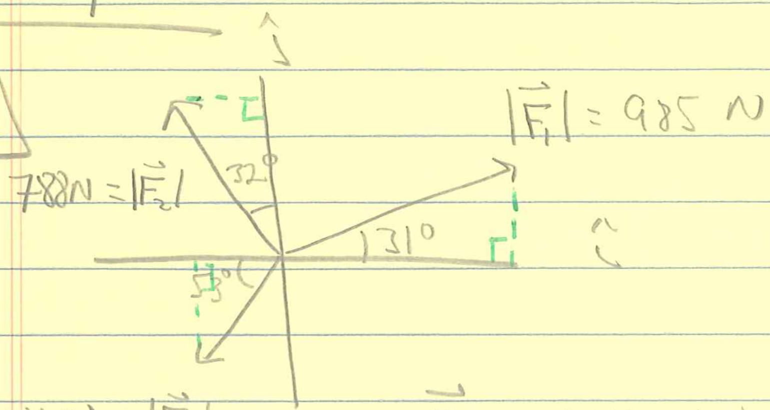
HW due 2/7

4.2)



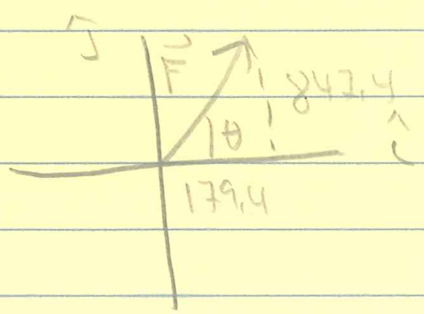
$$\vec{F}_1 = 985\cos(31)\hat{i} + 985\sin(31)\hat{j}$$
$$= \underline{844.3\hat{i} + 507.3\hat{j}}\ \text{Ans}$$

$$\vec{F}_2 = -788\sin(32)\hat{i} + 788\cos(32)\hat{j} = -417.6\hat{i} + 668.3\hat{j}$$

$$\vec{F}_3 = -411\cos(53)\hat{i} - 411\sin(53)\hat{j} = -247.3\hat{i} - 328.2\hat{j}$$

$$\vec{F}_{NET} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 = (844.3 - 417.6 - 247.3)\hat{i}$$
$$+ (507.3 + 668.3 - 328.2)\hat{j}$$

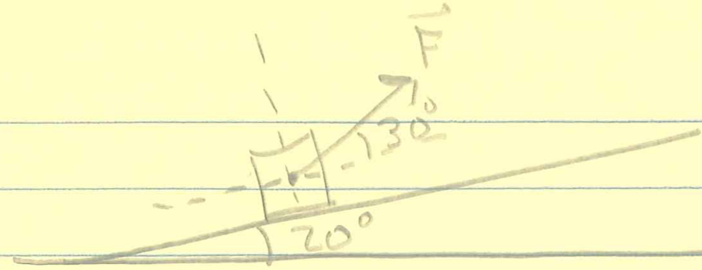
$$\vec{F}_{net} = 179.4\hat{i} + 847.4\hat{j}$$



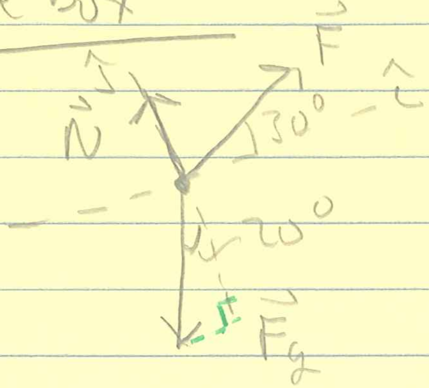
$$|\vec{F}_{net}| = \underline{866.2\ N}\ \text{Ans.}$$

$$\theta = \tan^{-1}\left(\frac{847.4}{179.4}\right) = \underline{78°}\ \text{Ans.}$$

4.4)



For the box



Since it does not mention friction, we assume no friction.

Answer Answer

$\vec{N} = N\hat{j}$

$\vec{F} = F\cos(30)\hat{i} + F\sin(30)\hat{j} = 90\hat{i} + 51.95\hat{j}$

$\vec{F}_g = -mg\sin(20)\hat{i} - mg\cos(20)\hat{j}$

Aside: They tell us that $(F\cos(30)) \equiv 90.0\text{ N}$

$\therefore F = \frac{90}{\cos(30)} = 103.9$ newtons

We can do more!! 2nd Law: $\sum \vec{F} = m\vec{a}$

Just to show you

$\boxed{\hat{j}}$ $\sum F_y = m\cancel{a_y}^{\,0}$

$N + 51.95 - mg\cos(20) = 0$

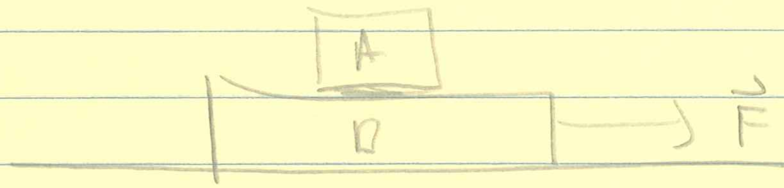
$N = mg\cos(20) - 51.95$

$\boxed{\hat{i}}$ $\sum F_x = ma_x$

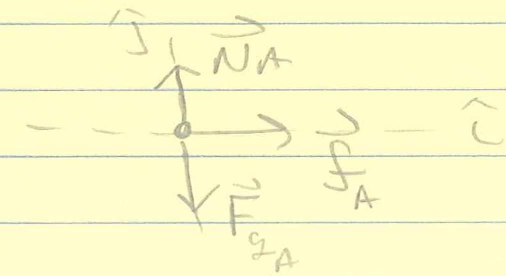
$90 - mg\cos(20) = ma_x$

With more information we could find m or a_x

4.26] Table is frictionless. That tells us there is a net force moving blocks to the right. ∴ There is an acceleration (a_x)



For A;



2^{nd}: $\sum \vec{F} = M_A \vec{a}$

$\boxed{\hat{i}}$ $\sum F_x = M_A a_x$

NOT ZERO. "+"

So this cannot be zero!

Set $\vec{f}_A = +f\hat{i}$ and a_x is "+", as expected.
Set $\vec{f}_A = -f\hat{i}$ and 2^{nd} law will have 'f' as negative so that $\vec{f}_A$ is in $+\hat{i}$ direction. Algebra fixes incorrect choice of direction!

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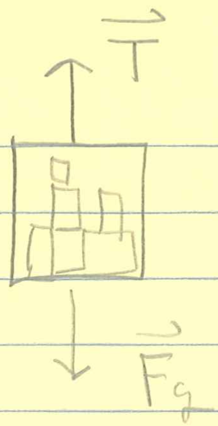
b.] If there is friction between M_B and table, and $|\vec{F}|$ is equal to the magnitude of that friction, then $a_x = 0$.

∴ There can be no $\vec{f}_A$ because M_A is not accelerating. We spent a fair amount of class time on this problem ☺

4.44



$M = 2200$ kg

for the elevator

$+\hat{j}$

$\vec{T} = +T\hat{j}$

$\vec{F}_g = -mg\hat{j}$

2^{nd} $\sum \vec{F} = m\vec{a}$

$\boxed{\hat{j}}$ $\sum F_y = ma_y$

$$\boxed{T - mg = ma_y} \quad \boxed{1}$$

IF maximum value for T is 28000 N, this tells us that the maximum acceleration can be:

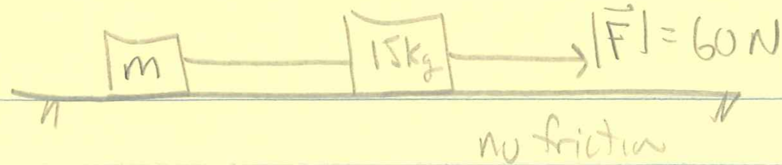
$$\boxed{1} \Rightarrow a_y = \frac{T - mg}{m} = \frac{28000 - 2200(9.8)}{2200} = +2.93 \ \frac{m}{s^2}$$

Answer in $(+y)$ direction.

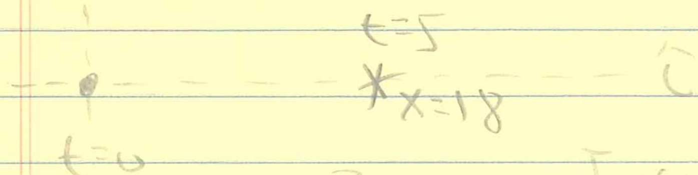
On Moon, let $g = 1.62$

$$\boxed{1} \Rightarrow a_y = \frac{28000 - 2200(1.62)}{2200} = 11.11 \ m/s^2$$

4.40)



From rest, "in first 5 sec. moves 18m to right"
Force is constant so acceleration is constant.



$x_0 = 0$ $a = ?$
$v_0 = 0$

$$\begin{cases} x(t) = x_0 + v_0 t + \frac{1}{2}at^2 \\ v(t) = v_0 + at \end{cases}$$

$$\begin{cases} x(t) = \frac{1}{2}at^2 & \boxed{1} \\ v(t) = at & \boxed{2} \end{cases}$$

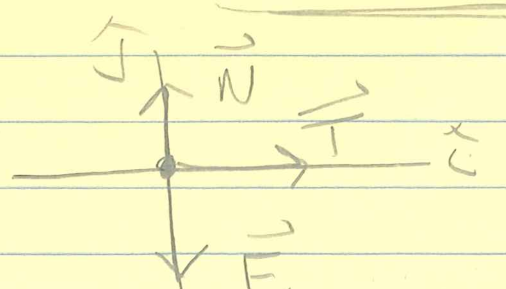
@ t = 5, x = 18

$\boxed{1} \Rightarrow 15 = \frac{1}{2}a(5)^2$
$\therefore a = 1.2 \, m/s$ ☆ NEED

$\boxed{2} \Rightarrow v\big|_{t=5} = 1.2(5) = 6 \, m/s$ (do not need)

Now to NEWTON

for m



$$\begin{cases} \vec{N} = N\hat{j} \\ \vec{T} = T\hat{i} \\ \vec{F}_g = -mg\hat{j} \end{cases}$$

2^{nd} $\sum \vec{F} = m\vec{a}$

$\boxed{\hat{i}}$ $\sum F_x = m a_x$

$\boxed{1}$ $\boxed{T = m a_x = 1.2m}$

FOUND THIS!!

$\boxed{\hat{j}}$ $\sum F_y = m a_y$ Don't need ☺

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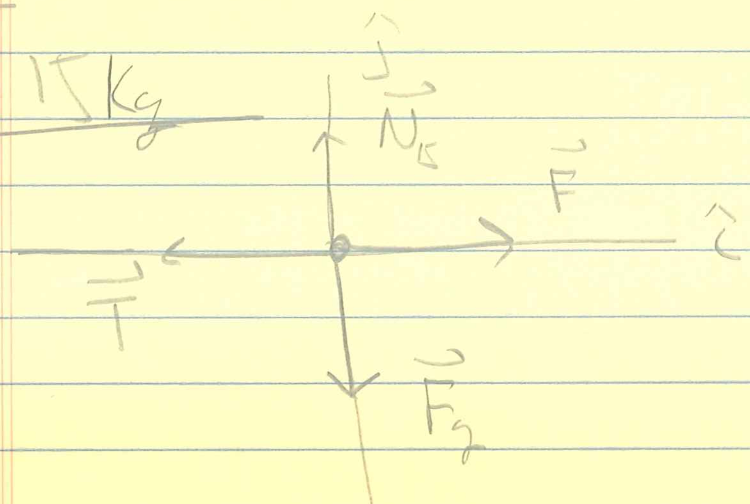
for 15 kg



$\vec{N}_{15} = N_{15}\hat{j}$

$\vec{F}_g = -15g\hat{j}$

$\vec{F} = 60\hat{i}$

$\vec{T} = -T\hat{i}$

2^{nd} : $\sum \vec{F} = 15\vec{a}$

$\boxed{\hat{i}}$ $\sum F_x = 15 a_x$

$\boxed{2}$ $\boxed{60 - T = 15 a_x}$

$\boxed{\hat{j}}$ $\sum F_y = 15 a_y$ Don't need ☺

From $\boxed{2}$: $T = 60 - 15a_x = 60 - 15(1.2) = \underline{\underline{42 \text{ newtons}}}$

Answer

Then from $\boxed{1}$: $T = 1.2m$

$\therefore m = \dfrac{T}{1.2} = \underline{\underline{35 \text{ kg}}}$ Answer

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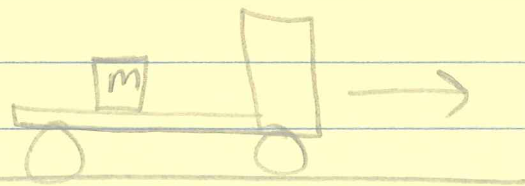
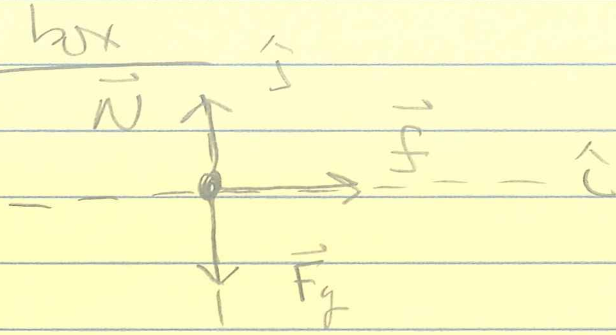
5.32



We want to find the maximum acceleration of truck (and thus the box) if the box is not to slide.

For the box



$\vec{N} = N\hat{j}$
$\vec{F} = -mg\hat{j}$
$\vec{f} = \mu_s N \hat{i}$

2nd Law: $\sum \vec{F} = m\vec{a}$

$\boxed{\hat{j}}$ $\sum F_y = m\cancel{a_y}^{\,0}$

$$N - mg = 0$$

$\underline{\underline{N = mg}}$ (Not always true!)

$\boxed{\hat{i}}$ $\sum F_x = ma_x$

$$f = ma_x$$

$$\boxed{\mu_s N = ma_x}$$

Substitute for N from previous result to get

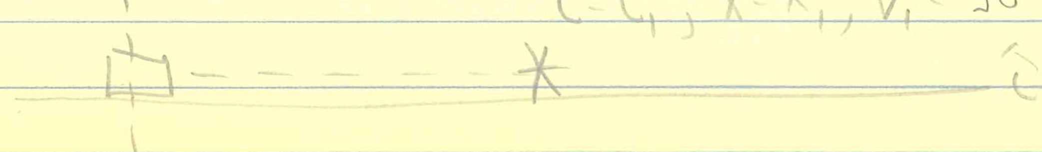
$$\mu_s mg = ma_x$$

$$\therefore a_x = \mu_s g = 0.650(9.8) = 6.37 \text{ m/s}^2$$

Ans

Now we have an eqn. of motion problem w/ constant acceleration

$t = t_1,\ x = x_1,\ v_1 = 30$ m/s



$t = 0$ $\quad a = +6.37$

$x_0 = 0$

$v_0 = 0$

$$\begin{cases} x(t) = x_0 + v_0 t + \frac{1}{2}at^2 \\ v(t) = v_0 + at \end{cases}$$

$$\begin{cases} x(t) = 3.185\,t^2 & \boxed{A} \\ v(t) = 6.37\,t & \boxed{B} \end{cases}$$

@ $t = t_1,\ x = x_1,\ v_1 = 30$

$\boxed{B} \Rightarrow 30 = 6.37\,t_1$

$\therefore t_1 = \underline{\underline{4.71 \text{ seconds}}}$ Answer

$\boxed{A} \Rightarrow x_1 = 3.185 t_1^2 = \underline{\underline{70.6 \text{ meters}}}$

because we can