1.

	x	y
s	5m	-.049m $s_y = 0 + 0t + \frac{1}{2} -9.8(.1)^2$
x_i	0	0
v_i	50 m/s	0 m/s
v_f	50 m/s	-.98 m/s → 50.95 m/s at 1.12° below Horizontal
a	0 m/s^2	-9.8
t	.1	.1

Ball will fall .049 m or 4.9 cm on its way to the plate

2.

	x	y
s	37.90m	0
x_i	0 m	400
v_i	$4.3 \cos 350$	$4.3 \sin 350 = -.746$
v_f	$v_i = 4.23$	$v_f = -.746 + -9.8(8.96) = -88.55$
a	0	-9.8
t	8.96 sec	8.96 sec

The prog will travel 37.90 m along the horizontal

3.

	x	y
s	12.57m	0
x_i	0	0
v_i	$5.8 + 13 \cos 15$	$13 \sin 15 = 3.36$
v_f	$v_i = 18.36$	-3.35 m/s
a	0 m/s^2	-9.8 m/s^2
t	.685	.685

B KE = PE

$\frac{1}{2} m v^2 = mgh$

$\frac{1}{2} (3.36)^2 = 9.8h$

$h = .58$ m

18.36 i + -3.35 j

Mag = 18.66 m/s

$\theta = \tan^{-1}\left(\frac{3.35}{18.36}\right) = 10.34°$

4.

	x	y
s	13.05	0
x_i	0	0
$\theta = 87°$ v_i	$35\cos 87$	$35\sin 87 = 34.95$
$v_f = v_i$	1.83	-34.92 m/s
a	0	-9.8
t	7.13	7.13

B) $KE = PE$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(34.95)^2 = 9.8h$

$h = 62.32$ m

$\theta = 3$	x	y
s	13.04	0
x_i	0	0
v_i	$35\cos 3$	$35\sin 3 = 1.83$
v_f	34.95	-1.83 m/s
a	0	-9.8 m/s²
t	.373	.373

B $KE = PE$

$\frac{1}{2}mv^2 = mgh$

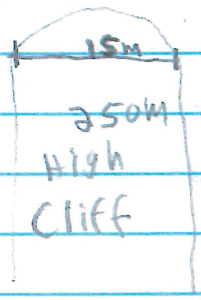
$\frac{1}{2}(1.83)^2 = 9.8h$

$h = .17$ m

5.

	x	y
s	104.32 m	0
x_i	0	0
v_i	$10.89 \quad 40\cos 15 = 49.44$	$40\sin 15 = 10.35$
$v_f = v_i$	49.44 m/s	-10.33 m/s
a	0	-9.8
t	2.11	2.11

6.A



	x	y
s	15	250
x_i	0	250
v_i	$V\cos 39$	$V\sin 39$
$v_f = v_i$		
a	0	-9.8
t	$\frac{15}{V\cos 39}$	$\frac{15}{V\cos 39}$

$V = 12.26$ m/s

$V_x = 9.52$ m/s

$V_y = 7.71$ m/s

$-4.9\left(\frac{15}{V\cos 39}\right)^2 + V\sin 39\left(\frac{15}{V\cos 39}\right) + 250 = 250$

$-4.9\left(\frac{225}{V^2 \cdot .604}\right) + 15\frac{V\sin 39}{V\cos 39} + 250 = 250$

$\frac{-1825.33}{V^2} + 15\tan 39 + 250 = 250$

$\frac{-1825.33}{V^2} + 12.15 = 0$

$12.15 = \frac{1825.33}{V^2}$

6B.

	x	y
	$S = 75.87\,m$	0
	$x_i = 0$	250
	$v_i = 9.52$	7.71
	$v_f = 9.52$	$-70.4\ m/s$
	$a = 0$	-9.8
	$t = 7.97\,sec$	$7.97\,sec$

60.87 m beyond Cliff Edge.

7.

$S_{Boat\,x} = S_{Bomb\,x}$

$4t = x_i + 59.08t$

$x_i = -55.08t$

$x_i = -55.08(10.79)$

$x_i = -594.33$

594.33 m in back of the boat

S	x	y
		0
x_i		458
v_i	$60\cos 10$	$60\sin 10 = 10.42$
$v_f = v_i$	$= 59.08$	
$a = 0$		-9.8
t		10.79

8.

	x	y
S	.3	0
x_i	0	90
v_i	$= .07\,m/s$	0
$v_f = v_i$	$= .07\,m/s$	$-41.94\,m/s$
a	$= 0$	-9.8
t	$= 4.28$	4.28

Accidental

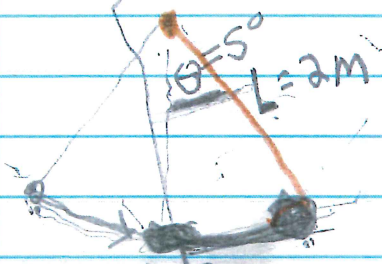
	x	y
9. S	$= 84.2\,M$	0
x_i	$= 0$	87
v_i	$= 20$	0
v_f	$= 20$	$-41.26\,M/s$
a	$= 0$	-9.8
t	4.21	4.21

$y = mx + b$

$s = \theta L$

$a = \omega_0^2 \cdot$ displacement

$\omega = 2\pi f$



$F_x = \frac{mg\sin\theta}{m}$ $\qquad F = ma$

A = θ

V =

t = .7125

$F_{restore} = F_{net}$

$mg\sin\theta = ma$

$mg\sin\theta = m\omega_0^2 \theta L$ (θL = displacement)

$g\sin\theta = \omega_0^2 \theta L$

$g\theta = \omega_0^2 \theta L$

$\omega_0 = \sqrt{\frac{g}{L}} = 2.21 \frac{rad}{sec}$

$\sin\theta = \theta$ if angle small (≤ 15°)

$x = A\cos(\omega t) = .175\cos(2.21t)$

$V = -A\omega\sin(\omega t)$

$a = -A\omega^2 \cos(\omega t)$

$f = \frac{\omega}{2\pi} = \frac{2.21}{2\pi} = .351\ Hz$

$T = \frac{1}{f} = 2.85\ sec$ (Event)

$a = -A\omega^2\cos(\omega t)$

$g\sin\theta = -A(2.21)^2 \cos((2.21)(0))$

$g = -A(2.21)^2$

$A = \frac{9.8(.087)}{(2.21)^2} = .175$

10.

	x	y
	$S = 1.36$	0
	$x_i = 0$	2.3
A)	$V_i = 1.98$ m/s	0
	$V_f = 1.98$ m/s	-6.71 m/s
	$a = 0$	-9.8
	$t = .685$	.685

B) $1.98\text{m/s}\,i + -6.71\text{m/s}\,j \rightarrow$ 7.0 m/s at an angle of 73.56° with the floor

11a	x	y	Part B x	Part B y
A)	$S = 74.31$ m	0	66.83 m	3.42 m
	$x_i = 0$	0	0	0
	$V_i = 30\cos 27 = 26.73$	$30\sin 27 = 13.62$	26.73	13.62
	$V_f = V_i = 26.73$	-13.62	26.73	
	$a = 0$	$a = -9.8$	0	-9.8
B)	t 2.78	↔ 2.78	2.5	↔ 2.5

C) $KE = PE$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(13.62)^2 = 9.8h$

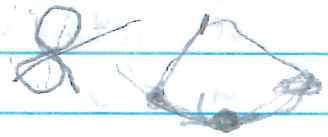
$h = 9.46$ m

D) 66.83 m i + 3.42 m j

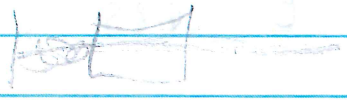
66.92 m at an angle of 2.93° above horizontal

~~Simple~~ Simple Harmonic Motion

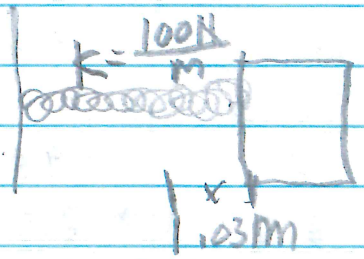
1st Oscillatory Motion



2nd Restoring Force directed toward Equilibrium



3rd Restoring Force Must be Linear.
↳ or Approx. Linear with system constraints



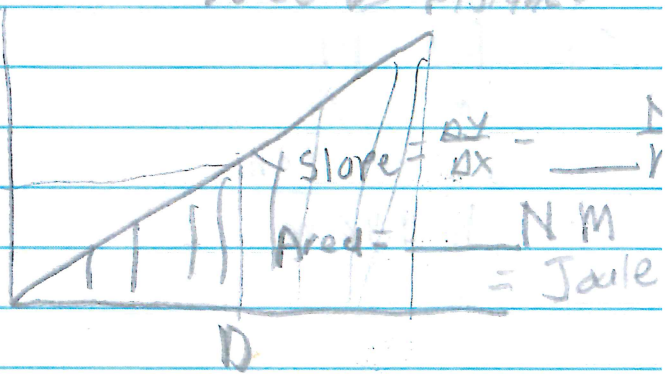
$F = -kx$

$F = -100(.03) = -3\ N$

$F = -kx$

spring $\left(\frac{N}{m}\right)$

Force vs Distance



12a) A

$s = 878.64\ M$	0
$x_i = 0$	0
$V_i = 6.4 + 90\cos 55$	$90\sin 55 = 73.72\ M/S$
$V_f = V_i = 58.42$	-73.67
$a = 0$	-9.8
t 15.04	15.04

B) $KE = PE$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(73.72)^2 = 9.8h$

$\boxed{h = 277.27\ m}$

13.

	x	y
s	50	$\boxed{27.70\ m}$
x_i	$= 0$	0
v_i	$50\cos 35 = 40.96$	$50\sin 35 = 28.68$
$V_f = V_i =$	40.96	16.72
a	$= 0$	-9.8
t	$= 1.22$	$\leftrightarrow$ 1.22

14.

$S_{boat\ in\ x} = S_{bomb\ in\ x}$

$70t = x_i + 150t$

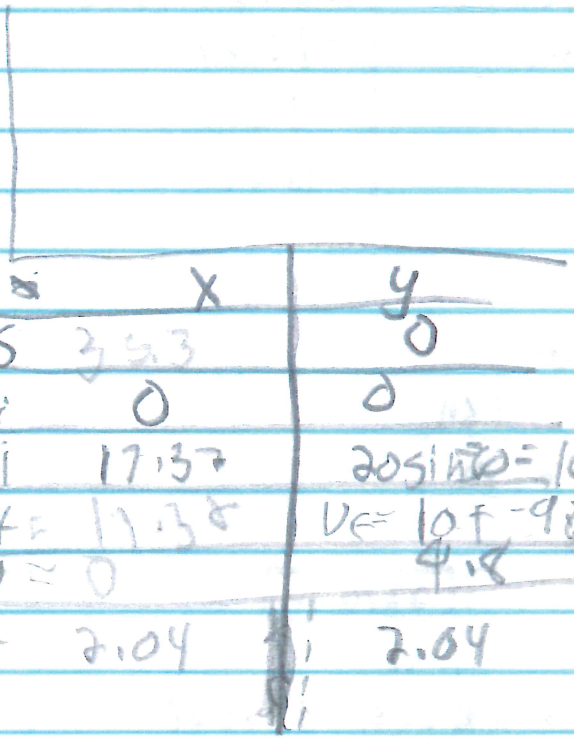
$x_i = -80t$

$x_i = -1616$

$\boxed{1616\ m\ behind\ the\ boat}$

	x	y
s		0
x_i		2000
V_i		0
V_f		-197.96
a		-9.8
t		20.20

20 m
30°



	x	y
s	17.32	0
xi	0	0
Vi	17.32	20sin30 = 10
Vf =	17.32	Vf = 10 + -9.8(2.04)
a =	0	-9.8
t	2.04	2.04

$0 = 0 + 10t + -4.9t^2$

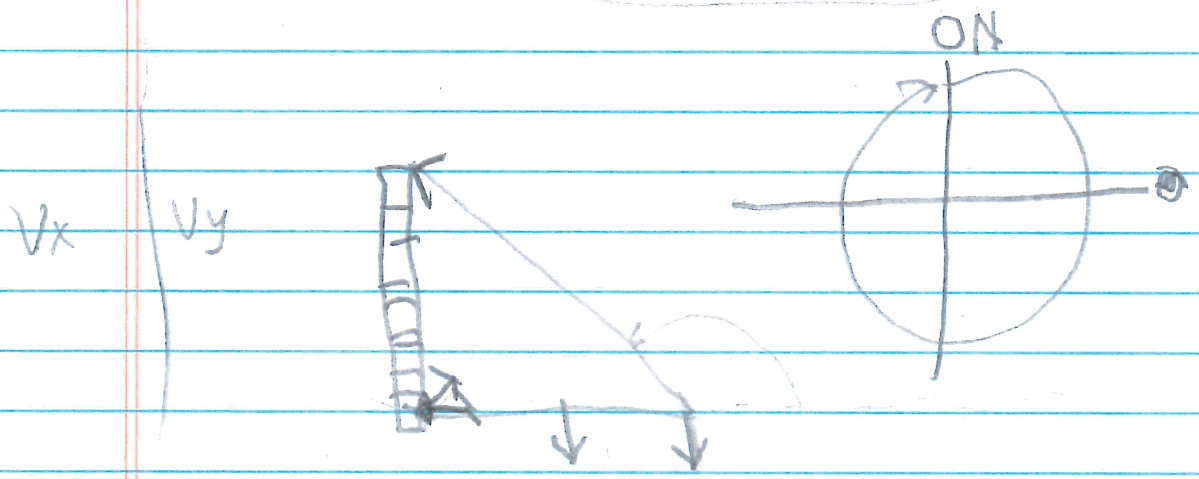
2.04

15

16.

x	y
$S = 40$	275
$x_i = 0$	300
$v_i = 17.77$ m/s	0
$v_f = v_i$	-22.05
a 0	-9.8
t 2.25	2.25

3/5



10 m East →

5m North →

20m at 45° S of E at an azimuth of 30°

i	j	k
10	0	0
0	5	0
12.24	-12.24	10
22.24	-12.24	10

→ 27.08 Mag