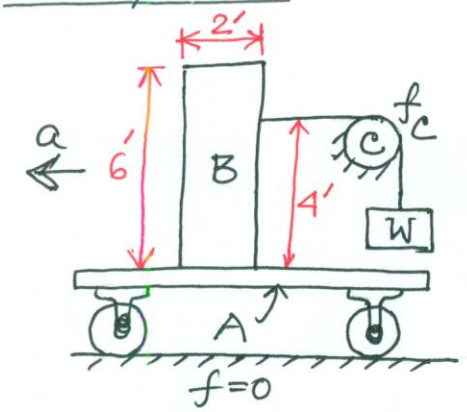
#1161 / P. 330




$W_B = 322$ lb

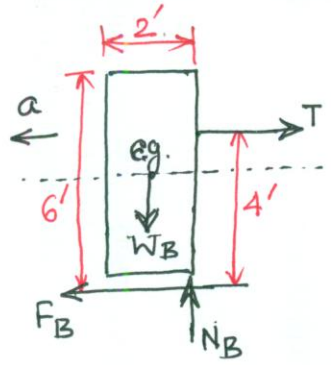
$f_c = 0$

$a = 3{\cdot}22$ fps$^2$ ←

(a) W = ? for B turning over
Solve with & without REF

(b) $f_B = 0{\cdot}1$ will B turn over or slide?

(a) Sol$^n$ without REF




Note: The direction of frictional resistance is opposite to the relative displacement/motion.

$\Sigma F_V$

Considering $\Sigma M_{cg} = 0$ ↷ +ve, from the freebody of B

$T \times 1 + F_B \times 3 - N_B \times 1 = 0$ ——— (1)

$\Sigma F_V = 0$ ↑ +ve gives

$N_B - W_B = 0 \Rightarrow N_B = W_B = 322$ lb

Now from eq$^n$ (1)

$T + F_B \times 3 - 322 = 0$

$\therefore T + 3F_B = 322$ ——— (2)

Again $\Sigma F_h = ma$ ← +ve gives

$-T + F_B = \frac{W_B}{g} \cdot a$

$\therefore -T + F_B = \frac{322}{32{\cdot}2} \times 3{\cdot}22 = 32{\cdot}2$ ——— (3)

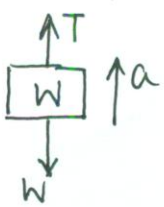
Adding eq$^n$s (2) & (3) we obtain

$4F_B = 354{\cdot}2$

$\therefore F_B = 88{\cdot}55$ lb

From eq$^n$ (2), $T = 322 - 3 \times 88{\cdot}55 = 56{\cdot}35$ lb

From the freebody of the weight, W




$\Sigma F_V = 0$ ↑ +ve gives

$T - W = \frac{W}{g} \cdot a$

$\Rightarrow 56{\cdot}35 - W = \frac{W}{32{\cdot}2} \times 3{\cdot}22$

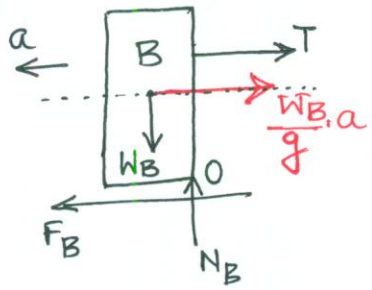
$\Rightarrow 1{\cdot}1W = 56{\cdot}35$

$\therefore W = 51{\cdot}23$ lb

contd.....

# 1161/P.330 Contd....

Sol$^n$ with REF




From freebody of B

$\Sigma F_y = 0 \uparrow +ve \Rightarrow N_B - W_B = 0$

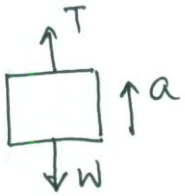
$\therefore N_B = W_B = 322$ lb

Taking $\Sigma M_O = 0 \circlearrowright +ve$

$T \times 4 + \frac{W_B}{g} \times a \times 3 - W_B \times 1 = 0$

$\Rightarrow T \times 4 + \frac{322}{32.2} \times 3.22 \times 3 - 322 = 0$

$\therefore T = 56.35$ lb




From freebody of weight W, $\Sigma F_y = 0 \uparrow +ve$

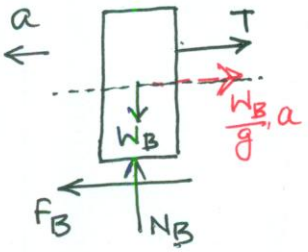
$T - W = \frac{W}{g} \times a$

$\Rightarrow 56.35 - W = \frac{W}{32.2} \times 3.22$

$\Rightarrow 1.1\,W = 56.35$

$\therefore W = 51.23$ lb

(b) Case : Sliding




$\Sigma F_y = 0 \uparrow +ve$

$\Rightarrow N_B - W_B = 0$

$\therefore N_B = W_B = 322$ lb

$F_B = N_B \times f_B$

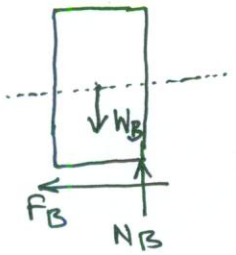
$= 322 \times 0.1$

$= 32.2$ lb

Inertia force $= \frac{W_B}{g}a = \frac{322}{32.2} \times 3.22 = 32.2$ lb

Since inertia force = Limiting frictional resistance, sliding is incipient.

Case : Overturning




From $\Sigma F_y = 0$, $N_B = W_B = 322$ lb

$\Sigma F_h = ma$, $F_B = \frac{W_B}{g} \times a = \frac{322}{32.2} \times 3.22 = 32.2$ lb

$\Sigma M_{c.g.} = F_B \times 3 - N_B \times 1 = 32.2 \times 3 - 322 \times 1$

$\circlearrowright +ve$

$= -225.4$ ft-lb, which is anti-clockwise ie stabilizing

The box would slide.