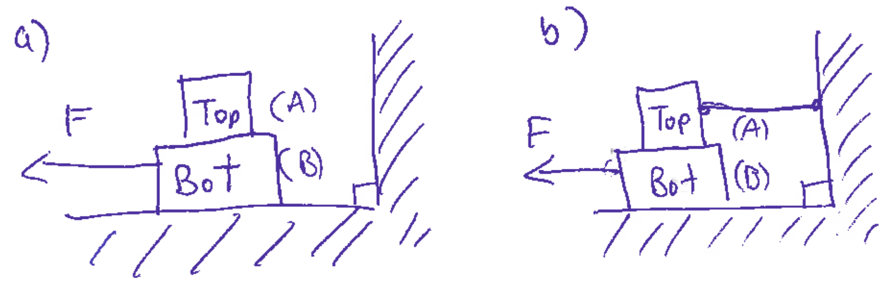
5.73



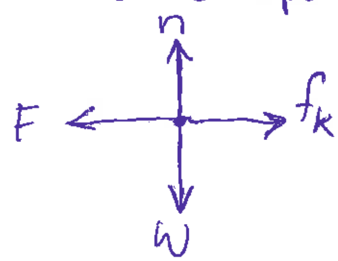
$w_{Top} = 2.40\,N$ $w_{Bot} = 3.60\,N$

$\mu_K = 0.300$ for all surfaces.

In each case, what Force F needed to drag Box Bottom at constant speed? $\Rightarrow a = 0$

Case a) Treat as composite object: $w_{Top} + w_{BOT} = 6.00\,N$

FBD:

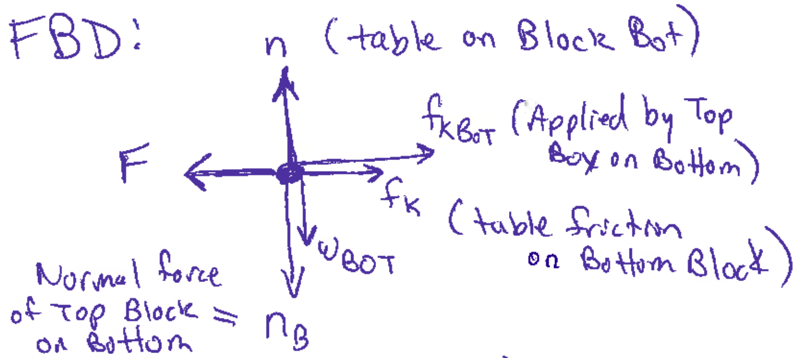


$n = w = 6.00\,N$

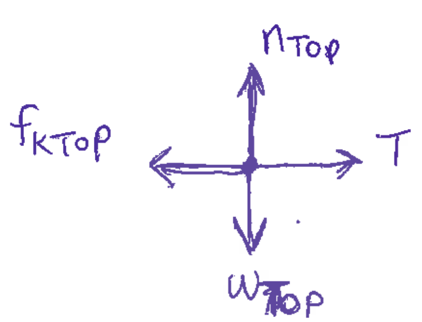
$$f_k = \mu_K n = (0.3)(6.00) = 1.80\,N$$

$\sum F_x = 0 \Rightarrow F = f_k$ since $a = 0$. $\boxed{F = 1.80\,N}$

Case b) FBD:



Bottom Block (B)



Top Block (A)

5.73 continued

- frictional forces $f_{K\,TOP} = f_{K\,BOT}$ from Newton's 3rd Law.
- Also, $n_{top} = W_{TOP} = 2.40\,N$ and the normal force of the top on Bottom, n_{BOT} must also equal 2.40 N.

$$f_{K\,TOP} = \mu_K n_{TOP} = (0.300)(2.40\,N) = 0.720\,N$$

so $f_{K\,BOT} = f_{K\,TOP} = 0.720\,N$.

Top Box: $\sum F_x = m_x a \Rightarrow T - f_{K\,TOP} = 0$

$$T = 0.720\,N$$

For Bottom Box: $\sum F_x = m_x a = 0$

$$F - f_{K\,BOT} - f_K = 0$$

$$F = 0.720\,N + 1.80\,N = 2.52\,N$$

$$\boxed{F = 2.52\,N}$$