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
   b) LiCl
   c) KCl

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

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

Plastic 2: yellow flame, plastic drips, burns slowly, light smoke

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

<table>
<thead>
<tr>
<th>Fiber 1:</th>
<th>Fiber 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
</tr>
</tbody>
</table>
Identify the type of hair (human, bat, cow, squirrel, or horse hair) (3 points)

Chromatography:

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

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

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

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)

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

Glass:
Light travels from air into a shattered glass piece with an angle of incidence of $33^\circ$. The angle of refraction on the end of the glass piece is $20.997^\circ$.

1. Calculate the index of refraction (4 points)

2. Identify the type of glass (3 points)

**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)

i.
ii.
iii.
iv.
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 Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burn Test Results:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Blue, yellow tipped flame</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Burns slowly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Plastic drips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Has sweet odor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Floats in water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-A Anti-B Anti-D Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 term of academics, but his criminal record speaks differently about his character. In the last year, he has committed an assault and has shopped twice.

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.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Fingerprint" /></td>
<td>B+</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
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<th>Blood Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2.png" alt="Fingerprint" /></td>
<td>AB-</td>
</tr>
</tbody>
</table>

4. **Ben Faiteur**  
*A cashier at Bon Magasin*  
Ben Faiteur recently graduated from college with a degree in Finance. He worked at Bon Magasin as a cashier during his time in college, and the owner told him recently that he was going to be promoted to 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.

<table>
<thead>
<tr>
<th>Fingerprint</th>
<th>Blood Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Fingerprint" /></td>
<td>O-</td>
</tr>
</tbody>
</table>

**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.