Forensics Key
Science Olympiad North Regional Tournament at the University of Florida
Forensics Test Division C

Names: KEY
School:
Team Number:

Qualitative Analysis:

1. Of the following chemicals, which is soluble? (2 points)
   a. Calcium sulfate
   b. Cornstarch
   c. Magnesium sulfate
   d. Calcium nitrate

2. Which of the following is/are basic? (circle) (4 points)
   sodium carbonate, calcium nitrate, sucrose, sodium acetate, calcium carbonate

3. Name the flame color: (6 points)
   a) NaHCO₃ yellow
   b) LiCl red
   c) KCl purplish

4. Why is testing for Benedict’s solution useful? (3 points)
   Distinguish sucrose and glucose

Polymers:
Identify the plastics from the given burn test results: (3 points per plastic)

Plastic 1: yellow flame w/ green spurts, plastic doesn’t drip, plastic chars, smells like hydrochloric acid, self-extinguishing
   PVC

Plastic 2: yellow flame, plastic drips, burns slowly, light smoke
   PETE (polyethylene terephthalate)

Identify the type of fiber (cotton, wool, silk, linen, nylon, spandex, or polyester) (3 points per fiber)

| Fiber 1: POLYESTER | Fiber 2: COTTON |
Identify the type of hair (human, bat, cow, squirrel, or horse hair) (3 points)

Chromatography:

\[
R_f = \frac{\text{distance of substance}}{\text{solvent front}} = \frac{2\text{cm}}{5\text{cm}} = \frac{2}{5}
\]

1. Calculate the \( R_f \) of Sample A (3 points)

2. Calculate the \( R_f \) of Sample B (3 points)

\[
R_f = \frac{3}{5}
\]

3. Calculate the \( R_f \) of Sample C (3 points)

\[
R_f = \frac{1}{5}
\]

Mass Spectroscopy:

1. Label the base peak on the chart. (1 point)
2. If the ion has a charge of one, what is the molecular weight of the molecule? (3 points)

\[
86\ \text{g/mol}
\]

3. What does TLC stand for? (2 points)

Thin layer chromatography
Glass:
Light travels from air into a shattered glass piece with an angle of incidence of 33°. The angle of refraction on the end of the glass piece is 20.997°.
1. Calculate the index of refraction (4 points)

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]
\[ n_2 = \frac{n_1 \sin \theta_1}{\sin \theta_2} \]
\[ \theta_1 = 33^\circ \]
\[ \theta_2 = 20.997^\circ \]
\[ n_2 = \frac{1 \times \sin 33^\circ}{\sin 20.997^\circ} \]
\[ n_2 = 1.5199834 \]

2. Identify the type of glass (3 points)
- Crown glass

Fingerprint:
Match the fingerprint types to the correct example (1 point each)

- Plain Arch
- Tented Arch
- Loop
- Plain Whorl

List four ways to develop fingerprints: (1 point each)
1. Dashing
2. Iodine fuming
3. Ninhydrin
4. Cyanoacrylate fuming
CASE

What Happened?
Located in Ville, Bon Magasin is the best grocery store in the county. Its variety of rare products have brought people from all over the world to the tiny town. The week after Siddarth Malhotra (a Bollywood Celebrity) came to the store, Bon Magasin was robbed! When the cops arrived on the crime scene they found the following evidence:

<table>
<thead>
<tr>
<th>Fingerprint</th>
<th>Plastic</th>
<th>Blood</th>
<th>Hair</th>
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</table>
| ![Image](image) Burn Test Results:  
- Blue, yellow tipped flame  
- Burns slowly  
- Plastic drips  
- Has sweet odor  
- Floats in water  
|          | Test Results | Anti-A | Anti-B | Anti-D | Control |
|          | ![Image](image) B+ blood | ![Image](image) Dog Hair |

As a forensic scientist, it is your job to help the police figure out who committed this crime. The task may seem daunting, but with your skills and intelligence anything is possible!

Suspects:

1. **Vole Sain Ur**  
A college student in the town nearby  
Vole Sain Ur is a third year rugby player (currently on probation) for Université de l'école. He has a record of being a perfect student in terms of academics, but his criminal record speaks differently about his character. In the last year, he has committed an assault and has shoplifted twice.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><img src="image" alt="Image" /></td>
<td>O+</td>
</tr>
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2. **Cam Brioleur**  
Owner of Belle Boutique, a competitor of Bon Magasin  
Cam Brioleur is the proud owner of Belle Boutique. Cam opened his store 10 years before Bon Magasin. He has worked full-time in his store ever since, not leaving any time for
family, which resulted in a divorce 2 years ago. He recently bought a dog as he was very lonely. Everyone in the town of Ville knows him as one to think of the owner of Bon Magasin as an arch nemesis. It is also well known that Cam Brioleur likes to win and has a huge crush on Siddarth Malhotra.

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3. **Charm Ante**  
*The stepwife of the owner of Bon Magasin*  
Charm Ante broke ties with her husband many years ago, and the divorce seemed mutual then, but recent gossip around Ville was that Charm Ante recently found out that her husband cheated on her many times during that marriage and was in the mood for revenge. Charm Ante had two twin sons the week before Siddarth Malhotra came to Ville.

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4. **Ben Faiteur**  
*A cashier at Bon Magasin*  
Ben Faiteur just recently graduated from college with a degree in Finance. He worked at Bon Magasin as a cashier during his time in college, but the owner told him recently that he was going to be promoted as the Chief Financial Officer (CFO) in two weeks. Ben has an odd love for things made out of polypropylene, as one of his ex-girlfriends (a chemistry major) wrote a thesis about it.

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ANALYSIS (40 points)

Who robbed the store Bon Magasin? Why are the other suspects innocent? Be sure to support your answer with evidence and reasoning.

Theif: Cam Bruleur
- matching finger prints + blood type
- dug hair

Innocent
- Vole Sam Ur
  - no matching evidence
  - no motive (on probation)
- Charm Ante
  - discharged w/ twins recently
  - no matching evidence
- Ben Faireur
  - matching plaque
  - no motive
  - no matching evidence