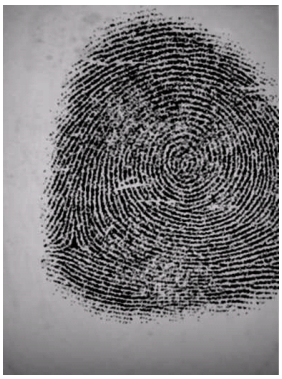
Forensics C - Forensics - Camas C-Invite - 12-12-2020

Facing impending budget cuts, the city council is requiring that cold cases from the last 10 years be reopened and solved to prove the value of the forensics department. You as the current head of the forensics department have been assigned the case of the missing lute and the murder of Pete Evergreen. Eight years ago, the local museum held an exhibit on antique musical instruments. However on the last day of the exhibit, after a private showing to an investor, the main attraction was stolen and the night watchman Pete Evergreen wa found dead. Six unknown powders were found located throughout the crime scene. A piece of plastic was found nearby which appears to have been used to kill Pete Evergreen as well as break into the glass case protecting the lute. Two blood samples were also found one belonging to Pete Evergreen who had type AB+ blood and the other was type B- blood. While reading through the report, you found that at the time the police had identified 4 suspects.

Mister Edward Ayers was the curator of the museum at the time. However, his poor business sense and extravagant lifestyle led to him getting into massive amounts of debt. Three days before the crime, Mister Ayers was discovered to have taken out a large insurance policy on the exhibit. Which is what caused the investigation on him. While reading through his file you learn that he was a 57 year old man with type A+ blood. Testimony from his friends stated that he was a habitual gambler who never quite knew when to quit. They also mentioned that due to his desire to lead a wealthy life he always wore expensive silk suits. During an investigation of his home, his shoes were found covered in Sodium Chloride anc Calcium Carbonate also found at the crime scene. Pieces of PMMA plastic was also found. Also included in his file was a fingerprint of his left index finger

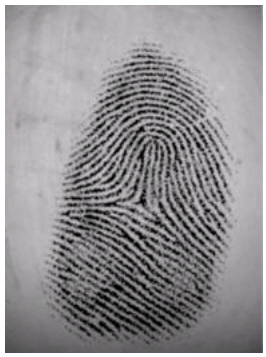
Mr. Robert Dain was the custodian of the museum at the time. A family man with a wife and two kids, he often held multiple jobs in an effort to support them. Due to the museum getting deeper and deeper into debt, Mister Ayers sent him a termination notice stating that three days after the closing of the antique musical instrument exhibit, he was to be fired. It was for this reason that the police marked him as a possible suspect. Continuing your reading of his file you learn that eight years ago, a day after the crime, police searched Mr. Dain's employee locker discovering samples of Salt. Also in the locker were pieces of PS plastic and a thick wool coat. Submitted with his file was a fingerprint of his right index finger



and his blood type B-.

Miss Elizabeth Quail was a famous wealthy resident of the town. Well known for her large investments in anything and everything that sparked her interest. She was also rather infamous for her out of control pet Dalmatian, Edward that followed everywhere. Edward would accompany Mrs. Quail everywhere often causing large sums of damage to businesses although out town. Miss Quail was also known for love of oddly colored silk scarves, which she wears everyday. Witness testimony placed Miss Quail as the wealthy investor that

received the private showing on the day of the crime. During the police investigation of her they discovered that she had recently purchased large amounts of Sulfuric Acid and Sodium. In a search of her person they discovered pieces of LDPE plastic in her purse. Along with her file was a fingerprint of her right index finger  . A well as a note which mentioned that she recently received a blood transfusion of type O+ blood.

Mrs. Rachel Pinch was Miss Quail's personal secretary. She was also present during the private showing at the museum. Footage from security cameras show that after the showing Mrs. Pinch returned to the museum late at night after closing. Footage ten minutes later shows Mrs. Pinch leaving the museum now carrying a large purse. Police questioning of Mrs. Pinch revealed that the purse belonged to Miss Quail who left it in the museum after closing. It was also revealed that Mrs. Pinch was poorly paid, and was spending her free time fixing and cleaning clocks to earn extra money. During the Investigation, it was found that Mrs. Pinch was wearing clothes made of cotton at the time of the crime and had HDPE plastic in her pockets. An investigation of her workshop found Sugar and Calcium. Along with her file is a fingerprint of her right index finger  along with her blood type AB-.

Using the information provided and your knowledge of forensics solve the cold case.

1. (1.00 pts) Mark which chemicals are insoluble.

(Mark **ALL** correct answers)

- ☐ A) Sodium Chloride
- ☐ B) Calcium Sulfate
- ☐ C) Calcium Carbonate
- ☐ D) Boric Acid
- ☐ E) Glucose
- ☐ F) Sucrose

2. (2.00 pts) When preforming the Benedict's solution test, one of the chemicals formed an orange precipitate. What chemical reacted and what type of reaction is shown?

3. (3.00 pts) Write the chemical equation when sodium bicarbonate reacts with HCl

4. (2.00 pts) Name the resultant chemical from mixing vinegar and baking soda.

5. (2.00 pts) Describe how to preform a sodium hydroxide test taking care to include how you know whether a chemical is reactive to sodium hydroxide.

6. (1.00 pts) During the flame test, one of the powders burned a vibrant green. Which chemical was is?

- ○ A) Sodium Chloride
- ○ B) Calcium Sulfate
- ○ C) Calcium Carbonate
- ○ D) Boric Acid
- ○ E) Glucose
- ○ F) Sucrose

7. (2.00 pts) During your second trial of the flame test, all of the chemicals burned a distinct yellow color. Why might that have happened?

8. (4.00 pts)
Identify the powders based on the following test results. Powder 2 formed an orange solid during the Benedict's solution test. Powder 3 was insoluble. Powder 4 turned brown in the iodine test. Powder 6 reacted to hydrochloric acid. Powder 1 burned green. Powder 5 has a molar mass of about 342 g/mol

(Mark **ALL** correct answers)

- ☐ A) Powder 2 is Glucose.
- ☐ B) Powder 5 is Calcium Sulfate.
- ☐ C) Powder 2 is Boric Acid
- ☐ D) Powder 6 is Calcium Carbonate.

- [ ] E) Powder 3 is Calcium Sulfate
- [ ] F) Powder 5 is Sucrose

9. (2.00 pts) HDPE has a higher crystallinity than LDPE because

(Mark **ALL** correct answers)

- [ ] A) It has less branching.
- [ ] B) It has undergone more polyaddition reactions.
- [ ] C) It has been through a condensation reaction.
- [ ] D) It has not gone through a condensation reaction.
- [ ] E) None of the above

10. (2.00 pts) How many pi bonds are used in the formation PMMA plastic ($C_5H_9O_2$)?

- ○ A) 0
- ○ B) 1
- ○ C) 2
- ○ D) 3
- ○ E) 5
- ○ F) 7

11. (2.00 pts) A 3 inch long strip of cotton is burned at the same time as a 3 inch long strip of wool. Which fabric will burn faster?

(Mark **ALL** correct answers)

- [ ] A) Cotton will burn faster.
- [ ] B) Wool will burn faster.
- [ ] C) The two materials will burn at the same rate.

12. (1.00 pts) The burning of nylon will produce what odor?

(Mark **ALL** correct answers)

- [ ] A) The smell of burning meat.
- [ ] B) The smell of burning hair.
- [ ] C) The smell of burning plastic.
- [ ] D) The smell of burning paper.

13. (1.00 pts) Human hair has a medulla index of around what value?

(Mark **ALL** correct answers)

- [ ] A) 1/4
- [ ] B) 1/3
- [ ] C) 1/2
- [ ] D) 1

14. (1.00 pts) Nuclear DNA is found at what part of the hair?

(Mark **ALL** correct answers)

- ☐ A) Medulla
- ☐ B) Cortex
- ☐ C) Cuticle
- ☐ D) Root
- ☐ E) Nuclear DNA is not found in part of the hair

15. (2.00 pts) A plastic found at the scene of the crime has a mass of 0.151 grams and is an 8mm by 8mm by 2mm cube . What plastic is it?

(Mark **ALL** correct answers)

- ☐ A) LDPE
- ☐ B) HDPE
- ☐ C) PMMA
- ☐ D) PS

16. (1.00 pts) A hair found at the crime scene has an interrupted medulla and a medulla index of 0.541. Is the hair animal or human?

(Mark **ALL** correct answers)

- ☐ A) Animal
- ☐ B) Human

17. (1.00 pts)
A fiber found caught on one of the broken display cases was found to be unable to conduct electricity and have a linear density of 1 denier. What is the identity of the fiber?

(Mark **ALL** correct answers)

- ☐ A) Wool
- ☐ B) Silk
- ☐ C) Cotton
- ☐ D) Nylon

18. (1.00 pts) Which polymer has a density of 1.05?

(Mark **ALL** correct answers)

- ☐ A) PS
- ☐ B) PP
- ☐ C) PMMA
- ☐ D) PETE

19. (2.00 pts) A TLC using silica gel as its stationary phase can only identify what types of chemicals?

(Mark **ALL** correct answers)

- ☐ A) Basic chemicals
- ☐ B) Amino Acids

- [ ] C) Hydrocarbons
- [ ] D) Acidic Chemicals
- [ ] E) Acid-labile Chemicals
- [ ] F) Gels

20. (1.00 pts) Allowing the paper strip to touch or lay against the side of the beaker will result in inaccurate results due to _____ between the glass and the liquid

- ○ A) adhesion
- ○ B) cohesion
- ○ C) gravity
- ○ D) surface tension

21. (1.00 pts) One reason TLC is used over paper chromatography is

- ○ A) The ability to test a greater variety of chemicals
- ○ B) The ability to test non-soluble chemicals
- ○ C) The ability to determine the purity of a substance
- ○ D) The ability to not need mobile phase for active testing

22. (6.00 pts) Describe how to preform a thin layer chromatography.

23. (1.00 pts) A chemical has a migration distance of 124mm and the solvent a migration distance of 3.54 inches. What is the retardation factor?

- ○ A) 0.725
- ○ B) 35.0
- ○ C) 0.350
- ○ D) 0.285
- ○ E) 0.715

24. (2.00 pts) Why is fragmentation essential for the identification of chemicals using mass spectrometry?

25. (2.00 pts) The width of a blood stain found at the crime scene is 32 mm, its length was found to be 3.54 cm. What was the angle of impact for the blood stain?

- ○ A) 25 degrees

B) 42 degrees

C) 65 degrees

D) 33 degrees

26. (2.00 pts) The blood stain from the last question was located at a point 2.74 ft high. How far away was the blood stain from the point of impact?

A) 0.76 meters

B) 1.8 meters

C) 0.54 meters

D) 0.39 meters

27. (1.00 pts) You can determine the time a crime occurred by how dry the blood is.

True False

28. (1.00 pts) Blood type can not change naturally over time.

True False

29. (3.00 pts) What could Miss Quail's blood type be? Select all possible answers.

(Mark **ALL** correct answers)

A) A+

B) B+

C) B-

D) AB-

E) O+

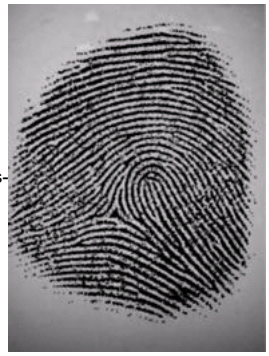
F) O-

30. (1.00 pts) The fingerprint submitted for Mr. Dain was of his right index finger. What type of fingerprint is it?

(Mark **ALL** correct answers)

- ☐ A) Whorl
- ☐ B) Arch
- ☐ C) Left Loop
- ☐ D) Right Loop
- ☐ E) Tented arch
- ☐ F) None of Above

31. (2.00 pts) Compare the fingerprint of Mister Edward to the right index fingerprint found on the display case.

Mister Edwards- 

Crime scene fingerprint- 

(Mark **ALL** correct answers)

- ☐ A) They are both right loops.
- ☐ B) They both have deltas.
- ☐ C) They are the same fingerprint, but rotated.
- ☐ D) They belong to the same person.
- ☐ E) There is no way to compare them.

32. (3.00 pts) What is the least common type of fingerprint and how often does it occur?

(Mark **ALL** correct answers)

- ☐ A) Whorl
- ☐ B) Arch
- ☐ C) Loop
- ☐ D) 5% of the time
- ☐ E) 10% of the time
- ☐ F) 30-35% of the time

33. (3.00 pts) To who does the crime scene finger print belong to?

Crime scene fingerprint of right index finger-

- ○ A) Mister Edward Ayers
- ○ B) Mr. Robert Dain
- ○ C) Miss Elizabeth Quail
- ○ D) Mrs. Rachel Pinch
- ○ E) Can not be determined

34. (2.00 pts) What is the 4R rule of glass analysis?

35. (2.00 pts) For what types of glass does the 4R rule not apply?

(Mark **ALL** correct answers)

- ☐ A) Tempered Glass
- ☐ B) Soda Glass
- ☐ C) Laminated Glass
- ☐ D) Lead Crystal Glass
- ☐ E) Optical Glass
- ☐ F) Plate Glass

36. (2.00 pts) High velocity impacts produce _____ impact patterns when striking glass.

37. (3.00 pts) Based on the evidence you gathered from the fingerprint test who is the culprit, if anyone? Why?

38. (3.00 pts) Based on blood type, who is the culprit? If anyone? Why?

39. (5.00 pts) Based on your evidence you gathered about plastics and fibers, who is the culprit? If anyone? Why?

40. (3.00 pts) Based on the evidence you gathered about the various powders found at the crime scene, determine the culprit? If anyone? Why?

41. (12.00 pts) Based on everything you learned, who is the most likely culprit among the four suspects? Why?

Thank you, all for participating in the Camas division C Invitational for Forensic!