

Do not write!

Unit 3: Forensic Ballistics

Graphing Activity:

FIREARMS: A COMPARISON of VELOCITY, KINETIC ENERGY and TRAJECTORY

Forensic scientists can accurately reconstruct what occurred at crime scenes involving a firearm, because each type of firearm has unique ballistic properties involving such things as velocity, kinetic energy and trajectory.

For example, during the Washington sniper shootings that occurred in the fall of 2002, ballistic experts determined which type of firearm was used through the identification of bullets found in most of the victims. This enabled forensic experts to determine approximately where the suspects had been hiding when they pulled the trigger.

In this activity you will create THREE GRAPHS that will compare the unique velocity, kinetic energy and trajectory of three basic types of firearms: handguns, rifles, and shotguns.

Graph #1: Comparison of the VELOCITY of Various Firearms

Problem: How do the average velocities of handgun, rifle and shotgun rounds differ from one another?

Background Info: *Velocity is defined as the speed at which the bullet leaves the barrel of the firearm.*

- Procedure:
- Use the data below to create one line graph.
  - The x-axis should represent the three distances (muzzle = 0 m, 50 m, 100 m).
  - The y-axis should represent bullet velocity (in feet/second).
  - Remember to incorporate a title and a legend in your graph.

| <u>Type of Ammunition</u> | <u>Type of Bullet</u> | <u>VELOCITY (feet/second)</u> |             |              |
|---------------------------|-----------------------|-------------------------------|-------------|--------------|
|                           |                       | <u>Muzzle</u>                 | <u>50 m</u> | <u>100 m</u> |
| handgun                   | 9mm Luger             | 1155                          | 1047        | 971          |
|                           | .40 S&W               | 1015                          | 960         | 914          |
| rifle                     | .22 Hornet            | 2690                          | 2420        | 2042         |
|                           | .223 Remington        | 3240                          | 2950        | 2759         |
| shotgun                   | 12-gauge Slug         | 1760                          | 1345        | 1075         |
|                           | 12-gauge Slug         | 1875                          | 1302        | 998          |

## Graph #2: Comparison of the KINETIC ENERGY of Various Firearms

**Problem:** How does the kinetic energy of handguns, rifles & shotguns differ from one another?

**Background** *Kinetic energy is a measure of projectile mass (bullet weight) times velocity.*

**Information:** *Heavier, faster bullets possess greater kinetic energy, measured in ft/lbs.*

- Procedure:**
- Use the data below to create one line graph.
  - The x-axis should represent the three distances (muzzle = 0 yards, 50 yards, 100 yards).
  - The y-axis should represent kinetic energy (in feet/lbs.).
  - Remember to incorporate a title and legend in your graph.

| Type of Ammunition | Type of Bullet        | KINETIC ENERGY (ft/lbs) |      |       |
|--------------------|-----------------------|-------------------------|------|-------|
|                    |                       | Muzzle                  | 50 m | 100 m |
| 9mm Luger          | jacketed hollow point | 341                     | 280  | 241   |
| .40 Smith & Wesson | jacketed hollow point | 412                     | 368  | 334   |
| .22 Hornet         | pointed soft point    | 723                     | 520  | 417   |
| .223 Remington     | metal jacket          | 1282                    | 1040 | 929   |
| 12-gauge Slug      | 3 inch/1 oz. slug     | 3005                    | 1753 | 1121  |
| 12-gauge Slug      | 3 inch/7/8 oz. slug   | 2989                    | 1442 | 847   |

## Graph #3: Comparison of the TRAJECTORY of Various Firearms

**Problem:** How do the trajectories of handguns, rifles and shotguns differ from one another?

**Background** *Trajectory is defined as the path of a bullet, determined by velocity and kinetic energy and the force of gravity. Lighter, faster bullets have flatter trajectories.*

- Procedure:**
- Use the data below to create one line graph.
  - The x-axis should represent the distances (50 yards, 100 yards, 200 yards).
  - The y-axis should represent trajectory (in inches).
  - Remember to incorporate a title and legend in your graph.

| Type of Ammunition | Type of Bullet        | TRAJECTORY ( inches/meter) |             |           |
|--------------------|-----------------------|----------------------------|-------------|-----------|
|                    |                       | 50 m                       | 100 m       | 200 m     |
| 9mm Luger          | jacketed hollow point | -0.9 in.                   | -3.9 in.    | -7.9 in.  |
| .40 Smith & Wesson | jacketed hollow point | -1.3 in.                   | -4.5 in.    | -9.8 in.  |
| 22 Hornet          | pointed soft point    | -1.0 in.                   | -7.1 in.    | -12 in.   |
| 223 Remington      | metal jacket          | 0.0 in.                    | -1.9 in.    | -5.5 in.  |
| 12-gauge Slug      | 3 inch/1 oz. slug     | -1.5 in.                   | -3.7 inches | -12.5 in. |
| 12-gauge Slug      | 3 inch/7/8 oz. slug   | 0.0 in.                    | -3.4 inches | -11.2 in. |

**Graphing Activity Related Questions:**  
**FIREARM COMPARISON of**  
**VELOCITY, KINETIC ENERGY and TRAJECTORY**

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The 9mm handgun is a popular weapon among gang members, while the .40 Glock handgun is used by many police agencies.

1. a) Which bullet has a greater velocity? \_\_\_\_\_  
b) Greater kinetic energy causes greater injury to a shooting victim. Which of these two rounds would cause the more serious injury, based on each bullet's kinetic energy?  
\_\_\_\_\_  
c) Which of these two rounds has the flattest trajectory? Why? \_\_\_\_\_

It was determined from shell casings left behind by the Washington snipers, John Allen Muhammad & John Lee Malvo, that a .223 caliber rifle had been used in the shooting of thirteen people.

2. Outline one piece of data from this graphing activity that suggests why the .223 round used by the Washington snipers would be effective over long distances.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

In the 1960's, the US military adopted the .223 caliber round for use in its standard infantry weapons, such as the M-16 seen in the Iraq war. With a flatter trajectory, lower bullet mass, and high muzzle velocity, the .223 caliber round is smaller in size than ammunition used by other countries such as Russia and China.

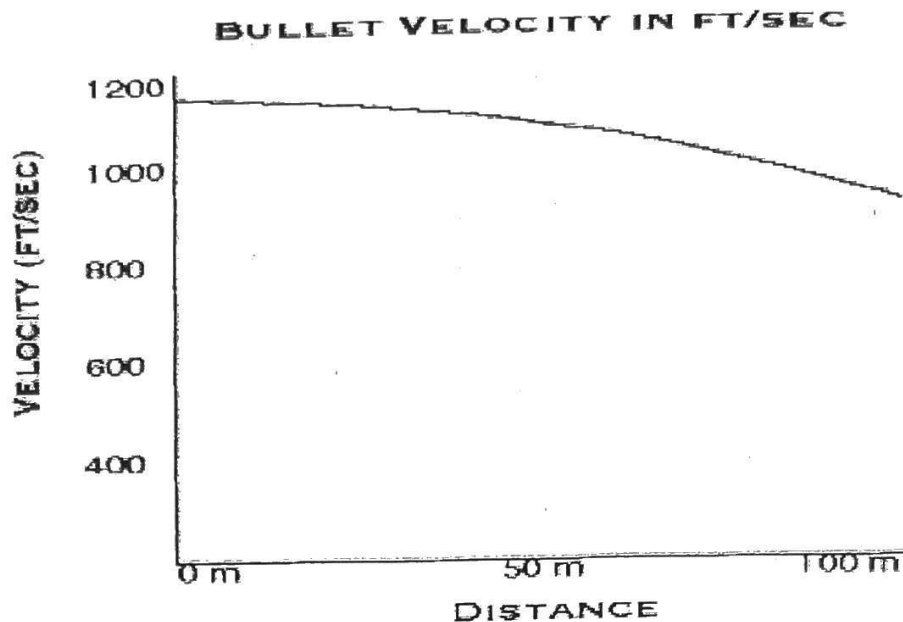
3. Explain why exactly the .223 caliber round might be more effective in a combat situation.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# Worksheet: Firearms Graph Analysis

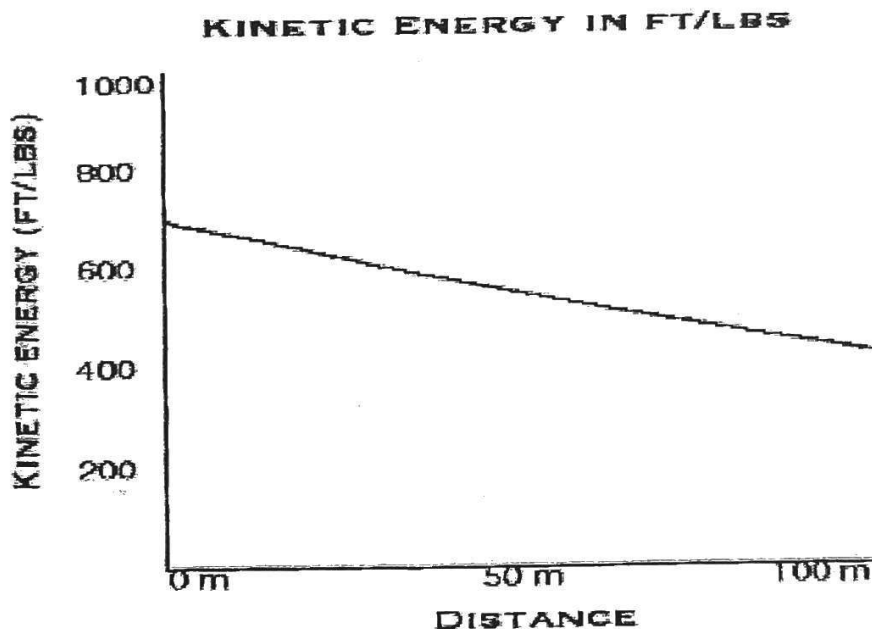
## Velocity, Kinetic Energy & Trajectory

Each of the following three graphs represents the velocity, kinetic energy and trajectory of three different types of ammunition shot from three different types of guns (ie. handgun, rifle, shotgun). Carefully review this data and then answer questions # 1 - 3 on the next page.

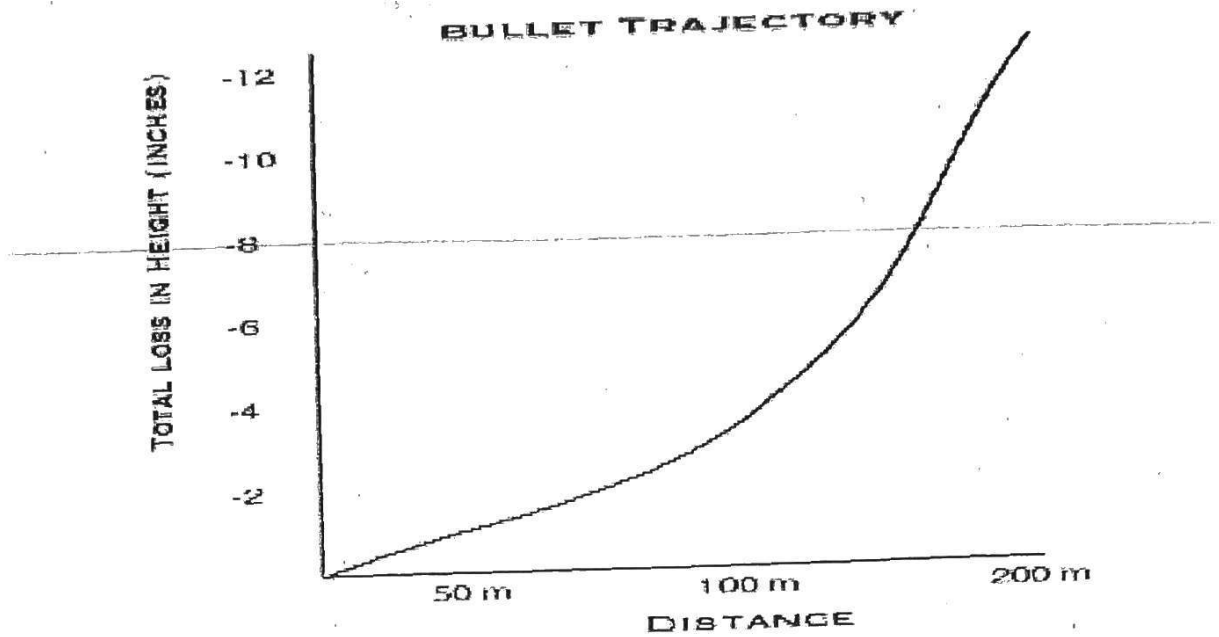
GRAPH A:



GRAPH B:



**GRAPH C:**



Related Questions...

1. Identify a type of gun, a type of ammunition and a type of bullet that is represented by the velocity described in **graph A**: (3 marks)

Type of Gun:            **handgun**                      **rifle**                      **shotgun**

Type of Ammunition: \_\_\_\_\_

Type of Bullet: \_\_\_\_\_

2. Identify a type of gun, a type of ammunition and a type of bullet that is represented by the kinetic energy described in **graph B**: (3 marks)

Type of Gun:            **handgun**                      **rifle**                      **shotgun**

Type of Ammunition: \_\_\_\_\_

Type of Bullet: \_\_\_\_\_

3. Identify a type of gun, a type of ammunition and a type of bullet that is represented by the trajectory described in **graph C**: (3 marks)

Type of Gun:            **handgun**                      **rifle**                      **shotgun**

Type of Ammunition: \_\_\_\_\_

Type of Bullet: \_\_\_\_\_