Bueno Nacho Blues – KEY (420)

I. Qualitative Analysis (112)

Complete the following table by identifying each unknown's full name, chemical symbol, and relationship with the corresponding suspect.

Powder	Full Name (5)	Chemical Symbol (3)	Relationship (5)
A.	Magnesium Sulfate	$MgSO_4$	N/A
B.	Potassium Chloride	KCl	Hypokalemia
C.	Sucrose	$C_{12}H_{22}O_{11}$	Grape soda
D.	Boric Acid	HBO_3	Ear infection treatment
E.	Calcium Sulfate	$CaSO_4$	Paint
F.	Magnesium Sulfate	$MgSO_4$	Tofu Coagulent
G.	Calcium Carbonate	$CaCO_3$	Shells
H.	Ammonium Chloride	NH_4Cl	Shampoo
I.	Sodium Carbonate	Na_2CO_3	Soap

II. Polymers (72)

(Note: Provide the abbreviated version of the polymer name, not the full name.)
Identify the polymers. Physical samples will be provided. (4 pts each)

J. _____LDPE_____

K. _____PMMA_____

L. _____PC_____

M. _____PP_____

N. _____PVC_____

O. _____LDPE_____

P. _____PETE_____

Q. _____PMMA_____

R. _____PC_____

S. _____HDPE_____

T. _____PS_____

Identify the polymer based on the description. (2 pts each)

_____PMMA_____ Sold under the trademarks Lucite, Plexiglas and Perspex

_____PP_____ Floats in water, floats in 46% isopropyl alcohol, floats in vegetable oil

_____HDPE_____ Floats in water, sinks in 46% isopropyl alcohol

_____PVC_____ Burn Test: Plastic chars, self-extinguishing, green flame

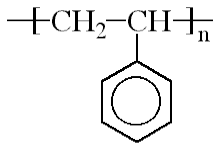
_____PC_____ Burn Test: plastic drips, self-extinguishing, orange flame, black smoke

_____LDPE_____ Used in cellophane wrap and diapers

_____PETE_____ Burn Test: Does not char, shrivels, plastic drips, yellow flame

Answer the following questions. (2 pts each)

1. PP polymerizes by ____addition_____.
2. Provide the full name for PMMA.
   Polymethyl methacrylate
3. What is the term describing a repeating unit in a polymer chain?
   Mer
4. What is the melting point of PVC?
   100-260°C
5. Draw the monomer unit structure of polysterene.



6. The recycling rate for polyethylene terephthalate is about __20__%.
7. Which polymer is commonly used in disk drives and swim noodles?
   LDPE

III. Hairs & Fibers (54)

In the space provided, identify the hair and fiber. (4 pts each)

U. 

human

V. 

bat

W. 

dog

X. 

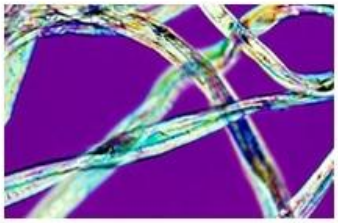
horse

Y. 

cat

Z. 

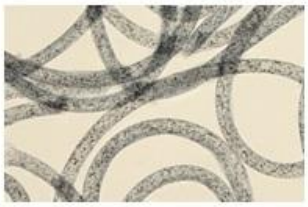
nylon

AA. 

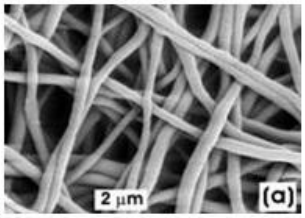
cotton

BB. 

polyester

CC. 

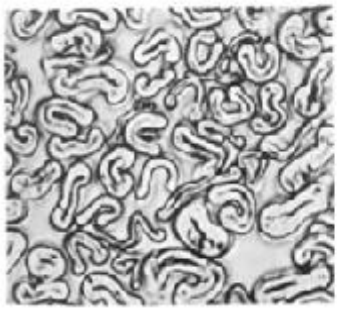
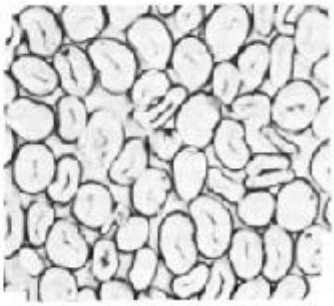
nylon

DD. 

silk

Answer the following questions. (2 pts each)

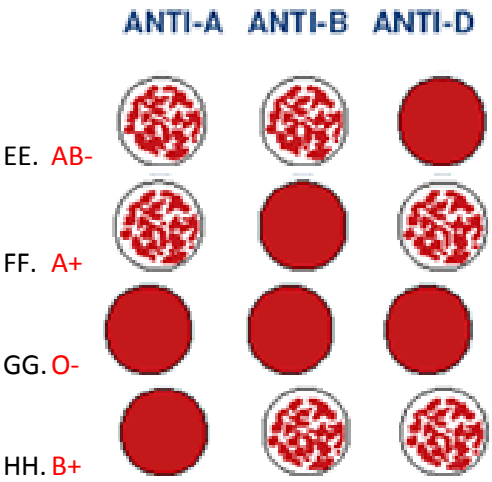
1. What characteristic of silk gives it a shimmering appearance?
   Prism-like structure of the silk fiber
2. Nylon was intended to be the synthetic replacement for which other fiber?
   Silk
3. Draw cross section of cotton, not mercerized and mercerized (respectively).

4. Define mercerization. (1 pt for describing its effect on cotton; 2 pts for explaining how the process works)
   The process of strengthening cotton by altering its chemical structure with the treatment of caustic alkali under tension
5. Name the fiber that produces sparks, does not produce smoke, and burns at a constant rate in a burn test.
   Linen
6. Name the fiber that does not shrink from the flame, leaves behind sticky ash, and melts quickly.
   Spandex
7. Name the fiber that shrinks from the flame, melts, produces black residue, and ignites only when brought to flame.
   Nylon

IV. Blood (22)

Identify the following blood types (including the Rh factor) based on the blood test results. (3 pts each)



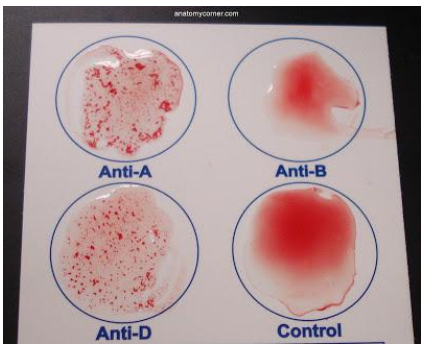
EE. AB-

FF. A+

GG. O-

HH. B+

II. A blood sample was taken from the scene. The results are shown to the right. Identify the blood type and the corresponding suspect.
A+, Duff Kiligan



Answer the following questions. (7)

1. A, B, and O are __(1)__. While A and B are __(2)__ __(1)__, O is a __(3)__ __(1)__.
   Hint: (1) is defined as one of many forms of the same gene. (3)
   Allele, Codominant, recessive
2. From which animal is the phrase "Rh Factor" derived from? (2)
   rhesus monkey
3. Define blood borne pathogen. (2)
   disease causing agent that is present in the blood and can be transferred from one person to another

V. Fingerprints (24)

Identify the fingerprint pattern. (2 pts each)

NN

OO: Right hand

PP: Left hand

QQ

RR

NN._____central pocket loop_____

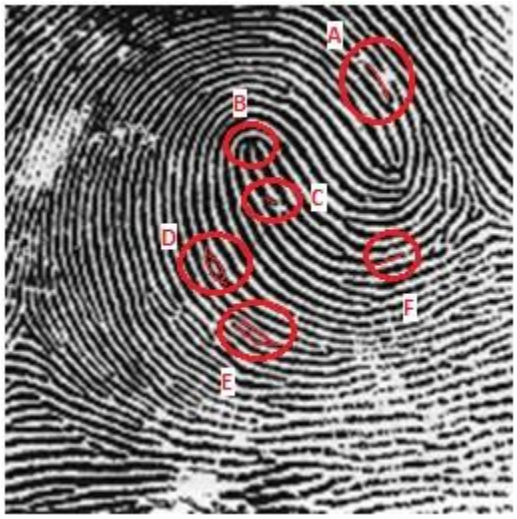
OO._____ulnar loop_____

PP. _____radial loop_____

QQ._____central pocket loop_____

RR. _____plain whorl_____

Identify the fingerprint minutiae. (2 pts each)



A. _____island_____

B. _____core_____

C. _____spur_____

D. _____lake/enclosure_____

E. _____bifurcation_____

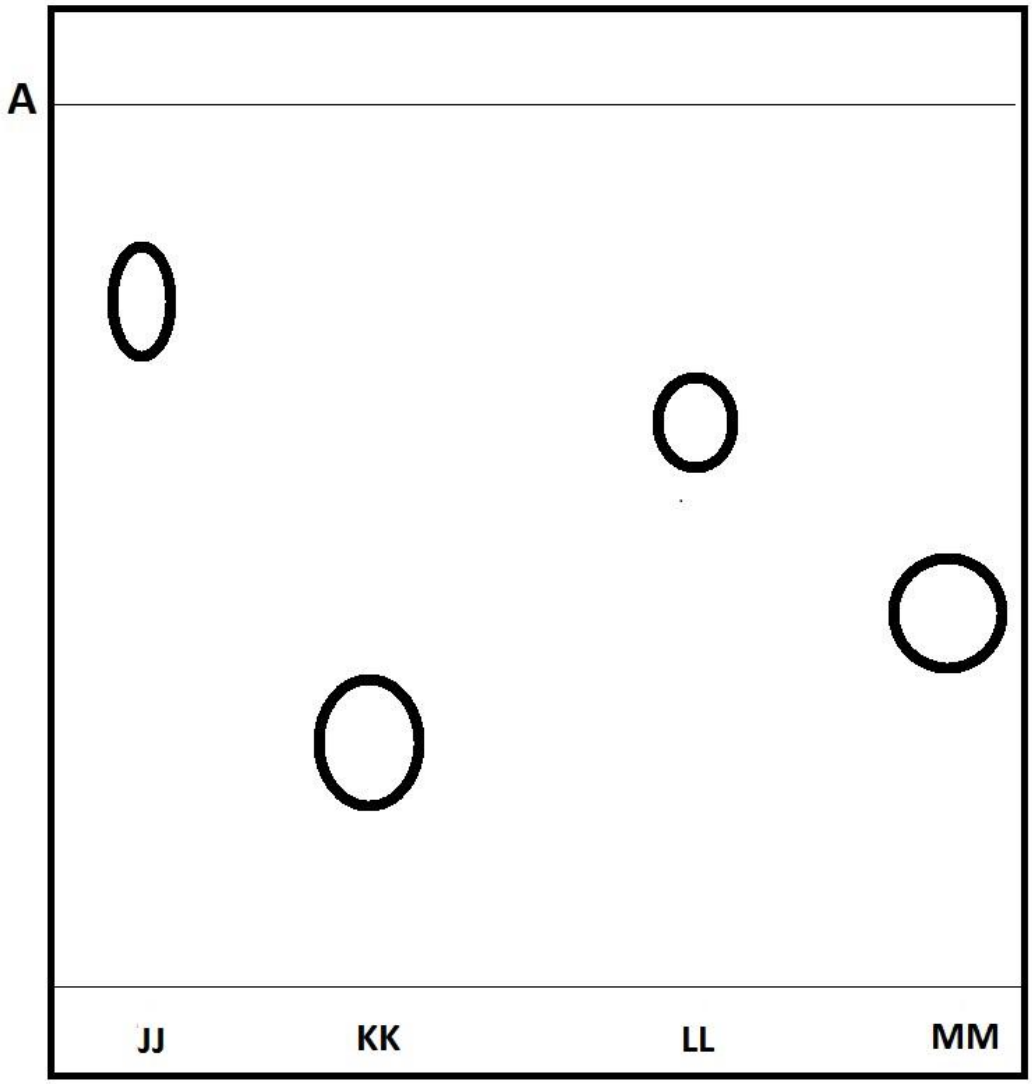
F. _____ridge ending_____

Identify the fingerprint pattern.

double loop

VI. Chromatography (15)

A represents the stopping point of the solvent. Find the Rf factors of each pen. (3 pts each)



JJ: ____0.777_____

KK: ___0.268_____

LL: ____0.636_____

MM: ___0.424_____

The Rf factor of the ink from the pen discovered at the crime scene is 0.64. Whose pen was found at the crime scene? (3)

Monkey Fist

VII. Entomology and Decomposition (12)

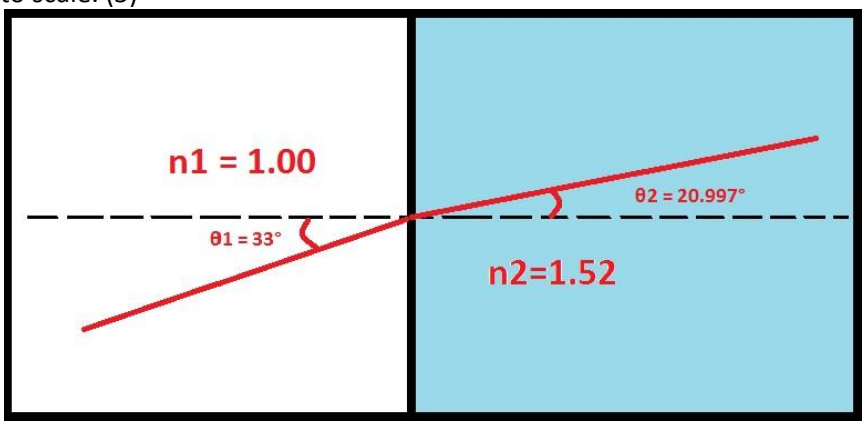
The following picture depicts the one of the larvae that were found in the wounds of various corpses at Bueno Nacho. The larva has already passed the first instar. (2 pts each)

1. Give the common name for 'larvae'.
   Maggot
2. Identify the order.
   Diptera
3. Give the common name of the specimen's order.
   True flies
4. Which two families (from the same order) are usually the first to arrive at a crime scene within minutes?
   Calliphoridae, Sacrophagidae
5. The corpse has started to swell and produce odors. Based on the information given, identify the stage of decomposition that the corpse has reached.
   Bloat/Putrefaction Stage
6. Approximately how many days ago was the crime committed?
   4-10 days

VIII. Glass (9)

Light travels from air into a shattered glass piece with an angle of incidence of 33°. The angle of refraction on the end of the glass piece is 20.997°.

1. Sketch a picture of the path of light as it travels through the two mediums. The angles do not have to be drawn to scale. (5)



2. Calculate the index of refraction of the glass. Round to the nearest two decimal places. (2)
   1.52
3. The glass piece is which type of optical glass? (2)
   Crown Glass

Analysis (100)

After weeks of thorough investigation and examination, the question still comes down to this:
Who is responsible for wreaking havoc at Bueno Nacho? Be sure to support your answer with evidence and reasoning.

Unknowns: Calcium Nitrate (meat preserve), Sodium Chloride (cooking), Magnesium Sulfate (Monkey Fist)
Polymers: LDPE (Duff Kiligan), PMMA (Monkey Fist), PC (Monkey Fist)
Hair: Human (Anyone but Monkey Fist)
Fiber: Spandex (Monkey Fist)
Blood Type: A+ (Duff Kiligan)
Fingerprint: Plain Whorl (Monkey Fist)
Chromatography: Monkey Fist

Culprit: Monkey Fist