

TPS Publishing Inc has been *created* and is owned predominantly by experienced teachers, specifically to improve the *success* of each student. We believe that for the core subjects *curriculum, instruction, and assessment must be aligned to government standards in order to ensure that success.*

We are very excited to deliver our first Forensic Science range which is designed for national use.

We believe that a key factor in *obtaining* the very best results in Forensic Science is to *help* students *master* the *content* and *skills* expressed in the *curriculum* and *assessed* in their exams. Thus, we have *focused* upon the *material* students are expected to know and be able to do for their examination. We have also made the books *fun* and *user friendly*.

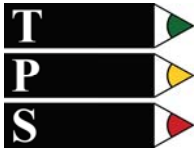
We provide both a *teacher edition* and a *student edition* which follow our *activity based approach* to *crime investigation*. The *teacher edition* is full of *details* and *instructions* to assist in the *teaching* of the subject, along with *exams* that can be copied and set for the students. Both the *Teacher* and *Student* editions provide *fun* and *informative investigations* to enable the *student's continuous activities* to aid in their learning. And of course we provide the *answers* to all *investigations* and *exams* in the *Teacher edition* only!

The cost of our books has been kept low, however we have not reduced the *high level* of quality we demand of *our writers, editors, and graphic designers*. Our *products* provide *materials* using *colourful graphics* to engage each student's mind.

We are confident that you will find our products useful and are confident you will enjoy them.

We are always looking for others to help us in our aims, and if you would like to work with TPS then please contact us on **help@tpspublishing.com**

Wishing you every success...



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Introduction

Television! For over fifty years parents and the public at large have blamed television for the creation of self-indulgent, sofa-hugging youngsters. They say the youth of today have simultaneously developed shrinking attention spans and expanding ideas of the need for every toy and game seen on TV.

But there is currently another phenomenon attached to television. In the past several years there seems to be an unquenchable thirst for crime investigation programmes, both real-life and drama, factual and “enhanced” for the television audience and for those all-important viewing figures!

Science educators have been watching this phenomenon unfold as well. They have recognised that a perfect marriage of science concepts and skills with the “real world application” of science knowledge can be found in the area of forensic science. The students, now intensely interested in the field of using science to solve crimes, as portrayed in the crime scene investigation programmes, find that they can carry out simulations of these investigations in their own secondary school laboratories.

The Pedagogy

Scientific inquiry is at the heart of forensic science. In a forensic science course, students, just as the professionals in the field, are expected to develop testable hypotheses and create logical connections between the design of the experiment and the scientific concepts that underlie the situation. They carry out their investigations, collect and analyse data, formulate explanations, revising their hypothesis if necessary, re-work their investigation, and draw conclusions.

Knowledge — Students will have an opportunity to use the science knowledge they have already collected throughout their school experience, such as concepts in biology, geology, weather, chemistry, and physics as a basis for their continued investigations.

Skills — Students will use and refine already acquired science process skills such as observing, inferring, analysing, evaluating, as well as those technical skills specific to forensic investigation in order to solve the crimes.

Application — Students will discover that “real-world” science requires a great deal of creativity. They will be expected to take knowledge from all the fields of science, researching where necessary to fill any gaps, in order to make their own meaning about their tasks and come to conclusions about the investigation.

In addition, students will be using mathematics concepts, such as trigonometry as applied to trajectories, as another invaluable tool to aid in the explanation of particular crime scenes.

The premise of this course of study is that students have the knowledge and skills to solve problems. They may not, initially, have the knowledge to determine, for example, the exact location of the perpetrator based on the range of blood spatters. However, they have the knowledge and skills to creatively figure it out. They might have to work to do it, but they have the capacity and, if years of testing these lessons is any indication, they enjoy the challenge.

Forensic courses, both in secondary school and at university, continue to grow in popularity just as forensic science continues to expand as a career. Students are recognising that all crimes are not solved in a one-hour segment, as on their favourite TV programmes. But they are also recognising, through courses like this one, that forensic science offers a wide range of opportunities for chemists, biologists, geologists, physicists, artists, photographers, mathematicians, historians, and others who are interested in bringing arts and sciences together with criminal justice.

This series of books are intended as a supplemental resource for the Forensic Science class and consists of a Teacher Edition and a Student Edition.

1. **Teacher Notes** — Detailed “teacher notes” are found at the beginning of each section of the book. Understanding that science teachers have different areas of expertise and that Forensic Science draws from many fields of science, notes have been included to provide background for each area.

These notes provide information about the science concepts and the application of the concepts to forensic investigation.

Teacher notes sections are organized as follows:

- Note sections that are in the Teacher Edition and **NOT** in the Student Edition are colour coded dark red and are identified by an alphabetical label.
- Investigation sections that are in both the Teacher Edition AND the Student Edition are colour coded blue and are identified by a numeric label. They match exactly in both editions and are cross referenced in the contents pages in the Teacher Edition.
- Where there is additional information specifically for the teacher within the investigation sections we have clearly identified these by colour coding them green.

Since the most effective way for students to learn this information is through hands-on investigations, these background notes are not provided in the student edition. When beginning a new section, it is recommended to have students engage in the introductory investigations first. Once those are completed, there may be a period of time in which the teacher provides elaboration on the concepts explored in the investigation. Background notes may be used to guide that discussion.

Since some investigations require the students to have specific knowledge before proceeding with the investigation, notes are provided before the activity in the Student Edition.

-
2. **Investigations** — Copies of the investigations contained in the Student Edition are duplicated in the Teacher Edition. Included are additional teacher tips on where to find specific materials and supplies, instructions on inexpensive ways to create solutions or provide materials necessary for a particular investigation, safety precautions, and areas which might cause confusion for students.

Contained within each unit are investigations that are designed to either deliver notes for key concepts in a captivating, non-didactic manner or guide the students to develop their own knowledge for key concepts through hands-on, real life applications.

3. **Examinations** — an exam is provided for each of the units and are colour coded black.
4. **Answer keys** — Embedded within the investigations and accompanying the unit exams are answer keys and are colour coded light red.

It should be noted that along with knowledge-based questions, for example types of fingerprints, most of the questions students are expected to complete require higher-order thinking skills. For this reason, several acceptable answers may be given in the answer key for a single question. The individual teacher, based on the students' scientific rationale, will be the best judge of the correctness of the statement.

5. **Student Handout Material** — Throughout the book you will see the word 'Handout' on the bottom of certain pages e.g., exam, exam answer sheets... Please feel free to photocopy these pages as handouts to your students. TPS Publishing Inc. are happy for you to photocopy the Handout pages but please refrain from copying others – Thanks.

Good luck with the course...

The Authors



Section A — What is Forensic Science?

Forensic Science

Just what does the word “Forensic” mean? What is “Forensic Science?”

The word “Forensic” comes from the Latin, “Forensis” meaning, “Of, relating to, or used in debate or argument.”

One of the settings in which debating or arguing occurs is in Court. A Court deals with matters of law. Therefore, Forensic Science can be defined as “the application of science to matters of law.”

The above information helps when defining the various areas of Forensic Science. For example, “Forensic Toxicology” is “the application of toxicology to matters of law.” If toxicology is the “study of poisons and their effects,” Forensic Toxicology can be further defined as “the study of poisons and their effects as applied to matters of law.” An example of how a Forensic Toxicologist may help during a criminal investigation is the analysis of the organs of the victim of a suspected poisoning for the presence of poisons.

The following are key concepts of Forensic Science: observation, inference, classification and individualisation. An **observation** is the use of one or more of the senses to learn something about the surroundings, a person or an object. An **inference** is an interpretation of, or a guess based on, an **observation**. Because they are not definitive, steps are typically taken to prove or disprove inferences. The following is an example of how a Forensic Chemist might use observations and inferences when analysing evidence:

A Forensic Chemist uses her sense of smell to *observe* the odour being given off by a white powder contained in a plastic evidence bag. From the odour, she *infers* that it is cocaine. Based on her **inference**, she will start her analysis with a test that is designed to detect the presence of cocaine. The test will either *prove* (the test is positive for cocaine) or *disprove* (the test is negative for cocaine) her **inference** that the white powder is cocaine.

The terms **classification** and **individualisation** are used when analysing evidence. **Classification** is the identification of objects based on general characteristics. For example, an impression of a shoe found in mud may be classified as a running shoe based on its tread pattern. **Individualisation** is the identification of objects based on unique characteristics. For example, the shoe impression found in the mud may be **individualised**, determined as coming from a specific running shoe, based on the presence of unique wear marks.

Section 3 — Areas of Forensic Science

Follow-Up Investigation

Someone wanted Ms. Nan Heff dead. On Saturday morning Ms. Heff received a package with no return address. Going against her gut feeling, Ms. Heff opened the package, which instantly blew up in her face. She was lucky though; part of the bomb malfunctioned causing a nonfatal explosion. Ms. Heff suffered lacerations to the face and neck with the worst injury being to her left eye.

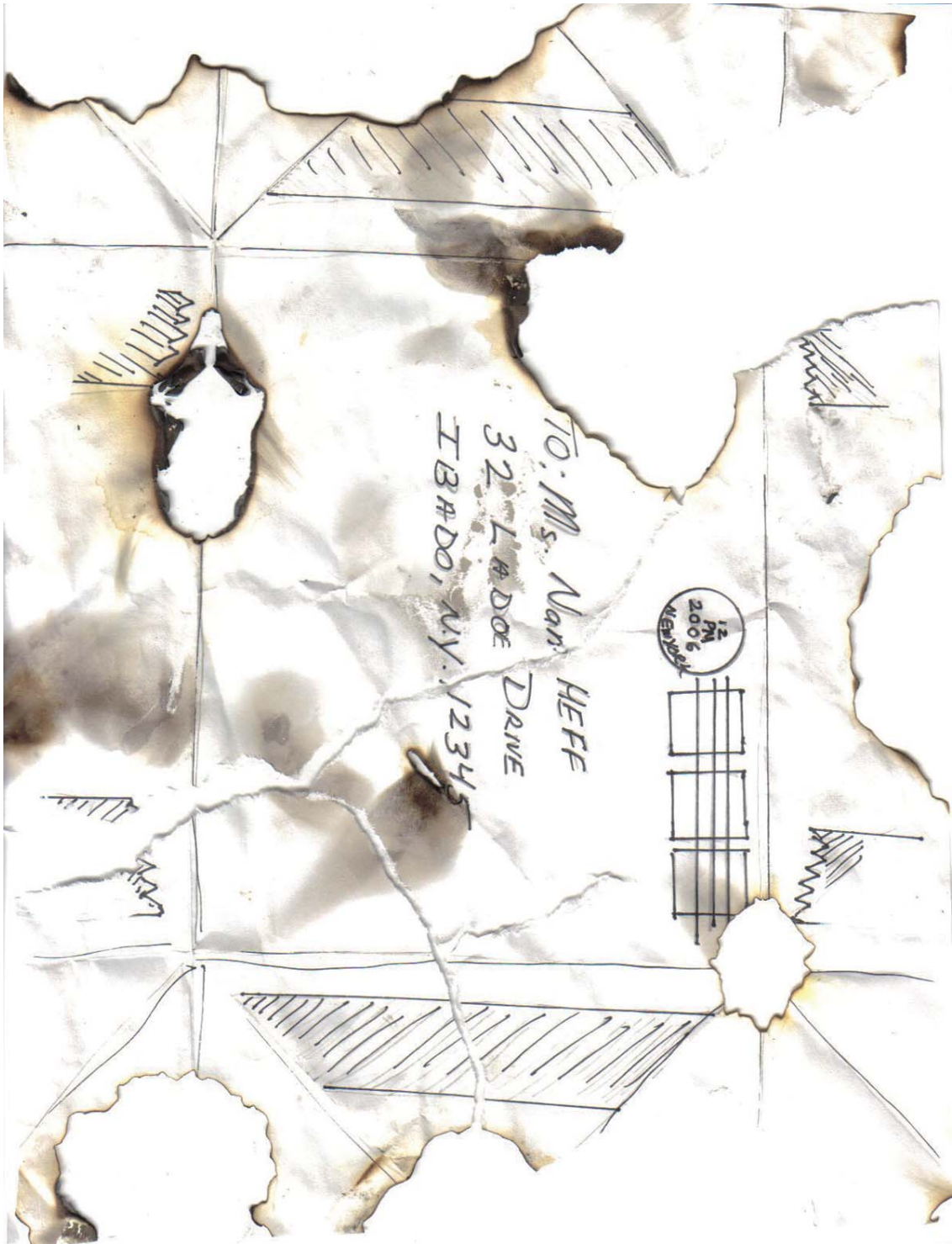
Included (next page) is a picture of the fragments of the bomb's wrappings after being pieced together.

There are at least ten pieces of valuable evidence that may be contained within the fragments of the bomb's wrappings. In the chart below, list the ten pieces of evidence, the region of the fragments where the evidence can be found, and the area of Forensic Science that you feel would be responsible for analysing the evidence. (An example has been provided for you.)

Evidence	Region Found	Area of Forensic Science
1. Hairs	Under the tape	Trace Evidence Analysis
2. Ink	Written address	Document Analysis
3. Handwriting	Written address	Document Analysis
4. Fibres	Under the tape	Trace Evidence Analysis
5. Fingerprints	Under the tape/wrappings	Fingerprint Analysis
6. Explosive residue	Wrappings	Chemistry
7. DNA	Saliva on stamps	Serology
8. Serrated edge of tape	Tape	Tool Mark Analysis
9. Paper composition	Wrappings	Document Analysis
10. DNA	Skin cells under tape	Serology

Section 3 — Areas of Forensic Science

Bomb Wrappings



Section A — Crime Scene Processing Notes

P1: Carry out an investigation to collect evidence from a crime scene

M1: Describe the process and explain how the techniques obtain valid forensic evidence

D1: Evaluate the process, interpreting how the evidence could be used in a criminal investigation

• Crime scene processing involves taking steps to ensure the methodical and lawful collection of information and evidence at a crime scene.



• Proper processing aids in the reconstruction of a crime and assists in the admissibility of evidence for court proceedings.

The following steps are taken by Investigators when processing a crime scene:

1. Provide medical attention to injured persons. *
2. Secure the scene. *
3. Interview witnesses. *
4. Photograph the scene.
5. Record notes.
6. Sketch the scene.
7. Conduct a search.
8. Collect and package evidence.



* Steps 1, 2 and 3 are performed simultaneously as there is typically more than one investigator present.
If there is just **one investigator** present then the priority is to **provide medical attention**.

Overview of Steps

1. Provide medical attention to injured persons.

2. Secure the scene.

- a. This is the responsibility of the first officers that arrive at the scene.
- b. Post tapes, ropes and barricades around the perimeter of the scene.
- c. Exclude people who are not directly involved in the investigation. This avoids possible tampering of evidence.
- d. Record the names of all people involved.



Section A — Crime Scene Processing Notes

3. Interview witnesses.

- a. Record the following information in a notepad:
(Use the witness question sheet to help)
 - Name of witness
 - Date of occurrence
 - Location
 - Give an account of the events of the crime.

- b. Remember, witnesses can:
 - Provide answers to questions to help investigators reconstruct the crime.
 - Help corroborate information about the crime.
(Ex. Confirm or support facts that have come from other sources).
 - Provide information about the crime that evidence alone cannot.
(Ex. Details about the activities of the victim or suspects).



4. Photograph the scene.

- a. Start with close up shots of significant aspects of the scene
(use a ruler in all photographs for scale)
(Ex. a broken window, overturned table, drawers pulled from a desk.)

- b. Next, photograph key pieces of evidence.
(Ex. A suspected weapon, bloody fingerprint, stained clothing.)

- c. Lastly, take various photographs of the entire scene from wide angles.



5. Record notes.

- a. Notes should include:
 1. A detailed description of the scene. (Notes serve to refresh Investigators' memories months or years after the crime.)
 2. Information that cannot be captured by photographs or included in sketches. Ex. unusual odour, time, weather, lighting.
 3. Information about how and when pieces of evidence were collected and who collected the evidence.

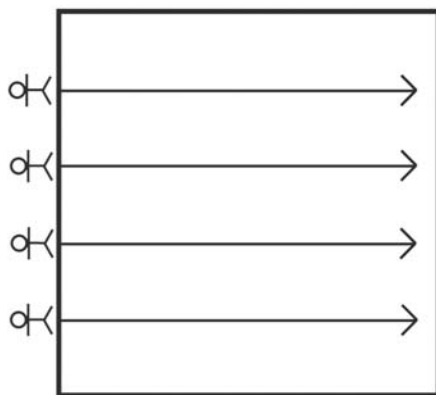
- b. Crime scene details can also be documented via a narrated videotape or audio recording. Both allow for more detailed notes and must be transcribed into a written document.



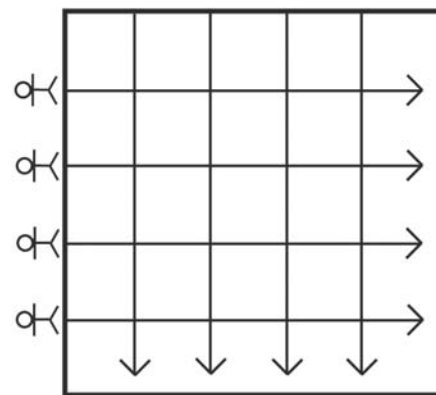
Section 1 — Investigation: Crime Scene Processing

Search Pattern Card

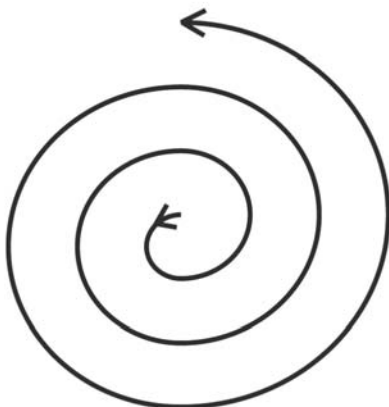
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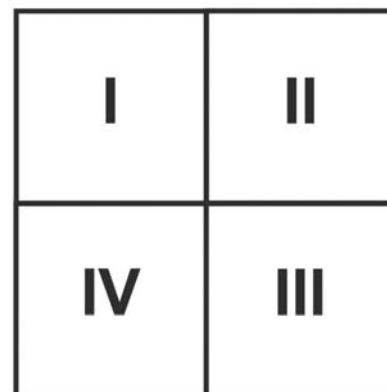
Grid



Spiral



Quadrant

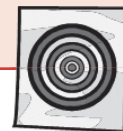


Section 4 — Investigation: Presumptive Test - Colour Test

Name _____ Date _____ Class _____

Objective:

To gain experience in the use of "Colour Tests" for the tentative identification of drugs.



Background:

Upon searching the suitcase of a passenger from an International flight, a U.S. Customs Inspector noticed that the passenger, who was travelling alone, possessed six (6) bottles of shampoo. The bottles were contained in an inside compartment of the suitcase. The unusual number of shampoo bottles and something about the passenger's appearance made the Inspector suspicious.



The Inspector opened the six bottles of shampoo and found that four (4) contained shampoo and two (2) contained plastic bags with white powder.

You are the Forensic Chemist assigned to analyse the bags of powder found in the shampoo bottles.

Materials:

- Safety glasses
- One (1) bottle of "Reagent no. 1"
- One (1) bottle of "Reagent no. 3"
- Ten (10) wooden stirrers
- Gloves
- Three (3) spot plates
- One (1) bottle of "Reagent no. 2"
- Powder samples, "A" to "H"
- One (1) China marker

Procedure:

1. Using the China marker, label the spot plates as illustrated below:

	R1	R2	R3
A	○	○	○
B	○	○	○
C	○	○	○
D	○	○	○

	R1	R2	R3
E	○	○	○
F	○	○	○
G	○	○	○
H	○	○	○

	R1	R2	R3
Unk 1	○	○	○
	○	○	○
Unk 2	○	○	○
	○	○	○

2. Starting with Sample "A", place 2-3 drops of "Reagent 1" in well, "R1."

Section 4 — Investigation: Presumptive Test - Colour Test

3. Using a wooden stirrer, sprinkle a small amount of “Sample A” into the reagent.
4. Record your observation(s) in Data Table I.
5. Repeat the procedure for Sample “A” for “Reagent 2” and “Reagent 3.”
6. Repeat the procedure for the remaining samples.
7. Show your teacher the data that you have collected and request two “Unknown” samples representing the powder found in the shampoo bottles.
8. Perform the Colour tests for each “Unknown” sample.
9. Record your observations in Data Table II.
10. Complete the Follow Up Questions.

Data Table I

Data Table I			
Sample	Reagent no. 1	Reagent no. 2	Reagent no. 3
A (talcum powder)	Light green	Light purple	No Colour Change
B (salt)	No Colour Change	No Colour Change	No Colour Change
C (corn flour)	No Colour Change	Light pink	No Colour Change
D (baking powder)	Green-Blue	Light purple	No Colour Change
E (caster sugar)	No Colour Change	No Colour Change	No Colour Change
F (granulated sugar)	No Colour Change	No Colour Change	No Colour Change
G (baking soda)	Blue-Green	Grey-Green	Bright pink
H (crushed vitamin C)	No Colour Change	Light pink	Pale yellow

Data Table II

Data Table II			
Unknown	Reagent no. 1	Reagent no. 2	Reagent no. 3
1	Answers will vary	Answers will vary	Answers will vary
2	Answers will vary	Answers will vary	Answers will vary

Section 4 — Investigation: Presumptive Test - Colour Test

Follow-Up Questions:

1. Complete the following statements:
 - a. Unknown _____ is consistent with Sample _____
(Number) (Letter)
 - b. Unknown _____ is consistent with Sample _____
(Number) (Letter)
2. Explain what is meant by the term, "reagent."
3. Explain why it is important to put the reagent into the well of the spot plate before putting the sample into the well of the spot plate.
4. Explain how Colour Tests are used by Forensic Chemists during their analysis.
5. A chemist is performing Spot Tests on a suspected heroin sample. When using the reagent, Marquis, the reagent turns purple upon the addition of the sample indicating the possible presence of heroin. The chemist decides to use a second reagent, Mecke, during her preliminary analysis. Upon the addition of the sample, the reagent turns green, indicating the possible presence of heroin.

Explain why you think the chemist decided to use a second reagent during her analysis.
6. Can Spot Tests be used to positively identify a suspected drug sample? Explain your answer.
7. Using your notes, **list** and **describe** the additional tests that are used by Forensic Chemists when analyzing suspected drug evidence.

Below is a suggested key for keeping track of the identity of the "Unknown" samples.



Sample	A	B	C	D	E	F	G	H
Unknown	I	II	III	IV	V	VI	VII	VIII
Unknown	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII

Exercise Answers:

1. (Answers will vary)
2. Answers may include but are not limited to:
(A chemical used to detect the presence of certain substances)
3. To prevent receiving false positive results due to contamination.
To make sure that the spot plate is clean.
4. To tentatively identify a drug sample.
5. Because more than one drug can yield the same colour for a single Colour Test.
6. No, because more than one drug can yield the same colour for a single Colour Test.
7. Students should use their notes from, "Processing a Powdered Drug Sample" to list and describe the following: Microscopy (Microcrystalline and Solubility Tests), Chemical Extraction, Infrared Spectroscopy, and Gas Chromatography

Investigation Prep:

"Reagent no. 1" is "Universal Indicator" that can be purchased from a Science supply company

"Reagent no. 2" is cabbage juice and can be prepared by boiling a head of red cabbage and collecting the liquid.

* Note: The reagent must be refrigerated when not in use.

"Reagent no. 3" is Phenolphthalein and can be purchased from a Science supply company and prepared according to company instructions.

Distribute different "Unknown" samples to each pair of students.

Prepare "Known" and "Unknown" samples by putting the powders in appropriately labelled plastic sandwich bags.

Section 5 — Exam: Document Analysis and Impression Evidence

Instructions

Record your answers on the Answer sheet provided

Included is a copy of a ransom letter that was received by the family of Milton Cuggles Mc Doodle. Milton's younger sister found the letter on Sunday morning in the family's postbox. The letter was found in a sealed, unmarked envelope. It consists of magazine cuttings glued to unlined white paper and four handwritten markings made by a black pen. The markings include two exclamation points, one dollar sign and the date.



1.
 - a. Describe the procedure you would use to collect and package the ransom letter for safe transport to the Crime Laboratory.
 - b. Explain why it is important to follow such a procedure for the type of evidence described above.
2.
 - a. List 6 (six) pieces of evidence that you would collect and analyse from the ransom letter. (Note: You may list pieces of evidence that you learned about in previous units)
 - b. Name or describe the technique you would use to analyse the evidence.

Section 5 — Exam: Document Analysis and Impression Evidence

3. Describe how you would attempt to match the glued letters on the paper to a magazine that is suspected of being the source of the letters.
4. A technique used by crime scene analysts to help them obtain “leads” is to survey the scene/ evidence for “oddities”; they look for things that do not seem to make sense to them.
 - a. Examine the ransom letter. List 3 (three) aspects that appear as “oddities” to you.
 - b. Explain why the aspects appear as “oddities.”
(An example has been provided in the chart on the answer sheet)
5. The example below compares the date from the ransom letter with the date written by one of the suspected kidnappers.
List 3 (three) handwriting characteristics that the Document Examiner could have used when comparing the two dates.

October 30, 2005

Date from ransom letter.

October 30, 2005

Date from suspect.

6. An analytical technique that the Forensic Scientist could use during his analysis on the ink samples from the ransom letter is paper chromatography.
 - a. Using at least 4 (four) steps, outline the procedure for paper chromatography.
 - b. Explain the purpose of the solvent in a chromatography system.
 - c. List 2 (two) solvents other than water, that can be used when performing paper chromatography on ink samples.
 - d. Explain why water would not be a good solvent to use when analysing pens with permanent ink.

Section 5 — Exam: Document Analysis and Impression Evidence

7. A clear impression of the sole of a shoe was found in the soil beneath the McDoodle's postbox.
 - a. List the steps that you would take to preserve the impression evidence.
 - b. List the steps that you would take to properly cast the shoe print.
8.
 - a. Explain the difference between a cast and a mould.
 - b. Use the scenario to give an example of a cast.
 - c. Use the scenario to give an example of a mould.
9. A set of tyre tracks was found on the street near the McDoodle's postbox.

On your answer sheet is the scaled down version of the photograph of the tyre tracks found near the McDoodle postbox and the scaled down versions of photographs of the tyre tracks of three suspect vehicles.

- a. Using a ruler, measure the track width for each set of tracks. Record your data on the answer sheet.
 - b. Using the magnifying glass, note the distinguishing characteristics for each set of tracks. Record your data on the answer sheet by circling the characteristic(s) and writing a description in the space provided.
 - c. Complete the following statement:
The Crime Scene tyre tracks are consistent with Suspect Vehicle _____.
(Letter of Vehicle)
10. To the right is a picture of Milton Cuggles Mc Doodle that has been provided by the kidnapers to prove that he is still well.

Based on the picture and ransom letter how would you answer the following questions regarding the kidnapping of Milton?

- Where is he being held? (e.g., type of building, type of neighbourhood)
- Who has kidnapped him? (e.g., type of individual(s) male, female, young, old)
- Why has he been kidnapped?

In the chart provided on your answer sheet, give an explanation for each of your answers.





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