Palmyra Macedon Invitational Forensics

PLEASE PRINT NEATLY !!

NAMES: _____

_____

SCHOOL: _____

SCORE:

Part I: Qualitative Analysis: 20 % _____

Part II: Polymer Analysis 20% _____

Part III: Chromatography: 15 % _____

Part IV: Physical Evidence: 15 % _____

Part V: Crime Analysis: 30 % _____

TOTAL SCORE **_____**

Contents: Crime Statement

Suspect Interviews and Information

Evidence List

Part I

Part II

Part III

Part IV

Part V

Crime Description

On Tuesday, January 5th, Mrs. Newton discovered her favorite mechanical pencil (a family heirloom passed down from a distant cousin Isaac) was missing. She used the pencil at the beginning of 5th period then spent the remainder of 5th working with Skippy at a table on the far side of the room. After running to the teachers room to get a Diet Coke between 5th and 6th periods she could not locate the pencil and on her desk was a soggy napkin with some smudged ink. Mrs. Newton quickly called in her forensic science students from the science Olympiad team. The students bagged all the evidence on the desk, took photos of the crime scene, then interviewed all students who had been in the room during the time when the crime occurred. Interviewers told all suspects the interview was training for Science Olympiad and did not reveal the nature of the crime, stating only that an item of value was missing from Room 234. Each suspect was asked to provide fingerprints, a DNA sample , and turn in any pens they have with them.

Suspect Notes from Interviews

Robby Plumber

Robby is a junior in the high school and has Mrs. Newton for Regents Physics during 3rd and 4th period. While not on the Science Olympiad team, Robby frequently spends 5th period in Room 234 eating his lunch and working on his math homework with Lucy Shephard as they have math 6th period. Robby reported that he had a peanut butter sandwich for lunch with Baked Lays chips and a Fiber One granola bar and Code Red Mountain Dew. Robby also works part time at Wegmans in the bakery department. Robby is about 6 feet 3 inches tall, has blue eyes, red hair and type A blood. He does not have any pets at home. He was wearing jeans, nike sneakers and a Harvard sweatshirt. Robby is left handed and turned in a black pen.

John (Skippy) Snow

Skippy is a senior at the high school and has Mrs. Newton for AP Physics 6th and 7th period. Skippy is a three year member of the science Olympiad team and usually spends 5th period in Room 234 eating lunch and working on his Mission Possible build. Skippy reported that he had a ham and cheese sandwich on wheat bread, some cheezits and a bottle of hawaiin punch for lunch. Skippy works as an ala carte chef at Wegmans. He is 5 feet eleven inches tall, has green eyes, black hair and does not know his blood type. Skippy does not have any pets at home. He was wearing blue jeans, work boots, and a science Olympiad t-shirt. Skippy is right handed and turned in both a black pen and an old fashioned number two pencil.

Maggie Chopper

Maggie is a sophomore at the high school and does not have Mrs. Newton for class but is a first year member of the science Olympiad team. Maggie frequently comes

in during 5th period after chemistry with Lizze Palmer to work on Forestry (they are both really into tree identification). Maggie has 6th period lunch so does not usually eat during 5th period but she does carry a "Sig" canteen and reportedly had some red Powerade in the canteen today. Maggie is 5 feet ten inches tall, has long brown hair and brown eyes. She is pretty sure her blood type is AB+. Her family has a psycho cat (on meds currently). She was wearing black cotton sweatpants, Ugg boots and a grey polyester Geneseo sweatshirt. Maggie is right handed and turned in a blue pen and a black fine line sharpie. Maggie had some white powder on her pants which she stated must have come from Gourmet Food class where they are learning to bake and decorate cakes.

Tim Franklin

Tim is a senior at the high school and has Mrs. Newton for Regents Physics 1st and 2nd period. Tim is not on the science Olympiad team and is not a regular visitor during 5th period but stopped by to drop off his lab book. Tim stopped to chat with Robby for a few minutes then left for the cafeteria. Tim is 5 feet 2 inches tall, has green eyes and light brown hair. He reportedly as type O + blood and has a dog at home. Tim was wearing jeans, adidas soccer shoes and a Manchester United jersey. He was carrying a bottle of Cherry 7-Up when questioned. He is currently on crutches as he sprained his ankle at badminton practice. Tim is left handed and said he loaned his black pen to a friend during lunch. (He dropped the pen off later.)

Lizzie Palmer

Lizzie is a sophomore at the high school and does not have Mrs. Newton for class. Lizzie is a first year member of the science Olympiad team and usually comes in fifth period to study Forestry with Maggie (they have chemistry together 4th period). Lizzie has lunch 7th period so brings a snack to eat during 5th period. She reports that today she had a whole wheat bagel and plain water while studying. Lizzie is five feet two inches tall, has blue eyes, blond curly hair and reports that she has type 0 blood. Her family has three cats. Lizzie was wearing blue jeans, mammoth crocs, and a pink fleece jacket. Lizze is right handed and turned in a cool pink pen.

Lucy Shephard

Lucy is a junior at the high school and has Mrs. Newton for Regents Physics 1st and 2nd period. Lucy is not a member of the science Olympiad team but comes in 5th period during her lunch to work on physics and math with Robby. She mentioned they had studied today for a big test 6th period in math. Lucy is 5 foot 4 inches tall and has brown hair and brown eyes. Lucy recently donated blood and showed off her donor card indicating she is blood type A+. Lucy reported eating a school salad, a bag of fruit snacks and a bottle of XXX vitamin water. Lucy was wearing blue jeans a red Cornell sweatshirt and Nike Shox sneakers. She works part time at the Purple Hippo (a local bakery). Lucy is right handed and turned in a black pen but asked to keep her pencil that she needed for the math test as the math teacher is adamant about using pencil.

Evidence –

A – Powder A found on desk.
B – Powder B found on floor.
C – Powder C found on desk.
D – Powder D found near door.
E – Powder E found near desk.
F – Powder F found on Maggie.
G – Plastic #1 found on floor.
H – Plastic #2 found near trash can.
I – Hair #1 found on desk.
J – Hair #2 found near door.
K – Fiber #1 found on chair.
L – Fiber #2 found on desk.
M – Ink sample.
N – Mass Spec Analysis
O– Fingerprint found on stapler.
P – Footprint found near desk.
Q– Spatter near trash can.

Provided –

5 black pens turned in by suspects
Napkins similar to one found on desk
Ink Solvent
NaOH
HCl
Flame Test Results
Benedicts Test Results
Fingerprint found at scene
Footprint found at scene

Test Results Flame and Benedict

Sample	Flame	Benedicts
A	Red-orange	No Reaction
B	Yellow	Bubbles in Heat
C	Red	No Reaction
D	Yellow	No Reaction
E	Yellow	No Reaction
F	No Change	Inconclusive

Part I – Qualitative Analysis

Use the material provided and your equipment to identify each of the six substances found at the crime scene. Points are as indicated. (20 pts max)

	Chemical Name	Chemical Formula	Use/Uses	Suspect/Suspects Implicated
Evidence A				
Evidence B				
Evidence C				
Evidence D				
Evidence E				
Evidence F				

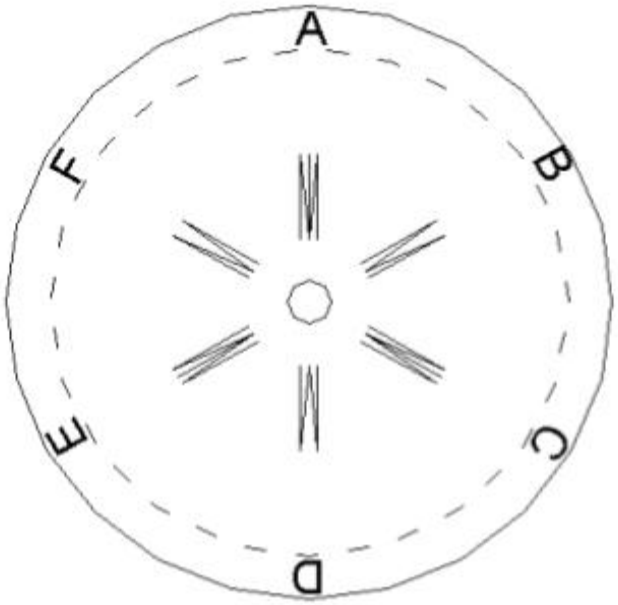
Part II – Polymer Analysis

	Identification	**Implicated Suspect/Suspects**
G – Plastic 1		
H – Plastic 2		
I – Hair 1		
J – Hair 2		
K – Fiber 1		
L – Fiber 2		

Part II – Chromatography and Mass Spec

Using the chromatography disk provided and the pens from each of the 5 suspects place the ink samples at approximately 60 degrees from each other, 1 cm from the center hole. Using an imaginary radial from the center hole through the ink sample to the outer edge, label the origins of the samples according to the following:

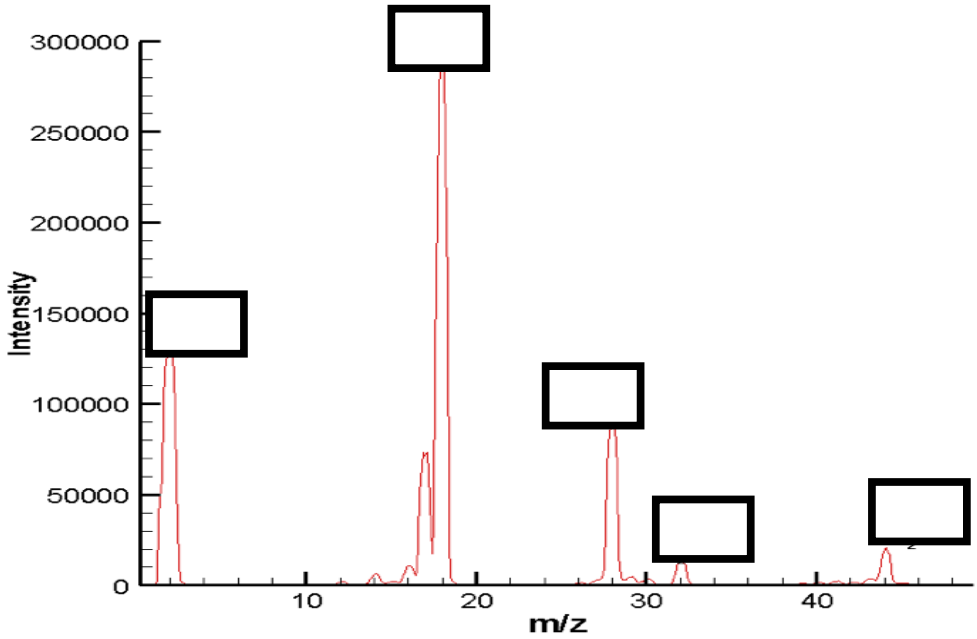
Note Sample A
Robbie B
Skippy C
Maggie D
Tanya E
Pete F



Next, fill the container provided approximately ¾ full with the 70% alcohol located at the communal liquids table. Using the blank filter disk, roll it into a tube and insert it into the center hole to form a wick. Now place the lower end of the wick in the eluting solution, allowing the disk to lay flat across the rim of the container.
The eluting solution will rise up the "wick" and move laterally into the disk, fractionalizing the samples. Do not allow the eluting solution to reach the labels for obvious reasons. Tape your completed chromatogram above.

Which pen was used to write the note? _____

Mass Spec: Mrs. Newton just received this in the mail, but the peaks are not lableled. Label the peaks with H_2, H_2O, CO_2, N_2 and O_2.



Explain why there are two peaks at approximately 18 on the m/z scale.

Mass Spec:

Part III – Physical Evidence

A. Fingerprint :

Fingerprint #1:

The fingerprint was found on a broken plastic bottle found in the trash.

a. What would be the best technique to use to capture the fingerprint from the plastic ?

b. Which suspect (or none) most likely left fingerprint #1 ?

c. IF you ID a suspect state what type of feature is identifiable, if no one, state one possible reason for no match.

B. Footprint (3 pts)

a. (1) What type of footwear most likely left the footprint ?

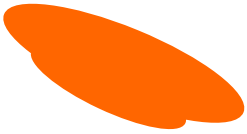
b. (1) Who is the most likely suspect implicated by the footprint ?

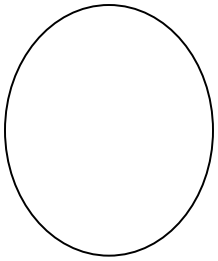
c. (1) Explain your reasoning for your answer to b.

C. Spatter analysis (6 pts):

Based on the picture of the spatter of red liquid found at the scene answer the following questions.

a. (2) Indicate in the circle with an arrow pointing the direction of travel of the liquid when the spatter was made.





b. (2) Based on the pattern, calculate the angle of impact assuming the ground was level. You must show formula and calculation for full credit.

c. (2) Assuming a linear trajectory with no air resistance, was the spatter low, medium or high velocity ? Explain your choice.

Part IV: Analysis of the Crime: (30 pts)

Complete the grid organizing the evidence presented. Rate the weight of the evidence from 1-5 with 5 being very important.

Evidence	Description	Class or Individual	Suspect Implicated	Weight
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				

6 pts – (1 pts each) Explain briefly why or why not each subject my be the culprit.

Robby-

Skippy-

Maggie-

Tim-

Lizzie-

Lucy-

7 pts - Citing specific evidence from the crime -

- State who is the most likely suspect (2)
- Explain why you suspect this person (2)
- Explain what you think might really have happened (1)
- Offer at least two further investigations that should be conducted (2)

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ANSWER KEY !!!!

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Part I – Qualitative Analysis
Use the material provided and your equipment to identify each of the six substances found at the crime scene. Points are as indicated. (20 pts max)

	Chemical Name	Chemical Formula	Use/Uses	Suspect/Suspects Implicated
Evidence A	Calcium Nitrate	Ca(NO3)2	Fertilizer/Ice Melt	No one
Evidence B	Baking Soda	NaHCO3	Food	Mag/Liz/Lucy/Skip/ Rob
Evidence C	Lithium Chloride	LiCl	BiPolar	Maggies Cat
Evidence D	Corn Starch		Food	Mag/Liz/Lucy/Skip/ Rob
Evidence E	Sucrose	C12H22O11	Food	Mag/Liz/Lucy/Skip/ Rob
Evidence F	Magnesium Sulfate	MgSO4	Sprains	Tim

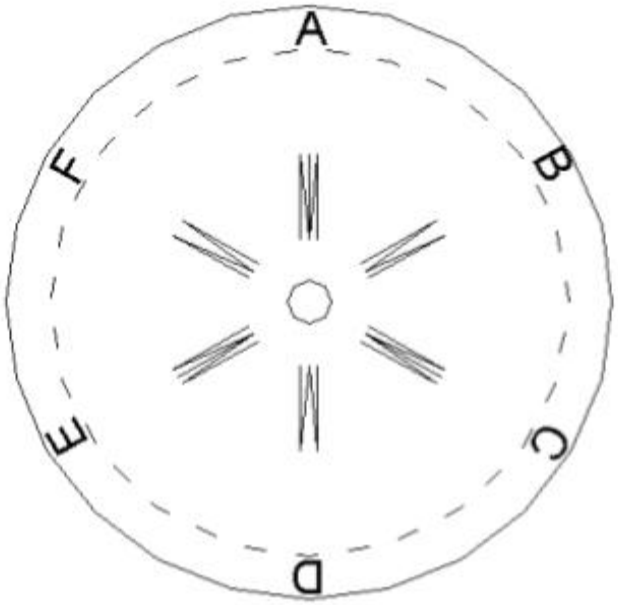
Part II – Polymer Analysis

	Identification	Implicated Suspect/Suspects
G – Plastic 1	**PETE**	**Anyone with a drink bottle.**
H – Plastic 2	**PS**	**Lizzie**
I – Hair 1	**Brown Human**	**Maggie**
J – Hair 2	**Cat**	**Maggie/Lizzie**
K – Fiber 1	**Cotton**	**All**
L – Fiber 2	**Wool**	**No one**

Part II – Chromatography and Mass Spec

Using the chromatography disk provided and the pens from each of the 5 suspects place the ink samples at approximately 60 degrees from each other, 1 cm from the center hole. Using an imaginary radial from the center hole through the ink sample to the outer edge, label the origins of the samples according to the following:

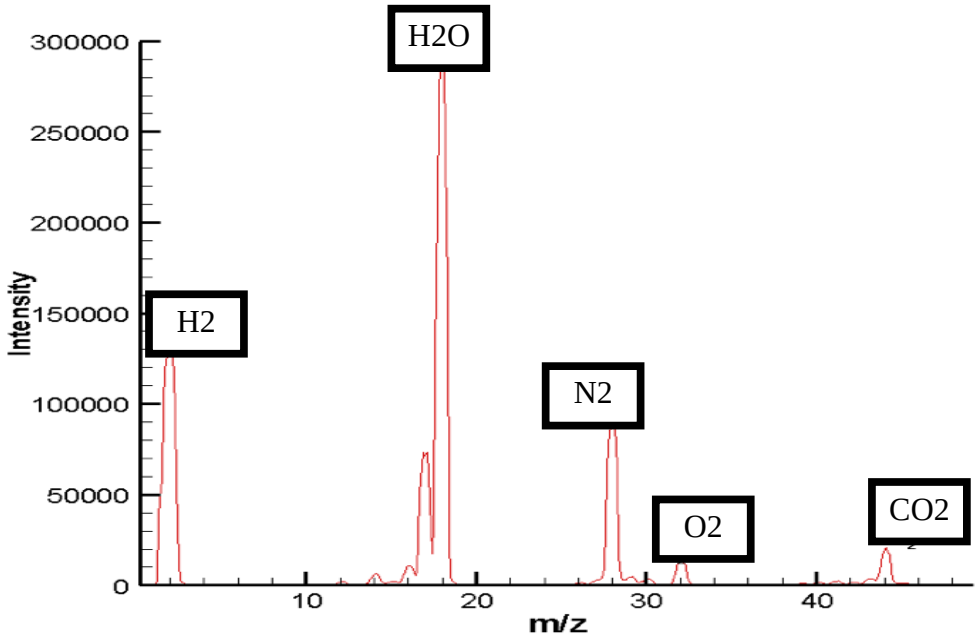
Note Sample A
Robbie B
Skippy C
Maggie D
Lucy E
Tim F



Next, fill the container provided approximately ¾ full with the 70% alcohol located at the communal liquids table. Using the blank filter disk, roll it into a tube and insert it into the center hole to form a wick. Now place the lower end of the wick in the eluting solution, allowing the disk to lay flat across the rim of the container.
The eluting solution will rise up the "wick" and move laterally into the disk, fractionalizing the samples. Do not allow the eluting solution to reach the labels for obvious reasons. Tape your completed chromatogram above.

Which pen was used to write the note? _____Maggie_____

Mass Spec: Mrs. Newton just received this in the mail, but the peaks are not lableled. Label the peaks with H_2, H_2O, CO_2, N_2 and O_2.



Explain why there are two peaks at approximately 18 on the m/z scale.

Isotopes

Mass Spec:

Part III – Physical Evidence

D. Fingerprint :

Fingerprint #1:

The fingerprint was found on a broken plastic bottle found in the trash.

d. What would be the best technique to use to capture the fingerprint from the plastic ?

Dusing/Super Glue

e. Which suspect (or none) most likely left fingerprint #1 ?

Maggie

f. IF you ID a suspect state what type of feature is identifiable, if no one, state one possible reason for no match.

Varies

E. Footprint (3 pts)

a. (1) What type of footwear most likely left the footprint ?

Ugg

b. (1) Who is the most likely suspect implicated by the footprint ?

Maggie

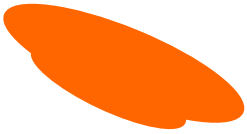
c. (1) Explain your reasoning for your answer to b.

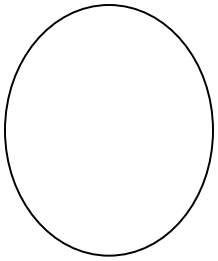
Definitely not a sneaker, only Maggie wearing Uggs

F. Spatter analysis (6 pts):

Based on the picture of the spatter of red liquid found at the scene answer the following questions.

a. (2) Indicate in the circle with an arrow pointing the direction of travel of the liquid when the spatter was made.





b. (2) Based on the pattern, calculate the angle of impact assuming the ground was level. You must show formula and calculation for full credit.

$\sin ø = (1 / 4.2) = 14^{o}$

c.(2) Assuming a linear trajectory with no air resistance, was the spatter low, medium or high velocity ? Explain your choice.

Medium – Elongated and Wide

Part IV: Analysis of the Crime: (30 pts)

Complete the grid organizing the evidence presented. Rate the weight of the evidence from 1-5 with 5 being very important.

Evidence	Description	Class or Individual	Suspect Implicated	Weight
A	Calcium Nitrate	Class	No one	1
B	Baking Soda	Class	Liz/Mag/Lucy/ Rob	2-4
C	LiCl	Class	Liz/Mag/Lucy/ Rob	2-4
D	Corn Starch	Class	Liz/Mag/Lucy/ Rob	2-4
E	Sucrose	Class	Liz/Mag/Lucy/ Skip	2-4
F	Magnesium Sulfate	Class	Tim	2-4
G	PETE	Class	Lots	1
H	PS	Class	Lucy	2-4
I	Human Brown	Individual	Maggie	4-5
J	Cat	Individiual	Maggie	4-5
K	Cotton	Class	Lots	1-2
L	Wool	Class	No one	1
M	Pen	Class	Maggie	4-5
N	NA			
O	Fingerprint	Individual	Maggie	4-5
P	Footprint	Class	Maggie	4-5
Q	Spatter	Class	Lots	1

6 pts – (1 pts each) Explain briefly why or why not each subject my be the culprit.

Robby- Works at bakery but otherwise no real evidence. Unlikely he would have powders still on him from work yesterday.

Skippy-Already had a pencil.

Maggie-Most Likely!! Most Evidence.

Tim-Very little evidence only sprained ankle.

Lizzie-Only links were from her job which like Robby it is unlikely that the powders came from her.

Lucy-Had a pencil.

7 pts - Citing specific evidence from the crime -

- State who is the most likely suspect (2)
- Explain why you suspect this person (2)
- Explain what you think might really have happened (1)
- Offer at least two further investigations that should be conducted (2)

Most likely Maggie. Probably left a note to borrow pencil. Follow up interviews, DNA testing on hair, fiber analysis to match the cotton. Check people for matching cat hairs. Lots of different answer can receive full credit.