1. a)

b) Using N's Second:

$F_{net,y} = ma_y$

$n_{SC} - w_{EC} = ma_y$.

$n_{SC} - mg = ma_y$

Now, $a_y = \frac{v^2}{r}$

Since the car is moving in a circle, accelerating towards the center,

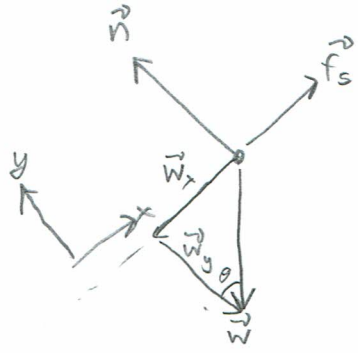
So $n_{SC} - mg = m\frac{v^2}{R}$

$$\Rightarrow n_{SC} = \frac{mv^2}{R} + mg = m\left(\frac{v^2}{R} + g\right)$$

$$= 1000\,kg\left(\frac{(30\,m/s)^2}{200\,m} + 9.8\,\frac{m}{s^2}\right)$$

$$= 14300\,N$$

2. FBD for Box:



(must be this way to "hold up" the box

$w_x = w\sin\theta = mg\sin\theta$

$w_y = w\cos\theta = mg\cos\theta$

$F_{net,x} = f_s - w_x = ma_x = 0$ (not moving)

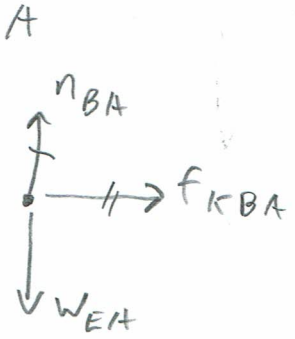
so $f_s = w_x = mg\sin\theta$

$= (10\,kg)\left(9.8\,\frac{m}{s^2}\right)\sin 20°$

$= 33.52\,N$

Note that since we know the box is not moving, we know the maximum friction is not exceeded. There is no guarantee $f_{s,max} = f_s$ here.

3. a)



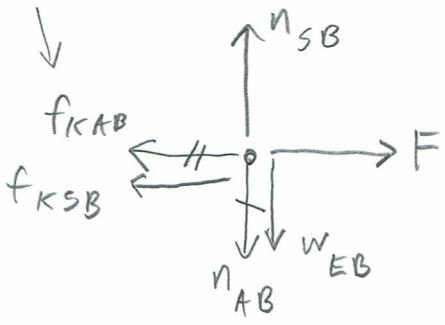
b) ① $F_{net,A,x} = f_{K,BA} = m_A a_{Ax}$

② $F_{net,A,y} = n_{BA} - W_{EA} = m_A a_{Ay}$

③ $F_{net,B,x} = F - f_{KAB} - f_{KSB} = m_B a_{By}$

④ $F_{net,B,y} = n_{SB} - n_{AB} - W_{EB} = m_B a_{By}$

f_K will resist B's motion



c) we know a_{Ay} and a_{By} are zero (no vertical motion).

so ② $n_{BA} - W_{EA} = 0 \Rightarrow n_{BA} = W_{EA} = m_A g$

so $f_{K,BA} = \mu_K n_{BA} = \mu_K m_A g$ (between blocks)

so ① $f_{KBA} = \mu_K m_A g = m_A a_{Ax}$

$\Rightarrow a_{Ax} = \mu_K g = 0.98\ m/s^2$

d) From ④ $n_{SB} - n_{AB} - W_{EB} = 0$ $(a_{By} = 0)$

$\Rightarrow n_{SB} = n_{AB} + W_{EB} = m_A g + m_B g$ (since $n_{AB} = n_{BA} = m_A g$)

$= (m_A + m_B) g$

so $f_{KSB} = \mu_K n_{SB} = 0.3(m_A + m_B) g$. (for surface)

$\left(f_{KAB} = f_{KBA} = \mu_K m_A g \right)$ (bet. blocks)

From ③ $F - f_{KAB} - f_{KSB} = m_B a_{Bx}$

$\Rightarrow a_{Bx} = \dfrac{F - f_{KAB} - f_{KSB}}{m_B} = \dfrac{F - 0.1 m_A g - 0.3(m_A + m_B) g}{m_B}$

$= \dfrac{40N - 0.1(3kg)(9.8 m/s^2) - 0.3(7kg)(9.8 m/s^2) 9.8 m/s^2}{4kg}$

$= 4.12\ m/s^2$