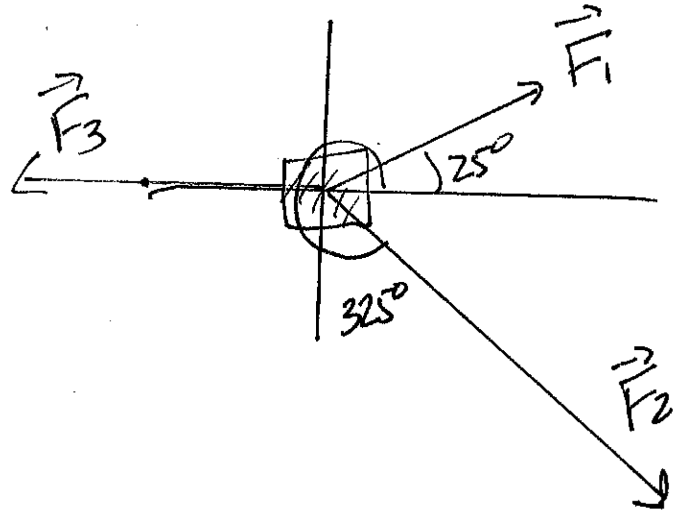
PHYSICS 160, HW #5

TEN Mastering Physics From Chapter 4 & 5

Written: 5.74

Motion of a Block with 3 Forces



$F_1 = 4N$

$F_2 = 6N$

$F_3 = 8N$

A: Calculate Magnitude of $\vec{F}_R = \sum \vec{F}$

$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

to left

$\Rightarrow F_{R,x} = F_{1,x} + F_{2,x} + F_{3,x} = 4N\cos 25^\circ \; 6N\cos 325^\circ - 8N$

(Standard Angles $\Rightarrow$ (Cosine) $\Rightarrow$ $F_{R,x} = .54N$

$F_{R,y} = F_{1,y} + F_{2,y} + F_{3,y} = 4N\sin 25^\circ + 6N\sin 325^\circ + 0$

$= 1.69N - 3.441N = -1.751N$

WE COULD ALSO USE $360° - 325° = 35°$

AND PUT THE NEGATIVE IN BY HAND

$4N \sin 25° - 6N \sin 35° = -1.75N$

$$F_R = \sqrt{F_{R,x}^2 + F_{R,y}^2} = \sqrt{(.54N)^2 + (1.75N)^2} = 1.83N$$

PART B: WHAT ANGLE $F_{R,x} > 0$, $F_{R,y} < 0 \Rightarrow$ 4th QUADRANT, SO CALCULATOR CORRECT

$$\theta = \tan^{-1}\left(\frac{F_{R,y}}{F_{R,x}}\right) = \tan^{-1}\left(\frac{-1.75}{.54}\right) = -72.9° = -73°$$

Part C: What is MAGNITUDE of $\vec{a}$?

MAGNITUDE

$\sum \vec{F} = M\vec{a}$ DOES MEAN THAT $|\sum F| = Ma$

OR IN THIS CASE $F_R = Ma \Rightarrow a = \frac{F_R}{M} = \frac{1.83N}{2 Kg}$

$= .915 m/s^2$

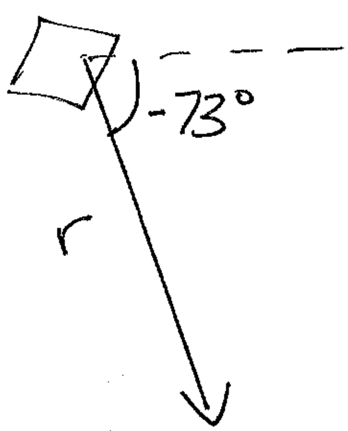
$= .92 m/s^2$

PART D: DIRECTION of $\vec{a}$, $\sum \vec{F} = M\vec{a}$

$\Rightarrow$ SAME DIRECTION SO $-73°$

PART E: How far? SINCE MASS starts FROM REST, IT will move IN DIRECTION of $\vec{F}_R = \sum \vec{F}$

$\vec{F}_R$ constant $\Rightarrow$ STRAIGHT LINE MOTION WITH Constant ACCELERATION. TO AVOID CONFUSION WITH x, CALL distance covered r. (NOTE, this Also Answers G since moving at $-73°$)



$$r = r_0 + V_0 t + \tfrac{1}{2} a t^2$$

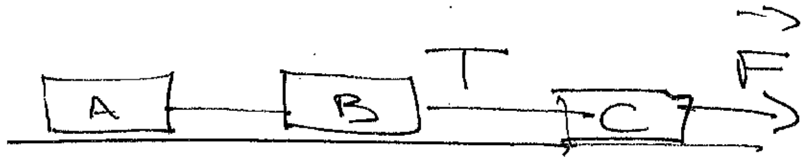
$$r_0 = 0, \; V_0 = 0$$

$$\Rightarrow r = \tfrac{1}{2} a t^2 = \tfrac{1}{2}(.92\,m/s^2)(5s)^2$$

$$= 11.5m = 12m$$

Part F: $V = ?$ at $5s$? $V = V_0 + at$ FOR SAME REASONS $\Rightarrow V = 0 + (.92\,m/s^2)(5s) = 4.6\,m/s$

Pulling 3 Blocks



$T = 3N$

$M_A = M_B = M_C = .4kg$

Part A: What is magnitude of F?

All 3 masses must have same acceleration magnitude and direction $\Rightarrow a_{A,x} = a_{B,x} = a_{C,x}$
$= a$

Horizontal surface

Forces on A: $\vec{T}_{AB}$ to right, $\vec{n}_A$ up, $\vec{w}_A$

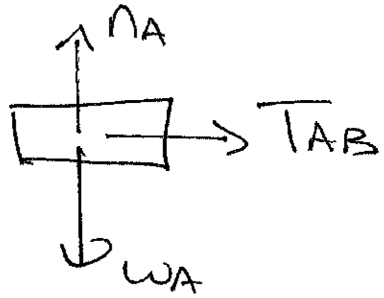
Forces on B: $\vec{T}_{AB}$ to left, $\vec{T}$ to right, $\vec{n}_B$ up, $\vec{w}_B$

Massless Rope $\Rightarrow$ Equal tension

Forces on C: $\vec{F}$ to right, $\vec{T}$ to left, $\vec{n}_C$ up, $\vec{w}_C$

Free-Body Diagrams

M_A:



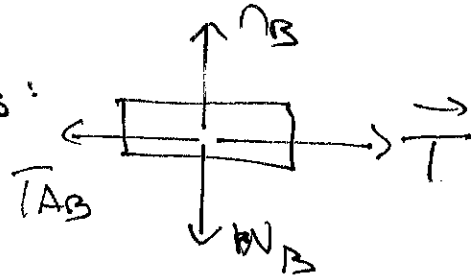
$$\sum F_{A,x} = M_A a_{A,x}$$

$$\Rightarrow T_{AB} = (.4\,kg)a \qquad (1)$$

$$\sum F_{A,y} = 0 \text{ since } a_{A,y} = 0$$

$$\Rightarrow n_A = w_A$$

M_B:

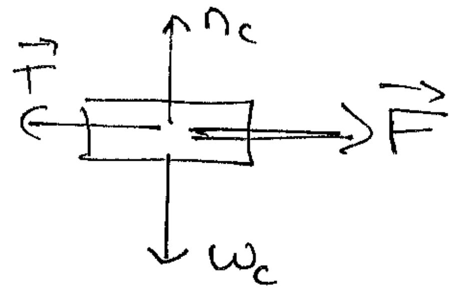


$$\sum F_{B,x} = M_B a_{B,x}$$

$$\Rightarrow T - T_{AB} = (.4\,kg)a \qquad (2)$$

$$\sum F_{B,y} = 0 \Rightarrow n_B = w_B$$

M_C:



$$\sum F_{c,x} = M_c a_{c,x}$$

$$\Rightarrow F - T = (.4\,kg)a \qquad (3)$$

$$\sum F_{c,y} = 0 \Rightarrow n_c = w_c$$

(1) $\Rightarrow T_{AB} = (.4\,kg)a$ so substitute into (2)

$$\Rightarrow T - (.4\,kg)a = (.4\,kg)a \Rightarrow T = (.8\,kg)a$$

$$\Rightarrow a = \frac{T}{.8\,kg} = \frac{3\,N}{.8\,kg} = 3.75\,m/s^2$$

So (3) Becomes:

$$F - T = (.4\text{kg})a \Rightarrow F = T + (.4\text{kg})a$$

$$\Rightarrow F = 3\text{N} + (.4\text{kg})(3.75\text{m/s}^2) = 3\text{N} + 1.5\text{N}$$
$$= 4.5\text{N}$$

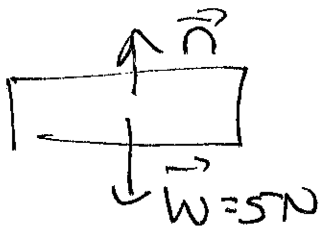
Part B: What is T_{AB}?

$$(1) \Rightarrow T_{AB} = (.4\text{kg})a = (.4\text{kg})(3.75\text{m/s}^2) = 1.5\text{N}$$

BOOK ON TABLE

A: DOWNWARD FORCE ON BOOK = GRAVITY

B:



$\vec{n}$ = UPWARD Force ON BOOK Exerted By table

$\sum F_y = 0 \Rightarrow n - W = 0 \Rightarrow n = W = 5N$

C: $\vec{n}$ AND $\vec{W}$ ARE NOT 3RD LAW PAIRS BECAUSE they ARE EXERTED ON THE SAME OBJECT.

D: THE REACTION to GRAVITY: IF THE EARTH pulls DOWN ON THE BOOK, THE BOOK pulls UP ON THE EARTH.

E: REACTION TO NORMAL: IF the table pushes UP ON THE BOOK, THE BOOK pushes DOWN ON THE TABLE

F: AS SHOWN ABOVE $\sum F_y = ma_y$

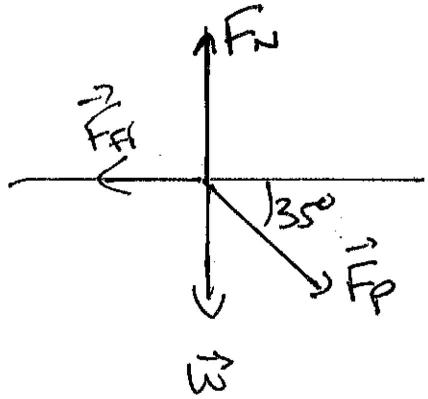
SHOWS $n = W$ $\therefore$ 1ST OR 2ND LAW

G: Newton's 3RD LAW tells us ACTION AND

REACTION ARE EQUAL.

Free Body Diagrams and Newton's Laws

Part A:



$M = 55\,kg$, $\vec{F}_P = 148N$, $35°$ Below Horizontal

So $\vec{W} = Mg$. Down

$W = 539N$

Friction, $F_{Fr} = 106N$

Friction opposite to velocity

$\Rightarrow$ to LEFT

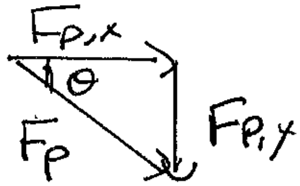
NORMAL, F_N, HORIZONTAL FLOOR $\Rightarrow$ UPWARDS

B: Given up, Down, left forces USUAL Cartesian

IS Best

C:

$\sum F_x = F_{P,x} - F_{Fr}$ SINCE F_N, W ARE BOTH VERTICAL



$\cos\theta = \dfrac{F_{P,x}}{F_P} \Rightarrow F_{P,x} = F_P \cos\theta$

$$\Rightarrow \sum F_x = F_p \cos\theta - F_{fr}$$

Part D:

$\sum F_y = ?$ As shown on last page $F_{P,y}$ is down

$\vec{w}$ is down, $\vec{F}_N$ is up

$$\Rightarrow \sum F_y = F_N - W - F_{P,y}.$$

From Previous:

$$\sin\theta = \frac{F_{P,y}}{F_P} \Rightarrow F_{P,y} = F_P \sin\theta$$

$\therefore \sum F_y = F_N - W - F_P \sin\theta$ or to use their notation, $\sum F_y = F_N - F_G - F_P \sin\theta$

Notice, we put negative sign in by hand so we'll set $\theta = +35°$ at end of problem.

Part E:

$$\sum F_x = Ma_x, \quad \sum F_y = Ma_y$$

NO MOTION IN y-DIRECTION $\Rightarrow a_y = 0,\ a_x = a = ?$

$$\sum F_x = Ma_x \Rightarrow F_p \cos\theta - F_{fr} = Ma_x$$

$$\Rightarrow 148N \cos 35° - 106N = 55kg\, a$$

$$\Rightarrow 15.2345N = 55kg\, a \Rightarrow a = \frac{15.2345N}{55kg} = .277 m/s^2$$

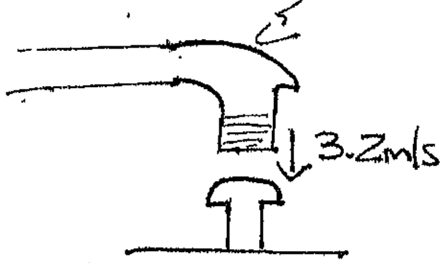
$$\sum F_y = Ma_y \Rightarrow F_N - W - F_p \sin\theta = 0$$

$$\Rightarrow F_N = W + F_p \sin\theta = 539N + 148N \sin 35°$$

$$\Rightarrow F_N = 624N$$

4.52

$4.9N = W \leadsto \vec{W} = 4.9N$, DOWN



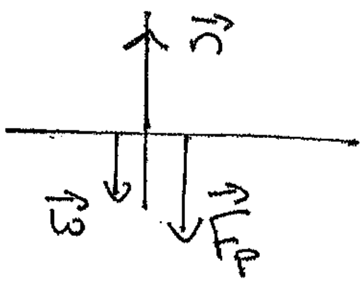
STOPPED IN .45cm $= 4.5\times10^{-3}$m

ADDITIONAL 15N DOWNWARD FORCE APPLIED BY PERSON

$\Rightarrow \vec{F}_p = 15N$, DOWN

a) DRAW FBD FOR HAMMER HEAD

FORCES ON HAMMER: $\vec{W}$, $\vec{F}_p$, AND NAIL PUSHES UP ON HAMMER, SOLID OBJECTS $\Rightarrow$ NORMAL FORCE, $\vec{n}$



ID REACTION FORCES: $\vec{W}$ → EARTH PULLS DOWN ON HAMMER WITH 4.9N $\Rightarrow$ REACTION = UPWARDS 4.9N pull ON EARTH,

$\vec{F}_p$ → PERSON PUSHES DOWN ON HAMMER WITH 15N $\Rightarrow$ REACTION = UPWARDS 15N PUSH ON PERSON

$\vec{n}$ ⇒ NAIL PUSHES UP ON HAMMER ⇒ HAMMER PUSHES DOWN ON NAIL WITH FORCE MAGNITUDE n. → THIS IS WHAT PUSHES THE NAIL INTO THE BOARD.

b. $n = ?$ $\qquad \sum F_y = Ma_y$

Assuming Constant ACCELERATION ⇒ $V_y^2 = V_{0,y}^2 + 2a_y(y - y_0)$

FOR HAMMER: $V_y = 0$, $V_{0,y} = -3.2\,m/s$, $y - y_0 = -4.5\times10^{-3}\,m$

Stops

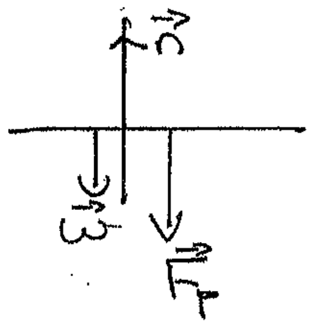
DOWN IS NEGATIVE

HAMMER goes DOWNWARD while Stopping

$$\therefore\ 0 = (-3.2\,m/s)^2 + 2a_y(-4.5\times10^{-3}\,m)$$

$$\Rightarrow 0 = 10.24\,m^2/s^2 + a_y(-9\times10^{-3}\,m) \Rightarrow a_y = \frac{-10.24\,m^2/s^2}{-9\times10^{-3}\,m}$$

$$\Rightarrow a_y = +1137.78\,m/s^2$$ ← UPWARDS ACCELERATION BECAUSE SLOWING DOWN



$W = Mg \Rightarrow 4.9N = M(9.8 m/s^2)$

$\Rightarrow M = \frac{4.9N}{9.8 m/s^2} = .5 Kg$

Unit: $\frac{N}{m/s^2} = \frac{kg \cdot m/s^2}{m/s^2} = Kg$

$\sum F_y = Ma_y \Rightarrow n - W - F_P = Ma_y$

$\Rightarrow n - 4.9N - 15N = .5Kg(1137.78 m/s^2) = 568.89N$

$\Rightarrow n = 4.9N + 15N + 568.89N \Rightarrow \boxed{n = 588.7889N = 589N}$

c) IF $y - y_0 = -.12cm = -1.2 \times 10^{-3} m$ what is n?

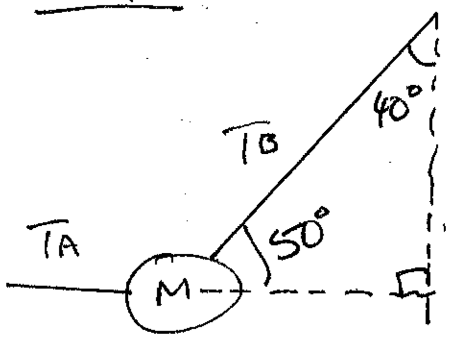
$a_y = \frac{-(3.2 m/s)^2}{2(-1.2 \times 10^{-3} m)} = 4266.67 m/s^2$

SAME FBD $\Rightarrow \sum F_y = Ma_y \Rightarrow n - W - F_P = Ma_y$

$\Rightarrow n - 4.9N - 15N = .5Kg(4266.67 m/s^2)$

$\Rightarrow \boxed{n = 2153.2 = 2150N}$

5.6 :



$M = 4090\,Kg$

Forces on M: $\vec{T}_A$ to left,

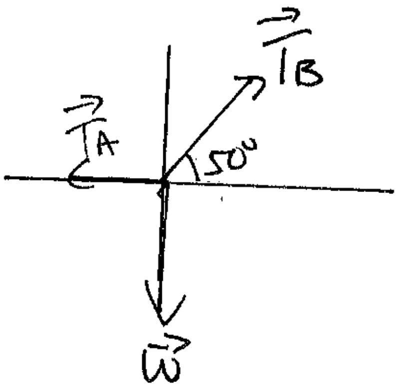
$\vec{T}_B$ at $50°$

$\vec{W}$ down.

A: What is T_B ?

$W = (4090\,kg)(9.8\,m/s^2)$

$= 40082\,N$



$\sum F_x = M a_x$

$\sum F_y = M a_y$

$a_x = 0,\ a_y = 0$ since not moving

$\sum F_y = 0 \Rightarrow T_{B,y} - W = 0.$ $\quad 50° = $ standard angle

$\Rightarrow T_B \sin 50° - W = 0 \Rightarrow T_B = \dfrac{W}{\sin 50°} = \dfrac{40082\,N}{\sin 50°} =$

$52323\,N = 52000\,N$

Part B :

$\sum F_x = 0 \Rightarrow T_{B,x} - T_A = 0 \Rightarrow T_B \cos 50° - T_A = 0$

$\Rightarrow T_A = T_B \cos 50° = 52323 \cos 50° = 33632\,N = 34000\,N$

THE WINDOW WASHER

FIRST, LOOK AT THE END OF THE MASSLESS ROPE

$$\sum F_y = M_{ROPE}\, a_{ROPE,y}$$

$$M_{ROPE} = 0 \Rightarrow T - F = 0 \Rightarrow F = T$$

$\Rightarrow$ WE REALLY NEED TO FIND TENSION IN ROPE.

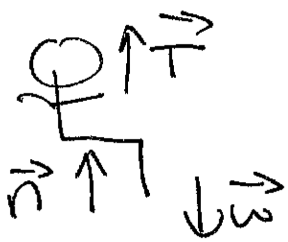
MINIMUM TENSION?

I RECOMMEND TAKING THIS ONE APART, CONSIDER THE MAN AND THE PLATFORM SEPARATELY

ON MAN: ROPE PULLS UP ON MAN $\Rightarrow \vec{T}$ UP

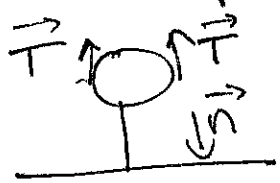
GRAVITY PULLS DOWN, $\Rightarrow \vec{W} = Mg$ DOWN

AND A NORMAL FORCE FROM INCLINE $\Rightarrow \vec{n}$ UP



$$\sum F_y = Ma_y \Rightarrow T + n - W = M_{MAN}\, a_{MAN}$$

ON THE PLATFORM: (including Pulley)



3RD LAW $\Rightarrow$ DOWNWARD force $\vec{n}$ on platform, ~~Rop~~ ROPE IS DOUBLED $\Rightarrow$ TWO UPWARD TENSION forces $\vec{T}$ (perfect pulleys $\Rightarrow$ SAME MAGNITUDE of tension)

Note, WE SHOULD ALSO HAVE ~~MASS~~ weight OF PLATFORM SINCE IN REALITY IT WOULD BE QUITE HEAVY.

$\sum F_y = Ma_y \Rightarrow T + T - n = M_{platform}\, a_{platform}$

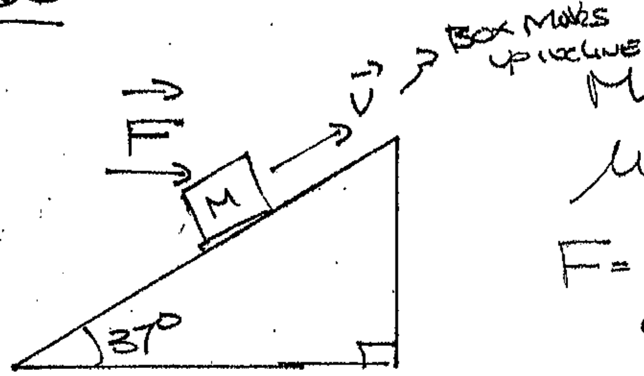
$\Rightarrow 2T - n = M_{plat}\, a_{plat}$. Notice T would get larger WITH ACCELERATION UPWARD $\Rightarrow$ MINIMUM T $\Rightarrow a_{plat} = 0 \Rightarrow a_{man} = 0$ too, so

$2T - n = 0$. FROM MAN $T + n - W = 0 \Rightarrow n = W - T$

so substitute: $2T - (W - T) = 0 \Rightarrow 2T - W + T = 0$

$\Rightarrow 3T = W \Rightarrow T = \frac{W}{3} = \frac{Mg}{3}$

5.66



$M = 6\,kg$

$\mu_K = .3$

$F = ?$ so mass accelerates at $4.2\,m/s^2$

Mass must move parallel to incline $\Rightarrow a_{\parallel} = 4.2\,m/s^2$, $a_{\perp} = 0$ still

Forces on mass, incline $\Rightarrow W_{\parallel} = mg\sin\alpha = (6\,kg)(9.8\,m/s^2)\sin 37°$

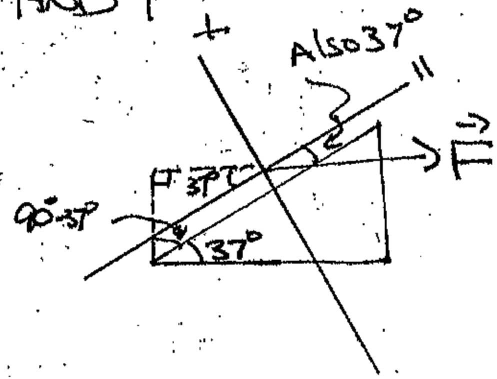
$\Rightarrow W_{\parallel} = 35.39\,N$, ↙

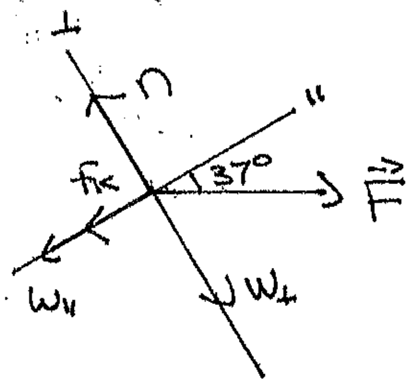
$W_{\perp} = Mg\cos\alpha = (6\,kg)(9.8\,m/s^2)\cos 37° = 46.96\,N$, ↘

Normal force, $\vec{n}$, at $90° \Rightarrow$ ↖

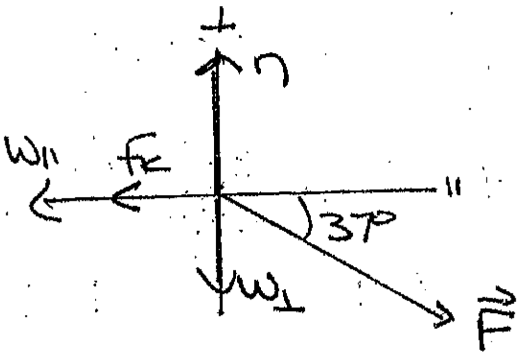
Kinetic friction, $\vec{f_K}$ at ↙ since mass going up incline

and $\vec{F}$.

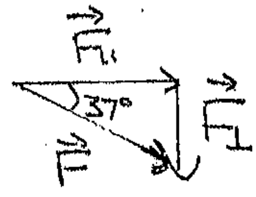




Without Straining Neck:



$a_{\parallel} = 4.2\,m/s^2,\ a_{\perp} = 0$



$\sin 37° = \frac{F_{\perp}}{F}$

$\Rightarrow F_{\perp} = F\sin 37°$

$\cos 37° = \frac{F_{\parallel}}{F} \Rightarrow F_{\parallel} = F\cos 37°$

$\sum F_{\perp} = Ma_{\perp} \Rightarrow n - W_{\perp} - F_{\perp} = 0 \Rightarrow n = W_{\perp} + F_{\perp}$

points down

$\therefore n = 46.96N + F\sin 37° = 46.96N + F(.602)$

Kinetic Friction $\Rightarrow f_K = \mu_K n = .3[46.96N + F(.602)]$
$= 14.088N + .1806F$

Finally, $\sum F_{\parallel} = Ma_{\parallel} \Rightarrow F_{\parallel} - W_{\parallel} - f_K = Ma_{\parallel}$

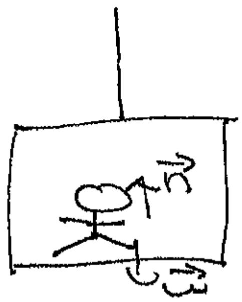
$\Rightarrow F\cos 37° - 35.39N - [14.088N + .1806F] = 6kg(4.2m/s^2)$

$\Rightarrow F(.799) - 35.39N - 14.088N - .1806F = 25.2N$

$\Rightarrow F(.799 - .1806) - 49.478N = 25.2N \Rightarrow F(.6184) = 74.678N$

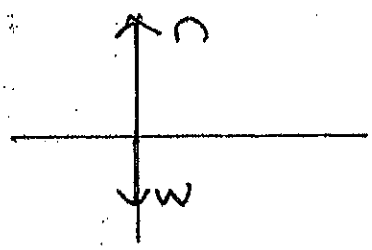
$\Rightarrow F = \frac{74.678N}{.6184} = 120.76N = 121N$

5.78



ACCELERATES OVER 3m
MAXIMUM SPEED SO THAT
~~FORCE EXERTED ON PATIENT~~
DOES NOT EXCEED 1.6 their
WEIGHT.

~~FORCES~~ ON PATIENT: $\vec{n}$ UP, $\vec{\omega}$ DOWN



$$\sum F_y = Ma_y$$

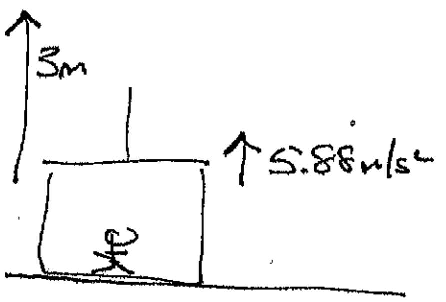
$$\Rightarrow n - \omega = Ma_y$$

at MAX a_y, $n = 1.6\omega$

$$\Rightarrow 1.6\omega - \omega = Ma_y \Rightarrow (1.6 - 1)\omega = Ma_y$$

$$\Rightarrow .6\omega = Ma_y. \quad \omega = Mg \Rightarrow .6Mg = Ma_y$$

$$\Rightarrow a_y = .6g = .6(9.8\,m/s^2) = 5.88\,m/s^2$$ ⟸ SAME FOR ALL MASSES!



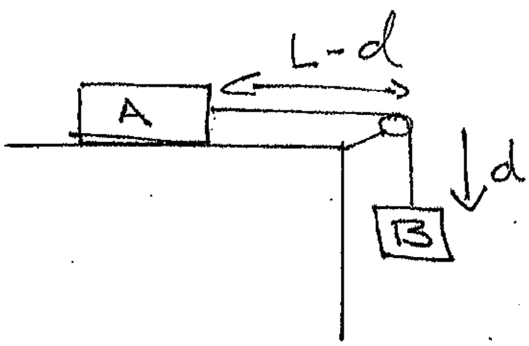
ELEVATOR STARTS FROM REST $\Rightarrow V_0 = 0$

$$V_y^2 = V_{0y}^2 + 2a_y(y - y_0)$$

$$\Rightarrow V_y^2 = 2(5.88\,m/s^2)(3m) = 35.28\,m^2/s^2$$

$$\Rightarrow \boxed{V_y = \sqrt{35.28\,m^2/s^2} = 5.94\,m/s}$$ ⟸ 13 mi/h

5.83



M_A, M_B
ROPE HAS NON-ZERO MASS M_{ROPE},
TOTAL LENGTH L

a) FIND ACCELERATION WHEN LENGTH d HANGS VERTICALLY.

TOTAL LENGTH $= L \Rightarrow (L-d)$ HORIZONTAL TO TABLE.

ASSUMING THE ROPE HAS UNIFORM DENSITY $\Rightarrow$ THE MASS OF A LENGTH X OF THE ROPE WOULD BE $M = \left(\frac{M_{ROPE}}{L}\right)X$ s.t. WHEN $X=L$, $M = M_{ROPE}$ AND $X=0 \Rightarrow M=0$.

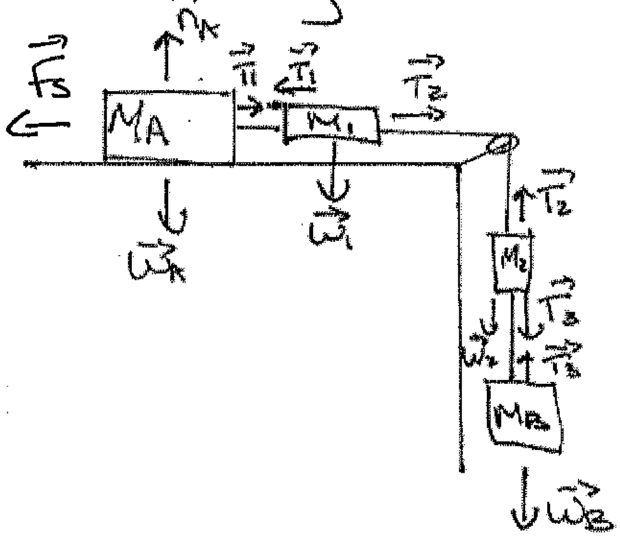
$\therefore$ THE MASS OF THE HORIZONTAL LENGTH IS

$$M_1 = \left(\frac{M_{ROPE}}{L}\right)(L-d) = M_{ROPE}\left(1-\frac{d}{L}\right)$$

THE MASS OF THE VERTICAL LENGTH IS

$$M_2 = \left(\frac{M_{ROPE}}{L}\right)d = M_{ROPE}\left(\frac{d}{L}\right)$$

IN THE PARTICLE MODEL, WE TREAT M_1 AND M_2 AS DOTS (THOUGH I'LL DRAW THEM AS BOXES TO MAKE THE ANALYSIS EASIER). SO WE'LL HAVE M_A AND M_1 ON THE TABLE, M_2 AND M_B HANGING. CONNECTING THEM WILL BE MASSLESS ROPES.



FORCES ON:

M_A: $\vec{w}_A, \vec{n}_A, \vec{T}_1, \vec{f}_S$

M_1: $\vec{T}_1, \vec{w}_1, \vec{T}_2$ → NOTICE HOW $\vec{w}_1$ ISN'T BEING CANCELED BY HORIZONTAL $\vec{T}_1$ AND $\vec{T}_2$. THIS IS WHY IN REALITY THE ROPE WOULD SAG, BUT THAT'S A MUCH HARDER PROBLEM.

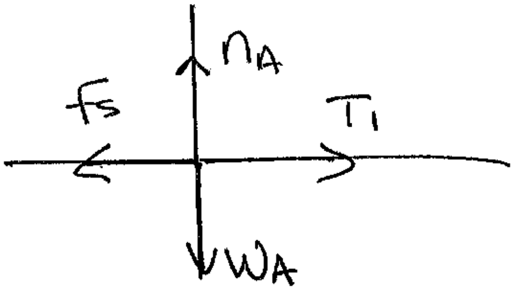
M_2: $\vec{T}_2, \vec{T}_3, \vec{w}_2$

M_3: $\vec{T}_3, \vec{w}_B$

MINIMUM VALUE OF $d \Rightarrow f_S = f_{S,MAX}$ but $a = 0$ still

NOTICE FRICTION ONLY ACTING ON $M_A \Rightarrow f_{S,MAX} = \mu_s n_A$

M_A Fbd



$$\sum F_{A,x} = M_A a_{A,x}$$

$$\sum F_{A,y} = M_A a_{A,y}$$

$$a_{A,x} = a_{A,y} = 0$$

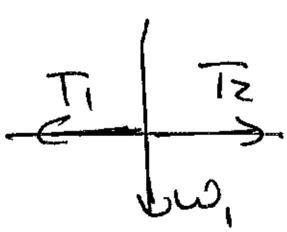
$$\Rightarrow T_1 - f_s = 0 \Rightarrow T_1 = f_s$$

$$n_A - W_A = 0 \Rightarrow n_A = W_A = M_A g$$

$$f_s = f_{s,MAX} = \mu_s n_A \Rightarrow f_s = \mu_s M_A g$$

$$T_1 = f_s \Rightarrow T_1 = \mu_s M_A g$$

M_1 Fbd



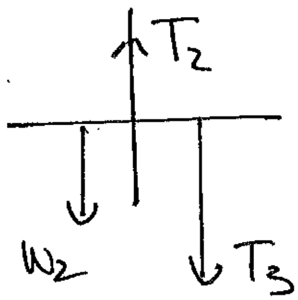
AGAIN NOTICE HOW IN REALITY $\vec{T}_1$ AND $\vec{T}_2$ WOULD NEED y-Components TO CANCEL W_1.

$$\sum F_{1,x} = M_1 a_{1,x} \Rightarrow T_2 - T_1 = 0$$

SINCE $a_{1,x} = 0$

So $T_2 = T_1 = \mu_s M_A g$

M_2 FBD



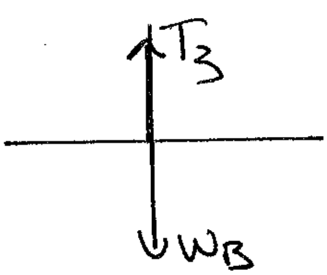
$$\sum F_{2,y} = M_2 a_{2,y} \,. \quad a_{2,y} = 0$$

$$\Rightarrow T_2 - W_2 - T_3 = 0$$

$$\Rightarrow T_3 = T_2 - W_2 = \mu_s M_A g - M_2 g$$

$$= \mu_s M_A g - M_{rope}\left(\frac{d}{L}\right) g$$

Finally on B:



$$\sum F_{B,y} = M_B a_{B,y} \,. \quad a_{B,y} = 0$$

$$\Rightarrow T_3 - W_B = 0$$

$$\Rightarrow \mu_s M_A g - M_{rope}\left(\frac{d}{L}\right) g - M_B g = 0$$

$$\Rightarrow (\mu_s M_A - M_B)\cancel{g} = \frac{M_{Rope}}{L} d \cancel{g}$$

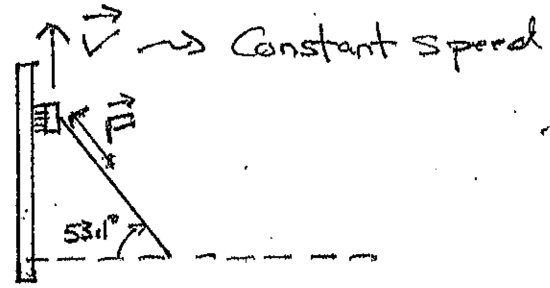
$$\Rightarrow d = \frac{(\mu_s M_A - M_B)L}{M_{Rope}}$$

MY NUMBERS WERE $\mu_s = .255$, $M_A = 2.07\,Kg$
$M_B = .35\,Kg$, $M_{Rope} = .243\,Kg$, $L = 1.02\,m$

$$d = \frac{(.255 \cdot 2.07 - .35\,\cancel{kg})(1.02m)}{.243} = \left(\frac{.17785}{.243}\right)(1.02m)$$

$$= .747m$$

5.74

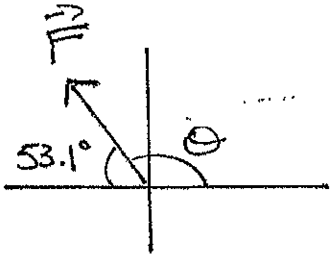


BRUSH WEIGHS 15N

$\mu_K = .15$

a) FIND MAGNITUDE OF F, b) FIND NORMAL force, n

FORCES ON BRUSH $\vec{W}$ DOWN, W = 15N, KINETIC FRICTION $\vec{f}_K$ DOWNWARD (opposite to $\vec{v}$), NORMAL force, $\vec{n}$. VERTICAL WALL ⇒ $\vec{n}$ to RIGHT. APPLIED FORCE $\vec{F}$. $\vec{F}$ parallel to HANDLE ⇒



So standard $\theta = 180° - 53.1° = 126.9°$

$\Rightarrow F_x = F\cos 126.9° = -.6F$

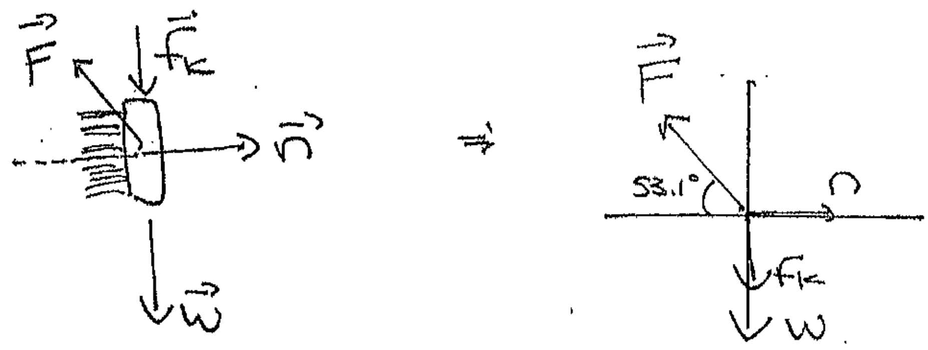
$F_y = F\sin 126.9° = .8F$

EQUIVALENTLY, USE 53.1° AND $\vec{F}$ IN 2ND QUADRANT

$\Rightarrow F_x < 0 \therefore F_x = -F\cos 53.1° = -.6F$

$F_y > 0 \therefore F_y = +F\sin 53.1° = .8F$

fbd



$\sum F_x = Ma_x$. NO MOTION IN $x \Rightarrow a_x = 0$

$\Rightarrow n + F_x = 0 \Rightarrow n - .6F = 0 \quad (1)$

$\sum F_y = Ma_y$. Constant speed $\Rightarrow a_y = 0$

$\Rightarrow F_y - f_k - W = 0 \Rightarrow .8F - f_k - 15N = 0$

KINETIC FRICTION $\Rightarrow f_k = \mu_k n = .15n \therefore .8F - .15n - 15N = 0$

$\Rightarrow .8F - .15n = 15N$

(1) $\Rightarrow n = .6F \Rightarrow .8F - .15(.6F) = 15N$

$\Rightarrow .8F - .09F = 15N \Rightarrow .71F = 15N \Rightarrow \boxed{F = \frac{15N}{.71} = 21.1N}$

$\boxed{n = .6F = .6(21.1N) = 12.7N}$