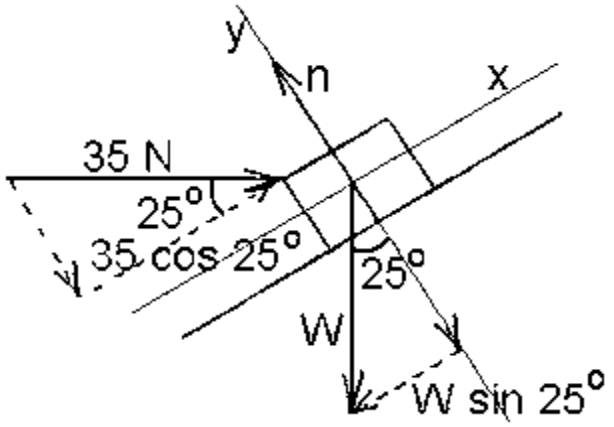
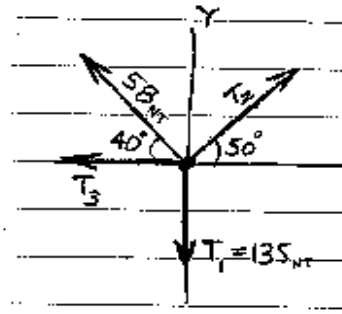
Phy 131 - Assignment 3

A.



$\Sigma F_x = ma$
$35 \cos 25^\circ - W \sin 25^\circ = (W/g)a$ (Using $W = mg$.)
$31.72 - W(.4226) = (W/9.8)(2)$
$31.72 = W(.4226) + W(.2041)$
$31.72 = .6267\ W$
$\boxed{W = 50.6\ N}$

B. Isolate the knot where the four ropes meet:



components of the 4 forces:

$\vec{T}_1 = 0\hat{i} - 135\hat{j}$ NT

$\vec{T}_2 = (T_2 \cos 50°)\hat{i} + (T_2 \sin 50°)\hat{j}$

THE 58 NT: $(-58\cos 40°)\hat{i} + (58 \sin 40°)\hat{j}$

$= -44.43\hat{i} + 37.28\hat{j}$ NT

$\vec{T}_3 = -T_3\hat{i} + 0\hat{j}$

$\Sigma F_y = 0$

$-135 + T_2 \sin 50° + 37.28 + 0 = 0$

$T_2 \sin 50 = 135 - 37.28$

$T_2 = \frac{97.72}{\sin 50} = 127.6$

ANS $T_2 = 128$ NT

$\Sigma F_x = 0$

$0 + T_2 \cos 50 - 44.43 - T_3 = 0$

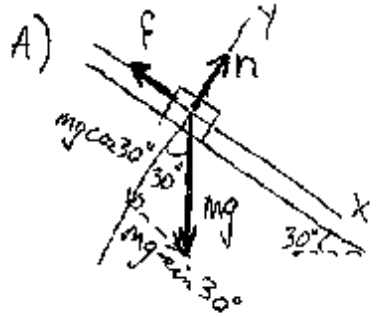
$(127.6)\cos 50 - 44.43 = T_3$

82.02

37.6 NT $= T_3$ ANS

C.

A)



$\Sigma F_x = ma$

$mg \sin 30 - f = ma$

$(3\text{kg})(9.8\ m/s^2)\sin 30° - f = (3\text{kg})(1.78\ m/s^2)$

$14.7 - f = 5.34$

$f = 9.36$N

B) $\Sigma F_y = 0 \Rightarrow n - mg\cos 30° = 0$

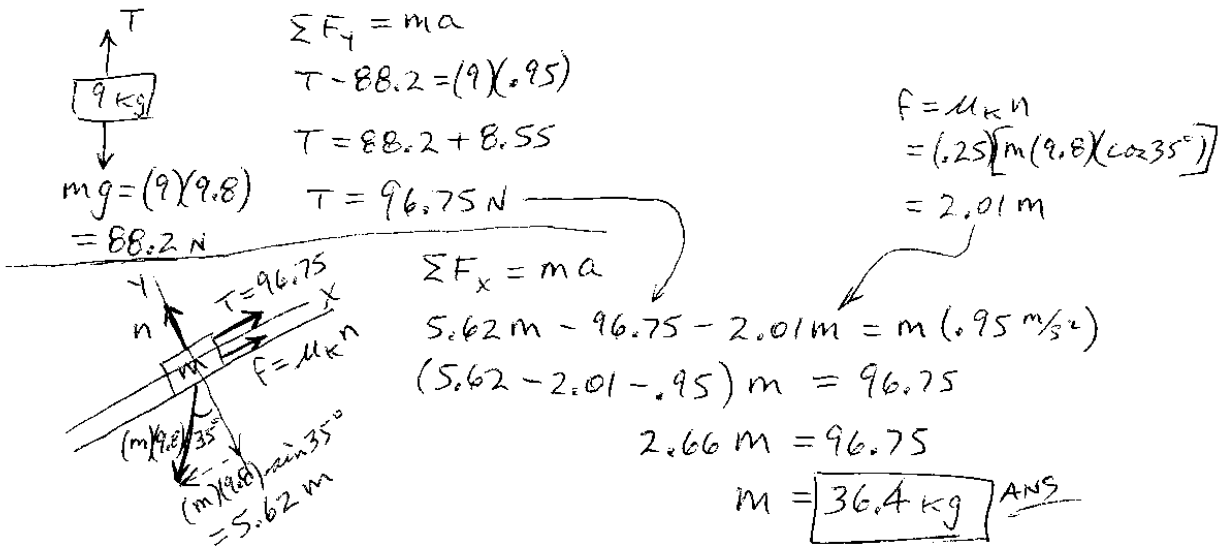
$n = (3)(9.8)(\cos 30°) = 25.46$N

$f = \mu_K n \Rightarrow \mu_K = \frac{f}{n} = \frac{9.36\text{N}}{25.46\text{N}} = .368$

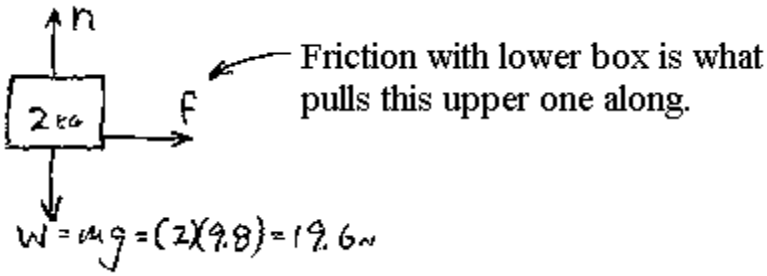
D. 1. Any four of these six things:

- The unit is missing on the answer.
- Mixed up weight and mass. (9 kg is the <u>mass</u> of the one box and m is the <u>mass</u> of the other. These are not forces.)
- The string tension does not equal the weight of the 9 kg box. (Since the box is accelerating upward, T > weight of 9 kg.)
- Friction should point <u>uphill</u> since the box is sliding downhill.
- Mixed up sine with cosine. (The weight times the <u>sine</u> of 35° equals the opposite side of the triangle.)
- The normal force does not equal the weight of m. (It would be the weight times cos 35°.)

The question does not ask for this, but for anyone who wants to see the correct solution, it looks like this:



2. Apply ΣF = ma to the top block:



f is equal to $\mu_s n$ only when you are right on the verge of slippage. To get the minimum μ_s, assume this is the case.

$\mu_s = \frac{f}{n}$

$\Sigma F_x = ma \Rightarrow f = ma$

$= (2\text{ kg})(3\text{ m/s}^2)$

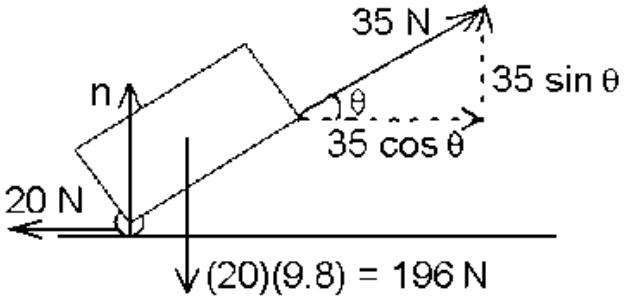
$= 6\text{ N}$

$\Sigma F_y = 0 \Rightarrow n = 19.6\text{ N}$

$= \frac{6\text{ N}}{19.6\text{ N}}$

$= \boxed{.306}$ ANS

E. a.



A constant speed means the acceleration is zero. If you put zero acceleration into Newton's second law, you get $\Sigma F_x = 0$ and $\Sigma F_y = 0$.

b. $\Sigma F_x = 0$

$35\cos\theta - 20 = 0$

$\cos\theta = 20/35$

$\boxed{\theta = 55^o}$

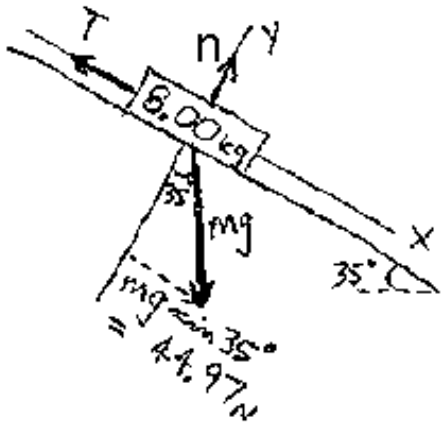
c. $\Sigma F_y = 0$

$n + 35\sin\theta - 196 = 0$

$n = 196 - 35\sin 55^o$

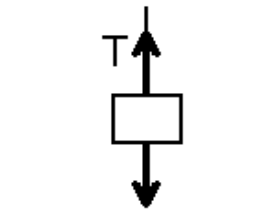
$\boxed{n = 167\text{ N}}$

F. Apply ∑F = ma to each individual block:



$\Sigma F_x = ma$

$44.97_N - T = (8\,kg)a$



$\Sigma F_y = ma$

$T - 29.4 = 3a$

$T/3 - 9.8 = a$

$mg = (3)(9.8)$

$= 29.4\ N$

Two equations with two unknowns. Put them together to eliminate one variable and solve for the other:

$44.97 – T = (8)(T/3 – 9.8)$

$44.97 – T = 2.667T – 78.4$

$44.97 + 78.4 = 2.667T + T$

$123.37 = 3.667T$

$\boxed{T = 33.6\ N}$

(Some people assume that because there is 29.4 N pulling down on the 3 kg, there must be 29.4 N pulling back up. That would only be the case if the 3 kg was not accelerating. Acceleration is caused by an imbalance in the forces. The block accelerates in the direction of the larger force.)