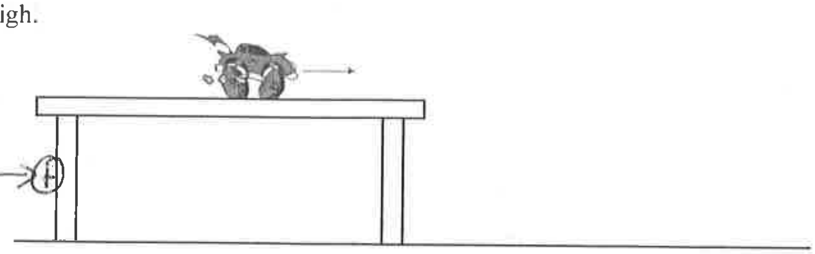
2. A toy car moving at 2.0 m/s runs off a table that is 1.3 m high. Determine:

V_x d_y



a) the time it takes for the car to hit the ground.

$$d_y = V_{iy}t + \frac{1}{2}at^2$$

$$-1.3m = \frac{1}{2}(-9.81\frac{m}{s^2})t^2$$

$$\vec{a} = -9.81 m/s^2$$

$$t = 0.51s$$

b) how far from the table the toy car lands (what is the range?)

$$d_x = V_x t + \frac{1}{2}at^2$$

$$d_x = (2.0 m/s)(0.51s) = 1.0m$$

	x	y
d	1.0 m	-1.3 m
t	0.51 s	0.51 s
a	Ø	-9.81 m/s²
v_i	2.0 m/s	Ø m/s
v_f	2.0 m/s	-5.1 m/s

c) the impact speed of the car (resultant velocity) or impact velocity

$\overline{V}$

$$V_{fy} = V_{iy} + at$$

$$V_{fy} = -9.81 m/s^2 (0.51s) = -5.1 m/s$$

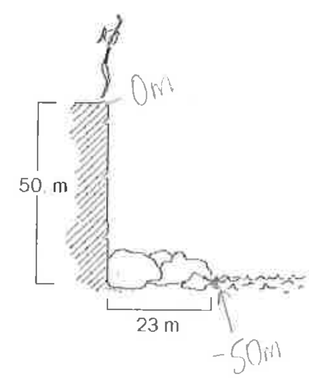
$$\vec{V} = \sqrt{\vec{V}_x^2 + \vec{V}_y^2}$$

$\uparrow$ 2.0 m/s $\uparrow$ -5.1 m/s

$$\vec{V} = 5.4 m/s$$

3. Cliff divers jump from heights as high as 50 meters. Suppose a diver wants to jump off a cliff that has rocks at the base that extend out for 23 m. Determine:

$\vec{a} = -9.81\frac{m}{s^2}$



a) how long it will take to hit the water.

$d_x = +23m$

$d_y = -50m$

$$d_y = V_{iy}t + \frac{1}{2}at^2$$

$$-50m = \frac{1}{2}(-9.81\frac{m}{s^2})t^2 \quad t = 3.2s$$

b) how fast the diver should run to clear the rocks below? $\vec{V}_x = ?$

$$d_x = V_x t + \frac{1}{2}at^2$$

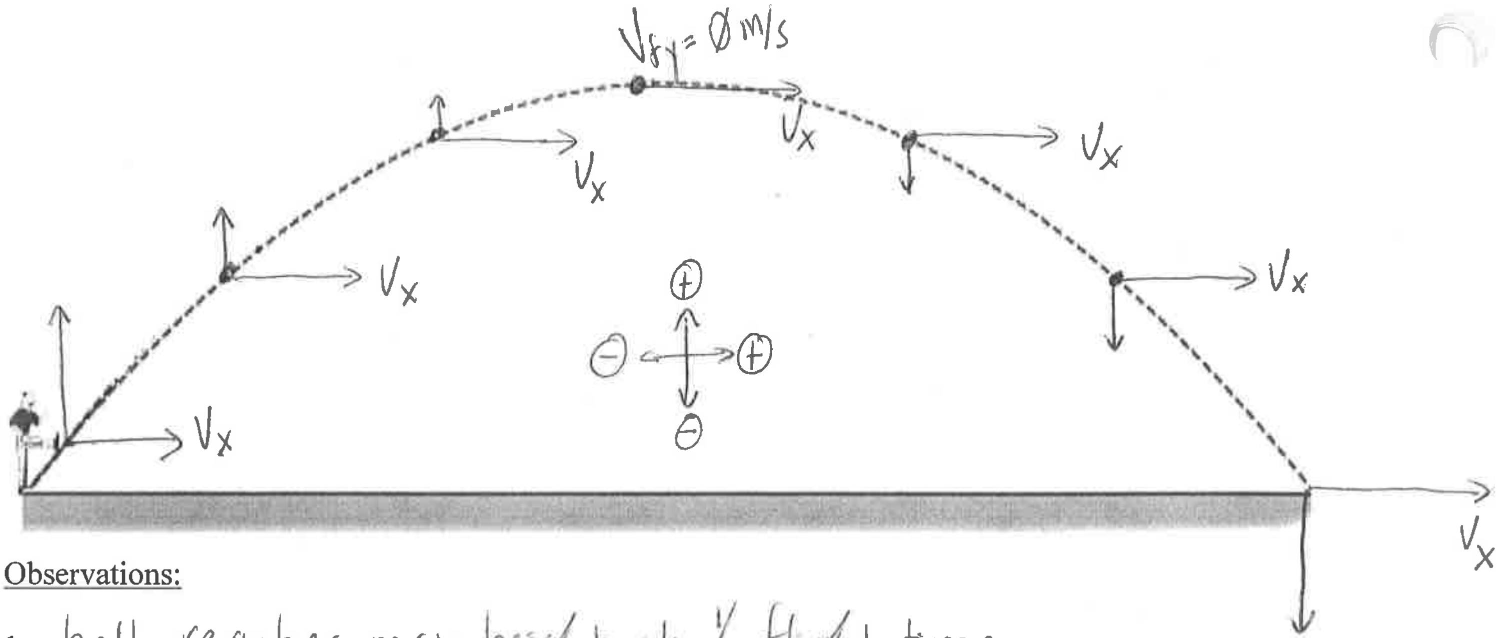
$$\frac{23m}{3.2s} = V_x \quad V_{ix} = 7.2 m/s$$

diver should run > 7.2 m/s

Try at home!

Projectiles Launched at an Angle

The opening kick-off of a football game is shown below.

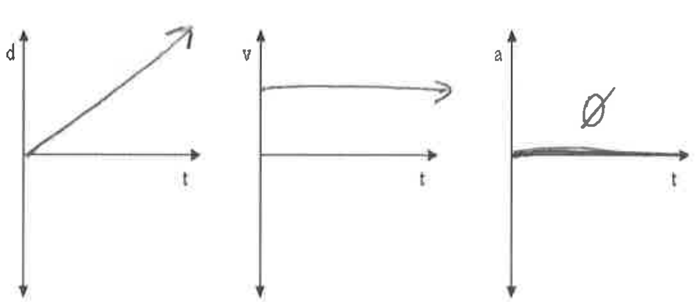


Observations:

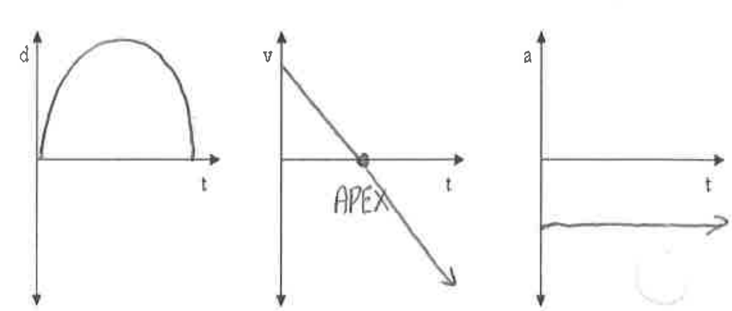
1. ball reaches max height at ½ flight time
2. range = horizontal distance = total flight time
3. analyze by breaking into x, y components
4. neglect air resistance V_x = constant horizontal velocity
5. at apex or max height, $V_{fy} = Ø \frac{m}{s}$
6. constant $\vec{a}$ toward the Earth

Sketch the graphs below for both the horizontal and the vertical component of the ball's motion.

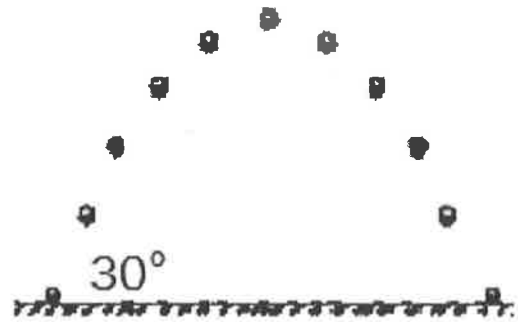
Horizontal Component



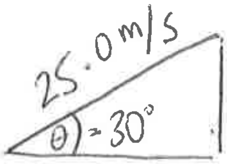
Vertical Component



1. A baseball was thrown with a speed of 25.0 m/s at an angle of 30.0°. Determine:

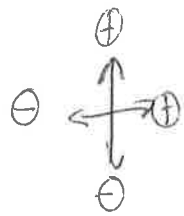


a) Horizontal and vertical components of the initial velocity



$V_y = V\sin\theta$

$V_x = V\cos\theta$



$V_{ix} = 21.7\frac{m}{s}$ $V_{iy} = 12.5\frac{m}{s}$

	x	y
d	55.3m	7.96m
t	2.54s	2.54s
a	Ø	$-9.81 m/s^2$
v_i	$21.7\frac{m}{s}$	$12.5 m/s$
v_f	$21.7\frac{m}{s}$	$-12.5 m/s$

b) time taken to reach the top of its flight

$V_{fy} = V_{iy} + at$ (V_{fy} = Ø)

$Ø\frac{m}{s} = 12.5\frac{m}{s} + (-9.81\frac{m}{s^2})t$

$t = 1.27s$ ½ total flight time

c) total time before baseball lands

$2(1.27s) = 2.54s$ total time

d) how high the ball went

$t = 1.27s$

$d_y = v_{iy}t + \frac{1}{2}at^2$ $d_y = 7.96m$

$\bar{V}$

$d_y = (12.5\frac{m}{s})(1.27s) + \frac{1}{2}(-9.81\frac{m}{s^2})(1.27s)^2$

e) how far away the ball landed

$d_x = V_{ix}t + \frac{1}{2}at^2$ (a = Ø)

$d_x = (21.7\frac{m}{s})(2.54s) = 55.3m$