

2017 Science Olympiad



Forensics Exam Answer Packet

NAME(S): _____

SCHOOL: _____

TOTAL POINTS: 645 points possible

NOTE: YOU WILL NEED SAMPLES FOR THIS TEST SO ASK YOUR INSTRUCTOR TO SET
THEM UP BEFORE YOU BEGIN

Situation

Kitty Latoff receives a strange letter from a client named Michelle Xu asking her to investigate a case on SciOly Island. However, she soon finds out that the woman requesting the investigation has been dead for 12 years. She was a world-renowned Science Olympian who suddenly destroyed all her medals and set Mr. Wood's classroom on fire. Spookily, as the classroom burnt down around her, she chanted everything she knew about the human body from studying for Anatomy/Physiology. Despite thinking the letter is a prank, Kitty decides to investigate anyway and finds the island is holding elections for team captain. Two years ago, a passerby heard the same chanting coming from Conestoga High School and discovered the body of captain Annie Xu slumped over a desk. Although she died from overstudying, the similarity to the death of Michelle caused the islanders to think the classroom is cursed.

People

Upon arrival, Kitty is welcomed by several people (Note: Everyone except Lauren Harris is salty about not getting a captain position).

- Lauren Harris: junior, the nerdiest member and co-captain of Conestoga's SciOly team
- Jordan Liu: sophomore, environmental science extraordinaire
- Alex Wang: senior, chemistry and physics prodigy
- Jerry Zhu: senior, professional bridge builder and participant of Dynamic Planet
- Michael Zhang: senior, Anatomy/Physiology partner of Michelle Xu, biology genius
- Jennifer Lee: sophomore, experienced Anatomy/Physiology and Disease Detective
- Jordan Gusdorf: junior, expert builder with air and wind constructions

Murder

That night, when the SciOly team is getting ready to leave for the national level SciOly competition, Lauren Harris' sodden body is found slumped over a desk in the cursed classroom as the same anatomy chant is playing in the background. Water marks show the body had been dragged to the desk from the lab area. On her wrist, a tiny red mark was found; she had been murdered by lethal injection **(KCI)**!

Victim and Suspects:

Lauren Harris (victim): wears high quality clothing (**silk**), owns a dog (**dog hair**), helps out with Air Trajectory (**PVC**), takes potassium supplements (**KCl**), drinks a lot of soda (**sucrose**)

Jordan Liu (suspect 1): loves eating potato chips (**NaCl**) and drinking apple cider (**sucrose**) straight from the carton (**HDPE**), works with pipes for Air Trajectory (**PVC**), wears squash apparel (**polyester**) to school everyday, uses cold packs (**Ca(NO₃)₂**) to treat his soreness after practice

Alex Wang (suspect 2): works as a car mechanic (**LiCl**), takes treatment for athlete's foot (**H₃BO₃**), wears tennis apparel (**polyester**) everyday, uses a lot of deodorants and antiperspirants (**NH₄Cl**), admits he has constipation and uses laxatives as treatment (**MgSO₄**)

Jerry Zhu (suspect 3): has diabetes (**glucose**), eats a lot of pickles (**NaCl**), clumsy in the lab area during lab day so he uses an antiseptic for his cuts and burns (**H₃BO₃**), loves to bake (**NaHCO₃**) but he can't eat his own pastries :(

Michael Zhang (suspect 4): likes to breed pea plants in his garden (**Ca(NO₃)₂**) to study heredity, teaches Biology at local community college using blackboards (**CaCO₃**), often uses calcium supplements (**CaCO₃**) to treat his calcium deficiency, owns a mutant dog (**dog hair**) as a result of a series of experiments

Jennifer Lee (suspect 5): uses a lot of acne medication (**MgSO₄**), uses cough medicine for her cold (**NH₄Cl**), loves ceramics and painting (**CaCO₃**), takes medication for her asthma (**MgSO₄**), drinks a lot of coffee (**sucrose, PS**), owns a bat (**bat hair**)

Jordan Gusdorf (suspect 6): works with pipes for Air Trajectory (**PVC**), wears a lot of fuzzy winter sweaters (**wool**) to school, drinks from a water bottle (**HDPE**) everyday, on the swim team (**nylon**), owns a lot of cats (**cat hair**)

Please help Kitty solve this extremely puzzling case! You have 50 minutes. Work efficiently and good luck! :)

BONUS: Draw a smiley face next to your name(s) for some extra help! +5 (if they get this)

Part I:

Please identify each powder (found on the suspects). Give its name AND molecular formula:

Each worth 10 points (5 points for the name, 5 points for the molecular formula)

1. Sodium Bicarbonate (NaHCO_3)
2. Boric Acid (H_3BO_3)
3. Potassium Chloride (KCl)
4. Sodium Chloride (NaCl)
5. Calcium Carbonate (CaCO_3)
6. Ammonium Chloride (NH_4Cl)
7. Sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$)
8. Magnesium Sulfate (MgSO_4)
9. Lithium Chloride (LiCl)
10. Calcium Nitrate ($\text{Ca}(\text{NO}_3)_2$)
11. Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$)

The following powders were found at the crime scene. Please identify them and give their molecular formula:

Each worth 10 points (5 points for the name, 5 points for the molecular formula)

1. Potassium Chloride (KCl)
2. Sodium Chloride (NaCl)
3. Sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$)
4. Calcium Nitrate ($\text{Ca}(\text{NO}_3)_2$)

Do the samples implicate anyone; if so, whom? (can be more than one person)

Each worth 5

Lauren Harris, Jordan Liu, Jerry Zhu, Jennifer Lee

Part II:

Please identify each plastic:

Each worth 5 points

- 1. HDPE**
- 2. PVC**
- 3. PS**
- 4. LDPE**

Give the structural formula and resin code of each identified plastic:

Each worth 15 points (10 points for the structural formula, 5 points for the resin code)

Sample Number	Structure	Resin Code
1	$\text{-(CH}_2\text{-CH}_2\text{)}_n\text{-}$	2
2	$\text{-(CH}_2\text{-CH)}_n\text{-}$ Cl	3
3	$\text{-(CH}_2\text{-CH)}_n\text{-}$ 	6
4	$\text{-(CH}_2\text{-CH}_2\text{)}_n\text{-}$	4

The following plastics were found at the crime scene. Please identify them:

Each worth 5 points

- 1. HDPE**
- 2. PVC**

Do the samples implicate anyone; if so, whom? (can be more than one person)

Each worth 5 points

Lauren Harris, Jordan Liu, Jordan Gusdorf

Part III:

Please identify each hair & fiber:

Each worth 5 points

- 1. Wool**
- 2. Silk**
- 3. Nylon**
- 4. Polyester**
- 5. Bat**
- 6. Cat**
- 7. Dog**
- 8. Human**

Identify the following characteristics for each hair sample:

Each worth 20 points (5 points for the Medulla (absent or present), 5 points for the Medulla Type, 5 points for the color, 5 points for the cuticle)

Sample Number	Medulla (absent or present)	Medulla Type	Color	Cuticle Type
5	Absent	None	Brown	Spinous
6	Present	Continuous	White	Spinous
7	Present	Continuous	Brown	Imbricate
8	Absent	None	Brown	Imbricate

The following hairs and fibers were found at the crime scene. Please identify them:

Each worth 5 points

- 1. Dog**
- 2. Polyester**
- 3. Human**
- 4. Silk**

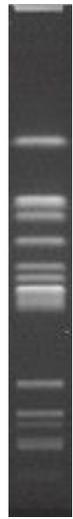
Do the samples implicate anyone; if so, whom? (can be more than one person)

Each worth 5 points

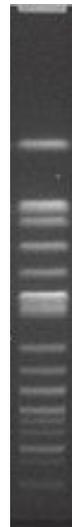
Lauren Harris, Jordan Liu

Part IV:

The following are gel electrophoresis of the DNA found at the crime scene:

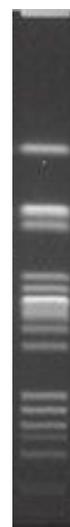
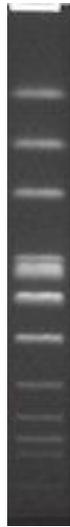
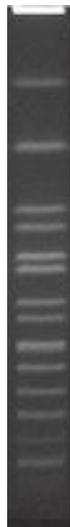
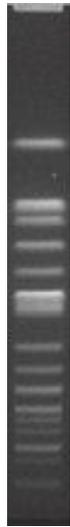
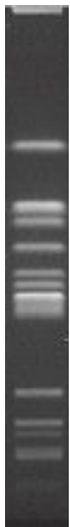


Gel #1



Gel #2

The following are gel electrophoresis of the DNA of the victim and the suspects:



Victim

Suspect #1

Suspect #2

Suspect #3

Suspect #4

Suspect #5

Suspect #6

Do the samples implicate anyone; if so, whom? (can be more than one person)

Each worth 5 points

Lauren Harris, Jordan Liu

Part V:

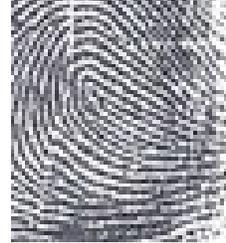
The following partial fingerprints were lifted off a syringe discovered near the crime scene. Please identify each fingerprint pattern:

Each worth 5 points



Sample #1

Tented Arch



Sample #2

Ulnar Loop

The following are the fingerprints collected from the suspects. Please identify each fingerprint pattern (all from right hand):

Each worth 5 points

Suspect #1

Tented Arch



Suspect #2

Ulnar Loop



Suspect #3

Tented Arch

Suspect #4

Ulnar Loop

Suspect #5

Ulnar Loop

Suspect #6

Plain Whorl

Part V (cont.)

Do the samples implicate anyone; if so, whom? (can be more than one person)

Worth 5 points

Jordan Liu

Circle the correct answers pertaining to fingerprints:

Each MC worth 5 points, each open-ended worth 10 points

01. The most common type of fingerprint pattern is the
 - a. Arch
 - b. Delta
 - c. Whorl
 - d. Loop**

02. What would be the best way of visualizing a print found on a matchbook?
 - a. Supergluing
 - b. Ninhydrin**
 - c. Dusting and lifting
 - d. It would not be possible to visualize a print on a matchbook.

03. How large an area of a latent print is needed to make a positive comparison to an inked print?
 - a. Large enough to find at least 8-12 ridge characteristics**
 - b. Large enough to find at least 5 ridge characteristics
 - c. A whole fingerprint
 - d. Half a fingerprint

04. What would be the best way of visualizing a print found on a glass bottle?
 - a. Iodine Fuming
 - b. Dusting and lifting
 - c. Superglue fuming
 - d. Either b or c**

05. A fingerprint left on a metal surface is mostly composed of
- Organic compounds
 - Amino Acids
 - Water**
 - Salt
6. Fingerprints are friction ridges of the **epidermis** layer of the skin.
7. Sweat glands that produce the oils left by fingerprints are found in the **dermis** layer of the skin.
8. A chemical reagent used to develop latent prints on porous materials by reacting with amino acids is called **ninhydrin**.
9. The individuality of a fingerprint is determined by **minutae**.

Part VI:

Based on your analysis of all of the evidence, can you determine who committed the crime? Explain what you think transpired.

Worth 100 points

75 points:

Jordan Liu:

- **Sodium Chloride (NaCl)**
- **Sucrose (C₁₂H₂₂O₁₁)**
- **Calcium Nitrate (Ca(NO₃)₂)**
- **HDPE**
- **PVC**
- **Polyester**
- **Human**
- **DNA Gel Electrophoresis**
- **Tented Arch Fingerprint**

25 points (for situation):

- **Jordan L. injected Lauren with potassium chloride which resulted in cardiac arrest**
- **Jordan L. was salty about the captainship so he murdered Lauren**