NYS Science Olympiad
Regionals 2011
C Division

Forensics

Do Not Open This Booklet Until Instructed To Do So

Introduction to Case 11-0108G

It was neither a dark nor a stormy night. In fact, the gentle 35^{o}C breeze entered softly through the open windows of the science labs.

The door to the Chemistry Lab was uncharacteristically open (Mr Donald Davis was such a stickler for security) and a sliver of light sliced into the hall. A figure rushed from the Chemistry Lab and sprinted away down the hall. Inside the Lab, Mr Davis lay on the floor, not moving, with a bucket next to his head. The floor around Mr Davis was strewn with small white pellets. Robbie Roley (this year's Lab Assistant) huddled in the dark far corner of the Lab in shock.

It took the police eight minutes to respond to the 911 call; Campus Security arrived three minutes later. The area was taped off and forensic Crime Scene Technicians collected evidence including:

- several of the white pellets
- a small piece of white fabric caught on a nail sticking out of the door jamb
- a partial fingerprint from the bucket
- white powder from the floor near Mr Davis
- several blonde hairs from Mr Davis' lab coat
- note from the pocket of Mr Davis' lab coat

A scaled crime scene sketch was made showing the location of the body, relevant objects, and blood spatter.

Police Report

Reporting Officer: Sgt. William Bender; Badge # 197

Responded to anonymous 911 call from Rolling Hills High. Upon arrival at scene, I observed a large quantity of small white pellets in the hall leading back to one of the science labs. At the door of the lab I observed the male victim, Mr Davis, laying on his left side approximately two feet inside the door. Ms Buckland was standing in the hall outside the Lab and Ms Roley was sitting on the floor in the furthest corner of the lab. A bucket with what appeared to be a streak of blood was next to the victim's head. Spatter was on the floor further into the lab. A small patch of white cloth was stuck on the door jamb. Several streaks of white powder were evident on the floor by the victim's feet and on lab tables. Blonde hairs were visible on the victim's black turtleneck.

I secured the scene and waited for the CSTs to arrive. I kept the crowd of students back from the scene so the CSTs could collect evidence and samples.

Witness Statement

Name: Ms Bonnie Buckland; Biology Teacher, Rolling Hills High
Statistics Vitae: female / 32 / 5' 7" / 132 lbs / caucasian / blue / blond

I was exhausted from doing mitosis all day with my classes so I was relaxing with a cup of chai and watching the fruit flies. I heard a clatter-like noise from down the hall. Right after the noise a lot of little white balls rolled by my door. I went out into the hall to look and was almost knocked down when a guy ran out of the Chemistry Lab and down the hall. When I got to the Chemistry Lab I saw Don on the floor and Robbie in the back corner. Don wasn't moving but was breathing okay. There was some blood on the floor. I called 911.

Evidence collected from witness:

- fingerprints
- ripped lab coat
- white powder from shoes
- black pen from desk
- scalp hair samples

Witness Statement

Name: Robbie Roley; Student (Senior) and Lab Assistant, Rolling Hills High
Statistics Vitae: female / 17 / 5' 2" / 116 lbs / african-american / brown / blonde (bleached)

I was in the Chemistry Prep Room at the back of the Lab and heard Mr Davis arguing with someone. Mr Davis never raises his voice but this was different. He sounded really mad and was saying stuff like, "You'll be kicked out for this." I went into the Lab to see what was going on just in time to see Mr Davis get hit with the pail. It looked like a snow explosion when it hit Mr Davis. I wanted to help him but I was so scared I hid in the corner and couldn't move. I didn't get a good look at who hit Mr Davis because his back was to me but it had to be either Brett Banks or Billy Brown. They're the only students who wear lab coats around all the time.

Evidence collected from witness:

- fingerprints
- black pen from locker
- white powder from shoes

Summary of Suspect Interview

Name: Brett Banks; Student (junior) at Rolling Hills High
Statistics Vitae: male / 16 / 5' 9" / 207 lbs / caucasian / blue / brown

Suspect has Mr Davis for Chemistry and is currently failing the course for not turning in the required lab reports and has therefore been benched by the football coach. Suspect claims to have seen Mr Davis earlier in the day for extra help but was in the library studying at the time of the attack. When asked about his torn lab coat, suspect says it was torn several weeks earlier during a food fight in the cafeteria.

Evidence collected from suspect:

- fingerprints
- torn lab coat
- white powder from pocket of lab coat
- scalp hair samples
- black pen from pocket of lab coat

Summary of Suspect Interview

Name: Billy Brown; Student (senior) at Rolling Hills High
Statistics Vitae: male / 18 / 5' 8" / 175 lbs / caucasian / hazel / brown

Suspect has Mr Davis for Chemistry; is tutored by Brett Banks and is currently passing (barely). Suspect owes a lot of lab reports. Suspect says he was with someone but will not give her name. When asked about his lab coat, suspect claims the coat was “lost a couple of days ago.”

Evidence collected from suspect:

- fingerprints
- black pen from backpack
- white powder from sneakers

Evidence - Exhibit List

A. hair from Mr Davis' lab coat
B. hair sample from Ms Buckland
C. hair sample from Ms Roley

D. white pellet (ball) from hall

E. powder from floor near Mr Davis
F. powder from Ms Buckland's shoes
G. powder from Ms Roley's shoes
H. powder from Mr Banks' lab coat pocket
I. powder from Mr Brown's sneakers

J. fiber from swatch found on door jamb
K. fiber from Ms Buckland's lab coat
L. fiber from Mr Banks' lab coat

M. chromatography strip prepared with ink extracted from the note from Mr Davis' pocket
N. chromatography strip prepared with ink extracted from Ms Buckland's pen
O. chromatography strip prepared with ink extracted from Ms Roley's pen
P. chromatography strip prepared with ink extracted from Mr Banks' pen
Q. chromatography strip prepared with ink extracted from Mr Brown's pen

R. partial fingerprint from bucket's bail
S. fingerprint card; Ms Buckland
T. fingerprint card; Ms Roley
U. fingerprint card; Mr Banks
V. fingerprint card; Mr Brown

W. scale photo of spatter from lab floor

Part 1 - Qualitative Analysis

1. Identify Exhibits E through I. (2 pts @)

2. What is the common "kitchen" name for sodium hydrogen carbonate ($NaHCO_3$)? (1 pt)

3. $NaHCO_3$ can be used to neutralize HCl. The reaction yields $salt_{(aq)}$, a liquid byproduct and a gaseous byproduct. Write the balanced equation for this reaction. (2 pts)

4. Name the liquid byproduct. (½ pt)

5. Name the gaseous byproduct. (½ pt)

6. How many grams of $NaHCO_3$ would be required to completely react with 10.0g of HCl? (2 pts)

7. Lithium chloride can be produced in the lab by combining lithium carbonate and hydrochloric acid. Write the balanced equation for the production of lithium chloride. (2 pts)

8. Name and write the chemical formulas of the compounds (excluding water) that most often make up Benedict's reagent. (2 pts)

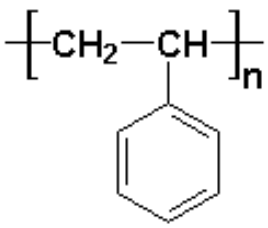
Part 2A - Polymers

1. The final report from the "Forensic Identification - Polymer Division" is attached (see Appendix 1). From the information in this report, identify Exhibit D. (2 pts)

2. Which recycling code is found on a recyclable plastic soda bottle? (1 pt)

3. From which polymer would the soda bottle referenced in #2 have been made? (1 pt)

4. What polymer is represented by the structural formula at right? (1 pt)

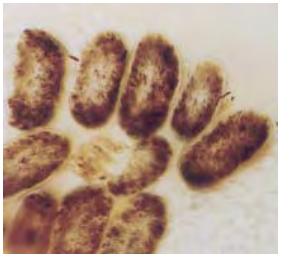


Part 2B - Hair

1. Identify Exhibit A. (2 pts)

2. What specific characteristic allows a forensic technician to differentiate a hair plucked from a live person from a hair plucked from a dead person? (1 pt)

3. A microscopic view of a hair sample (cross section) is provided at right. This hair most likely came from what race classification? (1 pt)

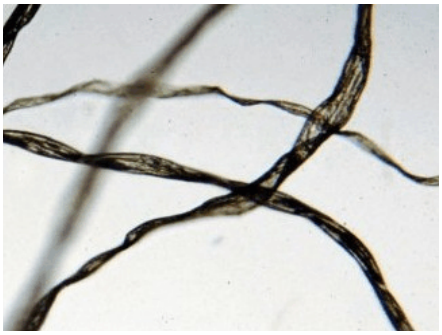


4. A microscopic view of a hair sample is provided at right. This hair most likely came from what part of the body? (1 pt)

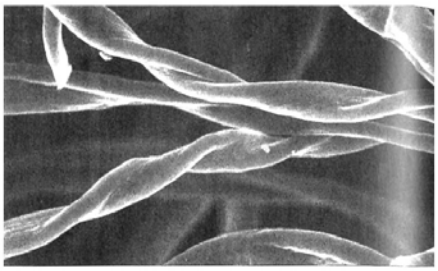
Part 2C - Fibers

1. Identify Exhibits J through L. (2 pts @)

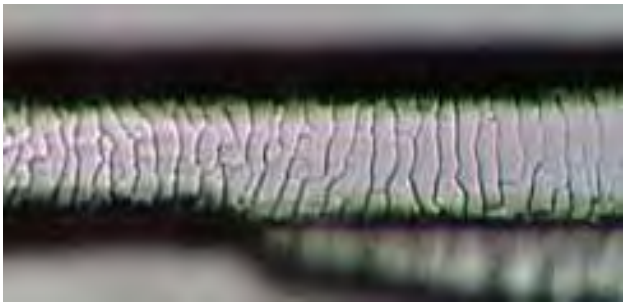
2. A microscopic view of a fiber is provided at right. Name this fiber. (1 pt)



3. A microscopic view of a fiber is provided at right. Name this fiber. (1 pt)



4. What scale pattern is shown in the microscopic view at right? (1 pt)



5. Why is hair usually considered class evidence? (½ pt)

6. What hair component must be included for hair to become individual evidence? (½ pt)

Part 3 - Chromatography / Spectroscopy

1. The ink for Exhibit M was extracted from the note (shown at right) which was found in Mr Davis' lab coat pocket. Which chromatography stript(s) match(es) Exhibit M? (4 pts)

I have to see you tonight

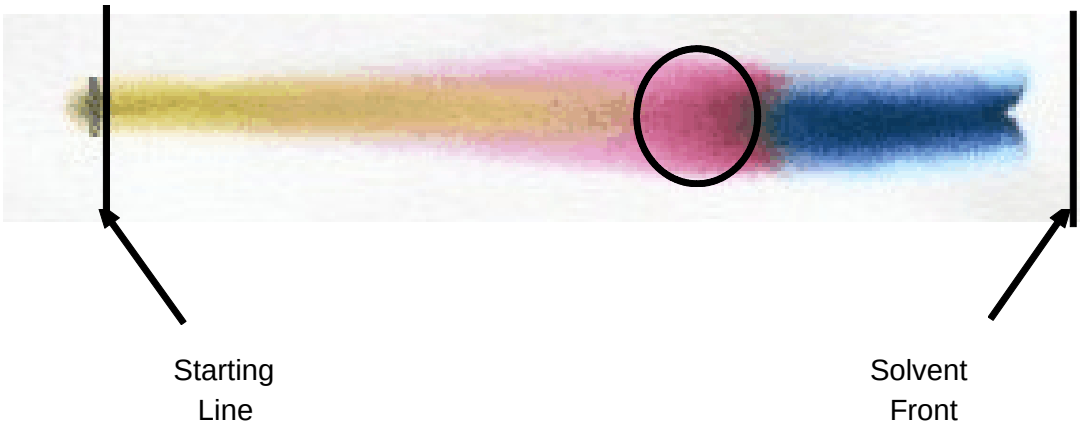
Your lab

6:00

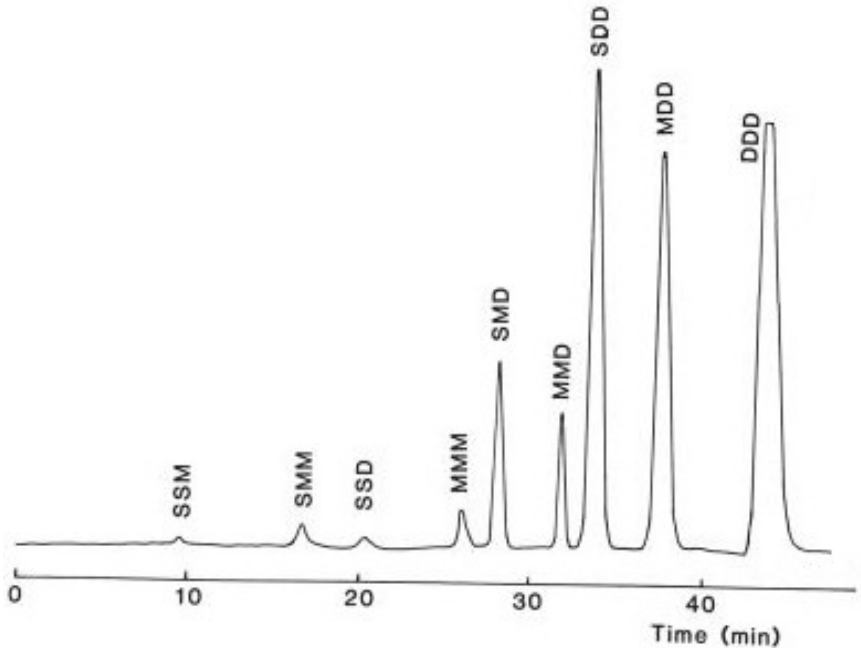
2. Which of the following substances could be considered the stationary phase in a chromatography experiment? (2 pt)
   a. alcohol
   b. beaker
   c. paper strip
   d. pen ink
   e. water

3. Which of the following has the greatest effect on how far a substance will travel on a chromatogram? (2 pt)
   a. color of the substance
   b. formula mass of the substance
   c. odor of the substance
   d. reactivity of the substance

4. Consider the chromatogram shown below. What is the R_f of the red (circled) spot? (3 pt)



Questions 5 and 6 refer to the gas chromatogram shown below.



5. Which substance has the highest affinity for the column material? (2 pts)

6. Which substance is present in the greatest amount? (2 pts)

Part 4A - Fingerprint Analysis

1. Exhibit R is shown at right. To whom does it belong? (2 pt)

2. Classify S:6.Left Thumb. (1 pt)

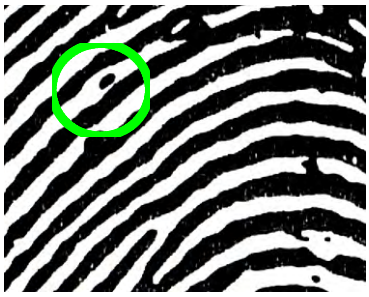
3. Classify T:6.Left Thumb. (1 pt)

4. Classify U:2.R. Index. (1 pt)

5. What characteristic is circled on the fingerprint at right? (1 pt)

6. What characteristic is circled on the fingerprint at right? (1 pt)

7. What characteristic is circled on the fingerprint at right? (1 pt)



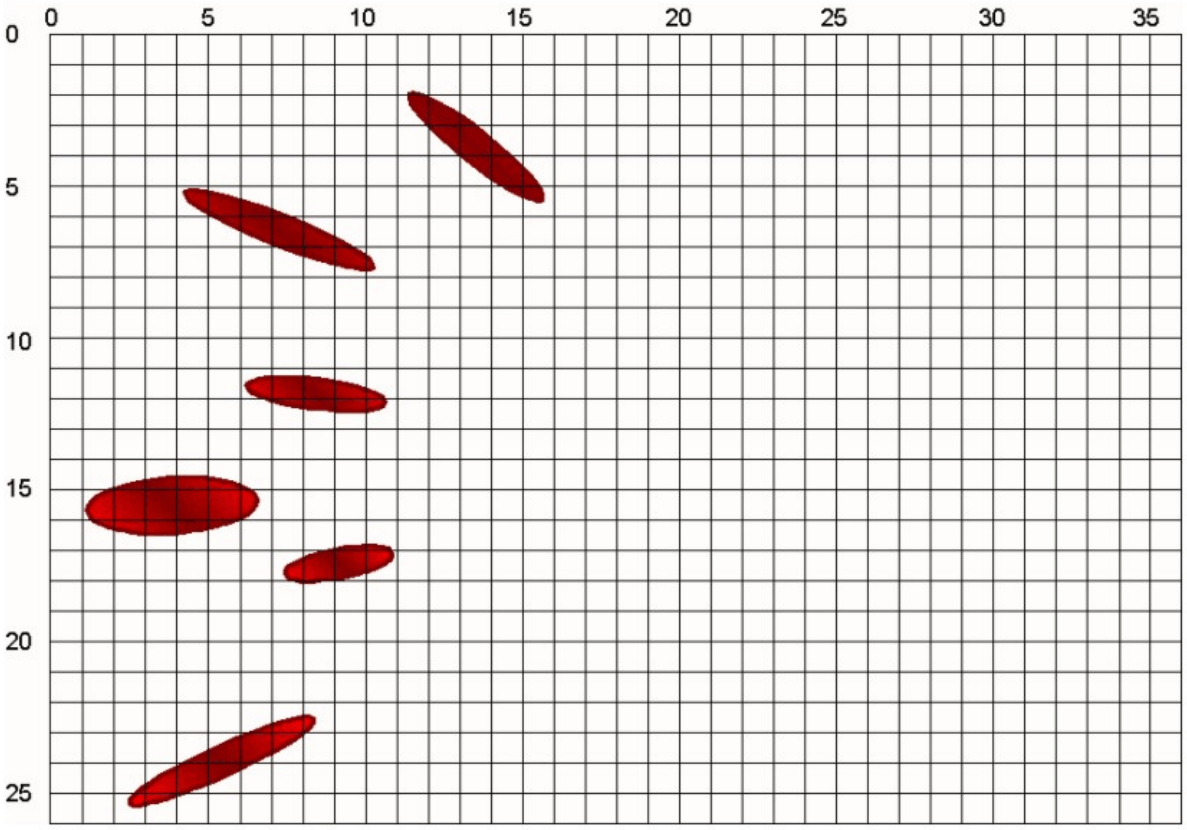
8. Ninhydrin is sometimes used to develop latent prints. What component of the latent print does ninhydrin react with? (1 pts)

9. Another method of developing latent prints is iodine fuming. During this development process, the solid iodine is directly changed into gaseous iodine. What is this conversion process called? (1 pt)

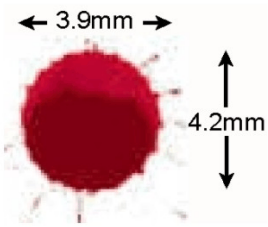
10. What is the full Henry Classification of FP5? (1 pt)

Part 4B - Spatter

1. Exhibit S1 is shown below on a reference grid. From what coordinate (to the nearest $^1/_2$ unit) did the spatter originate? (1 pt)
   Give your answer in the form (horizontal reference, vertical reference).



2. At what angle (to the nearest tenth degree) did the spatter shown at right hit the surface? (2 pts)



3. Was the spatter shown below traveling to the left or right? (1 pt)

Part 5 - Analysis of the Crime

1. Who is the prime suspect? Support your answer; be specific and refer to specific evidence, tests, and/or information gathered. (10 pts)

2. Who is the second most likely suspect? Support your answer; be specific and refer to specific evidence, tests, and/or information gathered. (10 pts)

3. Cite one cluster of evidence (hair, powders, fibers, inks, or fingerprints) which provided no incriminating evidence. Support your answer; be specific. (5 pts)

4. What other evidence should have been gathered and why? (3 pts)

5. Hypothesize on motive. (2 pts)

Appendix 1

County Division of Criminalistics

Forensic Identification - Polymer Division

Case Number 11-0108G SR

Exhibit Number D

Results: Standard Polymer Float Tests

Solution	Floats	Sinks
Alcohol, Isopropyl, 46%	✓	
Alcohol, Isopropyl, 70%		✓
Alcohol, Isopropyl, 91%		✓
Oil, Vegetable		✓
Saline, 10%	✓	
Saline, 20%	✓	
Saline, Sat	✓	
Sucrose, 10%		✓
Sucrose, 20%	✓	
Sucrose, Sat	✓	
Vinegar, White		✓
Vinegar, Cider	✓	
Water, distilled	✓	

Technician Sydney J. Russo

Date 06 Jan 2011

Exhibit FP2

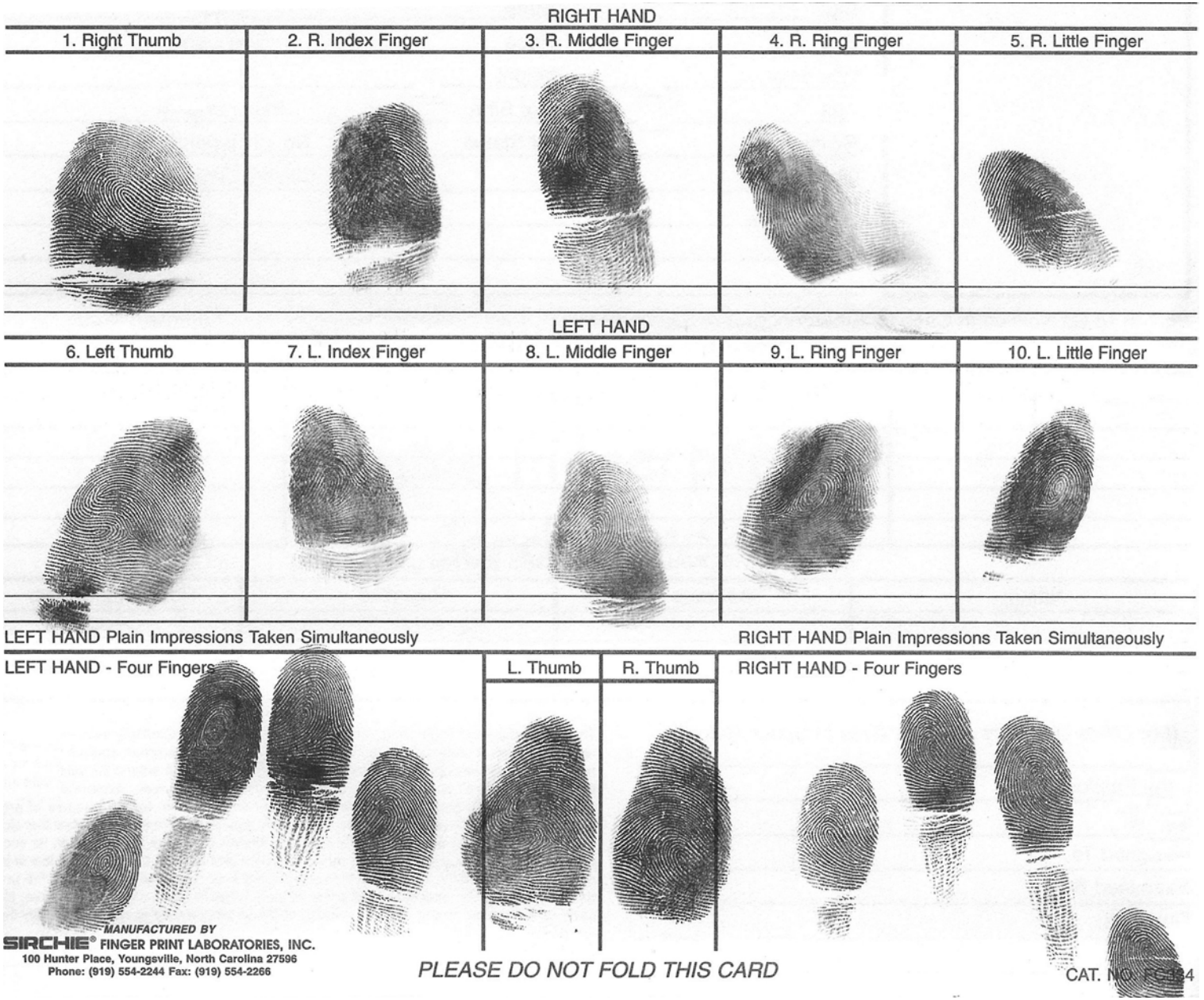

RIGHT HAND
1. Right Thumb
2. R. Index Finger
3. R. Middle Finger
4. R. Ring Finger
5. R. Little Finger
LEFT HAND
6. Left Thumb
7. L. Index Finger
8. L. Middle Finger
9. L. Ring Finger
10. L. Little Finger
LEFT HAND Plain Impressions Taken Simultaneously
RIGHT HAND Plain Impressions Taken Simultaneously
LEFT HAND - Four Fingers
L. Thumb
R. Thumb
RIGHT HAND - Four Fingers
MANUFACTURED BY
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Exhibit FP3


37. Signature
1. Right Thumb
2. Right Index
3. Right Middle
4. Right Ring
5. Right Little
6. Left Thumb
7. Left Index
8. Left Middle
9. Left Ring
10. Left Little
Left Four Fingers Taken Simultaneously
Left Thumb
Right Thumb
Right Four Fingers Taken Simultaneously
"PLEASE TYPE INFORMATION"

Exhibit FP4

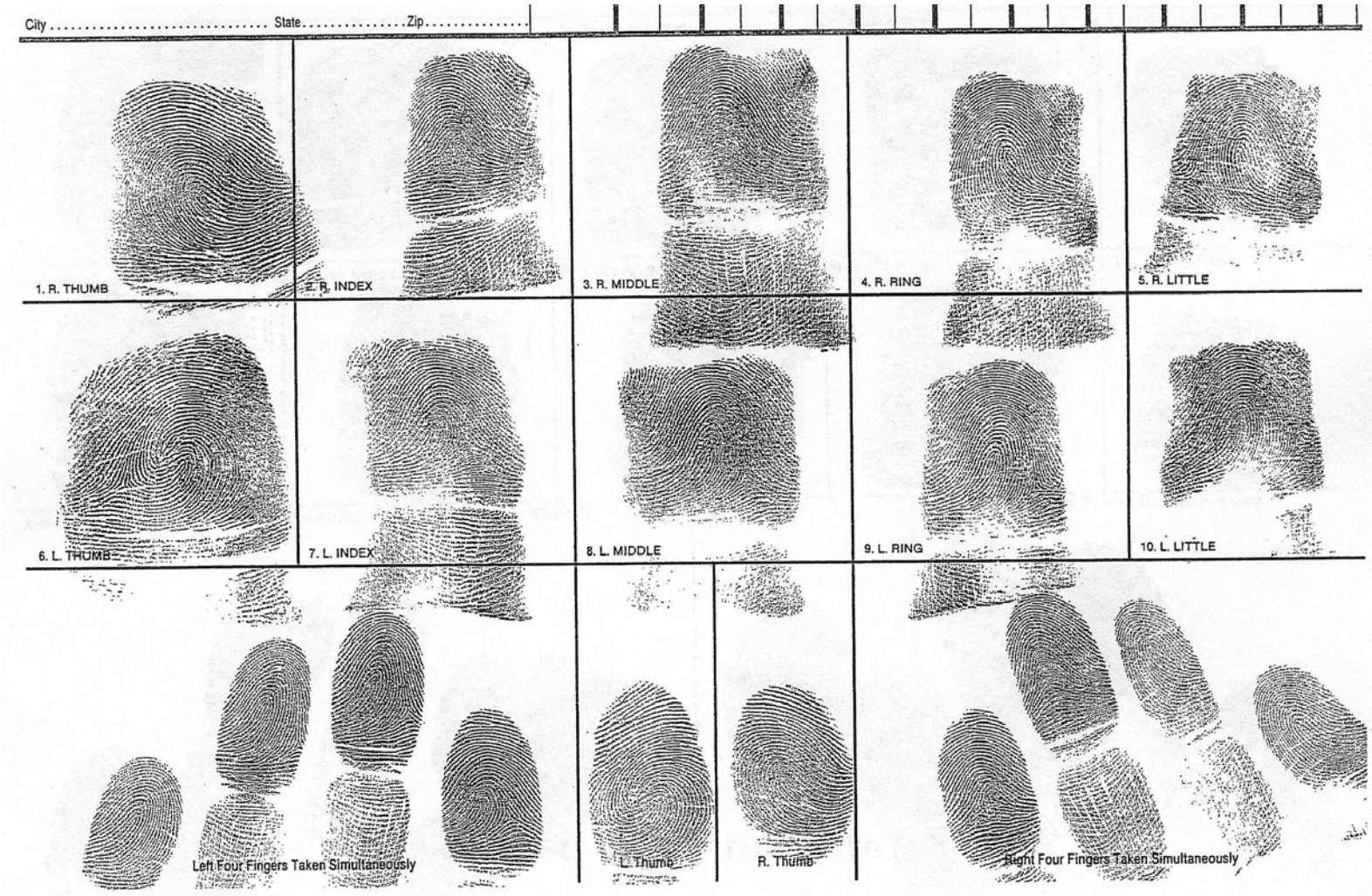
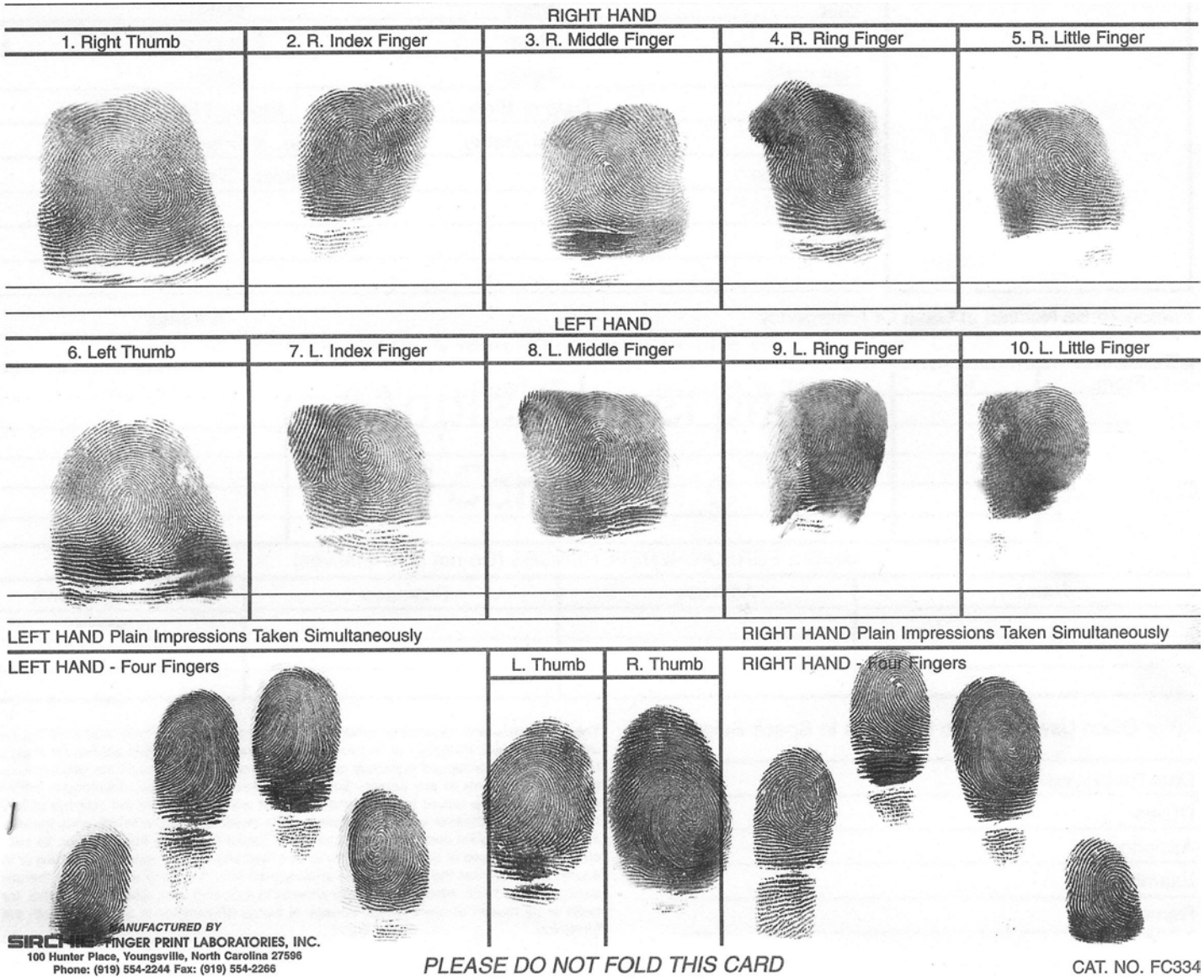

City ..... State ..... Zip .....
1. R. THUMB
2. R. INDEX
3. R. MIDDLE
4. R. RING
5. R. LITTLE
6. L. THUMB
7. L. INDEX
8. L. MIDDLE
9. L. RING
10. L. LITTLE
Left Four Fingers Taken Simultaneously
L. Thumb
R. Thumb
Right Four Fingers Taken Simultaneously

Exhibit FP5


RIGHT HAND
1. Right Thumb
2. R. Index Finger
3. R. Middle Finger
4. R. Ring Finger
5. R. Little Finger
LEFT HAND
6. Left Thumb
7. L. Index Finger
8. L. Middle Finger
9. L. Ring Finger
10. L. Little Finger
LEFT HAND Plain Impressions Taken Simultaneously
RIGHT HAND Plain Impressions Taken Simultaneously
LEFT HAND - Four Fingers
L. Thumb
R. Thumb
RIGHT HAND - Four Fingers
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