Please note that (except where otherwise noted) these are *decidedly not* intended to model "excellent" or even "good" solutions; you would need to add figures, more words of explanation, and some math. They are intended to help *you* work through problems that you may have had trouble with, *not* to demonstrate superior quality writeups. See the class website for examples of good (and not so good) solutions. And *please* come see me if you have further questions. Thanks!

7.32 Draw very clear FBD's for both objects showing the *four* forces that act on the top block and the *six* forces that act on the bottom block. For the top block you should get something like

x: $\mu_k n_{top} - T = 0$

y: $n_{top} - m_{top} g = 0$

For the bottom block …

x: $F - \mu_k n_{top} - \mu_k n_{bottom} = m_{bottom} a$

y: $-n_{top} + n_{bottom} - m_{bottom} g = 0$

where n_{top} and n_{bottom} are the normal forces exerted on the top and bottom surfaces of the bottom block.

a) The first two equations suffice to show that $T = \mu_k m_{top} g = 3.92$ N

b) Substituting $n_{top} = mg$ into the two bottom equations and then eliminating n_{bottom} and solving for *a* gives

$$a = \frac{F - \mu_k g\left(2m_{top} + m_{bottom}\right)}{m_{bottom}} = 2.16 \text{ m/s}^2$$

7.34 Again draw clear FBD's for both objects showing the *four* forces that act on the top block and the *seven* forces that act on the bottom block. For the top block you should get something

x: $\mu_k n_{top} - T = m_{top}\left(-a\right)$

y: $n_{top} - m_{top} g = 0$

For the bottom block …

x: $F - \mu_k n_{top} - \mu_k n_{bottom} - T = m_{bottom} a$

y: $-n_{top} + n_{bottom} - m_{bottom} g = 0$

where n_{top} and n_{bottom} are the normal forces exerted on the top and bottom surfaces of the bottom block. Note that both blocks have the same magnitude of acceleration, but in opposite directions.

Eliminating the two normal forces and the tension force and solving for *a* you should find that

$$a = \frac{F - \mu_k g\left(3m_{top} + m_{bottom}\right)}{m_{top} + m_{bottom}} = 0.133 \text{ m/s}^2$$

7.40 a) If the blocks are held at rest, then the tension in the string must simply support the hanging block. Thus, $T = m_{hanging} g = 19.6\ \text{N}$.

b) Assuming that the acceleration is *up* the slope, you should be able to get something like the following two equations from NII:

Hanging block: $m_{hanging} g - T = m_{hanging} a$

Incline block: $T - m_{incline} g \sin\theta = m_{incline} a$

(I have ignored the component of NII perpendicular to the incline, because it gives us no useful information.)

Solving for a, we get $a = \left(\frac{m_{hanging} - m_{incline} \sin\theta}{m_{hanging} + m_{incline}} \right) g < 0 \quad \Rightarrow\Leftarrow$ so the block moves *down* the incline.

c) Solving for T we get $T = \frac{m_{hanging} m_{incline} (1 + \sin\theta) g}{m_{hanging} + m_{incline}} = 20.6\ \text{N}$