



**SCIENCE OLYMPIAD**  
— AT THE —  
**UNIVERSITY OF FLORIDA**

Northern Regional: January 19<sup>th</sup>, 2019

# Forensics C Test

**Name(s):** \_\_\_\_\_

**Team Name:** \_\_\_\_\_

**School Name:** \_\_\_\_\_

**Team Number:** \_\_\_\_\_

**Rank:** \_\_\_\_\_

**Score:** \_\_\_\_\_

## Forensics Division C

**PLEASE DO NOT WRITE ON TEST! Points will be deducted for marking this test packet.**

### Qualitative Analysis

Determine the chemical formulas of the three given powders and describe their results in a flame test, their solubility in water, and their pH.

#### 1. Powder A

Chemical formula: \_\_\_\_\_ (2 pts)

Flame test: \_\_\_\_\_ (1 pt)

Solubility: \_\_\_\_\_ (1 pt)

pH: \_\_\_\_\_ (1 pt)

#### 2. Powder B

Chemical formula: \_\_\_\_\_ (2 pts)

Flame test: \_\_\_\_\_ (1 pt)

Solubility: \_\_\_\_\_ (1 pt)

pH: \_\_\_\_\_ (1 pt)

#### 3. Powder C

Chemical formula: \_\_\_\_\_ (2 pts)

Flame test: \_\_\_\_\_ (1 pt)

Solubility: \_\_\_\_\_ (1 pt)

pH: \_\_\_\_\_ (1 pt)

4. Why does sucrose **not** react with Benedict's reagent? (2 pts)

5. If iodine is added to a solution containing cornstarch, the solution will be \_\_\_\_\_. If the solution does **not** contain cornstarch, the solution will be \_\_\_\_\_. (2 pts)

### Polymers

Draw the monomer structure for the following plastics:

6. PETE (2 pts)

7. PVC (2 pts)

8. PMMA (2 pts)

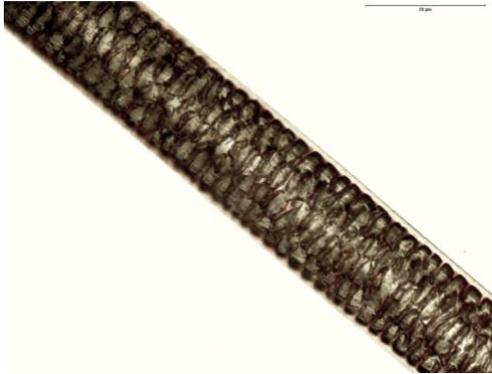
Identify the fibers given.

9. Fiber A \_\_\_\_\_ (2 pts)

10. Fiber B \_\_\_\_\_ (2 pts)

11. Fiber C \_\_\_\_\_ (2 pts)

What kind of hair is pictured below? (1 pt each)



14. Draw a cross-sectional diagram of hair and label the three layers. (3 pts)

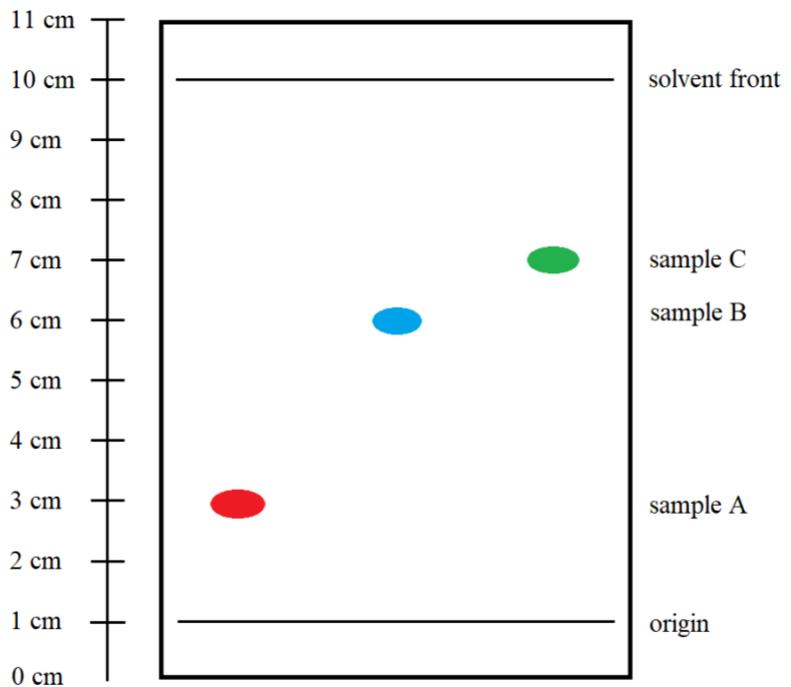
### Chromatography/Spectroscopy

Calculate the R<sub>f</sub> values for the following samples from the TLC results shown to the right.

15. R<sub>f</sub> for sample A: \_\_\_\_ (2 pts)

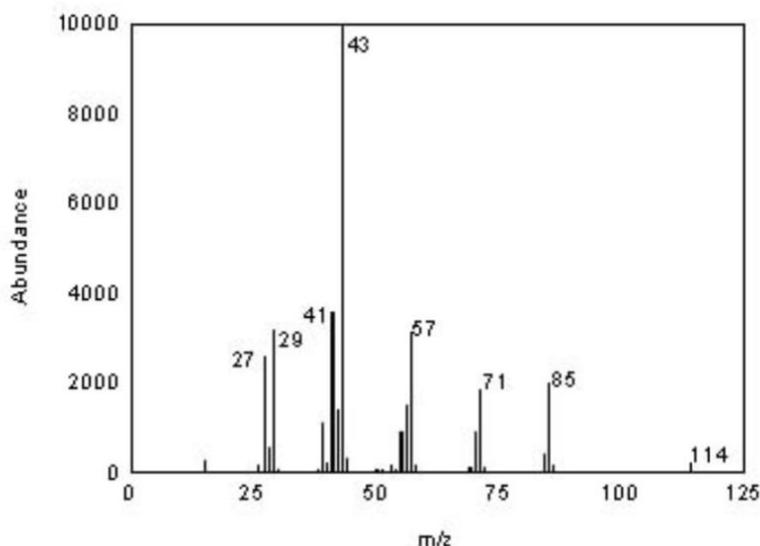
16. R<sub>f</sub> for sample B: \_\_\_\_ (2 pts)

17. R<sub>f</sub> for sample C: \_\_\_\_ (2 pts)



18. Which sample interacts most with the stationary phase? (1 pt)
19. Perform paper chromatography on the three pens provided at the front of the classroom and submit the results. Make sure to label the spots, origin, and solvent front and indicate your team number on the back. (3 pts; tiebreaker)

Refer to the following mass spectrograph of a hydrocarbon for questions 20-22.



20. Label the base peak. (1 pt)
21. Determine the molecular weight of the hydrocarbon. (1 pt)
22. Determine the identity of this chemical. (2 pts)

## Crime Scene Physical Evidence

### Fingerprint Analysis

23. What kind of tissue is the epidermis made of? (1 pt)
- simple squamous epithelial
  - simple columnar epithelial
  - stratified squamous epithelial
  - stratified columnar epithelial
24. Which of the following is true of fingerprints? (1 pt)
- They are formed by dermal papilla in the epidermal layers of the skin.
  - They are formed during gestation.
  - Identical twins have identical fingerprints.
  - They are formed entirely by genetic factors.

25. Identify the following fingerprint patterns, from left to right. (4 pts)

(word bank: plain arch | tented arch | ulnar loop | radial loop | plain whorl | central pocket loop | double loop whorl | accidental whorl)

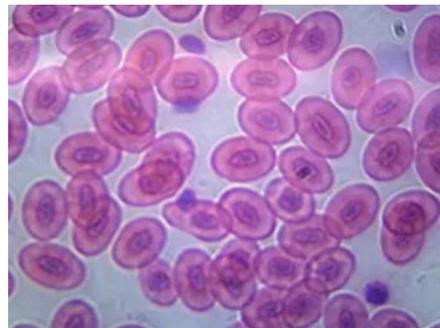


26. A forensics scientist wants to analyze a sheet of paper found at the crime scene for fingerprints. What fingerprinting methods would they most likely use **and** why? (2 pts)

**Blood**

27. Identify the source of the blood sample shown on the right. (1 pt)

- a) human
- b) avian
- c) mammalian
- d) reptilian/amphibian



28. What are the differences between human and amphibian blood? (4 pts; tiebreaker)

29. Identify the blood type (including Rh factor) of the provided blood sample. If a person with this blood type were to receive a blood transfusion, what types of blood would they be able to receive? (4 pts)

30. Which of the following is true of O type blood? (2 pts)

- I. Contains A antigens
- II. Contains B antigens
- III. Contains anti-A antibodies
- IV. Contains anti-B antibodies

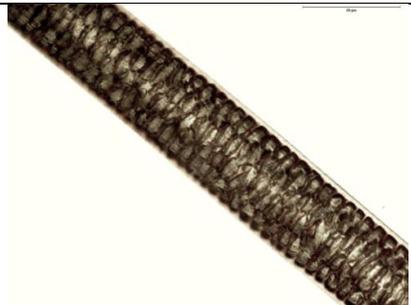
## Crime Analysis

A murder has occurred, and the police have chosen you to help them investigate!

Marigold Thornton, a florist at a local flower shop, was finally promoted to a manager position after years of hard work. To celebrate her achievements, she held a party at her house and invited over some friends and coworkers. They ate good food, blasted her favorite heavy metal album, and played Mario Kart all afternoon. Unfortunately, though, this party would be Marigold's last.

Police estimate that the incident occurred in the evening just a few hours after the party ended. At the scene of the crime, a few drops of blood that could not be matched to the victim, some hair, and three powders identified to be calcium nitrate, magnesium sulfate, and sodium bicarbonate were discovered. These samples have been given to you for analysis. Upon further investigation, the police also found that a threatening note written in pen had been left on the kitchen counter. Paper chromatography was performed on the writing and the results have been provided. Additionally, fingerprints found on the surface of the paper have been reproduced below.

Evidence found at crime scene:

<u>Ink</u>	<u>Blood</u>	<u>Hair (from Q12)</u>	<u>Powders</u>	<u>Fingerprint</u>
See color-printed picture sheet	Sample given in Q28		-Calcium nitrate -Magnesium sulfate -Sodium bicarbonate	

The police believe that one of the attendees at Marigold's party left the note while they were at her house. The four suspects are described below. Their pens have also been confiscated and given to you for analysis (see Q19).

Suspect A: Azalea Brooks

Marigold's neighbor. She loves animals and works at a small cattle ranch in town. She hopes to be able to have her own ranch someday, though unfortunately right now she is still stuck on clean-up duty. Although she enjoyed Marigold's party, Azalea is very prone to getting migraines and therefore had to leave early due to the commotion. As a method of relaxation, she paints and blows glass as hobbies in her free time.

<u>Blood type</u>	<u>Fingerprint</u>
AB+	

Suspect B: Aster Woods

Marigold's ex-boyfriend. He is well known as the best barber in town and has great reviews on Yelp. Unfortunately, he recently sprained his ankle and has been taking a break from work. To soothe the pain, he has been visiting the spa every evening. He and Marigold broke up on bad terms as she was fed up with his extreme obsession with collecting PEZ candy dispensers. However, they were allegedly getting along much better recently and trying to work on becoming friends again.

<u>Blood type</u>	<u>Fingerprint</u>
O-	

Suspect C: Lily Hale

A handywoman who regularly services the flower shop. Although she works at a car repair shop as her day job, Lily also somehow finds time in her day to work part-time doing odd repair jobs at local businesses to scrape up money. She has been spending a lot of time in the past few months at the flower shop due to their ongoing plumbing issues. As a result, she and Marigold started becoming very good friends. Lily enjoys her work but is a little jealous of how much easier and better paying Marigold's job seems to be.

<u>Blood type</u>	<u>Fingerprint</u>
A+	

Suspect D: Daisy Fields

Marigold's coworker. They have worked at the same flower shop together for nearly a decade. She is passionate about nature and has dreamed about this job since she was young. When she's not at work, she pursues her passion by spending as much time outdoors as possible and exploring forests. She also has her own garden and uses the fruits she grows for baking, which is a new hobby for her. She sells her pastries at the weekly flea market to scrounge up money, as she is struggling to buy a home with a bigger garden.

<u>Blood type</u>	<u>Fingerprint</u>
B+	

31. Who committed the crime and why? Support your answer by describing the evidence linked to each suspect, explaining how you matched the evidence, and why the other suspects are innocent. (25 pts)