**BVF Forensics 2017 Answer Key**

**Part A: Qualitative Analysis (2 pts each for chart and implication, 34 pts total)**

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Scientific Name</th>
<th>Chemical Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium bicarbonate</td>
<td>NaHCO₃</td>
</tr>
<tr>
<td>2</td>
<td>Sucrose</td>
<td>C₁₂H₂₂O₁₁</td>
</tr>
<tr>
<td>3</td>
<td>Sodium bicarbonate</td>
<td>NaHCO₃</td>
</tr>
<tr>
<td>4</td>
<td>Sucrose</td>
<td>C₁₂H₂₂O₁₁</td>
</tr>
<tr>
<td>5</td>
<td>Sodium bicarbonate</td>
<td>NaHCO₃</td>
</tr>
<tr>
<td>6</td>
<td>Sucrose</td>
<td>C₁₂H₂₂O₁₁</td>
</tr>
<tr>
<td>7</td>
<td>Glucose</td>
<td>C₆H₁₂O₆</td>
</tr>
<tr>
<td>8</td>
<td>Sodium Chloride</td>
<td>NaCl</td>
</tr>
</tbody>
</table>

1. Implicates: Suspects 1, 2 and 3

**Part B: Plastics (3 pts each, 12 pts total)**

1. Density of 29% acetone solution: 0.94 g/cm³; Density of 20% ethyl acetate solution: .98g/cm³; Density of 52% corn syrup solution: 1.19 g/cm³

Evidence implicates: Suspect 2

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Material</th>
<th>Synthetic or Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Crime Scene)</td>
<td>Nylon</td>
<td>Synthetic</td>
</tr>
<tr>
<td>2 (Crime Scene)</td>
<td>Cotton</td>
<td>Natural</td>
</tr>
<tr>
<td>3</td>
<td>Linen</td>
<td>Natural</td>
</tr>
<tr>
<td>4</td>
<td>Polyester</td>
<td>Synthetic</td>
</tr>
<tr>
<td>5</td>
<td>Silk</td>
<td>Natural</td>
</tr>
</tbody>
</table>

**Part C: Fibers (2 pts for correct material, 1 pt for synthetic or natural, 2 pts for implication, 17 pts total)**

1. Implicates: All suspects; both males and females are involved.

**Part D: Hairs (1 pt each answer for 1 & 3, 3 pts for 2, 17 pts total)**

1. Sample 1: a. vacuolated  
   Sample 2: a. continuous  
   Sample 3: a. fragmented  
   Sample 4: a. uniserial ladder  
   b. imbricate  
   b. cow  
   b. imbricate  
   b. spinous  
   c. dog  
   c. human  
   c. human  
   c. cat

2. Animal hair: consistent medulla, thicker medulla  
   Human hair: inconsistent medulla, thinner medulla, consistent distribution of pigment throughout shaft

3. Ovoid bodies; dogs, cows

**Part E: Chromatography (2 pts for each Rf value, 2 pts for implicates, 1 pt per answer for 2 & 3, 27 pts total)**

1. Sample 1: Solvent Front: 10-10.1 cm  
   Spots: 8cm; 9.3-9.4cm  
   Rᵥ values: .79-.80; .92-.94  
   Sample 2: Solvent Front: 8.7 cm  
   Spots: 0.9cm,3.2cm, 6.1cm  
   Rᵥ values: .10, .36-.37, .70  
   Sample 3: Solvent Front: 8.1 cm  
   Spots: 5.4-5.5cm, 7.2cm  
   Rᵥ values: .66-.68, .89  
   Sample 4: Solvent Front: 9.2cm  
   Spots: 5.7-5.8cm, 7.2-7.3cm  
   Rᵥ values: .61-.63, .78-.79
Sample 5: Solvent Front: 8.1-8.2 cm Spots: 1.2 cm, 7.6 cm \[ R_f \text{ values: } .14-.15, .92-.93 \]
Crime Scene Sample: Same as sample 3 Implicates Suspect 3

<table>
<thead>
<tr>
<th>Central Pocket Whorl</th>
<th>Radial Loop</th>
<th>Ulnar Loop</th>
<th>Radial Loop</th>
<th>Plain Whorl</th>
<th>Ulnar Loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Arch</td>
<td>Ulnar Loop</td>
<td>Ulnar Loop</td>
<td>Ulnar Loop</td>
<td>Radial Loop</td>
<td>Ulnar Loop</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ulnar Loop</td>
</tr>
</tbody>
</table>

**Suspect 1**

**Suspect 2**

**Suspect 3**

1. Implicates suspects 2, 3, and 4 because only they have fingerprints—at least for the thumb and index fingers—on their dominant hands that are all loops and not an arch or whorl.

<table>
<thead>
<tr>
<th>Plain Whorl</th>
<th>Ulnar Loop</th>
<th>Plain Whorl</th>
<th>Ulnar Loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Arch</td>
<td>Radial Loop</td>
<td>Ulnar Loop</td>
<td>Ulnar Loop</td>
</tr>
</tbody>
</table>

**Suspect 4**

**Suspect 5**

2. Less

3. Mobile phase: water; Stationary phase: paper

**Part F: Fingerprint Analysis (1 pt per ID, 2 pts for implication, 1 pt per answer for 2-7, 32 pts total)**

2. Latent

3. Ninhydrin, Purple

4. Iodine

5. Silver Nitrate, Sunlight/UV light

6. loop, 70, arch, 5

**Part G: DNA (2 pts per question, 12 pts total)**

1. STR or Short Tandem Repeats

2. No because impurities in the DNA will be multiplied. It is okay that the DNA sample is highly degraded—that’s one of the reasons why scientists use PCR.

3. Sweat, Blood, Dandruff, Ear Wax

4. Denaturation, Annealing, Primer Extension

5. \[ 2 \times 2^{12} = 2^{13} = 8192 \]
6. 3’ or 3’-OH, Taq

Part H: Glass Analysis (4 pts per refraction index, 2 pts for implication, 14 pts total; deduct 1 pt for correct answer but no work)

1. PMMA: 1.48 (or within reasonable distance if work is shown)
   Diamond: 2.4 (or within reasonable distance if work is shown)
   Amber: 1.55 (or within reasonable distance if work is shown)
   Implicates suspect 2 because he wears a Plexiglass shard as a necklace and Plexiglass is made of PMMA.

Part I: Entomology (2 pts question, 10 pts total)

1. Because flesh flies are attracted to the body undergoing microbial fermentation.
2. Order: Calliphoridae; Common name: blowfly
3. Can infer that the corpse has been moved (blowflies wouldn’t be found in closet, body was most likely outside where flies would have arrived at the body and then the body was moved indoors.
4. They feed on dead flesh/are carrion eaters.
5. Complete; egg larva, pupa, adult

Part J: Blood Analysis and Spatters (6 pts for 1a, 1 pt for 1b, 2 pts for parts of 2, 1 pt for each answer for 3-5, 5 pts total for 5 (3 for ID and 2 for implication)

1a. The person is 5’2” or 62” tall.
1b. The size of the spatter would be larger.
2. a. Knife stab: smaller stains, linear pattern
   b. Whack from bat or hammer: drops of varying sizes
   c. Gun-shot: mist-like spatters
3. i. Contact and collapse
   ii. Displacement
   iii. Dispersion
   iv. Retraction
4. Void
5. A: spines
   B: satellites
6. Type A, Implicates Suspect 3 who is of blood type A-.

Part K: Bullet Striations (2 pts for questions 1,2,7; 1 pt per answer for 3-5; 5 pts for 6; 16 pts total)

1. Rifling means that inside of the barrel, there are rotating grooves that impart spin to a bullet when it is fired. It increases the accuracy of the firearm.
2. It can be concluded that the victim was shot at close range (so that the residue from the firearm would be found on his/her body). Accepted that victim shot himself.
3. Bottom/casing/shell
4. a. Land
   b. Groove
   Twist: Right/clockwise
   (for labeled picture, see last page)
5. Caliber of a bullet is its diameter
6. 2.28 inches
7. The pitch is the angle at which rifling is cut into barrel; effects the rate of twist.

**Crime Analysis: (2 pts for each piece of correct evidence, 3 pts for verdict)**

<table>
<thead>
<tr>
<th>Suspect</th>
<th>Evidence Convicting This Person</th>
<th>Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suspect 1 (Joe Jackson)</strong></td>
<td>Powder (Samples 2,4), Fiber</td>
<td>Release (Not guilty)</td>
</tr>
<tr>
<td><strong>Suspect 2 (Mason Montclair)</strong></td>
<td>Powder (Samples 1, 3, 5), Fiber, Fingerprints, Glass Analysis, Soil, Plastic</td>
<td>Hold for Hearing (Guilty)</td>
</tr>
<tr>
<td><strong>Suspect 3 (Liza Lafar)</strong></td>
<td>Powder (Samples 2,6), Fiber, Chromatography, Fingerprints, Blood Spatters, Blood</td>
<td>Hold for Hearing (Guilty)</td>
</tr>
<tr>
<td><strong>Suspect 4 (Janice Jahn)</strong></td>
<td>Fiber, Fingerprints</td>
<td>Release (Not guilty)</td>
</tr>
<tr>
<td><strong>Suspect 5 (Morgan Mabel)</strong></td>
<td>Fiber, Soil</td>
<td>Release (Not guilty)</td>
</tr>
</tbody>
</table>

**Analysis (not limited to this answer, 1 pt per correct piece of info mentioned in analysis):**

Mason Montclair and Liza Lafar should be held for hearing because of the following reasons:

Mason’s powder sample (sodium bicarbonate) matched those of the crime scene (1 & 3) and one of the crime scene’s fibers was nylon, which is found on the men’s uniforms. His dominant hand’s fingerprints are all loops and the glass analysis evidence concluding that PMMA was the material found at the scene, matches with that of the Plexiglass (made of PMMA) necklace that he wears. The loamy soil found at the scene would link to him because he also works as the gardener. In addition, the plastic found at the scene—HDPE—has the resin number 2, which matches with his bracelet’s material. Furthermore, his sketchy history and frequent transitions from workplace to workplace makes him a suspicious suspect.

Liza’s powder sample (Sucrose) almost matched that of the crime scene (2) and one of the crime scene’s fibers was cotton, which is found on the women’s uniforms. Her dominant hand’s fingerprints are all loops and the chromatography sample from the ink found at the crime scene matches that of her pen. Someone with her height would have caused the paint spatter on the wall and her blood type, A-, matches the blood type of the sample found (A). An anti-superhero activist, Liza also had the incentive to wreak havoc on the Incredibles’ vacation, a sentiment expressed in the wording of the note.

The other three suspects has a couple pieces of evidence pointing to them, but none significant or numerous enough to implicate them or to have them held for further questioning.