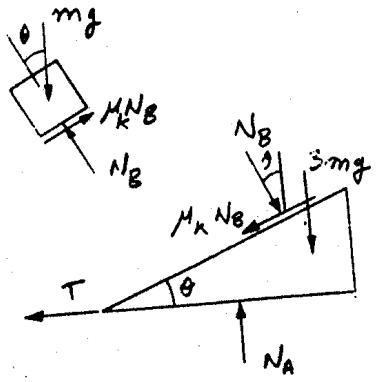
$\overset{+}{\rightarrow} \Sigma F_x = ma_x; \quad 63.60\cos 30° - 0.3(91.80) = \left(\frac{60}{32.2}\right)a$

$a = 14.8 \text{ ft/s}^2$ **Ans**



13-29. Block B has a mass m and is released from rest when it is on top of cart A, which has a mass of $3m$. Determine the tension in cord CD needed to hold the cart from moving while B is sliding down A. The coefficient of kinetic friction between A and B is μ_k.





Block B :

$+\nearrow \Sigma F_y = ma_y$: $\quad N_B - mg\cos\theta = 0$

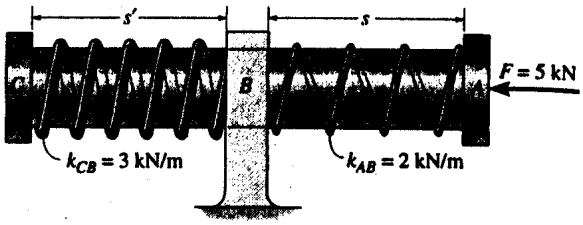
$$N_B = mg\cos\theta$$

Cart :

$\stackrel{+}{\rightarrow} \Sigma F_x = ma_x$: $\quad -T + N_B\sin\theta - \mu_k N_B\cos\theta = 0$

$$T = mg\cos\theta(\sin\theta - \mu_k\cos\theta) \qquad \textbf{Ans}$$

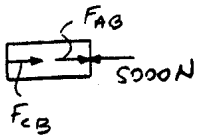
13-31. The 2-kg shaft CA passes through a smooth journal bearing at B. Initially, the springs, which are coiled loosely around the shaft, are unstretched when no force is applied to the shaft. In this position $s = s' = 250$ mm and the shaft is originally at rest. If a horizontal force of $F = 5$ kN is applied, determine the speed of the shaft at the instant $s = 50$ mm, $s' = 450$ mm. The ends of the springs are attached to the bearing at B and the caps at C and A.



$F_{CB} = k_{CB}x = 3000x \qquad F_{AB} = k_{AB}x = 2000x$

$\stackrel{+}{\leftarrow} \Sigma F_x = ma_x; \qquad 5000 - 3000x - 2000x = 2a$

$2500 - 2500x = a$



$a\,dx = v\,dv$

$\int_0^{0.2} (2500 - 2500x)\,dx = \int_0^v v\,dv$

$2500(0.2) - \left(\frac{2500(0.2)^2}{2}\right) = \frac{v^2}{2}$

$v = 30$ m/s **Ans**