Forensics Name_____

Bullet Trajectory

Introduction:

The angle of impact (the bullet's path) is the angle created by the pathway of the bullet and the horizon. To determine this angle, at least two points along the trajectory must be identified. These two points could be an entry wound and exit wound (see figure 1) or possible a windshield penetration before entering the body (see figure 2).

Figure 1

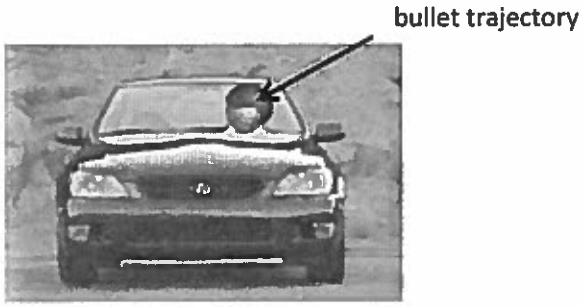
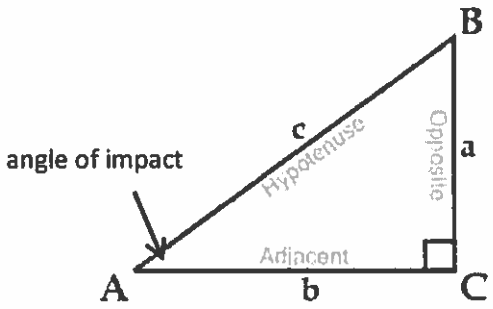


Figure 2

Sin (angle) = opposite/hypotenuse

Cos (angle) = adjacent/hypotenuse

Tan (angle) = opposite/adjacent



Procedure:

1. Analyze each of the 4 crime scene scenarios and draw a diagram showing how a right triangle is formed by the bullet trajectory.
2. Determine the angle of impact of the bullet in each scenario. In the case of scene 4, determine the height from which the bullet came (i.e. the story of the building from which the bullet was shot).

Diagram of Scenario 1	**Diagram of Scenario 2**
Diagram of Scenario 3	**Diagram of Scenario 4**

	Bullet Trajectory Data			
	"Adjacent" Distance	"Hypotenuse" Distance	"Opposite" Distance	Angle of Impact
Scene 1: bullet through window hitting table				
Scene 2: Entry and exit wound through skeleton				
Scene 3: Bullet hole through wall and into person				
Scene 4: Bullet penetrating person at known angle of impact in hallway				22.8°

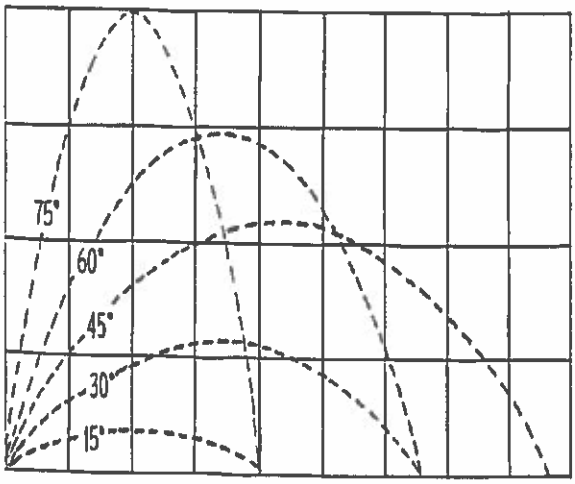
Analysis Questions

1. Describe two problems (other than human error in measuring) that might interfere with the accuracy of your results and your ability to calculate the angle of impact of a bullet.

2. If a trajectory could not be calculated, how else might you be able to determine the location of the shooter?

Lab: External Ballistics - Bullet Trajectories

Background: *External Ballistics is concerned with what happens to the bullet when it leaves the weapon until it strikes the target. You will calculate and reconstruct the bullet trajectories and establish the maximum range of a given bullet. Bullets travel based upon the principle of projectile motion. The angle of firing affects the path of the bullet over a period of time. This can be visualized and calculated according to the graph and equations below.*



Gun pointing up:
$y = y_0 + v_0\sin(\Theta)t - \frac{1}{2} gt^2$

Gun pointing down:
$y = y_0 - v_0\sin(\Theta)t - \frac{1}{2} gt^2$

Where…
y = height of victim/wound in meters (m)
y0 = height of shooter's location in meters (m)
v0 = initial speed of bullet in meters/second (m/s)
Θ = angle of firing
t = time for bullet to travel in seconds
g = acceleration due to gravity (*always* 9.8 m/s^2)

Pre-Lab Questions: *(show your work for each problem and circle your answer with the correct units)*

1. A sharpshooter is located in a tree. The sharpshooter fires down at a 30 degree angle. It takes the bullet 0.5s to hit the victim's shoulder at 1.2m high. The speed of the bullet was 62m/s. How high up is the sharpshooter?

2. A sharpshooter is located in a tree 15m tall. The sharpshooter fires down at a 25 degree angle. It takes the bullet 0.5s to hit the victim's shoulder (located at 1.5 m high). What is the speed of the bullet as it leaves the gun?

3. A sharpshooter fires a gun from the ground at a height of 2.0m and angle of 45 degrees up. It takes the bullet 1.2s to hit the victim located in a building 120m high. What is the speed of the bullet as it leaves the gun?

4. A sharpshooter is located in a three 25m tall. The tree is located 15m away from the victim. It takes the bullet 0.1s to hit the victim's shoulder (located at 1.2m high). What is the speed of the bullet as it leaves the gun?