

SciOly.org Captain Tryouts 2017-2018

International Academy - Central, MI

FORENSICS

Name: _____

Score: _____/100

The test will be broken up into two sections: Knowledge & Analysis. The Knowledge section will be short answer and multiple choice. In the Analysis section, you will be presented with pre-tested evidence and asked to draw conclusions about the crime. This test will not include a lab portion as it is intended to be used for tryout purposes.

Please contact adams-boone.kathleen16@bloomfield.org with any questions.

KNOWLEDGE

1. a) You take a sample of a solid substance at a crime scene. You find the substance is soluble in water and has the pH of a weak acid. You do not notice an odor. What is this substance? (2) _____

b) There are three main suspects involved in this case. Suspect A works with cattle. Suspect B works at a commercial apple orchard. Suspect C works at a factory which produces latex gloves. Which suspect does this substance indicate?(2)

2. A substance is soluble in water, has a neutral pH, and caramelizes in a flame test.

a) What should you do next to determine what substance it is? (2)

b) What reactions will occur for each possible substance? (4)

Match each plastic to its burn test results. Mark your answers on the lines provided. Not all answers will be used. (1 each)

3. Polyethylene Terephthalate
(PETE)

a. Dense black smoke with soot

4. High Density Polyethylene
(HDPE)

b. Smells like acetaldehyde

5. Polypropylene
(PP)

c. Bright flame, no smoke

6. Polystyrene
(PS)

d. Burns cleanly, white smoke when extinguished

e. May burn and char

f. May drip flames

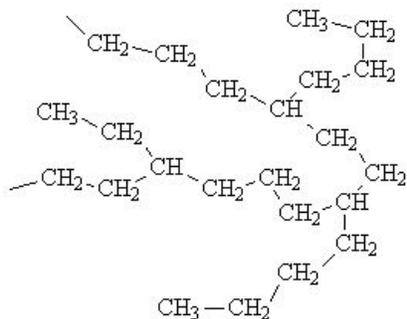
3. _____ 4. _____ 5. _____ 6. _____

Complete the table. (0.5 each)

Plastic Name	Structure	Sink or float? in water	Sink or float? in vegetable oil	Sink or float? in 10% NaCl
7.	$\left[\begin{array}{c} \text{CH}_3 \\ \\ \text{---CH---CH}_2 \end{array} \right]_n$	8.	9.	10..
11.	12.	Sink	Sink	Float

13. a) What plastic is typically used for 3D printer filaments? (0.5)

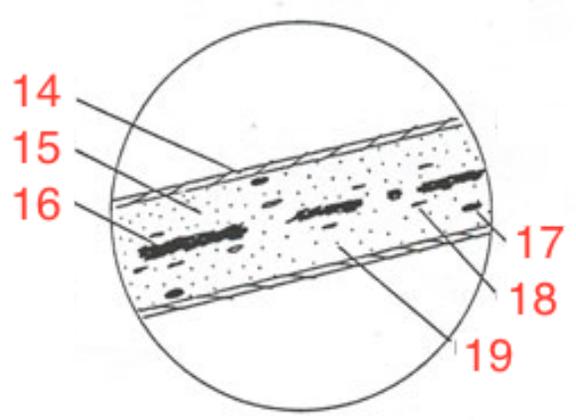
b) Name the plastic whose structure is shown below. (1)



c) What type of polymerization does polystyrene undergo? (1)

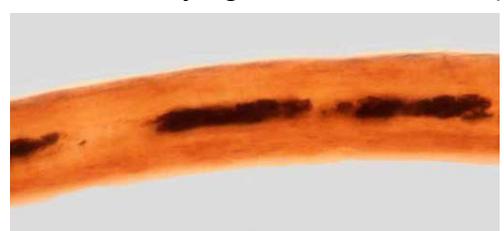
d) What is the monomer of LDPE? (0.5) _____

Label the diagram of a hair shaft. (0.5 each)



- 14. _____
- 15. _____
- 16. _____
- 17. _____
- 18. _____
- 19. _____

For #20-21, identify whether the hair shown is human, cow, squirrel, bat, or horse and list an identifying feature for each. (2 each)



20. _____



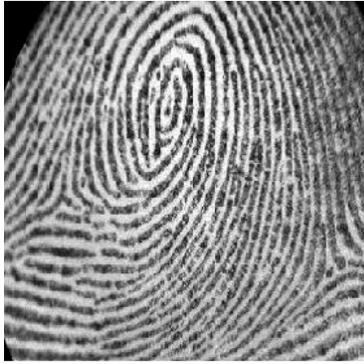
21. _____

- 22. a) A fiber is 11 microns in diameter. What is the identity of this fiber? (0.5)

- b) A fiber sparks during a burn test. What is the identity of this fiber? (0.5)

- c) A fiber curls away from a flame. What is the identity of this fiber? (0.5)

For # 23-25, identify which of the 8 specific fingerprint patterns is present in the picture. Assume all prints are taken from the thumb on the subject's right hand. Assume these prints are on the subject's hand, not transferred onto paper or another medium. (1 each)



23. _____



24. _____



25. _____

Draw the following fingerprint minutiae in the boxes provided. (0.5 each)

26. Spur



27. Bifurcation



28. Lake



29. Island



30. You want to check a scarf for latent fingerprints at a crime scene. What fingerprint development technique should you use? (1) _____

31. a) What is the chemical formula for methyl cyanoacrylate? (1) _____

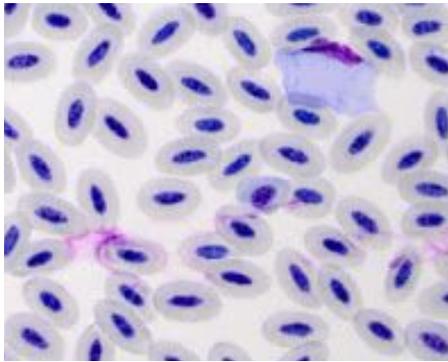
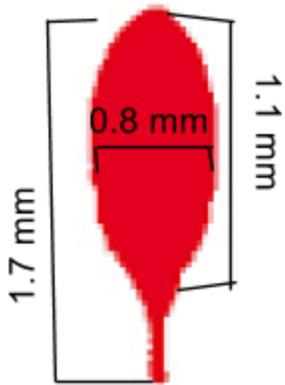
b) What does cyanoacrylate react with to form the image of a fingerprint? (1)

32. What is a fingerprint made in blood or ink called?(1) _____

33. You want to check a newspaper for latent fingerprints at a crime scene. What fingerprint development technique should you use? (1) _____

34. Which fingerprint development techniques are not chemical reactions, but physical actions? (0.5) _____

35. a) Mark the direction of travel for the blood spatter below with an arrow. (0.5)
 b) Calculate the angle of impact. (3) _____
 c) Give a range of possible velocities for the blood spatter. (0.5) _____



36. Identify the above blood smear as mammalian, avian, or amphibian. (1)

37. a) Which ABO blood type has no antigens in the red blood cell?(0.5) _____
 b) Which ABO blood type has A antibodies only in plasma? (0.5) _____
 c) What is the name of the blood protein that determines whether a person with type A blood is considered "A positive" or "A negative"?(1) _____

38. You have 3 samples of the same person's blood. In the first sample you add anti-A. In the second sample you add anti-B. In the third sample you add anti-Rh. You notice clumping in the first sample only. What blood type does the person have? (3)

ANALYSIS

The Crime: A valuable Swarovski crystal gnome figurine has been stolen from Mrs. Gneiss, an extremely wealthy gnome enthusiast. She returned to her home one night to find her prized gnome missing. To add insult to injury, the thief had left the Gneiss household a mess. Various powders had been strewn across the room, plastic shavings were found in the corner, and blood droplets were splattered across the wooden floor. Mrs. Gneiss hired you as her private investigator. Your team has collected and tested all of the evidence in the lab, it is now up to you to determine who stole the precious gnome.

The Suspects: Mr. and Mrs. Gneiss have made many enemies. Mrs. Gneiss has provided you with a list of those who may have had reason to commit the crime and your team has collected information on them.

Linda Halite- Mr. Gneiss's jilted ex-wife. Ms. Halite resents Mrs. Gneiss and has a documented hatred of gnomes. She has tented arch fingerprints, and type A-positive blood. She enjoys salt & vinegar potato chips.

David Gneiss- Mr. Gneiss and Ms. Halite's son. David is bitter that the gnome will be receiving his father's inheritance instead of him. David has type AB positive blood and double loop whorl fingerprints. He often gets stomachaches. He is a construction worker.

Lucy Shale- Mrs. Gneiss's childhood friend. Lucy shares Mrs. Gneiss's affinity for gnomes, however, she is not as wealthy as the Gneiss's and covets their vast, expensive gnome collection. She has type B-negative blood and plain arch fingerprints. She is a middle school chemistry teacher and coaches a Science Olympiad team in her free time. She is a vegetarian and wears contacts.

Jason Diorite- The Gneiss's next-door neighbor. He is always losing lawn-decorating contests to the Gneiss's and their exquisite gnomes. He has type O-negative blood and accidental whorl fingerprints. He is an electrician. He has just returned home from a vacation to Hawaii. He has been hired to fix the wiring problems in the middle school at which Ms. Shale works.

The Evidence:

Powders: These powders were found at the scene of the crime. Your team has tested them in the lab already, their results are in the table.

Sample 1 Ammonium chloride volcanos	Soluble in water, has pH of a weak acid, strong odor
Sample 2 calcium sulfate tofu	Not soluble in water, does not react to HCl or iodine
Sample 3 NaCl contacts	Soluble in water, neutral pH, orange flame
Sample 4 sodium hydrogen carbonate stomachache	Soluble in water, pH of a weak base, fizzes in HCl

Plastics: Your team found 2 types of plastic shavings at the scene.

Plastic 1 PS labware	Reacts with acetone
Plastic 2 PVC wire insulation	Green flame

Fingerprints: Your team found these fingerprints at the scene- one on the doorknob and one on the gnome's display case.



Display case



Doorknob

Blood: Your team collected samples of the blood found at the crime scene and ran the typing test on it. Here are the results of the test:

