2012 Twin Tiers Invitational

Forensics: Information Sheet

The Great Tuna Caper

Recently a prize tuna was caught off the coast of Japan that was so amazing that a Japanese businessman, Kiyoshi Kimura, bid and paid $736,00 for it (Event Supervisors Note: I'm not kidding about that part). Unfortunately, after he had the fish shipped to his warehouse in the United States awaitin8 distribution to his top of the line sushi restaurants, the fish was stolen.

A night watchman at the warehouse was knocked unconscious after a brief scuffle and is at the hospital with a severe head laceration. Hereafter he will be referred to as the "victim".

Investigators found 11 forensic samples at the crime scene which you have labeled 1-11 at your table as well as ink, DNA, and shoe print evidence.

Five suspects were rounded up for having possible connections to the crime. Any relevant forensic samples found on them or in their possession are catalogued underneath their name. Hopefully some of it matches the evidence found at the crime scene so that we can narrow down the suspect list. That is your task.

Steve
- Boric acid
- Linen
- PC
- Bat hair
- Ink sample
- Shoe

Janet
- Ammonium chloride
- Cat hair
- Polyester
- HDPE
- DNA
- Shoe

Amanda
- Sodium bicarbonate
- PVC
- Silk
- Ink Sample
- DNA
- Shoe

Murphy
- Sodium carbonate
- PMMA
- Wool
- Shoe

Tyler
- Magnesium Sulfate
- PP
- Nylon
- Dog hair
- DNA

School Name: _____ Team Number: _____

Competitors: _____

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Forensics: Answer Sheet

Part 1 Qualitative Analysis (20 pts)

Samples 1-5 are all powders. Determine their identity and give either the formula or name here.

Sample 1 _____

Sample 2 _____

Sample 3 _____

Sample 4 _____

Sample 5 _____

Part 2 Polymers, Fibers, Hairs (18 pts)

Samples 6-11 are either polymers, fibers, or hairs. Determine their identity and report it here.

Sample 6 _____

Sample 7 _____

Sample 8 _____

Sample 9 _____

Sample 10 _____

Sample 11 _____

Part 3 Chromatography (15 pts)

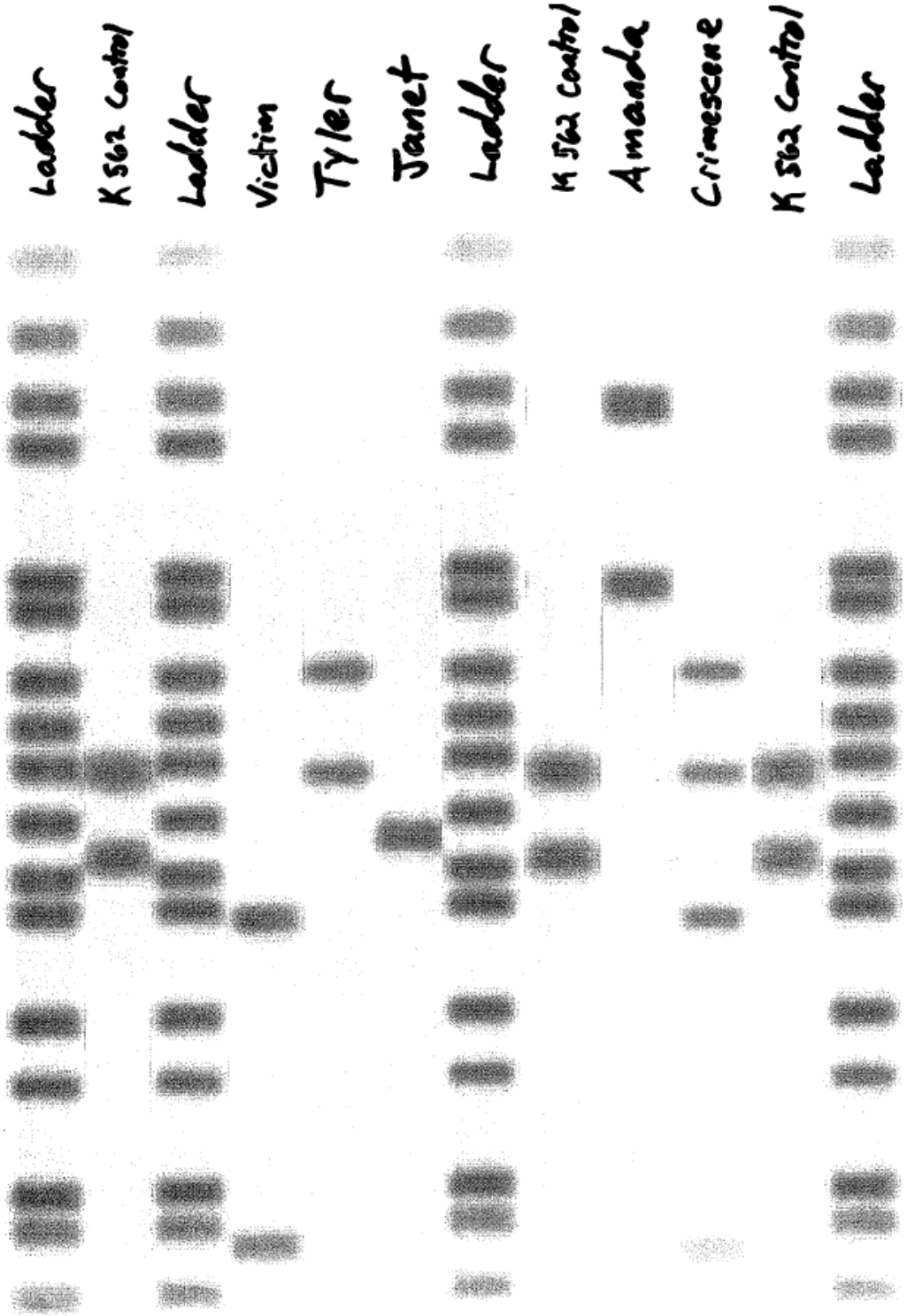
A piece of paper with an ink spot on it was found at the crime scene and pens were found both Steve and Amanda. Samples of the ink are on prepared paper chromatograms at your station.

a. Develop the chromatogram for at least 30 minutes.
b. Label the solvent front.
c. Staple it to this page.
d. Determine the R_f of each spot. Show calculations.
e. Draw appropriate conclusions in the Analysis section.

Part 4 Crime Scene Physical Evidence (15 pts)

A. DNA Analysis

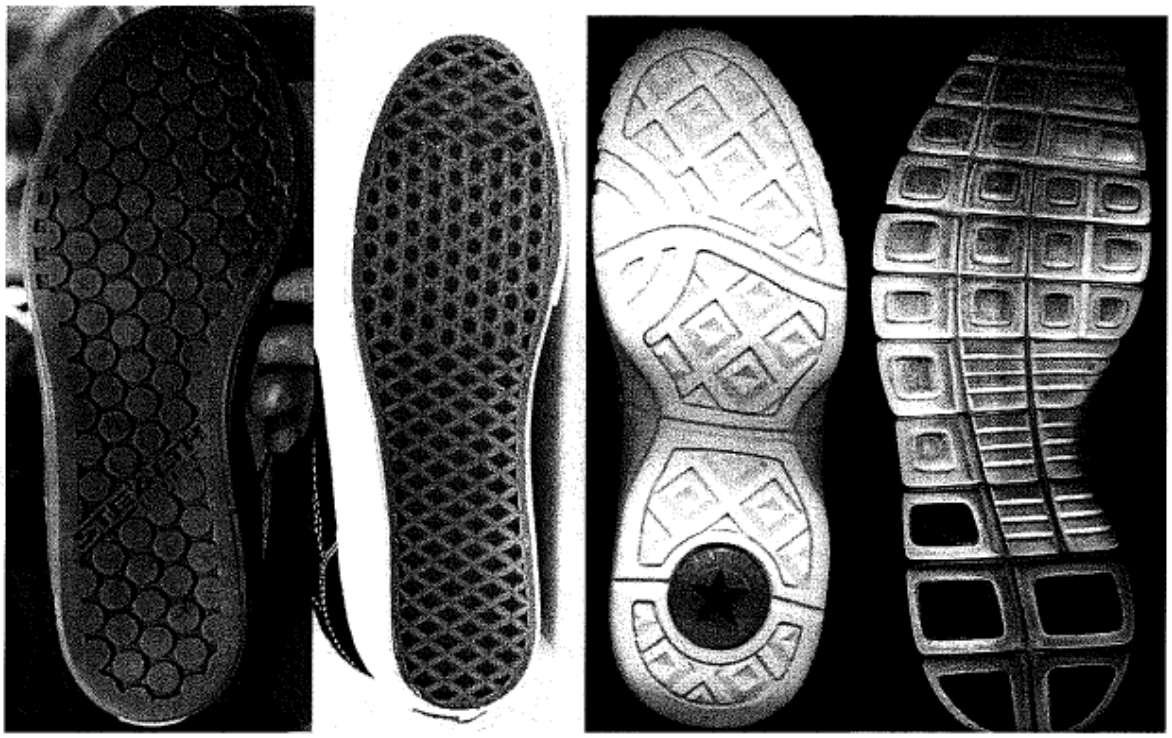
DNA evidence was collected from the crime scene as well as from the victim. DNA evidence was also collected from Tyler, Janet, and Amanda. Analyze the evidence below



B. Shoeprint Analysis

A set of shoeprints was found at the scene and photographed. The soles of the shoes of four suspects were also photographed for comparison. IF one of the shoes matches, circle the name of the appropriate suspect above the photograph. If none of the shoes match, write "No Match" on the page.

Steve Amanda Janet Murphy



Part 5 Analysis of the Crime (30 pts)

For each of the suspects below, discuss all evidence that pertains to them and circle either "Release" or "Hold For Questioning"

Steve Release Hold for Questioning

Evidence:

Amanda Release Hold for Questioning

Evidence:

Tyler Release Hold for Questioning

Evidence:

Janet Release Hold for Questioning

Evidence:

Murphy Release Hold for Questioning

Evidence:

Supplemental Questions: (30 pts)

1. Write a balanced chemical equation for solid sodium carbonate reacting with aqueous hydrochloric acid. Include all state symbols.

2. Which of the fifteen possible powders in the event is deliquescent?

3. What chemical causes the reddish-orange color in a positive Benedict's test?

4. Draw the repeating unit of polypropylene.

5. Circle the addition polymers.

PP PMMA HDPE PETE PVC

6. Name the plastic and fiber (listed In the Forensics rules) that have the same internal chemical structure.

7. In paper chromatography, what is the stationary phase? (Be specific)

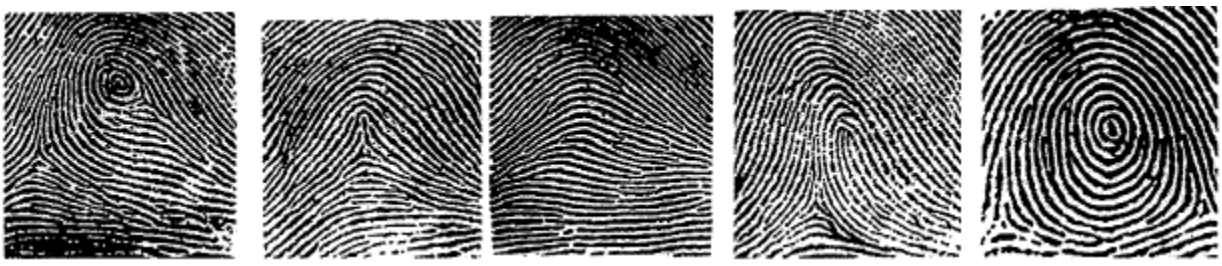
8. With respect to chromatography, define partitioning.

9. Which particle would show the greatest deflection in a mass spectrometer? (Circle the correct answer)

CH_3^+ $C_2H_5^+$ OH^+ $C_2H_5^{2+}$ CH_3^{2+}

10. What does VNTR stand for?

11. Place a check mark above the fingerprint below which is a loop.



12. If a light beam passes from air (refractive index 1.00) to plexiglass (refractive index 1.32) and the incident angle (Θ_1) is 65.0°, what will be the refraction angle (Θ_2) of the light beam?

13. If a body is found and only blowfly eggs (no larva or pupa) are present, what is the maximum amount of time that has passed since the victim was killed? (Circle the best answer and assume that adult blowflies found the body immediately.)

2 hrs 24 hrs 3 days 10 days 14 days

14. lmmunoglobulin is another name for _____

15. In what portion of a hair are ovoid bodies found?

School Name: _____ Team Number: _____

Competitors: _____

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Forensics: Answer Sheet

Part 1 Qualitative Analysis (20 pts)

Samples 1-5 are all powders. Determine their identity and give either the formula or name here.

Sample 1 **$CaSO_4$**

Sample 2 **$NaCH_3COO$**

Sample 3 **$MgSO_4$**

Sample 4 **KCl**

Sample 5 **$NaHCO_3$**

Part 2 Polymers, Fibers, Hairs (18 pts)

Samples 6-11 are either polymers, fibers, or hairs. Determine their identity and report it here.

Sample 6 **PP**

Sample 7 **PS**

Sample 8 **silk**

Sample 9 **dog hair**

Sample 10 **human hair**

Sample 11 **cotton**

Part 3 Chromatography (15 pts)

A piece of paper with an ink spot on it was found at the crime scene and pens were found both Steve and Amanda. Samples of the ink are on prepared paper chromatograms at your station.

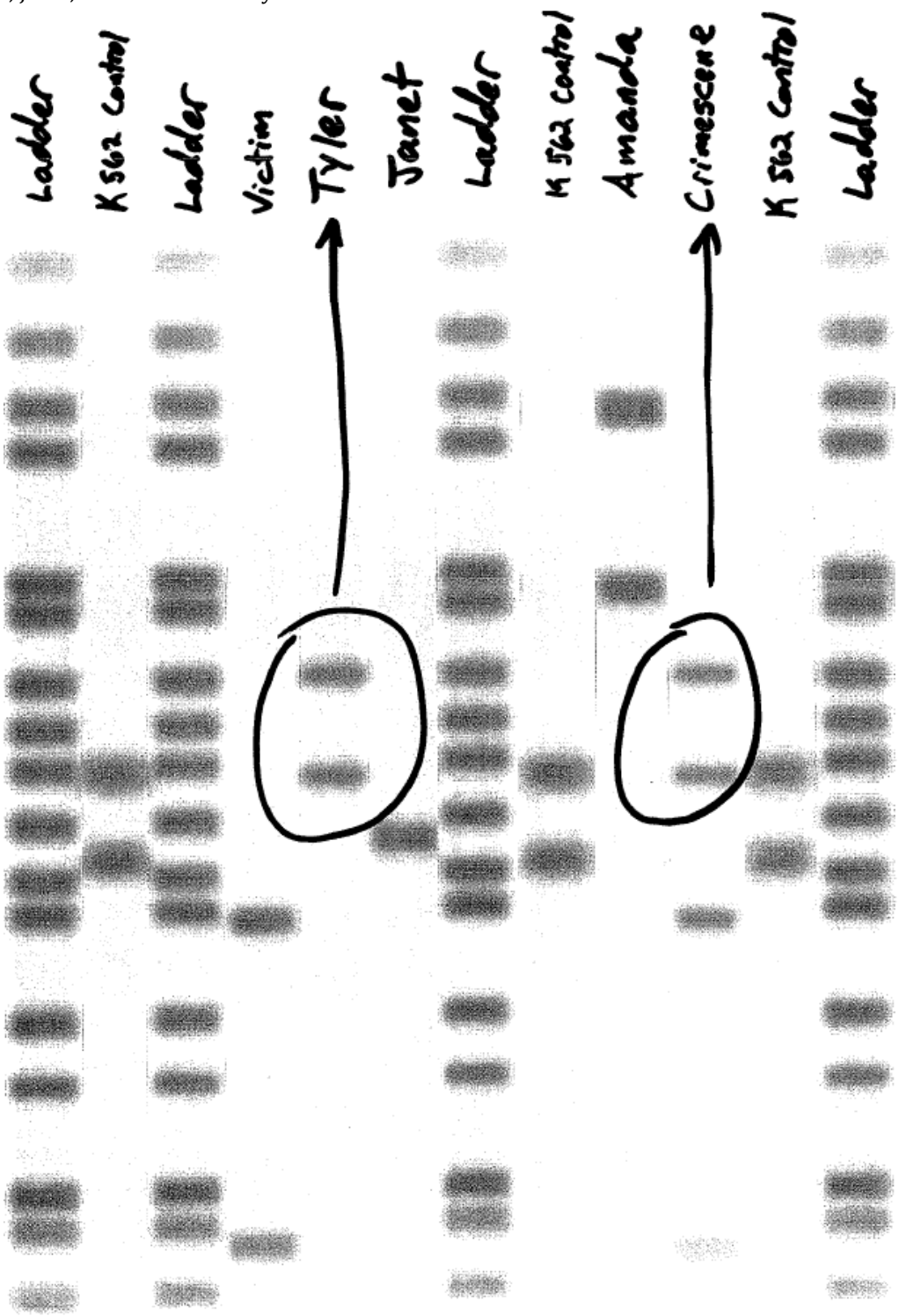
a. Develop the chromatogram for at least 30 minutes.
b. Label the solvent front.
c. Staple it to this page.
d. Determine the R_f of each spot. Show calculations.
e. Draw appropriate conclusions in the Analysis section.

The ink from Amanda matches that which was found at the crime scene.

Part 4 Crime Scene Physical Evidence (15 pts)

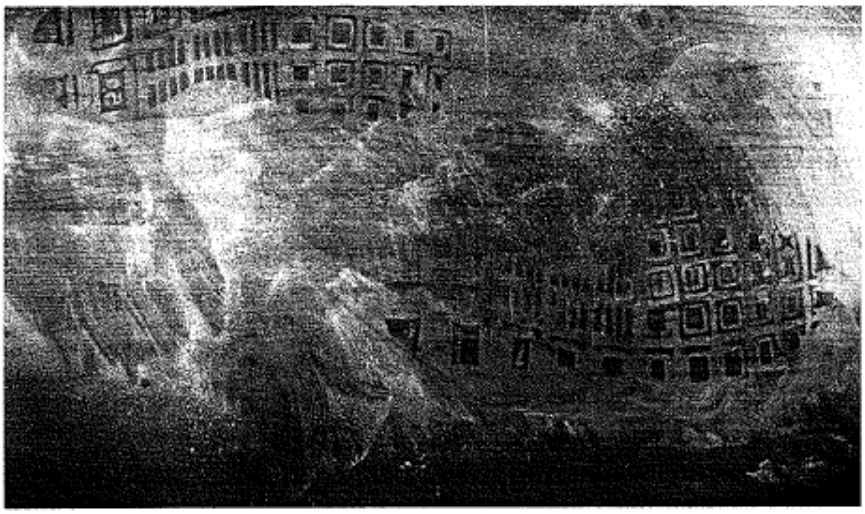
A. DNA Analysis

DNA evidence was collected from the crime scene as well as from the victim. DNA evidence was also collected from Tyler, Janet, and Amanda. Analyze the evidence below

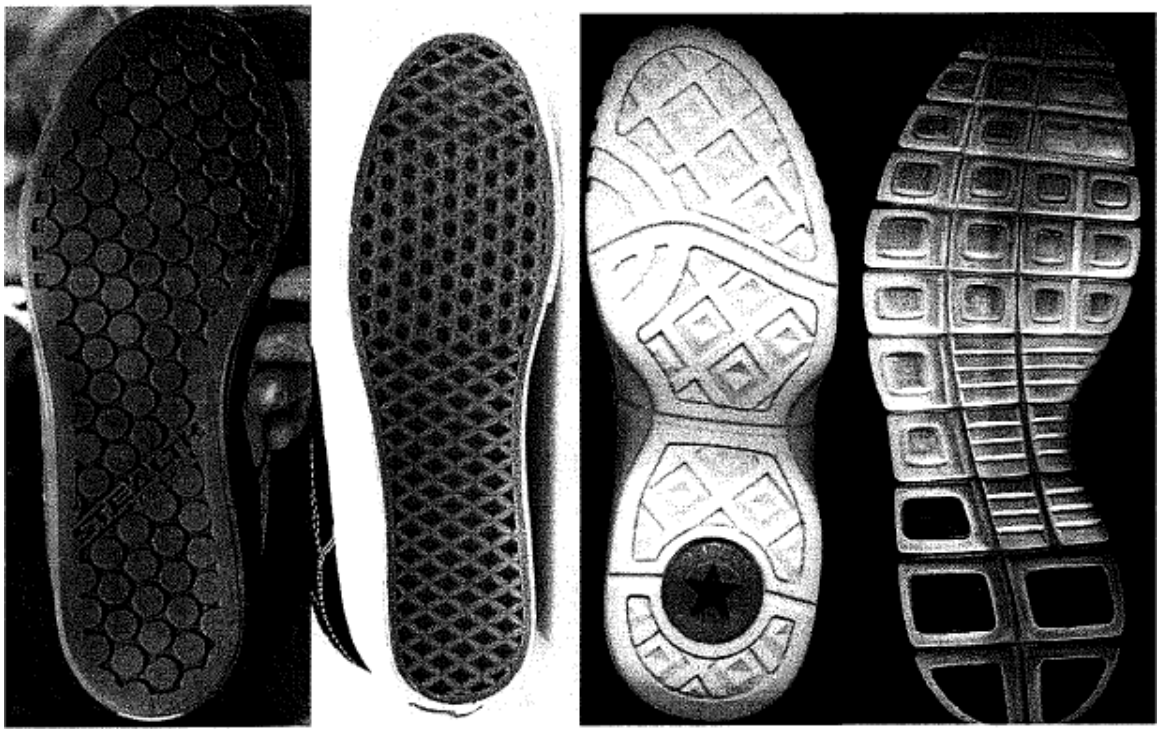


B. Shoeprint Analysis

A set of shoeprints was found at the scene and photographed. The soles of the shoes of four suspects were also photographed for comparison. IF one of the shoes matches, circle the name of the appropriate suspect above the photograph. If none of the shoes match, write "No Match" on the page.



Steve Amanda Janet Murphy



Part 5 Analysis of the Crime (30 pts)

For each of the suspects below, discuss all evidence that pertains to them and circle either "Release" or "Hold For Questioning"

Steve **Release** Hold for Questioning

Evidence: Boric acid not found, PC not found

Linen not found, bat hair not found

Ink doesn't match, shoe print doesn't match

Amanda Release **Hold for Questioning**

Evidence: Sodium bicarbonate found ✓, silk found ✓

Ink matches that at the crime scene ✓

PVC not found, DNA doesn't match, shoe print doesn't match

Tyler Release **Hold for Questioning**

Evidence: Magnesium sulfate found ✓, PP found ✓

Dog hair matches ✓, DNA matches ✓

Nylon not found at the crime scene

Janet **Release** Hold for Questioning

Evidence: Ammonium chloride not found, cat hair not found

Polyester not found, HDPE not found

DNA doesn't match, shoe print doesn't match

Murphy Release **Hold for Questioning**

Evidence: Shoe print matches ✓

Sodium carbonate not found, PMMA not found

Wool not found

Supplemental Questions: (30 pts)

1. Write a balanced chemical equation for solid sodium carbonate reacting with aqueous hydrochloric acid. Include all state symbols.

Na_2CO_3 (s) + 2HCl (aq) --> H_2O (l) + CO_2 (g) + 2NaCl (aq)

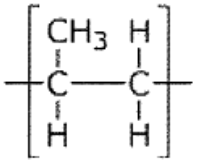
2. Which of the fifteen possible powders in the event is deliquescent?

Lithium chloride

3. What chemical causes the reddish-orange color in a positive Benedict's test?

Cu_2O or copper(I) oxide

4. Draw the repeating unit of polypropylene.



5. Circle the addition polymers.

PP **PMMA** **HDPE** PETE **PVC**

6. Name the plastic and fiber (listed In the Forensics rules) that have the same internal chemical structure.

PETE and Polyester

7. In paper chromatography, what is the stationary phase? (Be specific)

Water (in the paper fibers)

8. With respect to chromatography, define partitioning.

The distribution of a solute between two immiscible solvents.

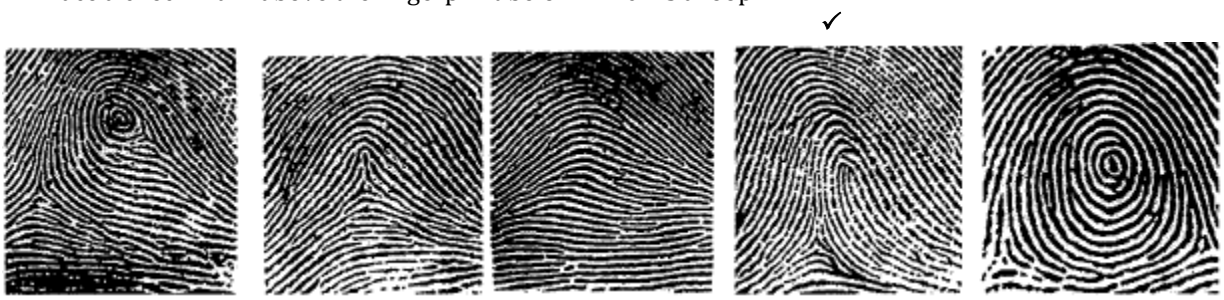
9. Which particle would show the greatest deflection in a mass spectrometer? (Circle the correct answer)

CH_3^+ $C_2H_5^+$ OH^+ $C_2H_5^{2+}$ **CH_3^{2+}**

10. What does VNTR stand for?

Variable Number Tandem Repeats

11. Place a check mark above the fingerprint below which is a loop.



12. If a light beam passes from air (refractive index 1.00) to plexiglass (refractive index 1.32) and the incident angle (Θ_1) is 65.0°, what will be the refraction angle (Θ_2) of the light beam?

43.2°

13. If a body is found and only blowfly eggs (no larva or pupa) are present, what is the maximum amount of time that has passed since the victim was killed? (Circle the best answer and assume that adult blowflies found the body immediately.)

2 hrs **24 hrs** 3 days 10 days 14 days

14. lmmunoglobulin is another name for _____antibody_____

15. In what portion of a hair are ovoid bodies found?

Cortex