Draft

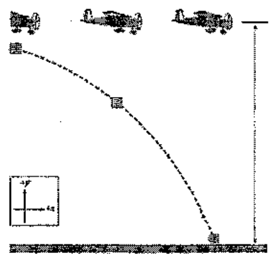
Physics 122

Worksheet – Projectile Motion

(2019)

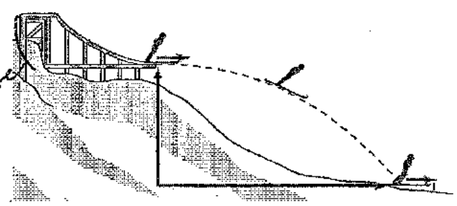
Projectiles Launched Horizontally

1. An airplane is dropping supplies to northern villages that are isolated by severe blizzards and cannot be reached by land vehicles. The airplane is flying at an altitude of 785 m and at a constant horizontal velocity of 53.5 m/s. At what horizontal distance before the drop point should the co-pilot drop the supplies so that they will land at the drop point?



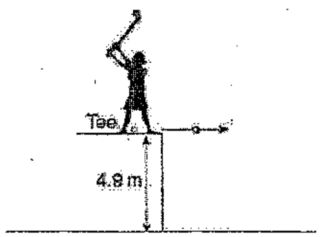
2. A cougar is crouched on the branch of a tree that is 3.82 m above the ground. He sees an unsuspecting rabbit on the ground, sitting 4.12 m from the spot directly below the branch on which he is crouched. At what horizontal velocity should the cougar jump from the branch in order to land at the point at which the rabbit is sitting?

3. A skier leaves a jump with a horizontal velocity of 22.4 m/s.
   a) If the landing point is 78.5 m lower than the end of the ski jump, what horizontal distance did the skier jump? could be removed
   b) What was the skier's velocity when she landed?



4. An archer shoots an arrow toward a target, giving it a horizontal velocity of 70.1 m/s. If the target is 12.5 m away from the archer, at what vertical distance below the point of release will the arrow hit the target?

5. A golfer practising on a range with a tee 4.9 m above the fairway is able to strike a ball so that it leaves the club with a horizontal velocity of 20. m/s. What is the acceleration of the ball 0.50 s after being hit?



Projectiles Launched at an Angle

1. A cannon on a pirate ship was fired at an angle of 30.0°. The cannon ball's launch speed is 40.0 m/s.
   a) Determine the vertical and horizontal components of the cannon's velocity.
   b) How long is the cannon ball in the air?
   c) What is the cannon ball's maximum height?
   d) How far away from the ship does the cannon ball land in the water?
   e) What is the cannon ball's velocity 1.50 seconds after it is fired?

2. An object is thrown from the ground into the air at an angle of 30.0°. If the object reaches a maximum height of 5.75 m, at what velocity was it thrown?

3. While hiking in the wilderness, you come to the top of a cliff that is 60.0 m high. You throw a stone from the cliff, giving it an initial velocity of 21 m/s at 35° above the horizontal. How far from the base of the cliff does the stone land?

4. During baseball practice, you go up into the bleachers to retrieve a ball. You throw the ball back into the playing field at an angle of 42° above the horizontal, giving it an initial velocity of 15 m/s. If the ball is 5.3 m above the level of the playing field when you throw it, what will be the velocity of the ball when it hits the ground of the playing field?

5. A batter hits a baseball, giving it an initial velocity of 41 m/s at 47° above the horizontal. It is a home run, and the ball is caught by a fan in the stands. The vertical component of the velocity of the ball when the fan caught it was 11 m/s, down. How high is the fan seated above the field?

Mandatory Problems

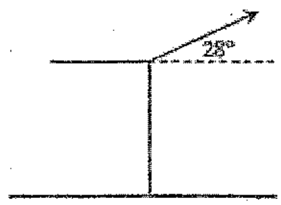
1. An airplane is in level flight at a speed of 138 m/s and at an altitude of 1.50×10^3 meters when one of its wheels falls off.
   a) How long does it take the wheel to reach the ground?
   b) What horizontal distance will the wheel travel before it strikes the ground?
   c) What will the wheel's velocity be just before it strikes the ground?

2. Batman is chasing after a criminal and needs to make a leap from one building rooftop to another. The second building is located 10.0 m away, and its roof is 5.00 m lower. What is the minimum speed that Batman must be running at in order to successfully leap to the other building? Assume his initial motion is horizontal.

3. A sharpshooter shoots a bullet horizontally over level ground with a velocity of 3.00×10^2 m/s. At the instant that the bullet leaves the barrel, its empty shell casing falls vertically and strikes the ground with a vertical velocity of 5.00 m/s. What is the vertical component of the bullet's velocity at the instant before it hits the ground?

4. A circus stunt person was launched as a human cannon ball over a Ferris wheel. His initial velocity was 24.8 m/s at an angle of 55°.
   a) Where should the safety net be positioned?
   b) If the Ferris wheel was placed halfway between the launch position and the safety net, what is the maximum height of the Ferris wheel over which the stunt person could travel?

5. An object is projected from the top of a building at an angle of 28° with a speed of 15 m/s. If the object hits the ground 32 m from the base of the building, how high is the building?

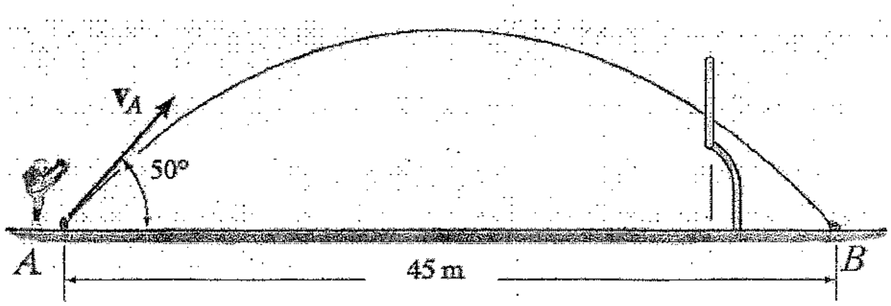


6. You throw a ball with a velocity of 18 m/s at 24° above the horizontal from the top of your garage, 5.8 m above the ground. Calculate the
   a) time of flight.
   b) horizontal range.
   c) maximum height.
   d) velocity when the ball is 2.0 m above the roof.
   e) angle at which the ball hits the ground.

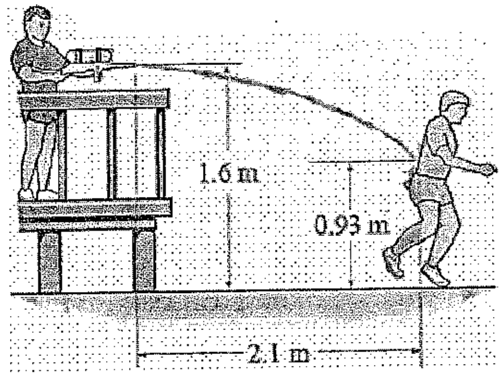
7. At a ballpark, a batter hits a baseball at an angle of 37° to the horizontal with an initial velocity of 58 m/s. If the outfield fence is 3.15 m high and 323 m away, will the hit be a home run?

8. An archer shoots a 4.0 g arrow into the air, giving it a velocity of 40.0 m/s at an elevation angle of 65°. Find
   a) its horizontal and vertical distance from the starting point 2.0 s after it leaves the bow.
   b) the horizontal and vertical components of its velocity 6.0 s after it leaves the bow.

9. Find v_A.



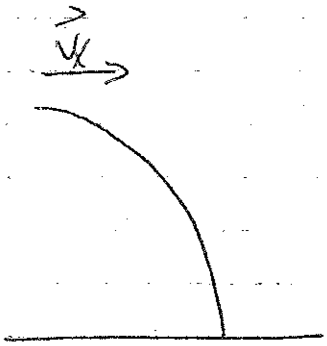
10. Your friend is standing on a deck as shown. He shoots water out of his super soaker horizontally at you and it hits you in the back. What was the velocity of that water when it left the gun?



Worksheet - Projectile Motion

Projectiles Launched Horizontally

1.



Horizontal	Vertical
$\vec{v}_x = 53.5\,m/s$	$\vec{y} = -785\,m$
$\vec{x} = ?$ (dist)	$\vec{a} = -9.80\,m/s^2$
	$\vec{v}_{y_i} = 0\,m/s$

$$\vec{y} = \cancel{\vec{v}_{y_i} t} + \frac{1}{2}\vec{a}t^2$$

$$t = \sqrt{\frac{2\vec{y}}{\vec{a}}}$$

$$t = \sqrt{\frac{2(-785)}{-9.80}}$$

$$t = 12.66\,s$$

$$\vec{v}_x = \frac{\vec{x}}{t}$$

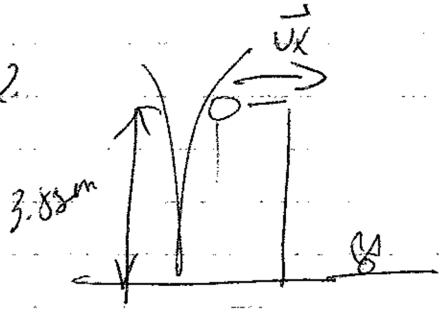
$$\vec{x} = \vec{v}_x t$$

$$\vec{x} = (53.5)(12.66)$$

$$\vec{x} = 677\,m$$

The supplies should be dropped 677m before the drop point.

2.



Horizontal	Vertical
$\vec{x} = 4.12\,m$	$\vec{y} = -3.82\,m$
$\vec{v}_x = ?$	$\vec{a} = -9.80\,m/s^2$
	$\vec{v}_{y_i} = 0\,m/s$

$$t = \sqrt{\frac{2(-3.82)}{-9.80}}$$

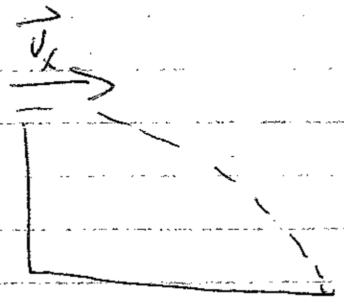
$$t = 0.8829\,s$$

$$\vec{v}_x = \frac{\vec{x}}{t}$$

$$\vec{v}_x = \frac{4.12}{0.8829}$$

$$\vec{v}_x = 4.67\,m/s$$

3.



Horizontal	Vertical
a) $\vec{v}_x = 22.4\,m/s$	$\vec{y} = -78.5\,m$
$\vec{x} = ?$	$\vec{a} = -9.80\,m/s^2$
	$\vec{v}_{y_i} = 0\,m/s$

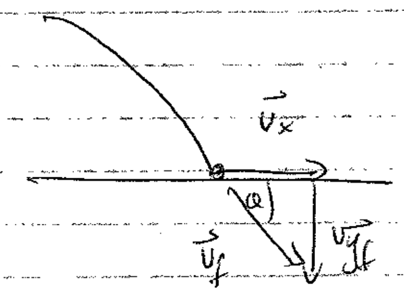
$t = \sqrt{\dfrac{2\vec{y}}{\vec{a}}}$ $\qquad$ $\vec{v}_x = \dfrac{\vec{x}}{t}$

$t = \sqrt{\dfrac{2(-78.5)}{-9.80}}$ $\qquad$ $\vec{x} = \vec{v}_x t$

$\vec{x} = (22.4)(4.003)$

$t = 4.003\,s$ $\qquad$ $\vec{x} = 89.7\,m.$

b)



$\vec{v}_{yf}^{\,2} = \cancel{\vec{v}_{y_i}^{\,2}} + 2\vec{a}\vec{y}$

$\vec{v}_{yf} = \sqrt{2(-9.80)(-78.5)}$

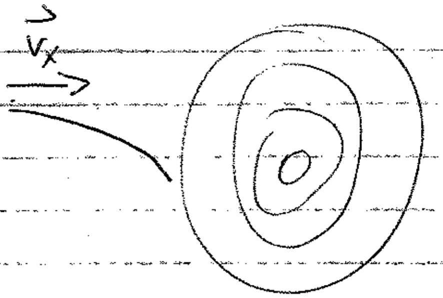
$\vec{v}_{yf} = -39.22\,m/s$

$v_f = \sqrt{(39.22)^2 + (22.4)^2}$ $\qquad$ $\tan\theta = \dfrac{45.2}{22.4}$

$v_f = 45.2\,m/s$

$\theta = 63.6°$

The velocity was 45.2 m/s, 63.6° below the horizontal.

4. 

Horizontal

$\vec{v}_x = 70.1 \text{ m/s}$

$\vec{x} = 12.5 \text{ m}$

Vertical

$y = ?$

$\vec{v}_{y_i} = 0 \text{ m/s}$

$\vec{a} = -9.80 \text{ m/s}^2$

$$\vec{v}_x = \frac{\vec{x}}{t}$$

$$t = \frac{\vec{x}}{\vec{v}_x}$$

$$t = \frac{12.5}{70.1}$$

$$t = 0.1783 \text{ s}$$

$$\vec{y} = \cancel{\vec{v}_{y_i} t} + \frac{1}{2}\vec{a}t^2$$

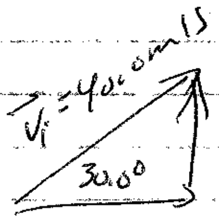
$$\vec{y} = \frac{1}{2}(-9.80)(0.1783)^2$$

$$\vec{y} = -0.156 \text{ m}$$

The arrow hits the target 0.156 m below the point of release.

5. The acceleration due to gravity is 9.80 m/s^2, down.

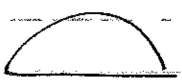
Projectiles Launched at an Angle

1. 

a) $\vec{v}_x = 40.0 \cos 30.0° = +34.6 \text{ m/s}$

$\vec{v}_{y_i} = 40.0 \sin 30.0° = +20.0 \text{ m/s}$

The vertical and horizontal components of the velocity are 20.0 m/s, up and 34.6 m/s, right respectively.

b) 

Horizontal

$\vec{v}_x = +34.6 \text{ m/s}$

Vertical

$\vec{y} = 0 \text{ m}$

$\vec{a} = -9.80 \text{ m/s}^2$

$\vec{v}_{y_i} = +20.0 \text{ m/s}$

$$\cancel{\vec{y}} = \vec{v}_{y_i}\cancel{t} + \frac{1}{2}\vec{a}t^{\cancel{2}}$$

$$0 = \vec{v}_{y_i} + \frac{1}{2}\vec{a}t$$

$$\frac{1}{2}\vec{a}t = -\vec{v}_{y_i}$$

$$t = \frac{-2\vec{v}_{y_i}}{\vec{a}} = \frac{-2(20.0)}{-9.80}$$

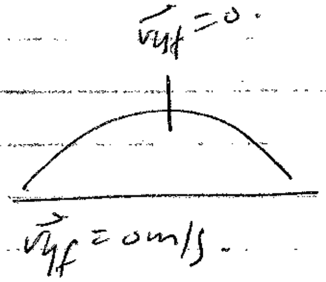
$$t = 4.08 \text{ s}$$

The cannon ball was in the air for 4.08 s.

Mund.

1. Cont'd.

c)



$$\cancel{\vec{v}_{yf}^{\,2}} = \vec{v}_{yi}^{\,2} + 2\vec{a}\vec{y}$$

$$2\vec{a}\vec{y} = -\vec{v}_{yi}^{\,2}$$

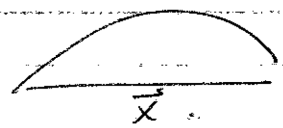
$$\vec{y} = \frac{-\vec{v}_{yi}^{\,2}}{2\vec{a}}$$

$$\vec{y} = \frac{-(20.0)^2}{2(-9.80)}$$

$$\vec{y} = 20.4\,m$$

The maximum height was 20.4m.

d)



$$\vec{v}_x = \frac{\vec{x}}{t}$$

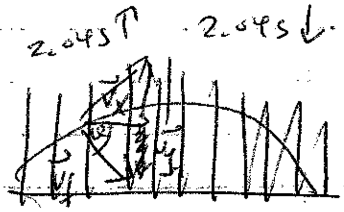
$$\vec{x} = \vec{v}_x t$$

$$\vec{x} = (34.6)(4.08)$$

$$\vec{x} = 141\,m.$$

The cannon ball lands 141m from the ship.

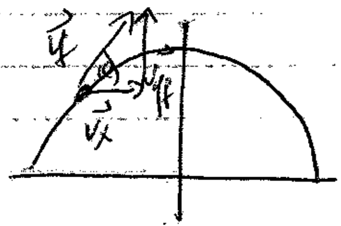
e)



$$\vec{v}_{yf} = \vec{v}_{yi} + \vec{a}t$$

$$\vec{v}_{yf} = 20.0 + (-9.80)(1.50)$$

$$\vec{v}_{yf} = +5.300\,m/s$$



$$v_f = \sqrt{v_x^2 + v_{yf}^2}$$

$$v_f = \sqrt{34.6^2 + (5.300)^2}$$

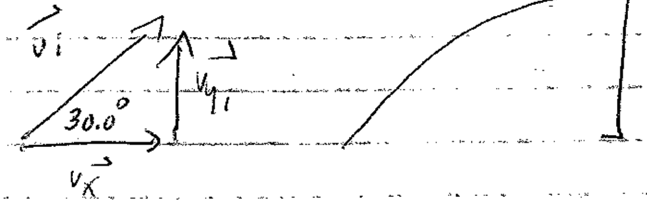
$$v_f = 35.0\,m/s$$

$$\tan\theta = \frac{5.300}{34.6}$$

$$\theta = 8.71°$$

The ball's velocity was 35.0m/s, 8.71° above the horizontal.

2.



max. height $\vec{v}_{yf} = 0$ m/s

$\vec{y} = +5.75$ m

$\vec{a} = -9.80$ m/s^2

① $\cancel{\vec{v}_{yf}^2} = \vec{v}_{y_i}^2 \pm 2\vec{a}\vec{y}$

$\vec{v}_{y_i} = \sqrt{-2\vec{a}\vec{y}}$

$\vec{v}_{y_i} = \sqrt{-2(-9.80)(5.75)}$

$v_{y_i} = +10.62$ m/s

② $\tan 30.0° = \dfrac{v_{y_i}}{v_x}$

$v_x = \dfrac{v_{y_i}}{\tan 30.0°}$

$v_x = \dfrac{10.62}{\tan 30.0°}$

$v_x = 18.39$ m/s

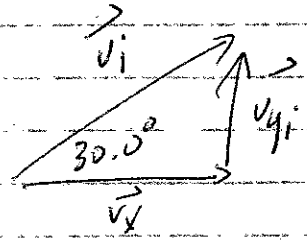
③ $v_i = \sqrt{18.39^2 + 10.62^2}$

$v_i = 21.2$ m/s

The object was thrown at a velocity of 21.2 m/s, 30.0° above the horizontal.

or/ ① $\vec{v}_{y_i} = \sqrt{-2(-9.80)(5.75)}$

$\vec{v}_{y_i} = +10.62$ m/s



$\sin 30.0° = \dfrac{v_{y_i}}{v_i}$

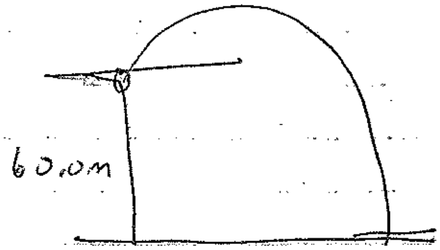
$v_i = \dfrac{v_{y_i}}{\sin 30.0°}$

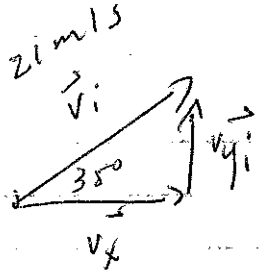
$v_i = \dfrac{10.62}{\sin 30.0°}$

$v_i = 21.2$ m/s

The initial velocity was 21.2 m/s, 30.0° above the horiz.

3.





$\vec{v}_x = +21\cos 35° = +17.20\,m/s$

$\vec{v}_{y_i} = +21\sin 35° = +12.05\,m/s$

① $\vec{v}_{yf}^{\,2} = \vec{v}_{y_i}^{\,2} + 2\vec{a}\vec{y}$

$\vec{v}_{yf} = \sqrt{\vec{v}_{y_i}^{\,2} + 2\vec{a}\vec{y}}$

$\vec{v}_{yf} = \sqrt{(12.05)^2 + 2(-9.80)(-60.0)}$

$\vec{v}_{yf} = -36.35\,m/s$

Could use

$\vec{y} = \vec{v}_{y_i}t + \frac{1}{2}\vec{a}t^2$

+

quadratic formula

to get t.

② $\vec{v}_{yf} = \vec{v}_{y_i} + \vec{a}t$

$\vec{a}t = \vec{v}_{yf} - \vec{v}_{y_i}$

$t = \dfrac{\vec{v}_{yf} - \vec{v}_{y_i}}{\vec{a}}$

$t = \dfrac{-36.35 - 12.05}{-9.80}$

$t = 4.939\,s$

③ $\vec{v}_x = \dfrac{\vec{x}}{t}$

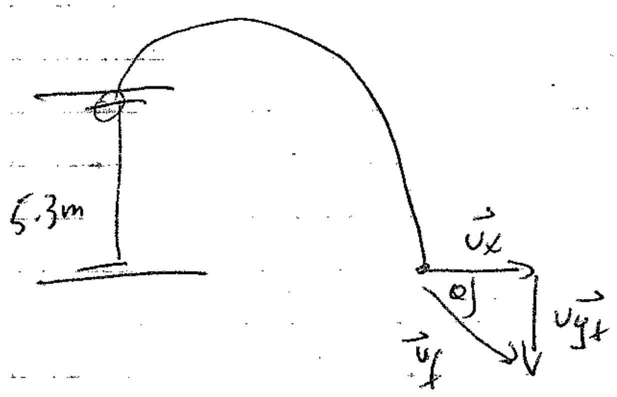
$\vec{x} = \vec{v}_x t$

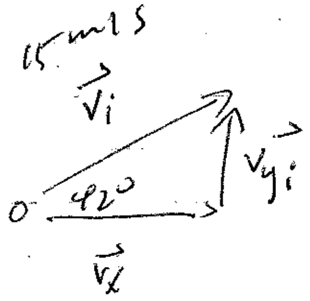
$\vec{x} = (17.20)(4.939)$

$x = 85.0\,m$

The stone lands 85.0m from the base of the cliff.

4.





$\vec{v}_x = 15\cos 42^\circ = +11.15\, m/s$
$\vec{v}_{yi} = 15\sin 42^\circ = +10.04\, m/s$

$\vec{y} = -5.3\, m$
$\vec{a} = -9.80\, m/s^2$
$\vec{v}_{yf} = ?$

$\vec{v}_{yf}^{\,2} = \vec{v}_{yi}^{\,2} + 2\vec{a}\vec{y}$

$v_{yf} = \sqrt{\vec{v}_{yi}^{\,2} + 2\vec{a}\vec{y}}$

$\vec{v}_{yf} = \sqrt{(10.04)^2 + 2(-9.80)(-5.3)}$

$\vec{v}_{yf} = -14.31\, m/s$

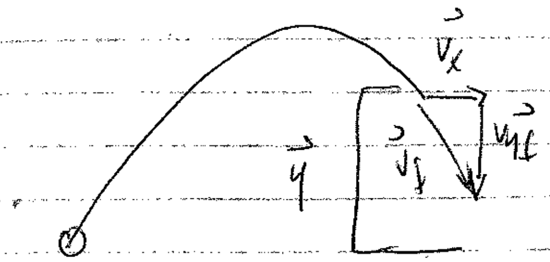
$v_f = \sqrt{v_x^2 + v_{yf}^2}$ $\tan\theta = \dfrac{v_{yf}}{v_x}$

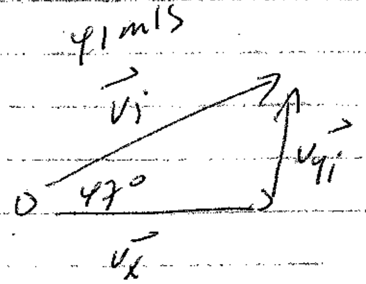
$v_f = \sqrt{11.15^2 + (14.31)^2}$ $\theta = \dfrac{14.31}{11.15}$

$v_f = 18\, m/s$ $\theta = 52^\circ$

The velocity was 18 m/s, 52° below the horizontal when it (the ball) hit the ground.

5.





$\vec{v}_x = +41\cos 47° = 28.0\,m/s$

$\vec{v}_{yi} = +41\sin 47° = 30.0\,m/s$

$\vec{v}_{yf} = -11\,m/s$

$\vec{v}_{yf}^{\,2} = \vec{v}_{yi}^{\,2} + 2\vec{a}\,\vec{y}$

$2\vec{a}\,\vec{y} = \vec{v}_{yf}^{\,2} - \vec{v}_{yi}^{\,2}$

$\vec{y} = \dfrac{\vec{v}_{yf}^{\,2} - \vec{v}_{yi}^{\,2}}{2\vec{a}}$

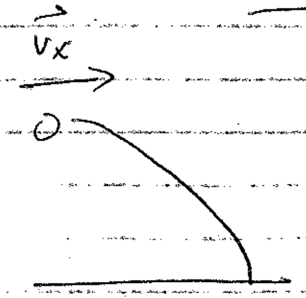
$\vec{y} = \dfrac{(-11)^2 - (30.0)^2}{2(-9.80)}$

$\vec{y} = 40m.$

The fan is seated 40m above the field.

Mandatory

1.



$\vec{v}_x = 138\,m/s$ $\quad$ $\vec{y} = -1.50\times10^{3}\,m$

$\vec{a} = -9.80\,m/s^2$

$\vec{v}_{y_i} = 0\,m/s$

a) $\vec{y} = \cancel{\vec{v}_{y_i} t} + \frac{1}{2}\vec{a}t^2$

$t = \sqrt{\frac{2\vec{y}}{\vec{a}}}$

$t = \sqrt{\frac{2(-1.50\times10^{3})}{-9.80}}$

$t = 17.5\,s$

It takes 17.5 s for the wheel to reach the ground.

b) $\vec{v}_x = \frac{\vec{x}}{t}$

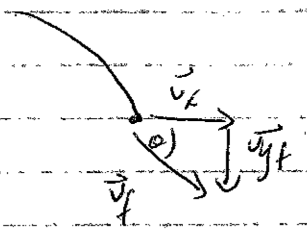
$\vec{x} = \vec{v}_x t$

$\vec{x} = (138)(17.5)$

$\vec{x} = 2.42\times10^{3}\,m$

The wheel travelled $2.42\times10^3\,m$ horizontally.

c)



$\vec{v}_{yf}^{\,2} = \cancel{\vec{v}_{y_i}^{\,2}} + 2\vec{a}\vec{y}$

$\vec{v}_{yf} = \sqrt{2(-9.80)(-1.50\times10^{3})}$

$\vec{v}_{yf} = -171.5\,m/s$

$\tan\theta = \frac{171.5}{138}$

$\theta = 51.2^\circ$

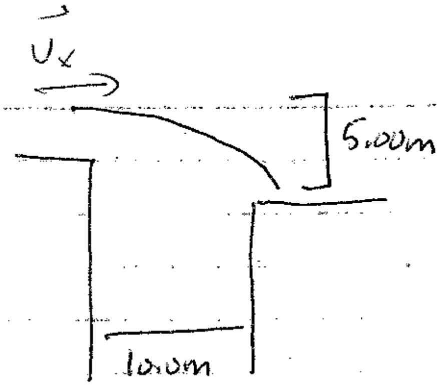
$v_f = \sqrt{v_x^2 + v_{yf}^2}$

$v_f = \sqrt{(138)^2 + (171.5)^2}$

$v_f = 220\,m/s$

Its velocity will be 220 m/s, 51.2° below the hor.

2.



$\vec{v}_x = ?$
$\vec{x} = 10.0\,m$

$\vec{y} = -5.00\,m$
$\vec{a} = -9.80\,m/s^2$
$\vec{v}_{y_i} = 0\,m/s$

$$\vec{y} = \cancel{\vec{v}_{y_i}}\, t + \frac{1}{2}\vec{a}t^2$$

$$t = \sqrt{\frac{2\vec{y}}{\vec{a}}}$$

$$t = \sqrt{\frac{2(-5.00)}{-9.80}}$$

$$t = 1.010\,s$$

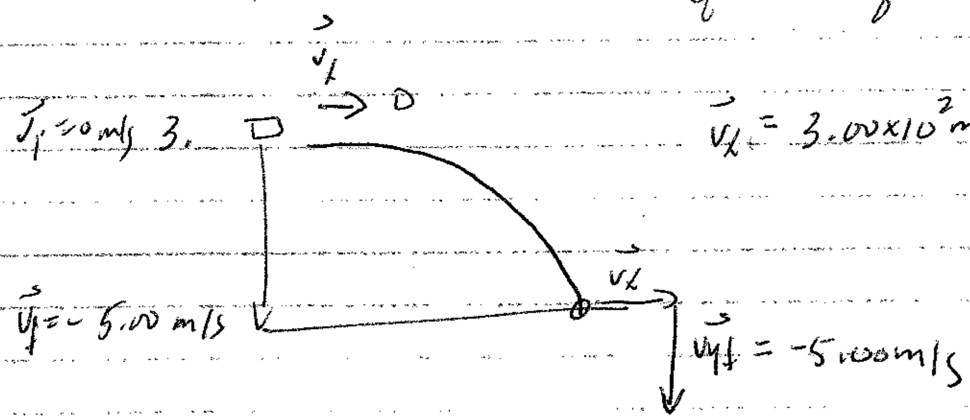
$$\vec{v}_x = \frac{\vec{x}}{t}$$

$$\vec{v}_x = \frac{10.0}{1.010}$$

$$\vec{v}_x = 9.90\,m/s$$

Batman requires a minimum speed of 9.90 m/s.

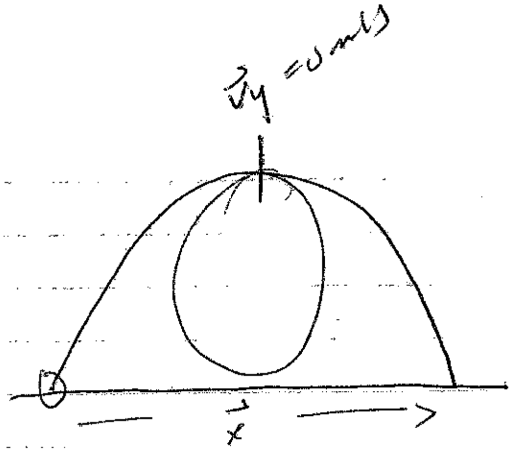
3.

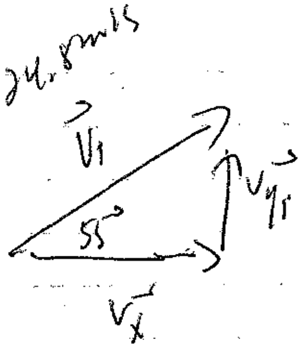


$\vec{v}_x = 3.00 \times 10^2\,m/s$

The vertical component of the bullet is 5.00 m/s, down.

4.





a) $\vec{x} = ?$

$\vec{v}_x = 24.8 \cos 55^\circ = 14.2$ m/s

$\vec{v}_{y_i} = 24.8 \sin 55^\circ = 20.3$ m/s

$\vec{y} = \vec{v}_{y_i} t + \frac{1}{2} \vec{a} t^2$

$0 = \vec{v}_{y_i} + \frac{1}{2} \vec{a} t$

$\frac{1}{2} \vec{a} t = -\vec{v}_{y_i}$

$t = \frac{-2\vec{v}_{y_i}}{\vec{a}}$

$t = \frac{-2(20.3)}{-9.80}$

$t = 4.14$ s

$\vec{v}_x = \frac{\vec{x}}{t}$

$\vec{x} = \vec{v}_x t$

$\vec{x} = (14.2)(4.14)$

$\vec{x} = 59$ m.

The safety net should be 59m away from the launch point.

b) $\cancel{\vec{v}_{y_f}^{\,2}} = \vec{v}_{y_i}^{\,2} + 2\vec{a}\vec{y}$

$2\vec{a}\vec{y} = -\vec{v}_{y_i}^{\,2}$

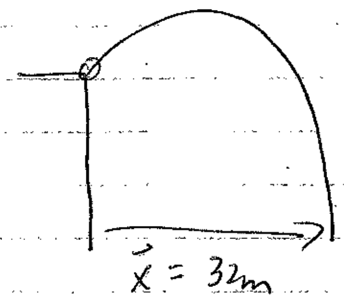
$\vec{y} = \frac{-\vec{v}_{y_i}^{\,2}}{2\vec{a}}$

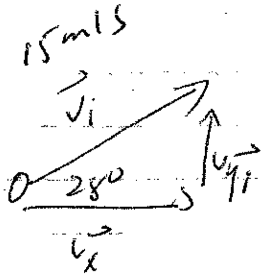
$\vec{y} = \frac{-(20.3)^2}{2(-9.80)}$

$\vec{y} = 21.$ m

The max height is 21m.

5.





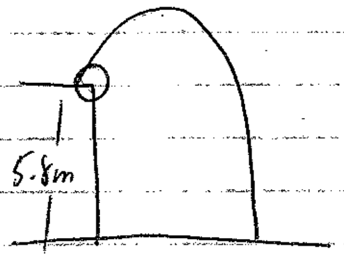
$$\vec{v_x} = 15\cos 28^\circ = 13.2\ m/s$$
$$\vec{v_{y_i}} = 15\sin 28^\circ = 7.04\ m/s$$

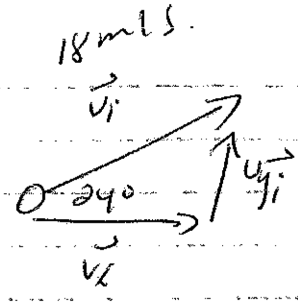
$$\vec{v_x} = \frac{\vec{x}}{t}$$
$$t = \frac{\vec{x}}{\vec{v_x}}$$
$$t = \frac{32}{13.2}$$
$$t = 2.42\,s$$

$$\vec{y} = \vec{v_{y_i}}\,t + \frac{1}{2}\vec{a}\,t^2$$
$$\vec{y} = (7.04)(2.42) + \frac{1}{2}(-9.80)(2.42)^2$$
$$\vec{y} = -12\ m$$

The building is 12m high.

6.





$\vec{y} = -5.8m$
$\vec{a} = -9.80 m/s^2$

$\vec{v_x} = 18 \cos 24° = 16.4 m/s$
$\vec{v_{y_i}} = 18 \sin 24° = 7.32 m/s$

a) $\vec{v_{yf}}^2 = \vec{v_{y_i}}^2 + 2\vec{a}\vec{y}$
$\vec{v_{yf}} = \sqrt{(7.32)^2 + 2(-9.80)(-5.8)}$
$\vec{v_{yf}} = -12.9 m/s$

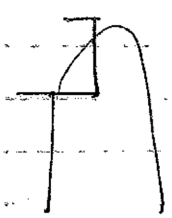
$\vec{v_{yf}} = \vec{v_{y_i}} + \vec{a}t$
$t = \dfrac{\vec{v_{yf}} - \vec{v_{y_i}}}{\vec{a}}$
$t = \dfrac{-12.9 - 7.32}{-9.80}$
$t =$ ~~2.0 s~~ $2.1 s$

The ball is in the air for 2.1 s.

b) $\vec{v_x} = \dfrac{\vec{x}}{t}$
$\vec{x} = \vec{v_x} t$
$\vec{x} = (16.4)(2.1)$
$\vec{x} = 34 m.$

The horizontal range is 34 m.

c) $\vec{v_{yf}} = 0$

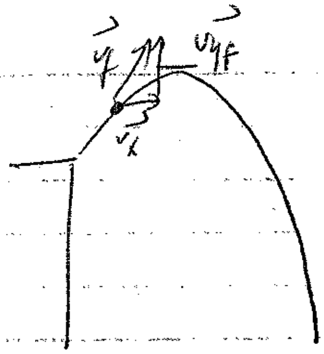


$\cancel{\vec{v_{yf}}^2} = \vec{v_{y_i}}^2 + 2\vec{a}\vec{y}$
$\vec{y} = \dfrac{-\vec{v_{y_i}}^2}{2\vec{a}}$
$\vec{y} = \dfrac{-(7.32)^2}{2(-9.80)}$
$\vec{y} = 2.73 m$

$$\begin{array}{r} 2.73 \\ + \; 5.8 \\ \hline 8.5 m. \end{array}$$

The maximum height is 8.5 m.

d)



$$\vec{v}_{yf}^{\,2} = \vec{v}_{yi}^{\,2} + 2\vec{a}\Delta\vec{y}$$

$$\vec{v}_{yf} = \sqrt{(7.32)^2 + 2(-9.80)(2.0)}$$

$$\vec{v}_{yf} = +3.79\,m/s$$

$$v_f = \sqrt{v_x^2 + v_{yf}^2}$$

$$v_f = \sqrt{(16.4)^2 + (3.79)^2}$$

$$v_f = 17\,m/s$$

$$\tan\theta = \frac{3.79}{16.4}$$

$$\theta = 13^\circ$$

The velocity of the ball is 17 m/s, 13° above the horizontal.

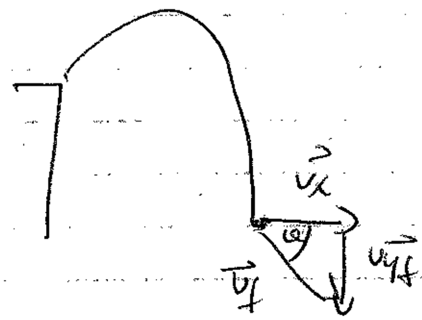
e)

$$\vec{v}_{yf} = \vec{v}_{yi} + \vec{a}t$$

total time in air

$$\vec{v}_{yf} = 7.32 + (-9.80)(2.1)$$

$$\vec{v}_{yf} = -13.3\,m/s.$$

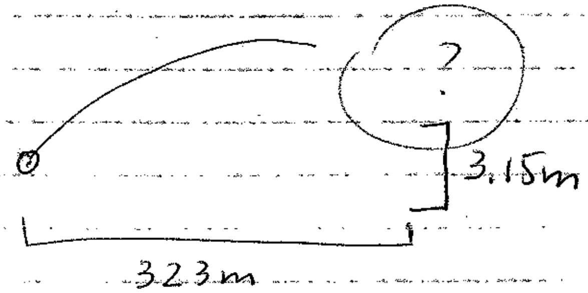


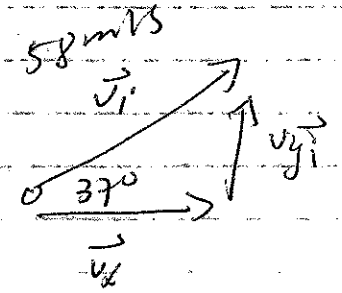
$$\tan\theta = \frac{13.3}{16.4}$$

$$\theta = 39^\circ$$

The ball hits the ground at an angle of 39° below the horizontal.

7.





$\vec{v_x} = 58\cos 37° = 46.3\,m/s$
$\vec{v_{y_i}} = 58\sin 37° = 34.9\,m/s$

$\vec{v_x} = \frac{\vec{x}}{t}$

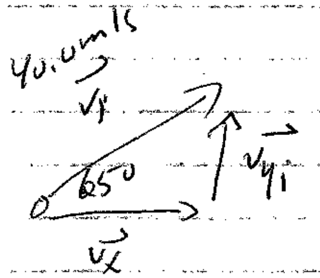
$t = \frac{\vec{x}}{\vec{v_x}}$ $\qquad \vec{y} = \vec{v_{y_i}}t + \frac{1}{2}\vec{a}t^2$

$t = \frac{323m}{46.3}$ $\qquad \vec{y} = (34.9)(6.98) + \frac{1}{2}(-9.80)(6.98)^2$

$t = 6.98s$ $\qquad \vec{y} = 4.9m$

The ball will be 4.9m from the ground 323m from the point the ball was hit so it will clear the fence and be a home run.

8.



$\vec{v_x} = 40.0\cos 65° = 16.9\,m/s$
$\vec{v_{y_i}} = 40.0\sin 65° = 36.3\,m/s$

a) $\vec{v_x} = \frac{\vec{x}}{t}$ $\qquad \vec{y} = \vec{v_{y_i}}t + \frac{1}{2}\vec{a}t^2$

$\vec{x} = \vec{v_x}t$ $\qquad \vec{y} = (36.3)(2.0) + \frac{1}{2}(-9.80)(2.0)^2$

$\vec{x} = (16.9)(2.0)$

$\vec{x} = 34m$ $\qquad \vec{y} = 53m$

The horizontal + vertical distances are 34m and 53m respectively after 2.0s.

8.b) The horizontal velocity after 6.0s is 17m/s.

$$\vec{v}_{yf} = \vec{v}_{yi} + \bar{a}t$$

$$\vec{v}_{yf} = 36.3 + (-9.80)(6.0)$$

$$\vec{v}_{yf} = -23\ m/s$$

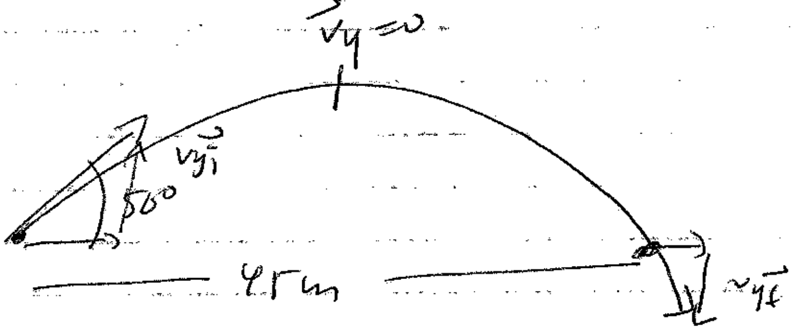
The vertical component after 6.0s is 23m/s, down.

9.

$\vec{x} = 45m$

$\vec{y} = 0m$

$\vec{a} = -9.80m/s^2$



$$\vec{v}_{yf}^{\,2} = \vec{v}_{yi}^{\,2} + 2\vec{a}\vec{y}$$

$$\vec{v}_y^{\,2} = \vec{v}_y^{\,2} + 2\vec{a}\vec{y}$$

$$0 = 2\vec{a}\vec{y}$$

$$\vec{y} = 0m$$

$$v_{yi} = v_{yf} = v_y$$

$$\vec{v}_x = v_i \cos 50^\circ$$

$$\vec{v}_{yi} = v_i \sin 50^\circ$$

$$\vec{v}_x = \frac{45}{t} \qquad \vec{y} = \vec{v}_{yi}t + \frac{1}{2}\vec{a}t^2$$

$$t = \frac{45}{\vec{v}_x} \qquad \text{Equ} \qquad 0 = \vec{v}_{yi} + \frac{1}{2}\vec{a}t$$

$$t = \frac{-2v_{yi}}{\vec{a}}$$

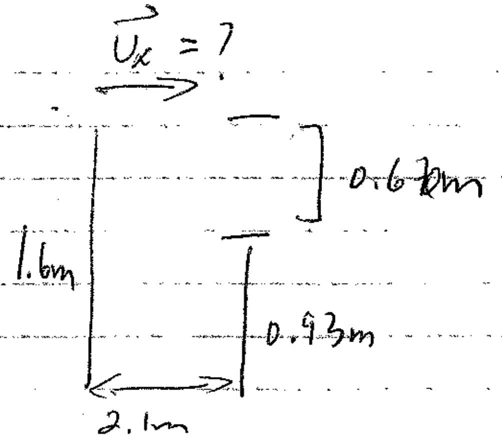
$$\frac{45}{v_i \cos 50^\circ} = \frac{-2v_i \sin 50^\circ}{\vec{a}}$$

$$45\vec{a} = -2v_i^2 \sin 50^\circ \cos 50^\circ$$

$$v_i = \sqrt{\frac{45\vec{a}}{-2\sin 50^\circ \cos 50^\circ}} = \sqrt{\frac{45(-9.80)}{-2\sin 50^\circ \cos 50^\circ}} = 21\ m/s.$$

$\vec{v}_A$ is 21m/s, 50° above the horizontal.

10.



$\vec{y} = -0.670\,m$
$\vec{a} = -9.80\,m/s^2$
$v_{y_1} = 0\,m/s$

$\vec{y} = \cancel{v_{y_1} t} + \frac{1}{2}\vec{a}t^2$

$t = \sqrt{\frac{2\vec{y}}{\vec{a}}}$

$t = \sqrt{\frac{2(-0.670)}{-9.80}}$

$t = 0.370\,s$

$\vec{v}_x = \frac{\vec{x}}{t}$

$\vec{v}_x = \frac{2.1}{0.370}$

$\vec{v}_x = 5.7\,m/s.$

The velocity of the water was 5.7m/s, east.