

Science Olympiad - C Division
ISLIP INVY 2016 FORENSICS
 Answer Sheet

School Name <u>Key</u>	
Team #	
Student 1	
Student 2	
FOR JUDGES ONLY	
Safety Penalties [] [] [] [] [] []	Score
Cleanup Penalty []	Rank

PART 1 - QUALITATIVE ANALYSIS	
P-A (1 pt)	magnesium sulfate
P-B (1 pt)	sodium bicarbonate
P-C (1 pt)	glucose
P-D (1 pt)	sucrose
P-E (1 pt)	sodium chloride

P-F (1 pt)	cornstarch	P-G (1 pt)	magnesium sulfate	P-H (1 pt)	sodium bicarbonate
Q2 (3 pt)	sodium citrate, sodium carbonate, copper (II) sulfate				
Q3 (2 pt)	sodium citrate ensures Cu^{+2} ions when stored; sodium carbonate provides basic solution for redox; copper (II) ions are reduced in the presence of reducing sugars to produce red Cu^+ ions. ① each				
Q4a (2 pt)	$Na_2CO_3 + CaCl_2 \rightarrow CaCO_3 + 2NaCl$		① formulas ① coefficients		
Q4b (2 pt)	$CaCO_3 \rightarrow CaO + CO_2$		① formulas ① coefficients		
Q4c (1 pt)	aragonite, calcite, dolomite		Q4d (1 pt)	limestone, marble, dolostone...	

PART 2 - POLYMERS

H-A (1 pt)	human	F-A (1 pt)	linen
H-B (1 pt)	human	F-B (1 pt)	cotton
H-C (1 pt)	human	F-C (1 pt)	silk
H-D (1 pt)	squirrel	F-D (1 pt)	wool
H-E (1 pt)	batt	F-E (1 pt)	cotton
H-F (1 pt)	cow	F-F (1 pt)	linen
H-G (1 pt)	horse	F-G (1 pt)	polyester
Q3 (1 pt)	synthetic	Q4 (1 pt)	spinrow
Q5 (2pt)	mangloid → nearly circular with densely distributed pigments ①		

PART 3 - CHROMATOGRAPHY & SPECTROSCOPY

Q1 (4 pt)	Be sure to attach chromatograph to the upper lefthand corner!		
Q2 (1 pt)	C and D	Q3a (1 pt)	blue
Q3b (1 pt)	The blue ink is the most soluble in the mobile phase so it will emerge first in column chromatography w/ similar stationary phase.		
Q4 (1pt)	helium	Q5a (1pt)	ketone

PART 3 - CHROMATOGRAPHY & SPECTROSCOPY (CONTINUED)

Q5b (1pt) alcohol

Q5c (1pt) ether

Q6 (1pt) had the strongest interaction with the stationary phase

Q7 (3pt) ethyl butyrate ① molar mass closest to largest m/z ①
 peak at 71 (right of C=O), peak at 29 (right of ether O)

PART 4A - FINGERPRINTS

Q1 (1 pt) DI or DM or DO (double loop)

Q2 (1 pt) Ken

Q3 (1 pt) Ophelia

Q4a (1/2 pt) enclosure / eye

Q4b (1/2 pt) dot / island

Q4c (1/2 pt) bifurcation / fork

Q4d (1/2 pt) ridge ending

Q5 (1 pt) chloride salts

PART 4B - BLOOD

B-A (1/2 pt) B-

B-B (1/2 pt) O+

B-C (1/2 pt) O+

B-D (1/2 pt) AB+

B-E (1/2 pt) A+

B-F (1/2 pt) AB+

B-G (1/2 pt) O+

B-H (1/2 pt) B-

PART 4C - GLASS

Q1 (1 pt) F

Q2 (1 pt) The glass has a higher refraction index than clove oil.

Q2 (1 pt) Due to circular nature of blood, the angle of impact is closer to 90° (straight down).

PART 4D - DNA

Q1 (1 pt) Skin from nails + Carrie

Q2 (1 pt) DNA backbone is \ominus charged, will run across to \oplus terminal.

PART 5 - ANALYSIS OF CRIME

Q1 (12 pt) Carrie ④

DNA from nails → individual evidence, difficult to transfer there ④
 Discussion of the following: MgSO₄ (2), linen (2), blood type (2)
 (max 4 points - class evidence)

Q2 (6 pt) Wanda ②
 no evidence implicates her ④

Eaton → ink from group
 Anna → blood type
 Ken → fingerprint

Q3 (4 pt) Horse hair would not be transferred (likely) during competition ②
 perhaps she is a horseback rider? ②

Q4 (4 pt) transfer during cooking competition ② glucose is a baking ingredient ② (glucose syrup common for thickening)

Q5 (4 pt) normal use during the competition ② worked in same team ②

Mass Spectrometry

IV. The Mass Spectrum and Structural Analysis

E. Fragmentation Patterns of Groups

10. Example MS: esters (aliphatic) – ethyl butyrate

