PROJECTILE MOTION WORKSHEET

1. A ball is kicked horizontally at 8.0 m/s from a cliff 80m high. How far from the base of the cliff will the stone strike the ground?

2. How long will it take a shell fired from a cliff at an initial velocity of 800 m/s at an angle 30° below the horizontal to reach the ground 150m below?

3. Jason Kendall throws a baseball with a horizontal component of velocity of 25 m/s. It takes 3.00s to come back to its original height. Calculate its horizontal range, its initial vertical component of velocity and its initial angle of projection.

4. An egg is thrown horizontally off the roof of SI, which is 60 meters high, with an initial velocity of 6.5 m/s. How long does it take to hit the ground? How far does it go in the x direction?

5. A diver jumps **UP** off a pier at an angle of 25° with an initial velocity of 3.2 m/s. How far from the pier will the diver hit the water (Assume the level of water is the same as the pier)

6. Wile E. Coyote is holding a "HEAVY DUTY ACME$_{TM}$ ANVIL" on a cliff that is 40.0 meters high. The Roadrunner (beep-beep), who is 1.0 meter tall, is running on a road toward the cliff at a constant velocity of 10.0 m/s. Wile E. Coyote wants to drop the anvil on the Roadrunner's head. How far away should the Roadrunner be when Wile E. drops the anvil?

7. A bullet is fired at an angle of 60° with an initial velocity of 200.0 m/s. How long is the bullet in the air? What is the maximum height reached by the bullet?

8. A bullet is fired at an angle of 45°. Neglecting air resistance, what is the direction of acceleration during the flight of the bullet?
   a) upward
   b) downward
   c) dependent on the initial velocity
   d) at a 45° angle

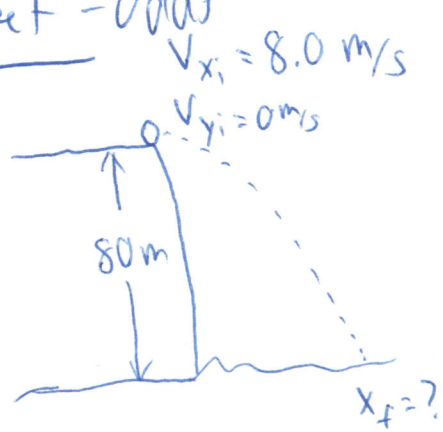
9. A golfer drives her golf ball from the tee down the fairway in a high arcing shot. When the ball is at the highest point of its flight:
   a. the velocity and acceleration are both zero
   b. the x-velocity is zero and the y-velocity is zero
   c. the x-velocity is non-zero, but the y-velocity is zero
   d. the velocity is non-zero, but the acceleration is zero

10. A bullet is fired horizontally from a gun. At the same time a similar bullet is dropped from the same height. The fired bullet will:
   a) hit the ground first
   b) hit the ground second
   c) hit at the same time as the dropped bullet
   d) never hit the ground

Answers

1. 32m
2. 0.37s
3. 75m; v_{0y}=15m/s; 31^0
4. a) 3.5s b) 21m
5. 0.8 m
6. 28.6 m
7. a) 35.4 s b) 4601 m
8. b
9. c
10. c

Projectile Motion Worksheet - Odds



(1) To find X_f I must know t.

To find t I use:

$y_f = y_0 + V_{y_i}t - \frac{1}{2}gt^2$

$80m = 0 + 0 - \frac{1}{2}(9.8 m/s^2)t^2$

$80m = -(4.9 m/s^2)t^2$ ⇒ since the sign only tells me direction, I drop it for the rest of the problem.

$t^2 = \frac{80m}{4.9 m/s^2}$

$t^2 = 16.3\ s$

$\boxed{t = 4\ s}$ Now that I know time!

$X_f = X_0 + V_{x_i}t = 0 + (8.0 m/s)(4s) = 32m$

$\boxed{X_f = 32m}$

(3)

$X_f = V_{x_i}t$

$X_f = (25 m/s)(3.00s)$

$\boxed{X_f = 75\ m}$

In the y-direction:

$V_{f,y} = V_{i,y} + at$

at the highest point, $V_{f,y} = 0$

$0 = V_{i,y} + (-9.8 m/s^2)(1.5s)$

$\boxed{V_{i,y} = 14.7 m/s}$

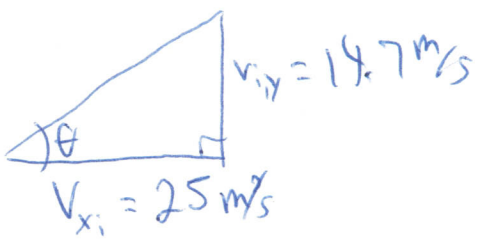
$V_{x_i} = 25$ m/s

$t = 3.00s$

divide time by 2 because you are just dealing with the time it takes to reach its highest point.

To find the angle I use

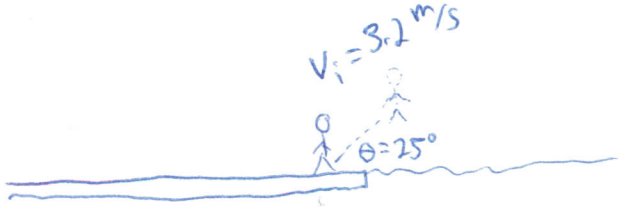
$\tan^{-1}\left[\tan\theta = \frac{14.7\ m/s}{25\ m/s} = 0.6\right]$



$\theta = \tan^{-1}(0.6)$

$\boxed{\theta = 31^\circ}$

(5)



The question is asking us to calculate X_f.

$X_f = X_0 + V_{x_i} t$

$X_0 = 0$

To find t:

$V_{y_f} = V_{y_i} - g t = \sin\theta \cdot V_i - g t$

$V_{y_f} = 0$ because this is at it's highest point.

$0 = \sin(25^\circ)(3.2\ m/s) - (9.8\ m/s^2)\, t$

$(9.8\ m/s)\, t = 1.35\ m/s$

$t = 0.14\ s$ ⇒ don't forget to multiply t by 2 because that is only the time to reach the highest point. He must return to the water.

$X_f = X_0 + V_{x_i} t = X_0 + (\cos(\theta) V_i)(t)$

$X_f = 0 + (\cos(25^\circ)(3.2\ m/s)(0.28\ s))$

$\boxed{X_f = 0.8\ m}$

(7) a)

to Find t:

$$V_{yf} = V_{yi} - gt = \sin\theta V_i - gt$$

$$0\ m/s = (\sin 60°)(200.0\ m/s) - (9.8\ m/s^2)t$$

$$(9.8\ m/s^2)t = 173\ m/s$$

$$t = \frac{173\ m/s}{9.8\ m/s^2}$$

$t = 17.7\ s$ which is the time to reach its highest point.

$$\boxed{t_{air} = 35.4\ s}$$

b) $y_f = y_0 + \sin\theta V_i t - \frac{1}{2} g t^2$

use the time to get to highest point which is y_f

$$y_f = 0 + (\sin 60°)(200.0\ m/s)(17.7\ s) - \frac{1}{2}(9.8\ m/s^2)(17.7\ s)^2$$

$$\boxed{y_f = 1531\ m}$$

I don't understand how the worksheet arrived at 460m. I believe it is incorrect.

(9) At the highest point, as discussed in class, $V_{yf} = 0$ but $V_{xi} = V_{xf} \neq 0$.