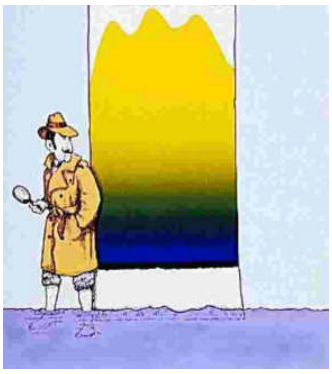
Science Olympiad
Nationals 2011
University of Wisconsin - Madison



Crime Busters

Do Not Open this Pac Until Directed To Do So

Place all answers on the Answer Sheets provided.
Point values are provided on the Answer Sheet.

Case#: 110521

Her model of the machine that would convert recyclable plastics back into oil had been almost done but now it was nothing more than pieces among the debris of the explosion. At least the explosion had blown the side wall of the garage out into the yard and not into the adjoining kitchen.

Neighbors had seen some kids speeding away from the house moments after the explosion on what were described as a "very different bicycle." After seeing pictures of a variety of radical new designs, the neighbors agreed the bikes had been the new *PoofBike* design. Neighborhood watch new these bikes; they were the trademark of a bunch of boys that called themselves *Η συμμορία αλυσίδα* (that's *The Chain Gang* in Latin).

The three boys were rounded up and questioned; Clothes and bikes were checked for physical evidence.

Summary of Suspect Interviews

Tad: 13; African American; 5' 4"; 106 lbs; brown / brown; right handed

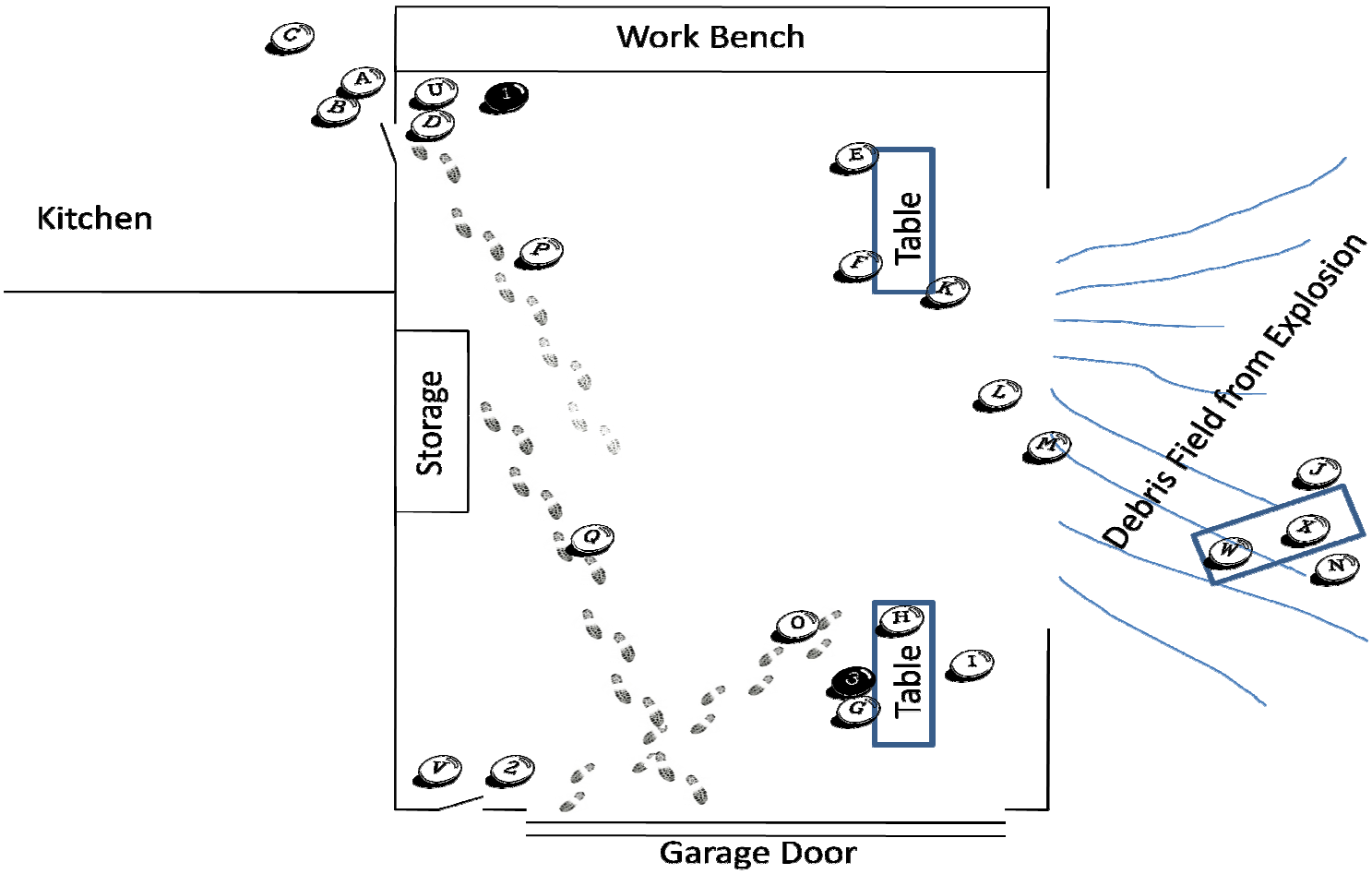
- Quiet; occasional outbursts
- Allergies: peanuts, cotton
- Hates the required polyester uniform
- Has a pet cat

Taj: 12; Meditaranian; 5' 1"; 101 lbs; blonde / blue; right handed

- Self-declared "leader of the gang"
- Allergies: cats
- Always wears his cotton camo coat
- Has a pet dog

Tim: 12; Caucasian; 5' 7"; 124 lbs; blonde / blue; right handed

- Allergies: none known
- Always seen in jeans and T-shirt
- Has pet fish



Evidence List

Note: Mixtures may only exist in evidence obtained from the suspects' clothes and tracks on floor.

Exhibit	Description	Exhibit	Description
A	Powder from A	O	Powder from Track
B	Powder from B	P	Powder from Track
C	Powder from C	Q	Powder from Track
D	Powder from D	R	Powder from Tad's clothes
E	Powder from E	S	Powder from Taj's clothes
F	Powder from F	T	Powder from Tim's clothes
G	Powder from G	U	Fiber from Door Jamb
H	Powder from H	V	Fiber from Door Jamb
I	Powder from I	W	Fiber from Damaged Table
J	Metal from J	X	Fiber from Damaged Table
K	Metal from K	1	Hair from Kitchen Door Jamb
L	Metal from L	2	Hair from Service Door Jamb
M	Metal from M	3	Hair from Work Table
N	Metal from N		

Part 1 – Powders

Samples of powders were collected from locations A through I and O through T. Perform the necessary tests to identify each of the samples. **Record your findings** on the answer sheet provided. Note: samples collected from the boy's clothes and tracks on the floor may (or may not) be mixtures.

Questions

1. Which of the "allowed powders for this event" would be most responsible for making a cake rise during baking?
2. According to the FDA, a person should be at least how old (in years) before using Alka-Seltzer?
3. Which of the "allowed powders for this event" is also known as sodium hydrogen carbonate?
4. Which of the "allowed powders for this event" would cause the greatest change in the pH of dH_2O when made into solution?
5. Which of the "allowed powders for this event" has the molecular formula $C_{12}H_{22}O_{11}$?

Part 2 – Metals

Samples of metals were collected from locations J through N. Perform the necessary tests to identify each of the samples. Record your findings on the answer sheet provided.

Questions

1. Five of the six "allowed metals for this event" should exist in small amounts in a well balanced diet. Which metal is not one of these five?
2. Which of the "allowed metals for this event" is commonly mixed with other metals to inhibit rusting?

Part 3 – Hair

Samples of hairs were collected from locations 1 through 3 and are provided as slides. Perform the necessary tests to identify each of the samples as human, cat, or dog. Record your findings on the answer sheet provided.

Questions

1. What is the single most obvious distinguishing characteristic for differentiating between cat and dog hair?
2. What is the medullary index threshold for human hair?
3. Is the threshold referenced in #2 a minimum or maximum?

Part 4 – Fibers

Samples of fibers were collected from locations U through X. Perform the necessary tests to identify each of the samples as animal, synthetic, or vegetable. Record your findings on the answer sheet provided.

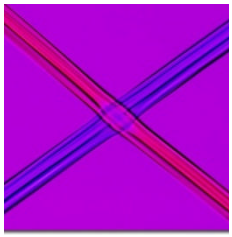
Questions

Several 400x micrographs of are provided below. Cite whether each is animal, synthetic, or vegetable.

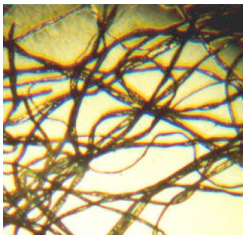
1 (polarized)

2

3



4 (polarized)



5

6. The fiber shown in Micrograph 3 is given a special name based on its shape. What is this name?
7. Synthetic fibers and regenerated fibers are both man-made. Explain the difference.

Part 5 – Chromatography/Spectroscopy

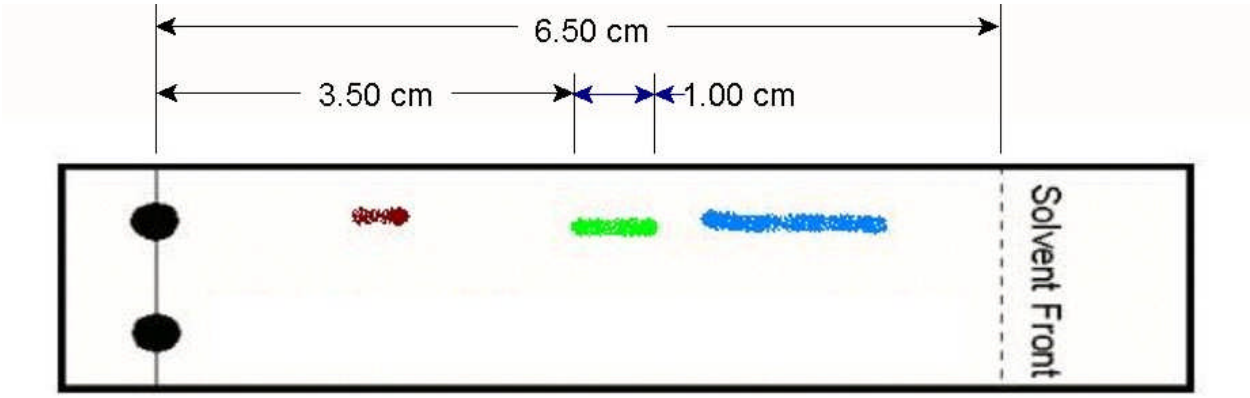
Markers taken from each of the boys are provided at your Lab Station. The finished chromatogram of the threatening note is shown below here.

Run a chromatogram of ink samples from each of the boy's pens. Attach the finished chromatograms to the Auxiliary Answer Card.

Part 5 (cont)

Use the diagram below to answer questions 1 and 2. Place your answers on the Answer Sheet provided.

1. Which pigment was most attracted to the mobile phase?
2. What is the R_f of pigment #2 (green)?
   a) 6.50 / 3.50 b) 6.50 / 4.00 c) 6.50 / 4.50 d) 6.50 / 1.0
   e) 3.50 / 6.50 f) 4.00 / 6.50 g) 4.50 / 6.50 h) 1.0 / 6.50
   i) 6.50 / 1.00 j) 1.00 / 3.50



3. Which suspect's pen most likely was used to write the threatening note?

Part 6 – Fingerprint Analysis

The sole fingerprint found on the service door's knob is shown at right. Fingerprint records of each suspect are provided in Appendix A.

1. To whom does it belong?

Using the NCIC classifications, identify the fingerprint type of each of the following fingers. Place your answer to each of the following questions on the Answer Sheet provided.

2. Tad's right index finger.
3. Taj's right index finger.
4. Tim's left thumb.

Part 7 – Soils

Soils were collected from various locations and from the suspects' bikes.

Exhibit	Where Collected
Soil 1	Tad's bike
Soil 2	Taj's bike
Soil 3	Tim's bike
Soil 4	Shoulder of the driveway
Soil 5	Rose garden

1. Which, if any, of the suspects most likely made the tracks on the shoulder of the driveway?
2. Which, if any, of the suspects most likely made the tracks through the rose garden?

Analysis of the Crime

1. Based upon the physical evidence analyzed and information collected, who most likely made the tracks originating at the kitchen door? Support your answer.

2. Based upon the physical evidence analyzed and information collected, who most likely made the tracks originating at the storage shelves? Support your answer.

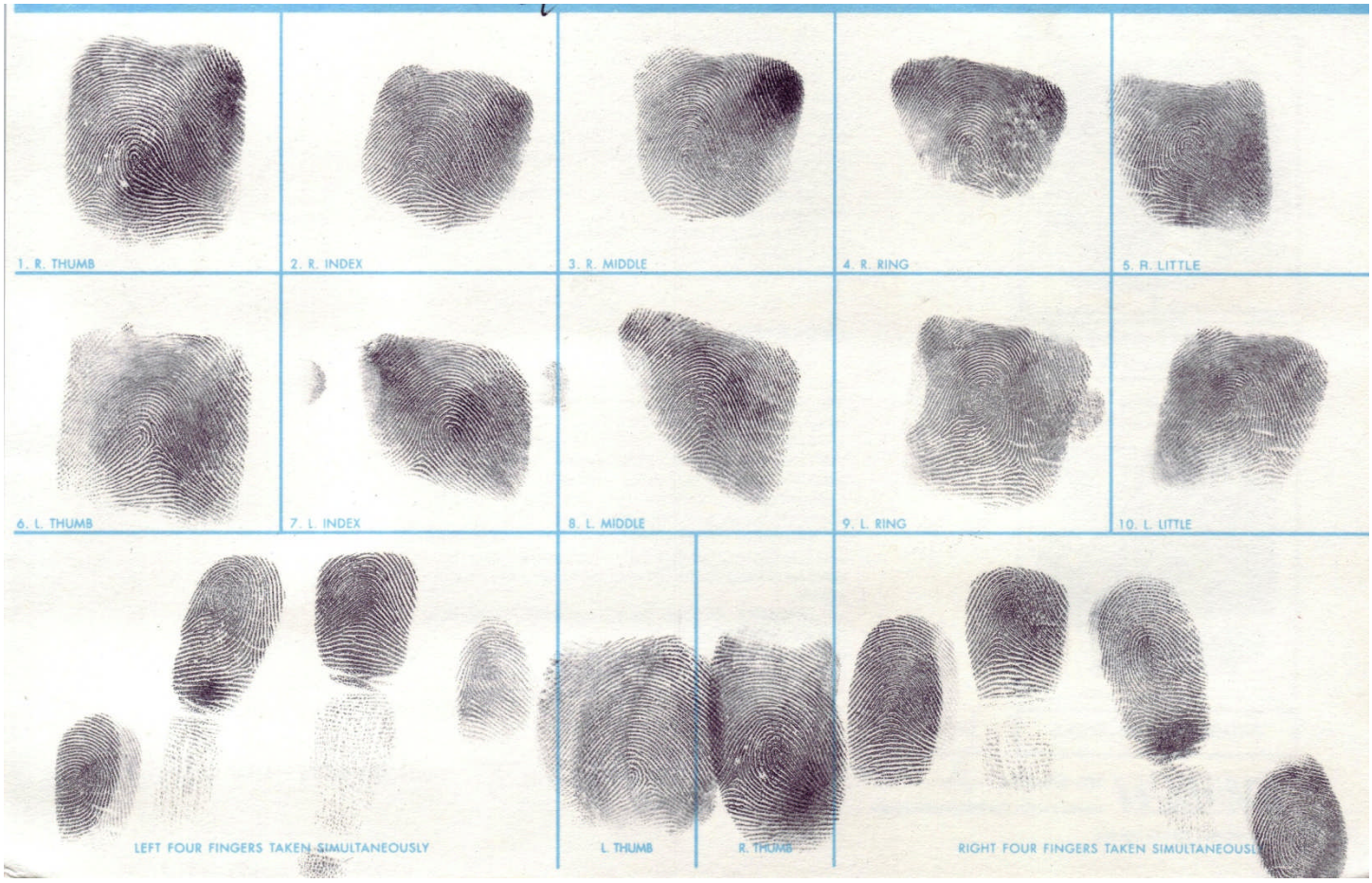
3. Based upon the physical evidence analyzed and information collected, who most likely made the tracks originating at the table? Support your answer.

4. Based upon the physical evidence analyzed, was each of the boys in the garage before the explosion, after the explosion, or not at all? Place checkmarks in the appropriate boxes on the answer sheet.

5. What evidence (not already collected) would help determine who wrote the threatening note?

6. Cite another piece of evidence that should/could have been collected. Explain how this evidence would be used to either prove a suspect's guilt or exculpate a suspect.

Appendix A – Fingerprint Cards – Tad



Appendix A – Fingerprint Cards – Taj

Appendix A – Fingerprint Cards – Tim