

Preparation Procedure for Laboratory Experiment

FORENSIC ANALYSIS**Chemicals** For a class of 24 students (12 pairs)

Unknowns	Preparation
Sodium chloride	50 g
Sodium bicarbonate	50 g
Sodium carbonate (monohydrate or anhydrous)	50 g
Boric acid	50 g
white sand (fine BUT not flour-like)	50 g
Calcium carbonate	50 g
Cornstarch	50 g
Glucose	50 g
Sodium tetraborate decahydrate (borax)	50 g
Sucrose ("pseudo-amphetamine")	50 g
Magnesium sulphate heptahydrate ("pseudo-ecstasy")	50 g
Calcium sulphate dihydrate ("pseudo-heroin")	50 g
Potassium iodide ("pseudo-LSD")	50 g
Trisodium phosphate, any hydrate ("pseudo-cocaine")	50 g

Test Reagents (in 12 droppers each)	Preparation
"Iodine solution"	10 g iodine diluted to 100 mL in ethanol
"Vinegar"	5 mL concentrated acetic acid diluted to 100 mL
"10% BaCl ₂ solution"	10 g of BaCl ₂ •2H ₂ O diluted to 100 mL
"5% Pb(NO ₃) ₂ solution"	5 g of Pb(NO ₃) ₂ diluted to 100 mL
"10% HCl solution"	Dilute 52 mL concentrated HCl to 200 mL
"NaOH solution"	Dilute 5.4 g NaOH to 200 mL
"Anthocyanin solution" (requires 1 L of 70% Isopropyl alcohol)	Mix 500 g of chopped red cabbage with 1 L of 70% isopropyl alcohol, gently boiled for 1 hour to extract the anthocyanin, filtered and boiled down to 100 mL of very deep purple liquid. Keep refrigerated or in freezer between uses.
"Fehling's Solution A"	Dilute 6.93 g of CuSO ₄ •5H ₂ O to 100 mL
"Fehling's Solution B"	Dissolve 0.44 g of sodium potassium tartrate and 13.0 g of NaOH and dilute to 100 mL
"Buffer"	Mix 250 mL of 0.10 M KH ₂ PO ₄ and 73 mL of 0.20-M NaOH (creates pH = 7.0)
"Bromothymol blue"	Dissolve 0.10 g bromothymol blue in 16 mL of 0.010 M NaOH and dilute to 250 mL

Equipment

12 – spatulas	3 – centrifuges	24 – 250 mL beakers	12 – match books
24 – small test tubes	24 – stirring rods	12 – ceramic pads	12 – test tube holders
12 – rubber stoppers to fit test tubes	6 – hot plates	12 – evaporating dishes	

Unknowns (Actual Composition)

Note that two unknowns in each set contain two different substances, one of which is soluble in water and one of which is insoluble. Each student will receive three separate unknown samples, labelled as a, b and c.

Note: The chemicals in each sample must be extremely well mixed, grinding them if necessary to guarantee that a “pea-sized” sample contains equal volumes of each substance.

Stock #	Insoluble compound	Soluble compound	Numbers Assigned to Unknowns
1.	a sand	H ₃ BO ₃	1, 20, 27
	b	pseudo-amphetamine (sucrose)	
	c pseudo-heroin (CaSO ₄)	glucose	
2.	a CaCO ₃	Na ₂ CO ₃	2, 11, 24
	b	NaCl	
	c cornstarch	pseudo-LSD (KI)	
3.	a cornstarch	NaHCO ₃	3, 19, 21
	b	pseudo-cocaine (Na ₃ PO ₄)	
	c pseudo-heroin (CaSO ₄)	glucose	
4.	a sand	Na ₂ B ₄ O ₇	4, 12, 28
	b	NaCl	
	c pseudo-heroin (CaSO ₄)	pseudo-ecstasy (MgSO ₄)	
5.	a sand	H ₃ BO ₃	5, 18, 25
	b	pseudo-amphetamine (sucrose)	
	c CaCO ₃	Na ₂ CO ₃	
6.	a cornstarch	pseudo-LSD (KI)	6, 13, 22
	b	pseudo-cocaine (Na ₃ PO ₄)	
	c sand	Na ₂ B ₄ O ₇	
7.	a cornstarch	NaHCO ₃	7, 17, 29
	b	NaCl	
	c pseudo-heroin (CaSO ₄)	pseudo-ecstasy (MgSO ₄)	
8.	a sand	H ₃ BO ₃	8, 14, 26
	b	pseudo-amphetamine (sucrose)	
	c pseudo-heroin (CaSO ₄)	glucose	
9.	a CaCO ₃	Na ₂ CO ₃	9, 16, 23
	b	NaCl	
	c cornstarch	pseudo-LSD (KI)	
10.	a cornstarch	NaHCO ₃	10, 15, 30
	b	pseudo-cocaine (Na ₃ PO ₄)	
	c sand	Na ₂ B ₄ O ₇	

Student Unknown Numbers and their Contents

Unknown #	Contains	Unknown #	Contains
1	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose	16	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD
2	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD	17	a = cornstarch + NaHCO ₃ b = NaCl c = pseudo-heroin + pseudo-ecstasy
3	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = pseudo-heroin + glucose	18	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = CaCO ₃ + Na ₂ CO ₃
4	a = sand + Na ₂ B ₄ O ₇ b = NaCl c = pseudo-heroin + pseudo-ecstasy	19	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = pseudo-heroin + glucose
5	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = CaCO ₃ + Na ₂ CO ₃	20	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose
6	a = cornstarch + pseudo-LSD b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇	21	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = pseudo-heroin + glucose
7	a = cornstarch + NaHCO ₃ b = NaCl c = pseudo-heroin + pseudo-ecstasy	22	a = cornstarch + pseudo-LSD b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇
8	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose	23	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD
9	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD	24	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD
10	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇	25	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = CaCO ₃ + Na ₂ CO ₃
11	a = CaCO ₃ + Na ₂ CO ₃ b = NaCl c = cornstarch + pseudo-LSD	26	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose
12	a = sand + Na ₂ B ₄ O ₇ b = NaCl c = pseudo-heroin + pseudo-ecstasy	27	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose
13	a = cornstarch + pseudo-LSD b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇	28	a = sand + Na ₂ B ₄ O ₇ b = NaCl c = pseudo-heroin + pseudo-ecstasy
14	a = sand + H ₃ BO ₃ b = pseudo-amphetamine c = pseudo-heroin + glucose	29	a = cornstarch + NaHCO ₃ b = NaCl c = pseudo-heroin + pseudo-ecstasy
15	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇	30	a = cornstarch + NaHCO ₃ b = pseudo-cocaine c = sand + Na ₂ B ₄ O ₇

Note: There are actually only 10 different mixtures, which are distributed as follows.

Mixture	Found in the following unknowns
NaCl	2-b, 4-b, 7-b, 9-b, 11-b, 12-b, 16-b, 17-b, 23-b, 24-b, 28-b, 29-b
sucrose	1-b, 5-b, 8-b, 14-b, 18-b, 20-b, 25-b, 26-b, 27-b
Na ₃ PO ₄	3-b, 6-b, 10-b, 13-b, 15-b, 19-b, 21-b, 22-b, 30-b
sand + H ₃ BO ₃	1-a, 5-a, 8-a, 14-a, 18-a, 20-a, 25-a, 26-a, 27-a,
CaSO ₄ + glucose	1-c, 3-c, 8-c, 14-c, 19-c, 20-c, 21-c, 26-c, 27-c
CaCO ₃ + Na ₂ CO ₃	2-a, 5-c, 9-a, 11-a, 16-a, 18-c, 23-a, 24-a, 25-c
cornstarch + KI	2-c, 6-a, 9-c, 11-c, 13-a, 16-c, 22-a, 23-c, 24-c
cornstarch + NaHCO ₃	3-a, 7-a, 10-a, 15-a, 17-a, 19-a, 21-a, 29-a, 30-a
CaSO ₄ + MgSO ₄	4-c, 7-c, 12-c, 17-c, 28-c, 29-c
sand + Na ₂ B ₄ O ₇	4-a, 6-c, 10-c, 12-a, 13-c, 15-c, 22-c, 28-a, 30-c

TEACHER NOTES

- The tests have been tried exhaustively and appear to work well. This lab is a test of a student's ability to accurately follow instructions. A student (or pair of student, if desired) should be able to test 3 samples in one hour **IF** they have been shown how to use a centrifuge properly in the period previous to the lab. Also, in the previous period students should be shown how to read the Instructions and how to interpret the results and what actions to follow. They should be shown how the Flow Chart allows them to keep track of where they are at a given point in the analysis. They should understand that "Analysis is Complete" should be interpreted as "Now start afresh on the next sample".
- IMPORTANT:** Students must be instructed that all measurements are approximate, so that "1 mL" can be a bit more or less than 1 mL, for instance, and still give good results. **ALSO**, to avoid contamination when using 10mL graduated cylinders, students **MUST** wash out a graduated cylinder three times with ordinary tap water before putting a new solution in it.
- At the start of the lab period, have one student at each bench get a hot plate, fill a 250 mL beaker 3/4 full of water and set the hot plate on "high". This is needed for students who have to do Step 9. Warn students that whenever the water boils down to 1/2 full, they should add extra water using another beaker.
- The anthocyanin solution should be kept in the refrigerator until ready to be used. (Storage at room temperature for a week may cause decomposition and changes in the colours.)
- The Fehling's test may give a false positive if reducing impurities are present. If a solution does not turn yellow-orange within about 30 seconds, the result should be considered to be **NEGATIVE**.

SUGGESTED MARKING SCHEME

2 marks for each substance correctly identified + 2 marks for quality of written descriptions of results

Total = 12 marks