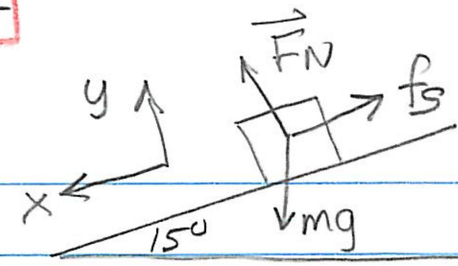
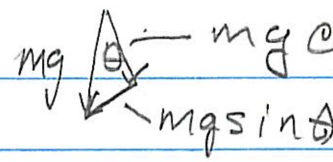
Part 2

$\boxed{4\text{-}43}$



$\theta = 15°$, $m = 1700\,kg$



$$\sum F_y = mg\cos 15 - F_N = 0$$

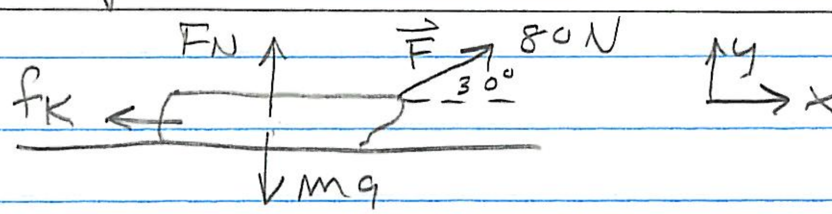
$$\sum F_x = mg\sin 15 - f_s = 0$$

$$f_s = \mu_s F_N$$

(a) $F_N = mg\cos 15 = 1700 \times 9.8 \times \cos 15 = \underline{16{,}092\,N}$

(b) $f_s = mg\sin 15° = 1700 \times 9.8 \times \sin 15 = \underline{4312\,N}$

$\boxed{4\text{-}45}$



$$\sum F_y = F_N - mg + F\sin 30° = 0$$

$$\sum F_x = F\cos 30 - f_K = 0 \qquad (\text{const. } v)$$

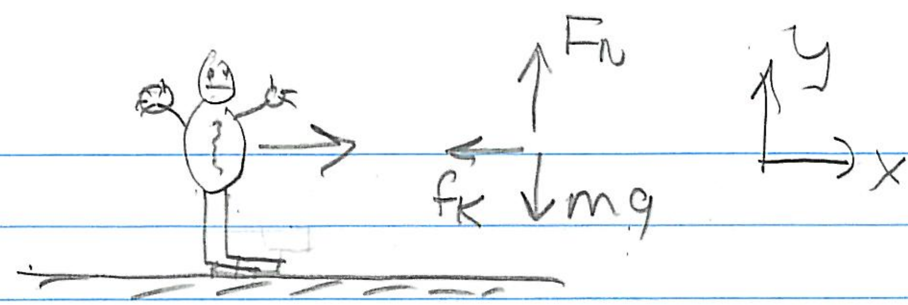
$$f_K = \mu_K F_N$$

$$F_N = mg - F\sin 30° = 20 \times 9.8 - 80\sin 30$$
$$= 156N$$

$$\mu_K F_N = F\cos 30$$

$$\mu_K = \frac{80\cos 30}{156} = \underline{0.44}$$

$$\boxed{4-49}$$



$$\Sigma F_y = F_N - mg = 0 \Rightarrow F_N = mg$$

$$\Sigma F_x = -f_K = -\mu_K F_N = m a_y$$

$$-\mu_K \cancel{m} g = \cancel{m} a_y$$

$$a_y = -\mu_K g = -0.081 \times 9.8$$

$$= \underline{-0.79\, m/s^2}$$

$$v = v_0 + a_y t$$

$$2.8\, m/s = 6.3\, m/s - 0.79\, t$$

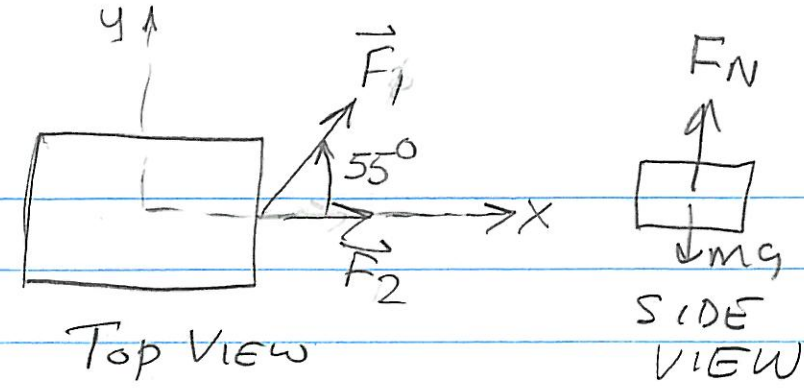
$$\frac{2.8 - 6.3}{-0.79} = t$$

$$\underline{t = 4.4\, s}$$

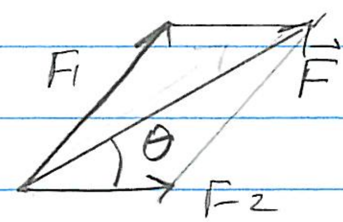
$\boxed{4-51}$

$F_1 = 88\,N$

$F_2 = 54\,N$



The friction force is always in the opposite direction to the motion. The crate will move in the direction of the acceleration which will be in the direction of the sum of $\vec{F}_1 + \vec{F}_2 = \vec{F}$



$\vec{F} = \vec{F_x} + \vec{F_y}$

$F_x = F_{1x} + F_{2x}$

$F_y = F_{1y} + F_{2y}$

$F_x = F_1 \cos 55 + F_2$

$= 88 \cos 55 + 54 = 104.5\,N$

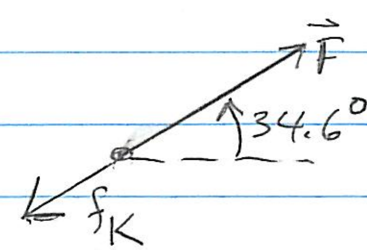
$F_y = F_{1y} = F_1 \sin 55 = 72.1\,N$

$\tan\theta = F_y / F_x = 72.1/104.5 \Rightarrow \theta = 34.6^\circ$

$F = \sqrt{F_x^2 + F_y^2} = 127\,N$

$f_K = \mu_K F_N = \mu_K m g$

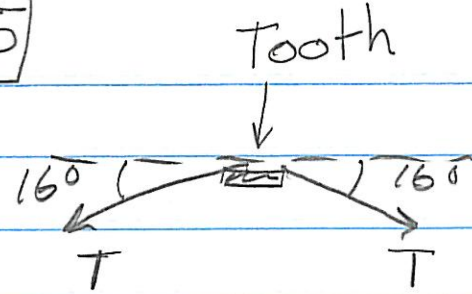
$= 0.35 \cdot 25 \cdot 9.8 = 85.8\,N$



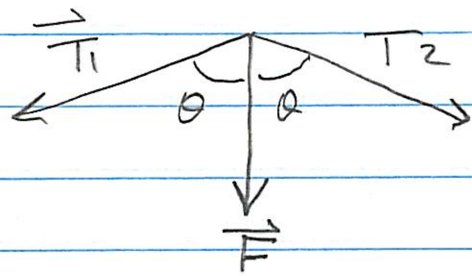
$\Sigma F = F - f_K = 127\,N - 85.8\,N = ma$

$a = \dfrac{41.3}{25} = \underline{1.65\,m/s^2}$, $\underline{34.6^\circ}$ from $+x$ axis

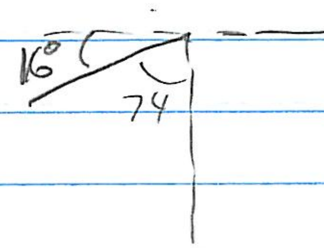
$\boxed{4-55}$



$T = 21\ N$



$\theta = 90 - 16 = 74°$



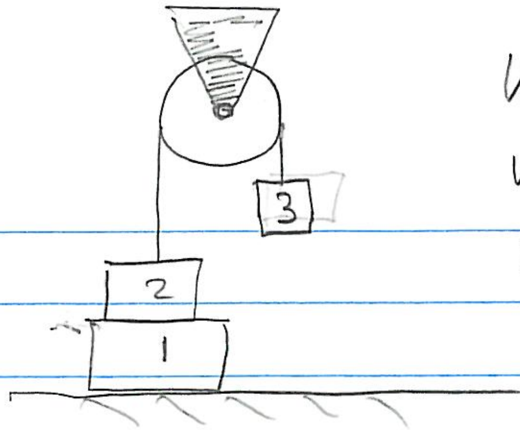
$$F = T_1 \cos\theta + T_2 \cos\theta$$

$$= 2T\cos\theta$$

$$= 2 \times 21 \cos 74°$$

$$= \underline{11.6\ N}$$

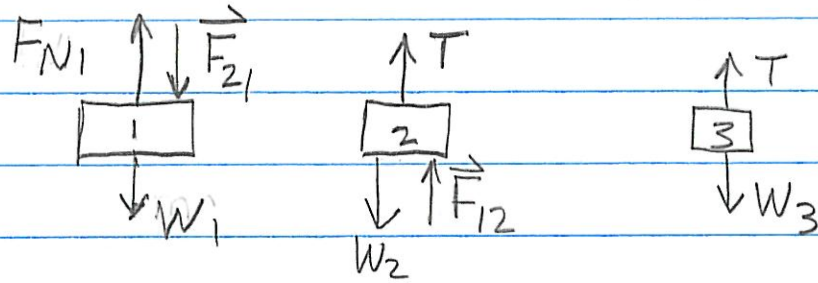
$$\boxed{4-61}$$



$W_1 = 55N$

$W_2 = 35N$

$W_3 = 28N$



$\vec{F}_{12}$ & $\vec{F}_{21}$ are the Action/Reaction forces on 1 & 2.

Choose up as ⊕ , $F_{21} = F_{12}$

1: $F_{N1} - F_{21} - W_1 = 0$

2: $T + F_{12} - W_2 = 0$

3: $T - W_3 = 0 \Rightarrow T = W_3 = 28N$

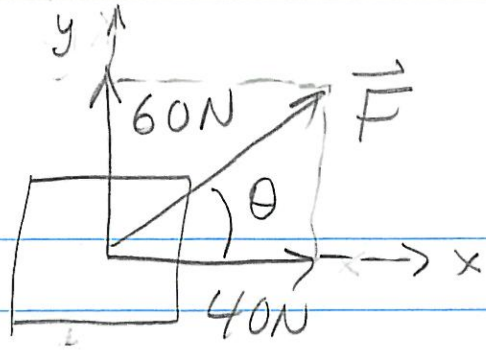
Add the first 2 equations recalling that $F_{21} = F_{12}$

$$F_{N1} - W_1 + T - W_2 = 0$$
$$F_{N1} - W_1 + W_3 - W_2 = 0$$

$$F_{N1} = W_1 + W_2 - W_3 = \underline{62\ N}$$

★ ① & ② are really like one block, so the floor must support $W_1 + W_2$ minus W_3

$\boxed{4-71}$

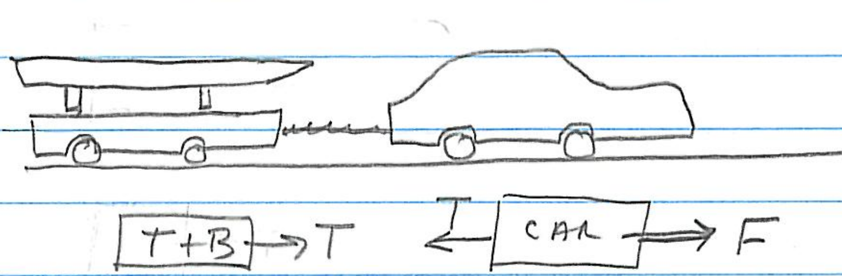


$$F = \sqrt{(40)^2 + (60)^2} = 72.1\ N$$

$$\theta = \tan^{-1}(60/40) = 56.3^\circ$$

$$a = F/m = 18\ m/s^2,\ 56.3^\circ \text{ to } +x$$

$\boxed{4-79}$



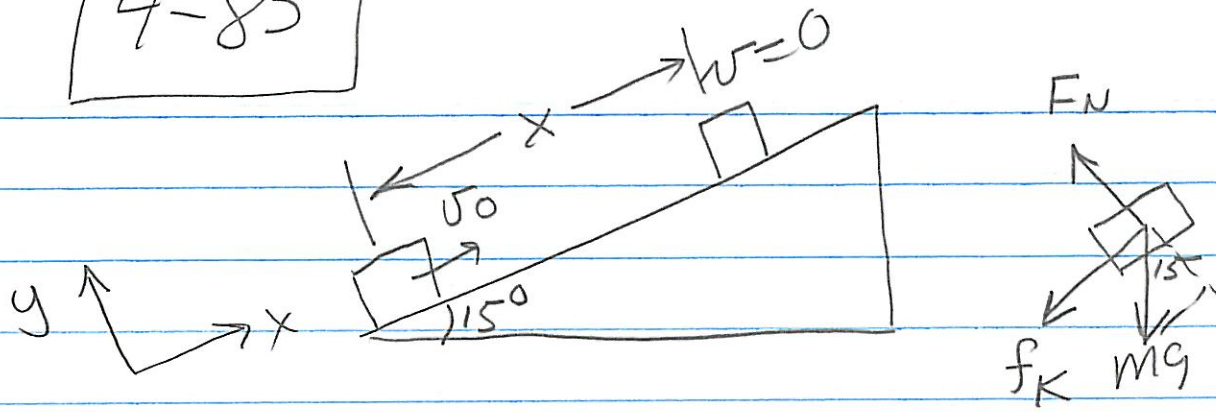
$$a = \frac{11\,m/s}{28\,s} = 0.39\ m/s^2$$

Trailer + Boat $\quad T = (m_t + m_b)\,a$

$$= 410\,kg \times 0.39\,m/s^2$$

$$= 160\,N$$

$\boxed{4\text{-}85}$



$$\sum F_y = F_N - mg\cos 15^\circ = 0$$

$$F_N = mg\cos 15^\circ$$

$$\sum F_x = -mg\sin 15 - f_K = m a_x$$

$$-\cancel{m}g\sin 15 - \mu_K \cancel{m}g\cos 15 = \cancel{m}a_x$$

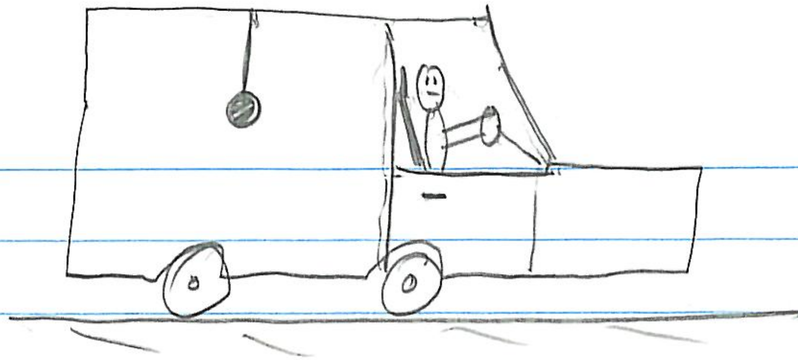
$$a_x = -g(\sin 15 + 0.18\cos 15) = -4.2\ m/s^2$$

then use: $v_f^2 = v_0^2 + 2a_x(x - x_0)$

$$0 = (1.5)^2 + 2(-4.2)(x - 0)$$

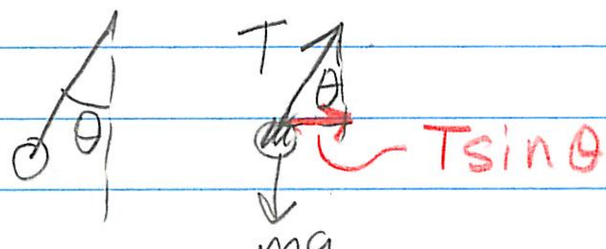
$$x = 0.27\ m$$

4-92



If the van is at rest and begins to accelerate forward ($\rightarrow$), the sphere swings backwards due to its inertia. Suppose the mass of the sphere is m

(a)



Vertical: $T\cos\theta = mg$

Horizontal:

$$T\sin\theta = ma$$

combining

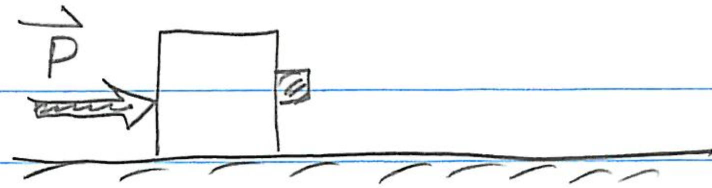
$$\frac{\cancel{m}g}{\cos\theta}\sin\theta = \cancel{m}a$$

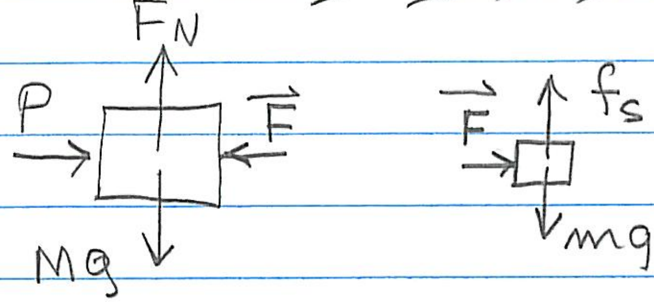
$$\boxed{a = g\tan\theta} = 9.8\tan 10^\circ = \underline{1.73\,m/s^2}$$

(b) if $v = \text{const}$, $a = 0$, $\tan\theta = 0$

$$\underline{\theta = 0^\circ}$$

4-112





F is the contact force between the large cube and the small cube.

LARGE CUBE $\quad F_N - Mg = 0, \quad P - F = Ma$

SMALL cube $\quad f_s - mg = 0, \quad F = ma$

$$\mu_s F - mg = 0$$

$$\mu_s (\cancel{m}a) - \cancel{m}g = 0, \quad a = g/\mu_s$$

$$P - ma = Ma$$

$$P = (m+M)a = (m+M)(g/\mu_s)$$

$$= (25+4)(9.8/0.71) \simeq 400\ \text{N}$$