Name:_____Class:_____Date:_____

The Case of Kirsten K.:
Weapon Analysis

All Reports are to be filed using the correct format, following the Lab Report Style Guide

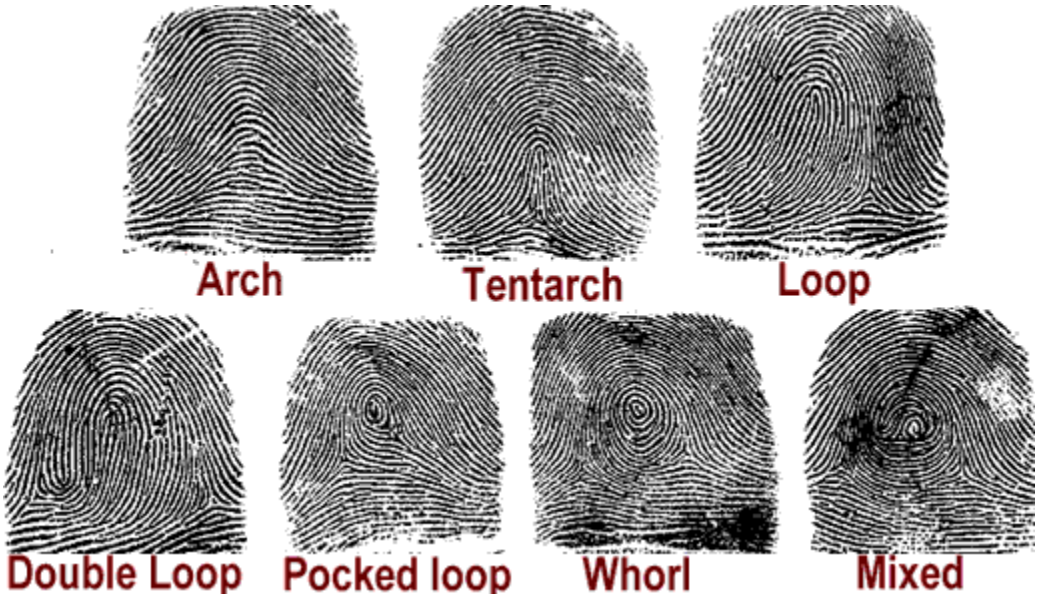
Part I: The Fingerprint Analysis

Case Background

Larry J. has been found murdered with several bullet wounds to the chest. Two guns were found at the crime scene: one next to the victim with the handle wrapped in aluminum foil, and the other, with a unique copper handle, at the bottom of a garbage can outside the cellar door to Gladys V.'s lake house. The police need your help to collect and analyze the fingerprints found on the aluminum foil and copper handle to determine if the prints match any of the suspects and/or victim. Samples from each gun handle are ready for analysis.

Background Information on Fingerprint Classification

Latent prints cannot be seen by the naked eye and often have to be dusted in order to see the patterns more clearly. Every person has a unique set of fingerprints, but three basic patterns allow forensic scientists to classify them. The three basic patterns are the whorl, the arch, and the loop. ***Whorl*** patterns have lots of circles that do not leave either side of the print. ***Arch*** patterns have lines that start on one side of the print, rise toward the center, and leave on the other side of the print. ***Loop*** patterns have lines that start on one side of the print, rise toward the center, turn back, and leave on the same side from which they started. Fingerprints are permanent; they form during fetal development and start in the basal layer of the skin. Fingerprints always grow in the same place and any damage to the basal layer becomes permanent.



Procedure

Aluminum Foil Handle Fingerprints

1. Examine the print first on the aluminum sample before dusting to identify whose print it most closely matches based on the prints in the evidence envelope.
2. Dust the Fingerprints with the powder and brushes provided. Be careful not to destroy the print when dusting with the brush.
3. After dusting the print with the brush, preserve the print by placing the clear tape over the dusted print on the aluminum foil.
4. Try to match the print to the suspect/victim prints in the evidence envelope.

Copper Handle Fingerprints

1. Examine the print first on the copper sample before dusting to identify whose print it most closely matches based on the prints in the evidence envelope.
2. Dust the fingerprints with the powder and brushes provided. Be careful not to destroy the print when dusting with the brush.
3. After dusting the print with the brush, preserve the print by placing the clear tape over the dusted print, then lifting the tape and the print off of the copper metal sample.
4. Stick the tape with the print on it onto a piece of white paper to preserve the print.
5. Try to match the print to the suspect/victim prints in the evidence envelope.

Materials

- Dusting powder and brushes
- Fingerprint samples
- Clear tape
- White paper

Data

Construct a table to identify which types of fingerprints are on each of the gun handles and to whom the prints belong from the suspect list.

Conclusion

1. Who are the possible matches to the aluminum foil fingerprints?

2. Who are the possible matches to the copper handle fingerprints?

3. Are there any suspects that can be ruled out at this point for the murders of Kirsten K. and her husband, Larry J.? Explain.

Part II: Gun and Bullet Matching

Background Information

Police have run the set of unknown fingerprints found on the gun handles through AFIS (Automatic Fingerprint Identification System) to try to match them to anyone in the system with a previous criminal record. After running these prints, a match for the unknown fingerprints has been found. Pick up a suspect list to find out more information about all the suspects, including the new suspect #5.

Bullets from each of the guns (aluminum and copper) were found at the scene of the crime as well. During the autopsy, remnants of silver bullets were found in the victim's chest. After a sweep of the crime scene, both silver and zinc bullets were found in the basement. The police need your help to match the bullets to the appropriate gun so they can start to piece together what happened the day of the murder.

The electric potential for each gun and bullet combination has to be within a certain range for the bullet to be compatible with the gun type. To match each gun metal and bullet metal type in the correct combination, they must have an electric potential difference between 0 and +1.0 V. In each case, the gun metal will be oxidized and the bullet metal will be reduced.

Analysis—Calculations

Show all calculations below to prove which of the metal bullets belongs to each gun.

Write the overall redox reaction and the standard cell notation for each of the gun/bullet combinations.

Conclusion

1. Which bullet type was matched to which gun and what evidence proves this?

2. Based on the evidence so far, which gun do you believe belonged to which suspect and which do you believe belonged to the victim, Larry J.?

Part III: Gunshot Residue

Background Information

All suspects have been brought in for a final questioning, during which time they were swabbed for gunshot residue on their hands. The gunshot residue swab has been placed in a solution of HCl. Police need your help in analyzing the suspects and the victim, Larry J., to see if the solutions show any signs of gunshot residue. A positive match for gunshot residue will show an acid concentration of 0.15M or higher.

Procedure

1. Put 10mL of each of the solutions for each titration into a 250 mL Erlenmeyer flask.
2. Dilute the 10mL of the solutions with 35mL of distilled water, yielding a total solution of 45 mL to be titrated.
3. Add 2-3 drops of the phenolphthalein indicator to the flask.
4. Fill the buret with the NaOH (base) solution provided.
5. Record the initial and final volumes of the base in the buret to determine how much of the 0.1M NaOH solution it took to titrate each sample.
6. Perform and record ***at least*** one trial for each of the solutions.

Data

Create a data table similar to the one provided below to record the initial amount of used, initial reading of the buret, and final reading of the buret for each of the suspects and the victim, Larry.

	Harold	**Gladys**	**Elizabeth**	**Larry**	**Gerald**
Amount of Acid from suspect sample					
Initial Buret Reading					
Final Buret Reading					
Volume of NaOH used					

Analysis—Calculations

Use the space below to show calculations for the acid concentration in each of the gunshot residue swabs from the solutions for each of the suspects and the victim.

Write the balanced neutralization reaction for the acidic solution with the basic solution.

1. Suspect #1: Harold M.

2. Suspect #2: Gladys V.

3. Suspect #3: Elizabeth G.

4. Suspect #4: New Victim: Larry J.

5. Suspect #5: Gerald V.

Conclusion

1. Who had positive matches for the gunshot residue? Who had negative matches for gunshot residue? Explain your results.

2. How does this evidence help to narrow down the suspects? What are possible scenarios at this point for what happened in the basement of Gladys V.'s lake house?

Part IV: Blood Stain Analysis

Background Information

Clothes from each of the suspects and victim have been taken to determine if the stains found on the clothes are blood stains. Your job is to determine which clothing items contain blood and identify the stains that are not blood.

Data—Part A

Each of the blood stains must fall within a pH range of 6.5-8.0 to be considered actual human blood. For each of the following pieces of data, calculate the pH from the information given. If the stain believed to be blood is too small, only the [OH-] concentration could be obtained. If the sample believed to be blood is large enough, the $[H_3O^+]$ concentration could be obtained.

Table 1: pH Range Calculations to Determine Blood Stains

Suspect Information	$[H_3O^+]$ (concentrations listed for # of stains found)	$[OH^-]$	pH	Blood Stain: Yes or No?
Victim: Kirsten K.	1) 1.00×10^{-7}M	----------		
Suspect #1: Harold M.	----------	1) 3.16×10^{-4}M		
Suspect #2: Gladys V.	----------	1) 3.16×10^{-7}M		
Suspect #3: Elizabeth G.	----------	1) 1.00×10^{-10}M		
Suspect #4: New Victim: Larry J.	1) 3.16×10^{-7}M 2) 3.16×10^{-8}M	----------		
Suspect #5: Gerald V.	----------	1) 3.16×10^{-7} M 2) 1.00×10^{-7} M 3) 3.16×10^{-8} M		

Analysis—Calculations Part A

Show the work below for the calculations to fill in Table 1 above.

Data—Part B

Further tests have been done on the stains that were proven to fall into the pH range matching the pH of blood from 6.5-8.0. More than one stain may have been found on more than one piece of clothing. Tests were done to see if the pH values that were calculated in Table 1 match any of the blood types from each of the suspects who were found to have blood on them.

Table 2: Blood Types and pH's

Blood Type	pH level
A	8.0
B	7.0
AB	7.5
O	6.5

Table 3: Blood Types of Suspects and Victims

Suspect Information	Blood Type
Victim: Kirsten K.	B
Suspect #2: Gladys V.	A
Suspect #4: New Victim: Larry J.	O
Suspect #5: Gerald V.	AB

Table 4: Blood pH Matching

Suspect Information	$[H_3O^+]$ of blood Sample 1	$[H_3O^+]$ of blood Sample 2	$[H_3O^+]$ of blood Sample 3	Suspect/Victim Matches
Kirsten K.	1.00×10^{-7} M	----------	----------	
Larry J.	3.16×10^{-7} M	3.16×10^{-8} M	----------	
Gerald V.	3.16×10^{-7} M	1.00×10^{-7} M	3.16×10^{-8} M	
Gladys V.	3.16×10^{-8} M	----------	----------	

Analysis—Calculations Part B

Calculate the pH of each of the samples from Table 4 to see which ones match the blood types provided in Table 2 and Table 3.

Conclusion

1. Which of the suspects and/or victims had stains that fell into the pH range of blood? (from Table 1)

2. Why may have Harold shown a basic stain and Elizabeth have shown an acidic stain? You may have to look back at previous assessments and/or suspect files.

3. After further calculations for those suspects with blood stains, which of the suspects/victims did those stains prove to be a match to? (from Table 4)

4. What are possible scenarios to link both of the murders of Kirsten K. and Larry J. together? Is there more than one suspect who could be responsible for the murder? Does the evidence lead one way or another?