Section A: Qualitative Analysis (20%)

<table>
<thead>
<tr>
<th>Powder</th>
<th>Chemical Name and identifying markers (results of tests) (2 points [1 chemical/1 explain])</th>
<th>Chemical Formula (1 point each)</th>
<th>Relation to suspect(s) (1 points)</th>
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</thead>
</table>
| Evidence P | SODIUM CHLORIDE
EXPLANATION COMPLETION | NaCl | ALL SUSPECTS EATING CHINESE FOOD |
| Evidence Q | SODIUM HYDROGEN CARBONATE
EXPLANATION COMPLETION | NaHCO₃ | HOWARD |
| Evidence R | CORNSTARCH
EXPLANATION COMPLETION | C₂₇H₄₈O₂₀ | HOWARD AND AMY |

7. What is the chemical formula for magnesium sulfate? MgSO₄ (1 point)
8. What is the chemical formula for boric acid? H₃BO₃ (1 point)
9. What is the chemical formula for Ammonium Chloride? NH₄CL (1 point)
10. What color will the lithium ion produce in a flame test? RED (1 point)
11. Which solid(s) will produce gas when HCl(aq) is added? SODIUM HYDROGEN CARBONATE, SODIUM CARBONATE, CALCIUM CARBONATE (1 point)
12. Which solid can be identified based on the outcome of the Benedict’s test? SUGAR/GLUCOSE (1 point)
Section B: Polymers (20%)

Hair:

10. If a strand of hair were a pencil, what part of the hair would the yellow paint represent? **CUTICLE** (1 point)

11. If a strand of hair were a pencil, what part of the hair would the wood represent? **CORTEX** (1 point)

12. If a strand of hair were a pencil, what part of the hair would the lead represent? **MEDULA** (1 point)

13. Where do you find DNA in a piece of hair evidence? **THE ROOT** (1 point)

14. Does Evidence M have a solid, broken, or absent medulla? **ABSENT** (1 point)

15. Does Evidence M belong to a human or animal? **HUMAN** (1 point)

16. Who, if anyone, does evidence M implicate? Explain

**HOWARD AND LEONARD BECAUSE THEY BOTH HAVE BROWN HAIR WITH NO MEDULA LIKE THE HAIR SAMPLE**

17. What kind of hair is Evidence N? **SQUIRREL** (1 point)

18. Who, if anyone, does Evidence N implicate? Explain

**BERNADETTE AND PENNY BECAUSE PENNY FEEDS A SQUIRREL AND BERNADETTE HAS ACCESS AT WORK**

(+2 points for HOWARD AND LEONARD BECAUSE RELATED TO PEOPLE WITH ACCESS) (2 points)

Fiber:

8. What type of Fabric is Evidence J? **POLYESTER** (1 point)

9. Who does Evidence J implicate? **AMY AND HOWARD** (1 point)

10. What type of Fabric is evidence K? **LINEN** (1 point)

11. Who does Evidence K implicate? **SHELDON LEONARD** (1 point)

12. What type of Fabric is evidence L? **COTTON** (1 point)

13. Who does Evidence L implicate? **BERNADETTE HOWARD LEONARD SHELDON** (1 point)

14. Are any of these fibers unimportant? Why?

**(FULL CREDIT) LINEN, ONLY ON CLOTHES OF TWO PEOPLE WHO LIVE IN THE APARTMENT**

**(HALF CREDIT) COTTON, MANY DIFFERENT PEOPLE WEAR IT;** (2 point)
Section C: Chromatography and Mass Spectroscopy (15%)

Directions: Complete a Chromatograph of Pen A and Pen B. Place them in the box below and label each:

2 POINTS FOR EACH CORRECT CHROMOTAGRAPh PLACED HERE

9. What is the Rf values of Pen A?
   PINK: 0.145   BLUE: 0.274   YELLOW: 0.194   PURPLE: 0.258   (2 points [.5 POINTS EACH])

10. What is the Rf values of Pen B? (2.5 POINTS [.5 POINTS EACH])
    ORANGE: 0.127   YELLOW: 0.040   BLUE: 0.222   PURPLE: 0.333   INDIGO: 0.278

11. Why must the level of the solvent be below the placement of the mixture to be tested?
    BECAUSE IT WILL WASH OUT THE INK SPOT OR THE INK WILL NOT TRAVEL UP THE CHROMOTOGRAHY PAPER.

12. Spot Y travels 6.0 cm and Spot X travels 4.5cm when Acetone is used as the solvent. Which spot has intermolecular forces most like acetone? Explain.
    Y BECAUSE IT TRAVELS FURTHER UP THE SOLVENT FRONT

13. What do your Rf values tell you about this crime?
    PEN USED IN WRITING THE NOTES IS BOY PEN B

14. For Penny, What is the average atomic mass of liquid1? 102 PLUS OR MINUS 15 (1point)

15. For Amy Farrah Fowler, Is 265 a reasonable average atomic mass for liquid 2? YES (1point)

16. Who has access to the crime scene blue liquid? Explain how you know.
    HOWARD, MASS SPEC OF LIQUID 2 MATCHES MASS SPEC OF CRIME SCENE LIQUID (1.5 points)
Section D: Crime Scene Physical Evidence (15%)

Fingerprint Analysis:

9. What type of fingerprint pattern is Evidence A? **PLAIN WHORL** (1 point)
10. What type of fingerprint pattern is Evidence B? **PLAIN ARCH** (1 point)
11. What minutiae is circled in both Evidence C and D? **Delta** (0.5 point)
12. What is the minutiae circled in Evidence E? **BRIDGE** (0.5 point)
13. What type of fingerprint pattern is Evidence F? **DOUBLE LOOP WHORL** (1 point)
14. When and how would a fingerprint like Evidences A-H be formed?
   MOVEMENT IN THE WOMB AT 11 WEEKS GESTATION (2 points)

15. Evidence G and H are both right thumb prints. Which once can you rule out as belonging to your suspect and why?
   G IT BELONGS TO SHELDON COOPER, HE WAS THE VICTIM AND LIVES IN THE APARTMENT (2 points)

16. Who does the other print you did not rule out implicate? Explain using three minutiae characteristics.
   HOWARD WOLOWITZ (.5 POINTS EACH), EXPLAINS AT LEAST 3 MINUTIAE (.5 POINTS EACH) (2 points)

Blood:

7. What type of blood cell would you need if you wanted to retrieve DNA? **WHITE BLOOD CELL** (0.5 point)
8. What are the four parts of blood? Circle the most abundant part.
   PLASMA, WHITE, RED, PLATELETS/ PLASMA MOST ABUNDANT (0.5 point)
9. What types of blood can someone with Type A blood receive in a transfusion? **A AND O** (1 point)
10. What Blood type is considered the universal acceptor and why?
    TYPE AB BECAUSE CAN RECEIVE FROM ALL OTHERS DUE TO HAVING ALL THE AGlutINOGENS OUTSIDE BLOOD CELL (1 point)
11. What blood type is Evidence O? **B** (1 point)
    HOWARD AND PENNY, BOTH HAVE B- BLOOD, AGlutINOGENS ONLY FORMED IN B, NOT IN A OR RH FACTOR (1 point)
Section E: Analysis of Crime (30% and used as a tiebreaker)

Directions: Answer the following questions, then write an analysis of the crime scene. Your analysis must include which pieces of evidence implicate the suspect(s), why the suspect(s) was (were) chosen as the culprit(s), and why other suspects were not chosen.

4. What evidence do you believe did not pertain to the crime and why? (3 POINTS)

EVIDENCE THAT ONLY POINTS TO SHELDON OR EVIDENCE THAT POINTED TO EVERYONE

5. What do you believe was the MOST important piece of evidence and why? (5 POINTS)

JUDGED BASED ON EXPLANATION

6. Is there anyone that is NOT implicated by any evidence? Explain. (2 POINTS)

RAJ NOT A SINGLE PIECE OF EVIDENCE POINTS TO HIS BIO

Written Analysis of Crime: (20 POINTS)

-HOWARD

-EACH PIECE OF EVIDENCE EXPLAINS WHY IT POINTS TO SOMEONE IN PARTICULAR AND WHY IT DOES NOT POINT TO OTHERS

-NARRATIVE OF EVENTS INCLUDED