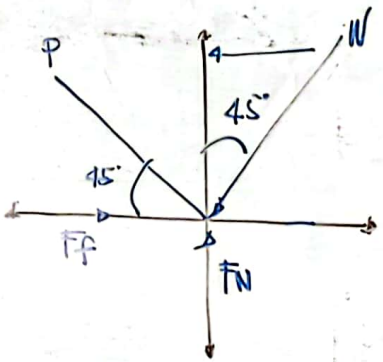
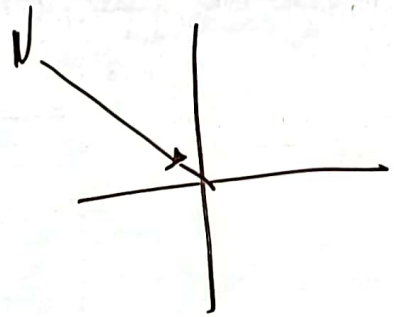
b.) FBD:





$\Sigma F_y = 0 \quad \uparrow + \downarrow$

$F_N = W\cos 45 + P\sin 45$

$F_f = \mu \times F_N = 0.25 \times (W\cos 45 + P\sin 45) =$

$F_f = 0.25(2225\cos 45 + 1335.0102\sin 45)$

$F_f = 629.3268\,N$

$\Sigma F_x = 0 \quad \rightarrow + \leftarrow$

$P_x + F_f = W_x$

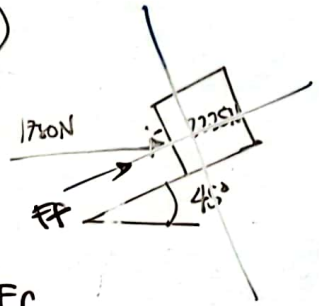
$P\cos 45° + 393.328\,N + 0.17677P = 2225\sin 45$

$P\cos 45 + 0.176777P = 2225\sin 45 N - 393.328\,N$

$P(0.88387) = 1179.984588\,N$

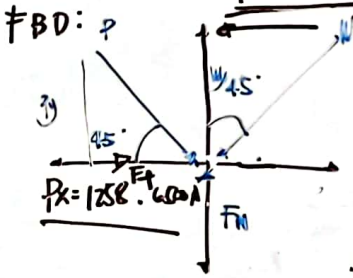
$P = 1335.0102\,N$

C.)



$P_x < W_x + F_f$

FBD:



$1573.3125\,N = W_x$ +

$F_f = 707.9906\,N$

$P_x = 1780\cos 45°$

$P_x = 1258.6500\,N$

$\Sigma F_y = 0 \quad \uparrow + \downarrow$

$F_N = P_y + W_y$

$F_N = P\sin 45° + W\cos 45°$

$F_N = 1780\sin 45 + 2225\cos 45$

$F_N = 2831.9626\,N$

$F_f = \mu F_N = 0.25(2831.9626\,N)$

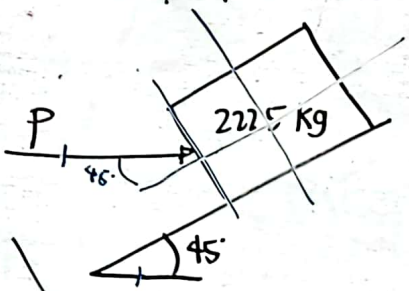
$F_f = 707.9906\,N$ Going ⇑ right

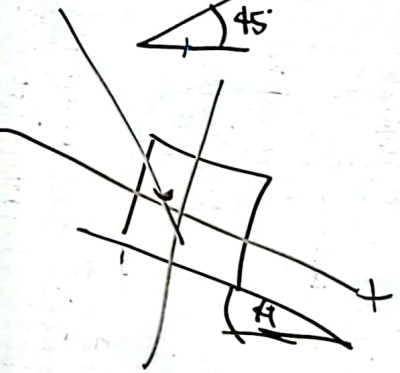
$W_x = 2225\sin 45$

$W_x = 1573.3125\,N$

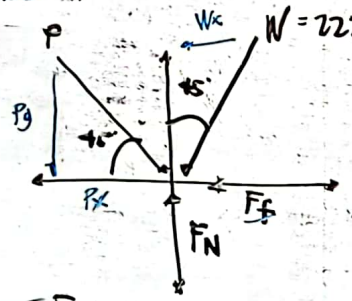
The 2225 N block below is in contact of 45° incline.
The $\mu_s = 0.25$. Compute the value of P=?

a.) Just start the block up to incline
b.) prevent the motion down the incline
c.) If P=1780N, what is the amount & direction of F_f?





FBD: A:



$\Sigma F_y = 0$

$+\uparrow -\downarrow$

$F_N = P_y + W_y$

$F_N = P\sin 45° + 2225\cos 45°$ ① eq.

$F_f = \mu_s F_N$

$F_f = 0.25\,(P\sin 45 + 2225\cos 45)$

$F_f = 0.25\sin 45(P) + (2225\cos 45)(0.25)$

$F_f = 0.17677P + 393.328\,N = 0.48.5500\,N$

$\Sigma F_x = 0 \rightarrow = \leftarrow$

$P_x = W_x + F_f$

$P\cos 45° = 2225\sin 45 + 0.17677P + 393.328\,N$

$P\cos 45 - 0.17677P = 2225\sin 45 + 393.328\,N$

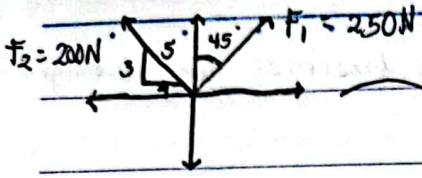
$\frac{0.53033P}{0.53033} = \frac{1966.640588\,N}{0.53033}$

$P = 3708.333\,N$

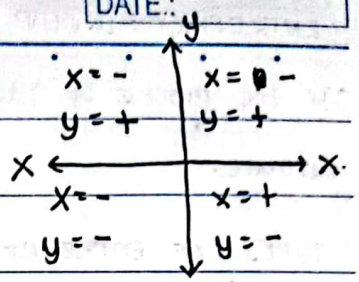
a.) P should be greater than 3708.333 N

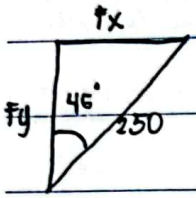
RESULTANT FORCES
it is always hypotaneous

NO.:
DATE:



$R = \sqrt{(\Sigma Fy)^2 + (\Sigma Fx)^2}$





Fx?

$\sin\theta = \frac{opp}{hyp} = \frac{Fx_1}{250}$

$Fx_1 = 250 \sin 45°$

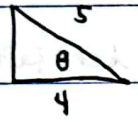
$Fx_1 = 176.776\ N$

$Fy_1 = ?$

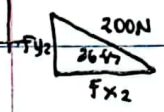
$\cos\theta = \frac{adj}{hyp} = \frac{Fy_1}{250}$ (Fy_1 & Fx_1)

$Fy_1 = 250 \cos 45°$

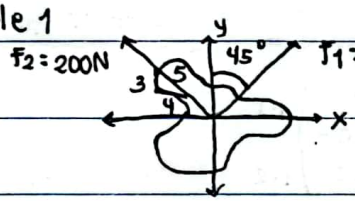
$Fy_1 = 176.775\ N$



$\sin\theta = \frac{3}{5}$	$\theta \sin^{-1}\left(\frac{3}{5}\right)$
$\cos\theta = \frac{4}{5}$	$\theta = 36.87°$
$\tan\theta = \frac{3}{4}$	SOH CAH TOA

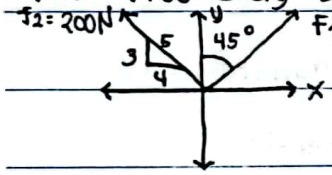


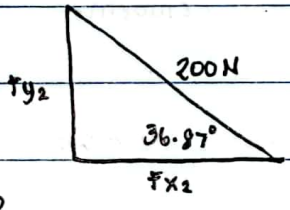
Example 1



↳ kg m/s²

FBD - Free Body Diagram





$Fy_2 = ?$

$Fy_2 = \sin(36.87°)(200N)$

$Fy_2 = 120N$

$Fx_2 = ?$

$Fx_2 = \cos(36.87°)(200N)$

$Fx_2 = -160N$

$\Sigma Fx = Fx_1 + Fx_2$

$= 176.78N - 160N$

$\Sigma Fx = 16.78N$

$\theta = \tan^{-1}\left(\frac{\Sigma Fy}{\Sigma Fx}\right)$

$\theta = \tan^{-1}\left(\frac{296.78N}{16.78N}\right)$

$\boxed{\theta = 86.76°}$

$\Sigma Fy = Fy_1 + Fy_2$

$= 176.78N + 120N$

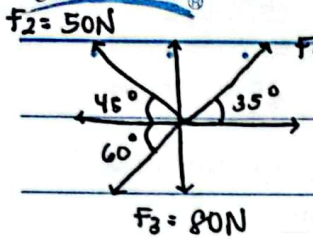
$\Sigma Fy = 296.78N$

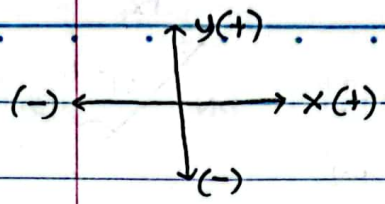
$R = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$

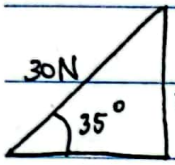
$R = \sqrt{(16.78)^2 + (296.78)^2}$

$\boxed{R = 297.25N}$

NO.:
DATE.:







$Fx_1 = ?$

$\cos\theta = \frac{adj}{hyp} = \frac{Fx_1}{30}$

$Fx_1 = 30 \cos 35°$

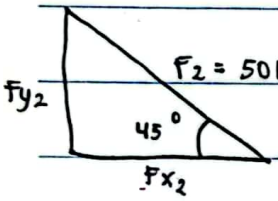
$Fx_1 = 24.57\ N$

$Fy_1 = ?$

$\sin\theta = \frac{opp}{hyp} = \frac{Fy_1}{30}$

$Fy_1 = 30 \sin 35°$

$Fy_1 = 17.20N$



$Fx_2 = ?$

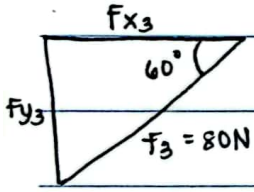
$Fx_2 = 50 \cos 45°$

$Fx_2 = -35.36$

$Fy_2 = ?$

$Fy_2 = 50 \sin 45°$

$Fy_2 = -35.36\ N$



$Fx_3 = ?$

$Fx_3 = 80 \cos 60°$

$Fx_3 = -40\ N$

$Fy_3 = ?$

$Fy_3 = 80 \sin 60°$

$Fy_3 = -69.28N$

$\Sigma Fx = Fx_1 + Fx_2 + Fx_3$

$= 24.57 - 35.36 - 40N$

$\Sigma Fx = -50.79N$

$\Sigma Fy = Fy_1 + Fy_2 + Fy_3$

$= 17.20 + 35.36 - 69.28\ N$

$\Sigma Fy = -16.72\ N$

$R = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$

$R = \sqrt{(-50.79N)^2 + (-16.72N)^2}$

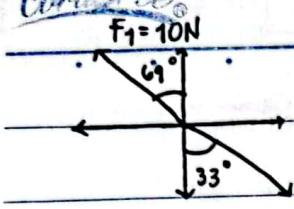
$R = 53.47N$

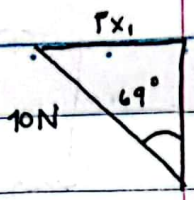
$\theta \tan^{-1}\left(\frac{\Sigma Fy}{\Sigma Fx}\right)$

$\theta \tan^{-1}\left(\frac{-16.72N}{-50.79N}\right)$

$\theta = 18.22°$

NO.:
DATE.:





$F_{x_1} = ?$

$\sin\theta = \frac{opp}{hyp} = \frac{F_{x_1}}{10}$

$F_{x_1} = 10 \sin 69°$

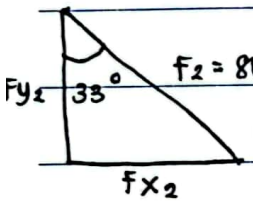
$F_{x_1} = -9.33\,N$

$F_{y_1} = ?$

$\cos\theta = \frac{adj}{hyp} = \frac{F_{y_1}}{10}$

$F_{y_1} = 10 \cos 69°$

$F_{y_1} = 3.58\,N$



$F_{x_2} = 80 \sin 33°$

$F_{x_2} = 43.57\,N$

$F_{y_2} = 80 \cos 33°$

$F_{y_2} = -67.1\,N$

$\Sigma F_x = F_{x_1} + F_{x_2}$

$= -9.33 + 43.57$

$\Sigma F_x = 34.24$

$\Sigma F_y = F_{y_1} + F_{y_2}$

$= 3.58 - 67.1$

$\Sigma F_y = -63.52\,N$

$R = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$

$= \sqrt{(34.24)^2 + (-63.52)^2}$

$R = 72.16\,N$

$\theta \tan^{-1} = \left(\frac{\Sigma F_y}{\Sigma F_x}\right)$

$\theta \tan^{-1} = \left(\frac{-63.52\,N}{34.24\,N}\right)$

$\theta = -61.67°$

NO.:
DATE.:

FRICTION - a resistive force

TYPES OF FRICTION

- DRY
- FLUID
- INTERNAL

COEFFICIENT OF FRICTION

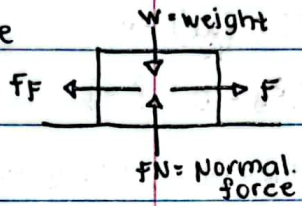
μ_s = static

μ_k = kinetic

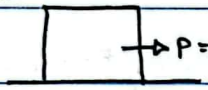
f_f = friction force $(\mu) f_n$

P = force (pull/push)

Sample



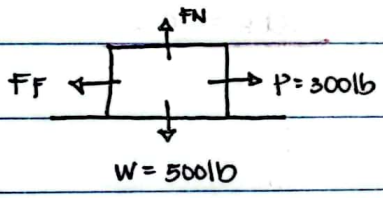
PROBLEM



W = 500lb

μ_s = 0.3

FBD (Free Body Diagram)



$\sum F_x = 0$ $\rightarrow = \leftarrow$ $P = f_f$ $f_f = 300lb$

$\sum F_y = 0$ $\uparrow = \downarrow$

$F_N = W$, $W = 500lb$

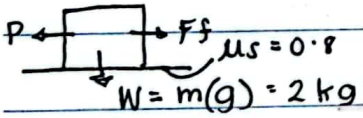
$F_N = 500lb$

$f_f = (\mu_s)(F_N) = (0.3)(500lb)$

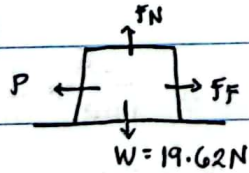
$f_{f\,max} = 150lb$

PROBLEM

An object of a mass 2kg reacting on the floor. The $\mu_s = 0.8$. What force must be applied on the object to move it?



FBD



$\sum F_x = 0$ $\rightarrow = \leftarrow$

$P = f_f$, $f_f = (\mu_s)(F_N)$

$P = 15.696\,N$

FORCE SHOULD BE GREATAR THAN 15.696N.

$\sum F_y = 0$ $\uparrow = \downarrow$

$F_N = W = 19.62N$

$F_N = 19.62N$

$f_{f\,max} = (\mu_s)(F_N)$

$f_{f\,max} = (0.8)(19.62N)$

$= 15.696\,N$

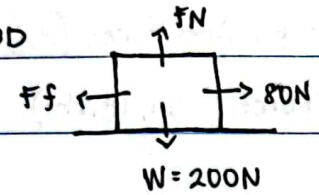
$f_f = 15.696N$

NO.:
DATE.:

EXAMPLE

A Block Weighing 200N is pushed along the surface if it takes 80N to get the block from moving & 40N to keep the block moving at constant velocity. What are the μ_s & μ_k?

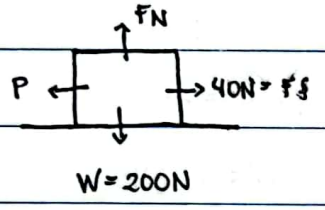
FBD



$f_f = (\mu) F_N$ $\quad f_f = (\mu_s)(F_N)$

$\Sigma F_y = 0$ $\quad \uparrow = \downarrow$ $\quad \mu_s = \frac{f_f}{F_N} = \frac{80N}{200N}$

$F_N = W$, $W = 200N$ $\quad \mu_s = 0.4$



$F_N = 200N$

$f_f = (\mu_K)(F_N)$ $\quad f_f = (\mu_K)(F_N)$, $f_f = 40N$

$\Sigma F_y = 0$ $\quad \uparrow = \downarrow$ $\quad \mu_K = \frac{f_f}{F_N} = \frac{40N}{200N}$

$F_N = W$, $W = 200N$ $\quad \mu_K = 0.2$

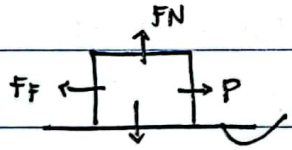
$F_N = 200N$

SAMPLE

A 10kg rubber block sliding on a concrete floor ($\mu_K = 0.65$) calculate the Ff (N)?

$\Sigma F_y = 0$ $\quad \uparrow = \downarrow$

FBD



$\mu_K = 0.65$

$F_N = W = 98.1N$

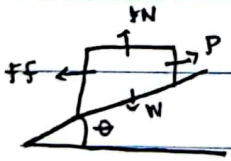
$W = 10kg\,(9.81 m/s) = 98.1N$

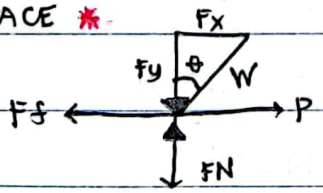
$f_f = (\mu_K)(F_N)$

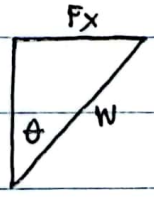
$f_f = (0.65)(98.1)N$

$f_f = 63.765\ N$

* INCLINED SURFACE *







$\cos\theta = \frac{adj}{hyp} = \frac{Fy}{W}$

$Fy = W\cos\theta$

$\sin\theta = \frac{opp}{hyp} = \frac{Fx}{W}$

$\Sigma F_y = 0$ $\quad \uparrow = \downarrow$

$\Sigma F_x = 0$ $\quad \rightarrow = \leftarrow$ $\quad F_N = Fy$ $\quad Fy = W\cos\theta$ $\quad Fx = W\sin\theta$

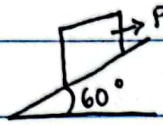
$P = f_f - F_x$ $\quad F_N = W\cos\theta$

$P = (\mu)(F_N) + W\sin\theta$

NO.:
DATE.:

CoralTree®

PROBLEM



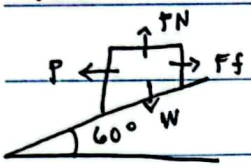
$W = 20N$

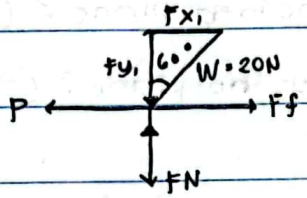
$P = 10N$

$\mu = 0.4$

$Ff = ?$

FBD





$\sum Fy = 0 \quad \uparrow = \downarrow$

$FN = Fy_1$

$FN = 20 \cos 60° = 10N$

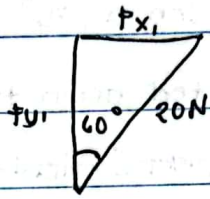
$Ff = (\mu)(FN)$

$Ff = (0.4)(10N) = 4N$

$P = Ff - Fx_1$

$P = 4N - 17.32N$

$P = 13.32\ N$



$\cos 60° = \frac{adj}{hyp} = \frac{Fy_1}{20}$

$Fy_1 = 20 \cos 60° \quad Fy_1 = 10N$

$\sin 60° = \frac{opp}{hyp} = \frac{Fx_1}{20}$

$Fx_1 = 20 \sin 60°$

$Fx_1 = 17.32\ N$

$\sum Fx = 0 \quad \leftarrow = \rightarrow$

$P + Fx_1 = Ff$

$P = Ff - Fx_1$

NO.:
DATE.:

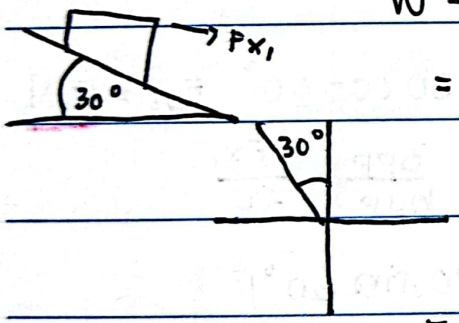
A 45kg object rests on a 30° inclined plane

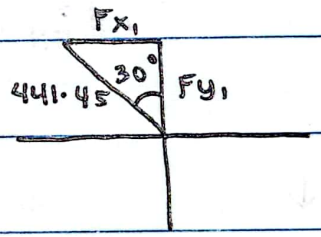
a) what force is exerted down the inclined plane? (F_{x_1})

b) what force acts perpendicular to the plane? (F_{y_1})

$W = 45kg \times 9.81 m/s$

$= 441.45 N$





a) $\sin\theta = \frac{opp}{hyp} = \frac{F_{x_1}}{W}$

$F_{x_1} = 441.45 (\sin 30°)$

$F_{x_1} = 220.725 N$

b) $\cos\theta = \frac{adj}{hyp} = \frac{F_{y_1}}{W}$

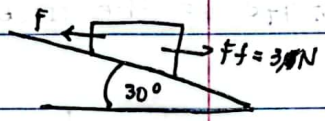
$F_{y_1} = W\cos\theta = 441.45 (\cos (30°))$

$F_{y_1} = 382.31 N$

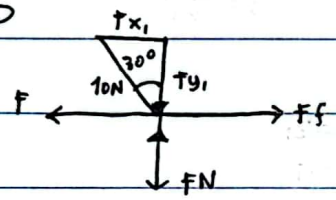
CoralTree® EXAMPLE

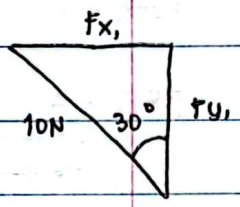
NO.:
DATE.:

A block is weighing 10N is on a ramp inclined at 30° to the horizon. A 3N force of friction (F_f) acts on the block as it is pulled up the ramp at constant velocity with force F, find the magnitude of F?



FBD





$\cos\theta = \frac{adj}{hyp} = \frac{Fy_1}{10}$

$Fy_1 = 10 \cos 30°$

$Fy_1 = 8.66\,N$

$\Sigma F_y = 0 \quad \uparrow = \downarrow$

$F_N = Fy_1$

$F_N = 8.66\,N$

$\sin\theta = \frac{opp}{hyp} = \frac{Fx_1}{10}$

$Fx_1 = 10 \sin 30°$

$Fx_1 = 5N$

$\Sigma F_x = 0 \quad \rightarrow = \leftarrow$

$F = F_f + Fx_1$

$F = 3N + 5N$

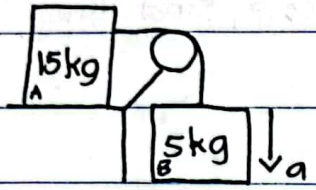
$F = 8N$

NO.:
DATE.:

PULLEY

-A 15kg box rest on a friction less surface

a) What is the acceleration? b) What is the tension of the rope?



REF (Reverse effective force)
↳ opposite of the acceleration.

$W_A = 15kg \times 9.81 m/s^2$

$F_N = W_A = 147.15N$

$F = \mu F_N$

$W_B = mg$

$W_B = 5kg \times 9.81 m/s^2$

$W_B = 49.05N$

$\Sigma F_x = 0 \quad \rightarrow = \leftarrow$

$T = REF + Ff$ or 0

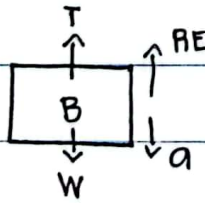
$T = REF$

$T = \frac{W}{g}(a)$

$T = \frac{147.15}{9.81}(a)$

$T = 15a$ (1)

FBD e B



① $W_B = 5kg \times 9.81 m/s^2$

$W_B = 49.05N$

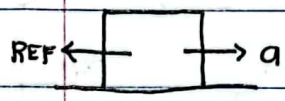
④ b) $T = ?$

$T = 15(a) = 36.75N$

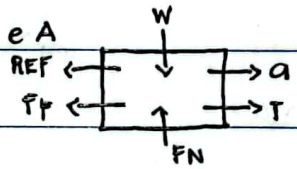
$T = 49.05 - 5(a) = 36.75/36.8N$

for $W = ma$

$a = \frac{W}{m}$



FBD e A



$\Sigma F_y = 0 \quad F_N = W_A, \; W_A = mg$

$F_N = 15kg \times 9.81 m/s^2$

$F_N = 147.15N$

$REF = \frac{W}{g}(a)$ $\quad m = \frac{W}{g}$

$= ma$

② $\Sigma F_y = 0 \quad \uparrow = \downarrow$

$T + REF = W$

$T = W - REF$

$T = 49.05 - \frac{W}{g}(a)$

$T = 49.05 - \left(\frac{49.05N}{9.81 m/s^2}\right)(a)$

$T = 49.05 - 5(a)(2)$ $\rightarrow (2.45 m/s^2)$

$T = 36.8N$

③ EQUATE 1 & 2

$T = T$

$15a = 49.05 - 5a$

$15a + 5a = 49.05$

$20 = 49.05$

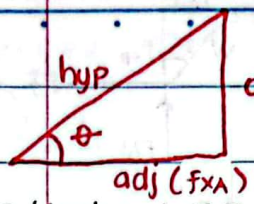
$a = 2.45 m/s^2$

NO.:
DATE.:

N

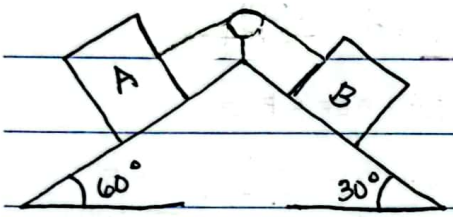
$T = 49.05 - (5kg)(2.45\ m/s^2)$

$T = 36.8\ N$

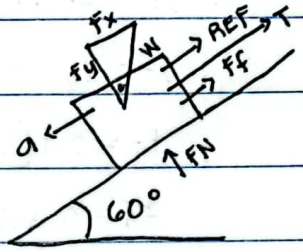


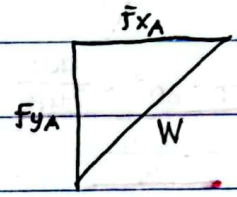
- Double Inclined plane supports 2 blocks A & B each moving a weight of 10lb. If the $\mu_K = 0.1$, determine the acceleration and tension?

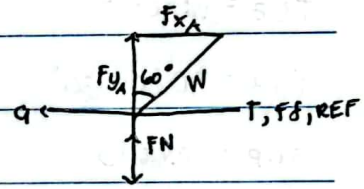
FIGURE



TBD







$\Sigma F_y = 0 \quad \uparrow = \downarrow$

$F_N = F_{yA}$

$F_N = 5lb$

$F_f = (\mu_K)(F_N) = (0.1)(5\ lb)$

$F_f = 0.5lb$

$\Sigma F_x = 0 \quad \rightarrow = \leftarrow$

$F_{xA} = T + REF + F_f$

$8.66 = T + \frac{10}{32.2}(a) + 0.5$

$W = N$

$W = mg$

$g = 9.81\ m/s^2 \times \frac{3.28ft}{1m}$

$W = lbf$

$W = mg = (lbm)(32.2\ ft/s^2)$

$g = 32.2\ ft/s^2\ lbf\ (WEIGHT)$

$\cos 60° = \frac{adj}{hyp} = \frac{F_{yA}}{W}$

$F_{yA} = W \cos 60°$

$F_{yA} = 10 \cos 60°$

$F_{yA} = 5lb$

$REF = \frac{W}{g}(a)$

$g = 32.2\ ft/sec^2 \rightarrow lb$

$g = 9.81\ m/s^2 \rightarrow N$

$\sin 60° = \frac{opp}{hyp} = \frac{F_{xA}}{W}$

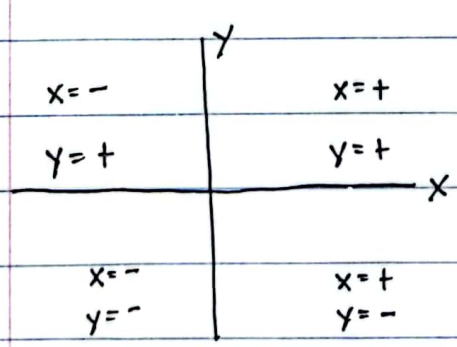
$F_{xA} = W \sin 60°$

$F_{xA} = 10 \sin 60°$

$F_{xA} = 8.66lb$

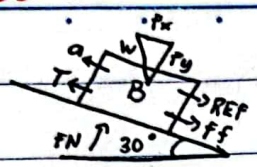
$T = 8.66 - 0.5 - \frac{10}{32.2}(a)$

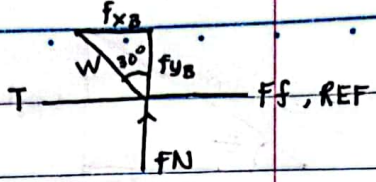
$T = 8.16 - \frac{10}{32.2}(a)\ (1)$



NO.:
DATE.:

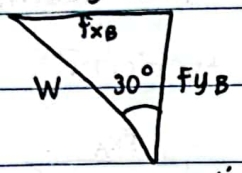
FBD of B





$REF = \frac{W}{g}(a)$

$\Sigma F_y = 0 \quad \uparrow = \downarrow$



$\sin 30^\circ = \frac{opp}{hyp} = \frac{F_{xB}}{W}$

$F_{xB} = W \sin 30^\circ = 10 \sin 30^\circ$

$F_{xB} = 5lb$

$\cos 30^\circ = \frac{adj}{hyp}$

$= \frac{F_{yB}}{W}$

$F_{yB} = W \cos 30^\circ$

$F_{yB} = 10 \cos 30^\circ$

$F_{yB} = 8.66lb$

$F_N = F_{yB}$

$F_N = 8.66lb$

$F_f = (\mu)(F_N)$

$F_f = 0.1(8.66)$

$F_f = 0.866lb$

$\Sigma F_x = 0 \quad \rightarrow = \leftarrow$

$T = F_f + REF + F_{xB}$

$T = 0.866 + \left(\frac{10}{32.2}\right)(a) + 5$

$T = 5.866 + \left(\frac{10}{32.2}\right)(a)$ (2) → (3.69)

$T = 7.01lb$

Eq1 = Eq2

$8.16 - \frac{10}{32.2}(a) = 5.866 + \frac{10}{32.2}(a)$

$a = 3.69 ft/s^2$

$8.16 - \left(\frac{10}{32.2}\right)(x) = 5.866 + \frac{10x}{32.2}$

ALPHA + SOLVE

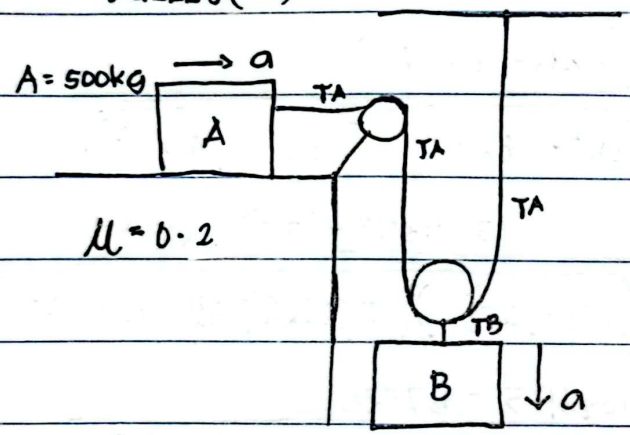
$8.16 - 5.866 = \frac{10}{32.2}(a) + \frac{10}{32.2}(a)$

$2.294 = \frac{100}{161}(a)$

$\frac{2.294}{0.6211} = \frac{0.6211\,a}{0.6211}$

$a = 3.69 ft/s^2$

PULLEY (2)



$W_A = mg$

$W_A = (500kg)(9.81 m/s^2)$

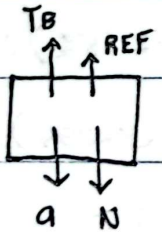
$W_A = 4905N$

$W_B = mg$

$W_B = (400kg)(9.81 m/s^2)$

$W_B = 3924N$

FBD cB



$\Sigma Fy = 0 \quad \uparrow = \downarrow$

$T_B + REF = W_B$

$T_B = W_B - REF$

$T_B = 3924 - 400a_1$

$T_B = 2T_A$

$FN_A = (\mu)(W_A)$

$FN_A = (0.2)(4905 N)$

$FN_A = 981 \quad N$

$W_B = mg$

$W_B = 400kg \times 9.81 m/s^2$

$W_B = 3924N$

$T_B = 2T_A$

$a_2 = \frac{a_1}{2}$

$3924 - 400a_2 = 2(500a_2 + 981)$

$3924 - 400\left(\frac{a_1}{2}\right) = 2(500a_2 + 981)$

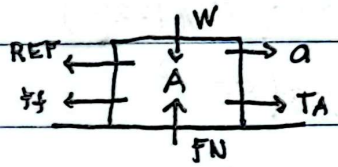
$a_1 = 1.635 m/s^2$

$\frac{a_1}{2} \leftarrow a_2 = 0.8175$

$REF = \frac{W}{g}(a) \qquad \frac{mg}{g}(a) = ma$

$W = mg$

FBD cA



$W_A = mg = 4905N$

$\Sigma Fy = 0 \quad \uparrow = \downarrow$

$FN = W_A = 4905N$

$Ff = \mu(FN) = 0.2 \times 4905 N$

$Ff = 981 \quad N$

$T_A = REF + Ff$

$T_A = 500(a) + 981$

$T_A = \frac{4905}{9.81}(a) + 981$

NO.:
DATE.:

$3924 - 400\left(\frac{a_1}{2}\right) = 2\left(500a_1 + 981\right)$

$3924 - 200a_1 = 1000a_1 + 1962$

$3924 - 1962 = 1000a_1 + 200a_1$

$1962 = 1200a_1$

$\frac{1962}{1200} \quad \frac{1200a_1}{1200}$

$a_1 = 1.635\ m/s^2$

$T_A = 500(a_1) + 981 = 1798.5\ N$ (→ 1.635)

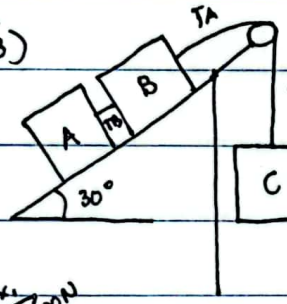
$T_B = 3924 - 400(0.8175) = 3597\ N$

PULLEY (3)

$a = ?$

$T_2 = ?$

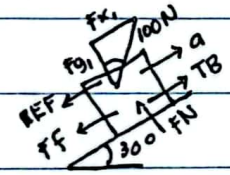
$T_1 = ?$

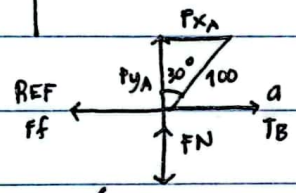


$A = 100N \quad \mu = 0.3$

$B = 200N \quad \mu = 0.2$

$C = 300N$





$\cos 30° = \frac{adj}{hyp} = \frac{F_{yA}}{100N}$

$F_{yA} = 100\cos 30°$

$F_{yA} = 86.60N$

$\sin 30° = \frac{opp}{hyp} = \frac{F_{xA}}{100N}$

$F_{xA} = 100\sin 30°$

$F_{xA} = 50N$

$\sum F_x = 0 \rightarrow = \leftarrow$

$T_B = REF + Ff + F_{xA}$

$T_B = \frac{100}{9.81}(a) + 25.98 + 50$

$T_B = \frac{100}{9.81}(a) + 75.98$

$\sum F_y = 0 \uparrow = \downarrow$

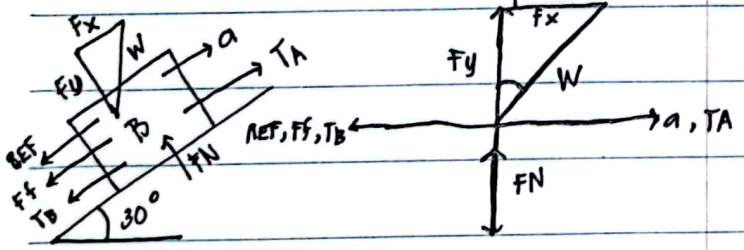
$F_N = F_{yA}$

$F_N = 86.60N$

$F_f = (\mu)(F_N)$

$F_f = 0.3 \times 86.60$

$F_f = 25.98\ N$



$\sin 30° = \frac{F_{xB}}{200}$

$= 200\sin 30$

$F_{xB} = 100\ N$

$\cos 30° = \frac{F_{yB}}{200}$

$= 200\cos 30$

$F_{yB} = 173.21N$

$\sum F_y = 0 \uparrow = \downarrow$

$F_N = F_{yB}$

$F_N = 173.21\ N$

$F_f = \mu(F_N)$

$F_f = (0.2)(173.21N)$

$F_f = 34.642\ N$

NO.:
DATE.:

$\Sigma F_x = 0 \quad \rightarrow = \leftarrow$

$T_A = REF + FF + T_B + F_{xB}$

$T_A = \frac{200}{9.81}(a) + 34.642 + T_B + 100$

$T_A = \frac{200a}{9.81} + 134.642 + T_B$

NO.:
DATE.:

RECTILINEAR MOTION

VELOCITY $\left(\frac{m}{s}\right)$

$V = \frac{S}{t} = \frac{m}{s}$, S = DISTANCE

t = TIME

ACCELERATION $\left(\frac{m}{s^2}\right)$

$a = \frac{V}{t} = \frac{m/s}{s} = m/s^2$

$2as = Vf^2 - Vi^2$

$\left(\frac{m}{s}\right)m = \left(\frac{m}{s}\right)^2 - \left(\frac{m}{s}\right)^2$

$\frac{m^2}{s^2} = \frac{m^2}{s^2} - \frac{m^2}{s^2}$

m/s^2

$a = \frac{Vf - Vi}{t} = \frac{m/s - m/s}{s} = \frac{m/s}{s} = \frac{m}{s^2}$

Vf = final velocity

Vi = initial velocity

$S = Vit + \frac{at^2}{2} = \left(\frac{m}{s}\right)s + \left(\frac{m}{s}\right)s = m$

+ acceleration
- decleration

PROBLEM 1

1.) What is the acceleration of the body that increase in velocity from $20^m/_s$ to $40^m/_s$ in 3 sec?

$Vi = 20^m/_s$ $t = 3\,sec$ $Vf = 40^m/_s$

$a = \frac{Vf - Vi}{t}$ $a = \frac{40 - 20}{3}$

$a = 6.667\ m/s^2$ //

2) From a speed of 70kph, a car accelerates at a rate of $0.5 km/min^2$ along a straight path. How far (meters), m travel in 40 sec?

Given: $Vi = \frac{70\,km}{hr} \times \frac{1000\,m}{km} \times \frac{1\,hr}{3600\,sec} = 19.444\ m/s$

$a = \frac{0.5\,km}{min^2} \times \frac{1000\,m}{km} \times \frac{(1\,min)^2}{(60\,sec)^2} = 0.1388\ m/s^2$

$t = 40sec$

$S = ?$

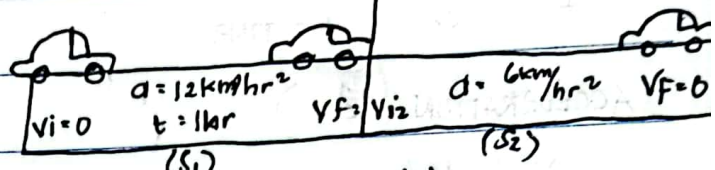
$S = Vit + \frac{at^2}{2}$

$S = (19.444\ m/s)(40s) + \frac{(0.1388\ m/s^2)(40s)^2}{2}$

$S = 888.8m$ //

NO.:
DATE.:

3.) A car standing from the rest moves with constant acceleration of $12\ km/hr^2$ for 1hr, the decelerates at a constant $6\ km/hr^2$ until it stop. How far has it travelled?



$S_T = S_1 + S_2 \qquad S_T = 6 + 12 = 18km$

$S_1 = Vit + \frac{at^2}{2}$

$S_1 = (0)(1hr) + \frac{\left(\frac{12km}{hr^2}\right)(1hr)^2}{2}$

$S_1 = 6km$

$a = \frac{Vf - Vi}{t} \rightarrow Vf_1 = a(t)$

$Vf_1 = \left(\frac{12km}{hr}\right)(1hr)$

$Vf = \frac{12km}{hr} = Vi_2$

$2aS = Vf^2 - Vi^2$

$2aS = -Vi_2^2 \rightarrow S = \frac{-Vi_2^2}{2a} = \frac{+12^2}{2(+6)} = \frac{144}{12}$

$S = 12km$

$2\left(-\frac{6km}{hr^2}\right)S = -\left(\frac{12km}{hr}\right)^2$

$S = \frac{(12km/hr)^2}{2\left(6km/hr^2\right)} = 12km$

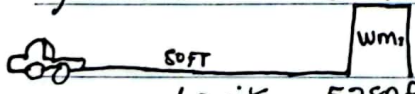
4.) The velocity of an automobile starting from the rest is given by $\frac{ds}{dt} = \frac{60}{t^2+10}\ \frac{ft}{sec}$. Determine the acceleration? $\frac{u}{V}, \frac{Vdu - udv}{V^2}$

$\frac{ds}{dt} = V = \frac{60 \rightarrow 4 \quad du = 0}{t^2+10 \rightarrow V \quad dv = 2t + 0}$

$a = \frac{dv}{dt} = \frac{(t^2+10)(0) - 60(2t+0)}{(t^2+10)^2}$

$a = \frac{-60(2t)}{(t^2+10)^2} = \frac{-60(2\times10)}{(10^2+10)^2} = -0.099\ ft/s^2$

5.) A man driving his car at 60mph suddenly sees an object in the road ahead. What constant deceleration is required to stop the car in the distance? (ft/s^2)



$1mil = 5280ft \qquad d = ?$

$Vi = \frac{60mil}{hr} \times \frac{5280ft}{1mil} \times \frac{1hr}{3600sec} = 88ft/sec$

$2aS = Vf^2 - Vi^2$

$2aS = -Vi^2$

$a = \frac{-Vi^2}{2S} = \frac{-(88\ ft/sec)^2}{2\times80ft} = 48.4\ ft/sec^2$

Coralbrace

NO.:
DATE.:

VELOCITY IF THROWN:
upward (+) positive
downward (-) negative

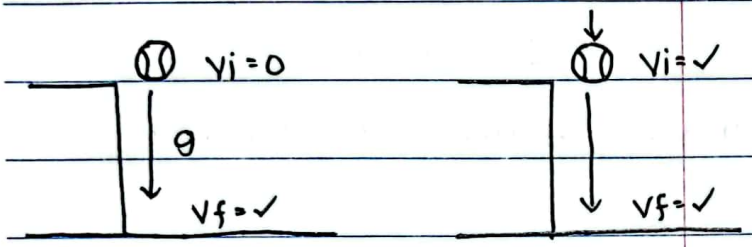
FREEFALL

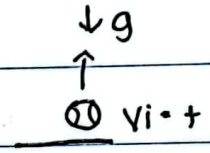
↳ gravity = (-) negative

$$a = \frac{V_f - V_i}{t} \longrightarrow g = \frac{V_f - V_i}{t} \longrightarrow -g = \frac{V_f - V_i}{t}$$

$$s = V_i t \pm \frac{at^2}{2} \longrightarrow s = V_i t \pm \frac{gt^2}{2} \longrightarrow s = V_i t - \frac{gt^2}{2}$$

$$2as = V_f^2 - V_i^2 \longrightarrow 2gs = V_f^2 - V_i^2 \longrightarrow 2(-g)s = V_f^2 - V_i^2$$





$S_T = S_{up} + S_{down}$

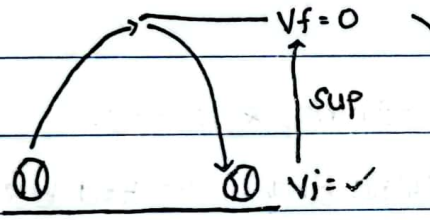
$S_{up} = S_{down}$

$S_T = 2S_{up}$ or $S_T = S_{down}$

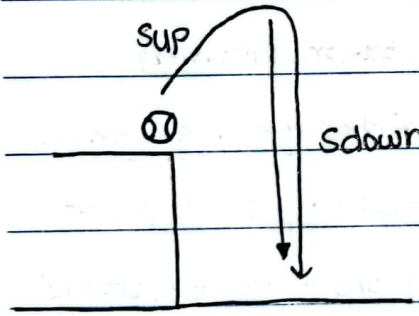
$T_T = T_{up} + T_{down}$

$T_{up} = T_{down}$

$T_T = 2T_{up}$ or $2T_{down}$



$V_i = V_f$



$S_T = S_{up} + S_{down}$

$S_{up} \neq S_{down}$

$T_T = T_{up} + T_{down}$

$T_{up} \neq T_{down}$

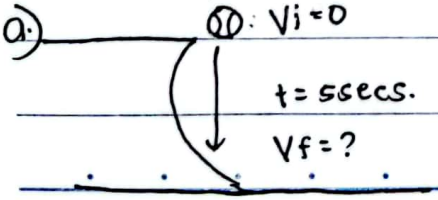
PROBLEM

1.) A ball is dropped from a rest on a cliff?

a.) What is the speed of the ball 5 seconds later?

b.) What is the distance covered?

a.)



$$-g = \frac{V_f - V_i}{t} \qquad V_f = -gt$$

$V_f = (-9.81\ m/s^2)(5s)$

$V_f = -49.05\ m/s$

$V_f = 49.05\ m/s$ going downward

NO.:
DATE.:

b) $S = Vit - \frac{gt^2}{2}$

$S = (0)(55) - \frac{(9.81 m/s^2)(55)^2}{2}$

$S = \frac{(-9.81 m/s^2)(55)^2}{2}$

$S = -122.625 m$

$S = 122.625 m$

$2gs = Vf^2 - Vi^2$

$Vf = 49.05 m/s$

$\frac{2gs}{2g} = \frac{Vf^2}{2g}$

$S = \frac{Vf^2}{2(g)} = \frac{Vf^2}{2(-g)} = \frac{(49.05 m/s)^2}{2(-9.81 m/s^2)}$

$S = -122.625 m$

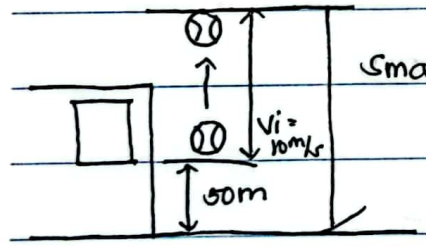
$S = 122.625 m$

2.) A stone is thrown vertically upward with a velocity of 10m/s from a window 50m above ground level.

a.) How high will the stone reach from the ground?

b.) How much time will it take travel to the ground?

c) With what velocity will it strikes the ground?

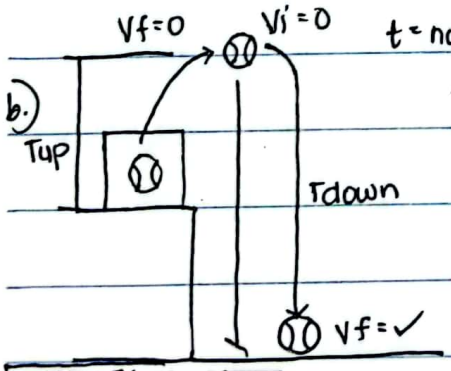


a.) $Smax = 50 + S = 50 + 5.096 = 55.096 m$

$-2gs = -Vi^2$

$-2gs = -Vi^2$

$S = \frac{-Vi^2}{-2g} = \frac{+(10 m/s)^2}{+(2 \times 9.81 m/s^2)} = 5.096 m$



t = no negative

$TT = Tup + Tdown$, $Tup \neq Tdown$

Tup = ?

$-g = \frac{Vf - Vi}{Tup}$, $Vf = 0$

$Tup = \frac{Vf - Vi}{-g} = \frac{+Vi}{+g} = \frac{-(10 m/s)}{-(9.81 m/s^2)} = 1.019 s$

$\sqrt{\frac{-55.096 \times 2}{-g}} = \sqrt{t^2}$

$t = \sqrt{\frac{-55.096 \times 2}{-9.81}}$

$t = 3.351 s$

Tdown = ?

$S = Vit - \frac{gt^2}{2}$, $Vi = 0$

$-55.096 m = \frac{-gt^2}{2}$

$TT = 1.019 s + 3.351 s$

$TT = 4.369 s$

NO.:
DATE.:

c) $-g = \frac{Vf - Vi}{t_{down}}$, $Vi = 0$

$Vf = -g\, t_{down}$

$Vf = (-9.81 m/s^2)(3.35 s)$

$Vf = -32.87 m/s$

$Vf = 32.87 m/s$ downward

OTHER SOL'N: $2gs = Vf^2 - Vi^2$

$Vf^2 = 2gs$

$Vf^2 = 2(-9.81 m/s^2)(-55.096 m)$

$\sqrt{Vf^2} = \sqrt{1080.98 m/s^2}$

$Vf = 32.878 m/s$ //

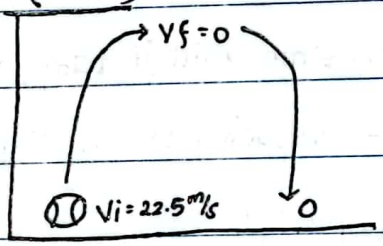
8.) A tennis ball is thrown up with an initial velocity of $22.5 m/s$. It is caught at the same distance above the ground?

a) How high the ball rise? (26m)

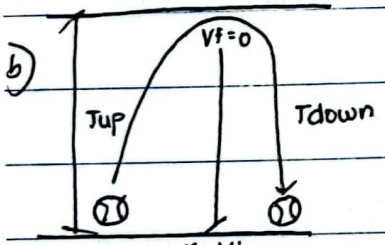
b) How long does the ball remain the air? (4.6s)

a) $-2gs = Vf^2 - Vi^2$

$s = \frac{Vi^2}{2g} = \frac{(22.5 m/s)^2}{2(+9.81 m/s^2)} = 25.80/26 m$



b)



$T_T = T_{up} + T_{down}$, $T_{up} = T_{down}$

$T_{up} = 2T_{up}$

$= 2(2.29) = 4.58 s$ //

$T_{up} = \frac{Vf - Vi}{-g}$

$= \frac{(22.5 m/s)}{-(9.81 m/s^2)}$

$T_{up} = 2.29 s$

$T_{down} = s = Vit - \frac{gt^2}{2}$

$26m = -\frac{(9.81 m/s^2)t^2}{2}$

$\sqrt{t^2} = \sqrt{\frac{-26 m \times 2}{-9.81 m/s^2}}$

$t_d = 2.30 s$

$T_T = T_{up} + T_{down}$

$= 2.29 s + 2.30 s$

$T_T = 4.59 s / 4.6 s$ //