Raleigh/Wake City-County
Bureau of Identification
Crime Laboratory Division

Drug Chemistry Unit
TRAINING PROCEDURES

Table of Contents

1: Training Procedure for Drug Classification and Structure

1. **Forward** - The CCBI Drug Chemistry Unit training program is a study of the concepts and analytical techniques used in the Unit to analyze evidence. The training consists of individual units. The objectives of each unit are accomplished with study questions, required reading and practical / laboratory exercises. The required units for each part and estimated training time for each unit are detailed in the corresponding Drug Chemistry Unit Training Schedule form. A training schedule ~~memorandum~~ is prepared by the Principal Instructor detailing the training schedule and estimated completion dates.

   1.1. The trainee must be able to give technical answers to the study questions. The trainee must also be able to give answers in layman's terms since they may be more appropriate in the courtroom. The questions are intended to be a guide or framework for the information needed to be successful in Forensic Drug Chemistry.

   1.2. The practical/laboratory exercises are intended to give the trainee the experience of performing laboratory techniques used in case work and to develop the independent analytical skills needed to perform casework.

   1.3. The principal instructor will be approved by the Forensic Quality Manager and will complete a Training Schedule for approval by the Forensic Quality Manager, Deputy Director and Unit Technical Leader prior to the commencement of training. At the conclusion of each unit the trainee shall present his/her work to the Principal Instructor. Throughout the training program the trainee must pass written exams with a minimum score of 85% and all practical exercises must be completed successfully. The Principal Instructor shall prepare a Section Completion Summary detailing training activities and evaluating progress. Upon successful completion of each section, the Principal Instructor and the trainee shall sign/initial the Drug Chemistry Unit Training Schedule and Section Completion Summary.

   1.4. By the 5th of each month, the principal instructor will prepare and review with the trainee a monthly CCBI Training Progress Report Form for approval by the Unit Technical Leader, Deputy Director and Forensic Quality Manager~~, which will be forwarded to the Forensic Quality Manager~~. This report will ~~reflect~~ detail each unit in which the trainee underwent training, describe and assess performance of the training activities and include a statement of completion for each ~~unit successfully completed competency testing and a statement to that effect. When appropriate, the CCBI Supervised Casework Log will be attached~~. The report will also include any less than satisfactory performance and any remedial activities. Any modifications of the training schedule and any remedial activities will be approved by the Unit Technical Leader, Deputy Director and Forensic Quality Manager prior to implementation.

   1.5. Trainee Analysts go through two phases of training, Phase I - Fundamentals and Phase II – 100 % Technical Review.

1.6. In order to complete Phase I training, the trainee must successfully complete all training topics fundamental to the discipline, practical exercises and examinations to demonstrate the ability to perform work in the discipline, oral and/or written examinations to assess knowledge of individual training topics, a final comprehensive written examination, a practical competency test comprised of sufficient unknown samples to cover the anticipated spectrum of assigned duties and evaluate ability to perform proper testing methods, a written test report to demonstrate ability to properly convey results and/or conclusions and the significance of those results/conclusions and a mock court. The mock court provides as realistic a courtroom experience as possible and will be used to evaluate the trainee's ability to effectively communicate his/her technical knowledge in a courtroom setting. Results of practical exercises, written examinations and the mock court serve as documentation of the competency of the Analyst trainee.

1.7. Upon completion of Phase I ~~the mock court~~, the principal instructor will prepare a memorandum summarizing the units on which written and practical competency tests were completed and the results of the mock court. The memorandum must also contain a statement indicating the trainee has successfully completed training on all instrumentation utilized in the discipline. The principal instructor will make recommendations for certification of the Analyst to perform independent ~~supervised~~ casework. This memorandum will be forwarded to the Forensic Quality Manager, Unit Technical Leader and Deputy Director.

1.8. Upon approval by the Forensic Quality Manager, Unit Technical Leader and Deputy Director, a~~A training~~ certificate of competency will be prepared by the Forensic Quality Manager, signed by the Director, and forwarded to the newly certified Analyst. The certificate will document that the employee is authorized and certified to perform analyses and issue reports in the ~~appropriate~~ Drug Chemistry discipline ~~or category of testing~~. Notice of certification will be placed in the Analyst's permanent training file.

1.9. Phase II – 100 % Technical Review training for Drug Chemistry will last for a minimum of ~~one~~ six months.

1.10. During Phase II training all cases will be technically reviewed by the ~~discussed with the~~ Principal Instructor ~~prior to preparation of a laboratory report~~. ~~All cases completed by the trainee will be technically reviewed by the Unit Technical Leader~~. ~~A CCBI Supervised Casework Log will accompany the CCBI Monthly Training Progress Report form during Phase II training.~~

1.11. If no significant technical discrepancies that could affect the reliability of the examiner's conclusion are noted during this time, Phase II training may be completed at the end of six months. When the principal instructor recommends that the analyst may be released from Phase II, the principal instructor will prepare a memorandum summarizing the analyst's performance during Phase II training and stating their recommendation for release from Phase II training. The memorandum will be forwarded to the Forensic Quality Manager. Upon approval by the Unit Technical Leader, Forensic Quality Manager and Deputy Director, the Forensic Quality Manager will issue a memorandum releasing the individual from Phase II training.

2. **Purpose –** Controlled substances, with the exception of anabolic steroids, generally produce their major effect by acting at the level of the central nervous system (CNS). Knowledge of the structure and chemistry of these compounds is useful in the process of identifying controlled substances present in evidence. In this unit, the Drug Chemist will become familiar with the NC statutes and the structures of commonly encountered controlled substances associated with forensic evidence.

3. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

4. **Procedure**

4.1. Objectives

4.1.1. Become knowledgeable of forensic science.

4.1.2. Learn the chemical structures of drugs commonly encountered in forensic evidence.

4.1.3. Identify the general class of a drug based on the structure.

4.1.4. Become familiar with Chapter 90 and Subchapter 26 F of the *North Carolina Controlled Substances Act.*

4.1.5. Use the *Micromedex*/*Identidex* database and other credible resources to identify marked tablets.

4.1.6. Successfully complete a written exam.

4.2. Study Questions

4.2.1. Review Chapter 90-95 of the *North Carolina Controlled Substances Act.* Determine the crime (i.e., misdemeanor, felony, or trafficking) based on the quantity and schedule of a controlled substance.

4.2.2. Define the following terms and prefixes:

4.2.2.1. Alkaloid
4.2.2.2. Analgesic
4.2.2.3. Antihistamine
4.2.2.4. Antipyretic
4.2.2.5. Antitussive
4.2.2.6. Ergot alkaloid
4.2.2.7. Histamine
4.2.2.8. Narcotic
4.2.2.9. Opiate
4.2.2.10. Opioid
4.2.2.11. Semi-synthetic opiate
4.2.2.12. Isomer

4.2.2.13. Enantiomer
4.2.2.14. Diastereomer
4.2.2.15. Pseudo-
4.2.2.16. Nor-
4.2.2.17. Desoxy-
4.2.2.18. Dextro-
4.2.2.19. Levo-

4.2.3. Memorize the primary chemical structure of the following:

4.2.3.1. Indoles
4.2.3.2. Opiates
4.2.3.3. Phenethylamines
4.2.3.4. Barbiturates
4.2.3.5. Benzodiazepines
4.2.3.6. Steroids

4.2.4. Draw the chemical structure, list the schedule, and identify the trade names of the following drugs based on Chapter 90 of the *North Carolina General Statutes*.

4.2.4.1. 4-Methylmethcathinone (Mephedrone)
4.2.4.2. Acetaminophen (Tylenol)
4.2.4.3. Acetylsalicylic acid (Aspirin)
4.2.4.4. Alprazolam (Xanax)
4.2.4.5. Amphetamine (Adderall)
4.2.4.6. Benzocaine
4.2.4.7. Benzoylecgonine
4.2.4.8. 1-Benzylpiperazine (BZP)
4.2.4.9. Bufotenine
4.2.4.10. Buprenorphine
4.2.4.11. Butalbital (Fioricet, Fiorinal)
4.2.4.12. Caffeine
4.2.4.13. Cannabidiol
4.2.4.14. Cannabinol
4.2.4.15. Carisoprodol
4.2.4.16. Clorazepate
4.2.4.17. Chlordiazepoxide (Librium)
4.2.4.18. Clonazepam
4.2.4.19. Cocaine (“Crack”)
4.2.4.20. Codeine
4.2.4.21. Delta-9 Tetrahydrocannabinol (THC)
4.2.4.22. Dextropropoxyphene (Darvon)
4.2.4.23. Diazepam (Valium)
4.2.4.24. Diltiazem
4.2.4.25. N,N-Dimethyltryptamine (DMT)
4.2.4.26. Diphenhydramine (Benadryl)
4.2.4.27. Fentanyl

4.2.4.28. Gamma-Butyrolactone (GBL)
4.2.4.29. Gamma Hydroxybutyric Acid (GHB)
4.2.4.30. Guaifenesin
4.2.4.31. Heroin
4.2.4.32. Hydrocodone or Dihydrocodeinone (Vicodin)
4.2.4.33. Hydromorphone (Dilaudid)
4.2.4.34. Ibuprofen (Advil)
4.2.4.35. JWH-018
4.2.4.36. JWH-073
4.2.4.37. Levamisole
4.2.4.38. Lidocaine
4.2.4.39. Lysergic Acid Diethylamide (LSD)
4.2.4.40. Lysergic Acid N-(Methylpropyl) Amide (LAMPA)
4.2.4.41. Meprobamate
4.2.4.42. Mescaline
4.2.4.43. Methadone (Methadose)
4.2.4.44. Methamphetamine (“Ice”, “Crank”)
4.2.4.45. Methandrostenolone
4.2.4.46. Methcathinone
4.2.4.47. Methorphan
4.2.4.48. 3,4-Methylenedioxyamphetamine (MDA)
4.2.4.49. 3,4-Methylenedioxymethamphetamine (MDMA, “Ecstasy”)
4.2.4.50. Methylenedioxypyrovalerone (MDPV)
4.2.4.51. Methylphenidate (Ritalin)
4.2.4.52. Morphine
4.2.4.53. Naproxen (Aleve)
4.2.4.54. Naloxone
4.2.4.55. Nordiazepam
4.2.4.56. Oxycodone (Percocet, Percodan, Oxycontin)
4.2.4.57. Papaverine
4.2.4.58. Pentobarbital
4.2.4.59. Pethidine (Meperidine, Demerol)
4.2.4.60. Phenazepam
4.2.4.61. Phencyclidine (PCP)
4.2.4.62. Phenobarbital
4.2.4.63. Phentermine
4.2.4.64. Phenylpropanolamine (PPA)
4.2.4.65. Procaine (Novocaine)
4.2.4.66. Pseudoephedrine (Sudafed)
4.2.4.67. Psilocin
4.2.4.68. Psilocybin
4.2.4.69. Secobarbital
4.2.4.70. Stanozolol
4.2.4.71. Testosterone
4.2.4.72. 3-Trifluoromethylphenylpiperazine (TFMPP)
4.2.4.73. Zolpidem (Ambien)

4.2.5. Sort the compounds listed in 4.2.4 into the following categories (Some compounds may fit into more than one category):

4.2.5.1. Antipyretic
4.2.5.2. Antitussive
4.2.5.3. Antidepressant
4.2.5.4. Non-narcotic analgesic
4.2.5.5. Narcotic analgesic
4.2.5.6. Antihistamine
4.2.5.7. Local anesthetic
4.2.5.8. Atimulant
4.2.5.9. Sedative/hypnotic
4.2.5.10. Muscle relaxant
4.2.5.11. Hallucinogen
4.2.5.12. Steroid
4.2.5.13. Synthetic cannabinoid
4.2.5.14. Identify any compound that does not fall within any of the categories.

4.3. Practical/Laboratory Exercises

4.3.1. Using credible reference materials, i.e., *Micromedex*, *The Physician's Desk Reference, The Logo Index for Tablets and Capsules* and manufacturer's published data, identify the following tablets based upon the description and imprint codes.

4.3.1.1. Mylan 345, orange, round, scored tablet
4.3.1.2. 71, green speckled, oblong tablet
4.3.1.3. Roche 10
4.3.1.4. OC on one side, 10 on other side, white, circular tablet
4.3.1.5. Vicodin, white, oblong tablet, scored
4.3.1.6. G 3722, white, rectangular tablet, scored
4.3.1.7. Watson 349, white, capsule shape, scored
4.3.1.8. AHR 6447, orange, tablet, scored

4.4. Required Reading

4.4.1. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions*, 4th edition, Pharmaceutical Press, 2011. Chapters 11 and 13.

4.4.2. Liu, R. H. and Gadzala, D. E. Handbook of Drug Analysis. Washington DC: American Chemical Society, 1997. pp 3 - 14.

4.4.3. Brown, T.L., et al, *Chemistry the Central Science*. 5th Ed., Prentice-Hall, 1991. pp 914 – 919.

4.4.4. CCBI Crime Laboratory Forensic Science Quality Manual

4.4.5. CCBI Crime Laboratory Administrative Procedure Manual

4.4.6. CCBI Crime Laboratory Evidence Submission Manual

4.4.7. CCBI Crime Laboratory Safety Manual

4.4.8. Drug Chemistry Unit Technical Procedures

4.4.8.1. Drug Chemistry Analysis

4.4.9. Saferstein, Richard. *Criminalistics: an Introduction to Forensic Science, 9th edition,* Pearson Education, 2007. Chapter 1.

5. References

5.1. CCBI Crime Laboratory Forensic Science Quality Manual

5.2. CCBI Crime Laboratory Administrative Procedure Manual

5.3. CCBI Crime Laboratory Evidence Submission Manual

5.4. CCBI Crime Laboratory Safety Manual

5.5. Baselt, Randall C. *Disposition of Toxic Drugs and Chemicals in Man*, 8th Ed.. Foster City, California: Biomedical Publications, 2008.

5.6. O'Neal, Maryadele J. ed. *The Merck Index – An Encyclopedia of Chemicals, Drugs and Biologicals*, Merck & Co Inc., Whitehouse Station, NJ, (2006).

5.7. Liu, R. H. and Gadzala, D. E. Handbook of Drug Analysis. Washington DC: American Chemical Society, 1997.

5.8. Moffat, Anthony C., et al., eds., *Clarke's Analysis of Drugs and Poisons*, 4th edition, Pharmaceutical Press, 2011.

5.9. Goldfrank, Howland et al., *Goldfrank's Toxicological Emergencies*, 7th Ed., USA: McGraw-Hill Company, Inc., 2002.

5.10. Butler, William P. *Methods of Analysis for Alkaloids, Opiates, Marihuana, Barbiturates, and Miscellaneous Drug, Publication #341*. Washington, D.C.: U.S. Treasury Department, Internal Revenue Service, December, 1966: 64.

5.11. Brown, T.L., et al, *Chemistry the Central Science*. 5th Ed., Prentice-Hall, 1991.

5.12. McMurry, John. *Organic Chemistry*, Brooks/Cole Publishing Co., 1992.

5.13. *North Carolina Controlled Substances Act and Regulations*, Internet: http://www.ncga.state.nc.us/gascripts/Statutes/Statutes.asp.

5.14. Saferstein, Richard. *Criminalistics: an Introduction to Forensic Science, 9th edition*, Pearson Education, 2007.

6. Records

6.1. Drug Chemistry Unit Training Schedule

Revision History

Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements
7/14/14	2	Incorporation of revised LAPM 22

2: Training Procedure for Color Tests

1. **Purpose** – A chemical color test is a preliminary screening test in which a sample of an unknown substance is added to a chemical reagent in order to produce a color change. The color change that occurs is indicative of a class or type of drug that may or may not be present. Knowledge of the structure of controlled substances can often be used to predict the results of color tests. In this section, the trainee will learn how color test reagents are used to classify and narrow the possible controlled substances present in forensic drug samples.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Be able to document, prepare and perform quality control checks or reagents.

3.1.2. Be able to identify/classify what drugs may be present based on the results of color tests.

3.1.3. Successfully complete a written exam.

3.2. Study Questions

3.2.1. Define the term reagent.

3.2.2. What types of compounds / functional groups generally cause the color change with each reagent? What causes the color change for each reagent?

- 3.2.2.1. Marquis
- 3.2.2.2. Duqenois-Levine
- 3.2.2.3. Cobalt thiocyanate
- 3.2.2.4. Ferric Chloride
- 3.2.2.5. Dile-Koppanyi
- 3.2.2.6. p-Dimethylaminobenzaldehyde (PDMAB)
- 3.2.2.7. Froehde
- 3.2.2.8. Mecke
- 3.2.2.9. Cobalt Nitrate
- 3.2.2.10. Simon's Test (Modified Sodium Nitroprusside)

3.2.3. Why do cocaine base and cocaine hydrochloride react to the Cobalt Thiocyante reagent with different intensities?

3.2.4. Are there any other substances that cause a positive reaction with the Duquenois-Levine

reagent?

3.2.5. Explain why a color test cannot be used to identify a substance definitively.

3.2.6. How can you ensure that a color test reagent is actually working since some substances do not cause a color change?

3.2.7. How do you avoid false positive color test results when performing a color test?

3.2.8. What would happen if potassium cyanide were added to the Marquis Reagent?

3.2.9. Why should unknowns be added in very small amounts?

3.3. Practical/Laboratory Exercises

3.3.1. With the Principal Instructor, prepare, label and properly document the following color test reagents:

3.3.1.1. Marquis
3.3.1.2. Duqenois-Levine
3.3.1.3. Cobalt thiocyanate
3.3.1.4. Ferric Chloride
3.3.1.5. Dile-Koppanyi
3.3.1.6. p-Dimethylaminobenzaldehyde (PDMAB)
3.3.1.7. Froehde
3.3.1.8. Mecke
3.3.1.9. Cobalt Nitrate
3.3.1.10. Simon's Test (Modified Sodium Nitroprusside)

3.3.2. Test a set of known substances provided to you by the Principal Instructor and record the results as you would in casework. Compare your results to published results. Present and discuss results with the Principal Instructor.

3.4. Required Reading

3.4.1. Moffat, A.C., et al., eds. *Clarke's Analysis of Drugs and Poisons.* 4rd Edition. London: Pharmaceutical Press, 2011. Chapter 30.

3.4.2. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997. Chapter 3.

3.4.3. References listed in section 4.

3.4.4. Drug Chemistry Unit Technical Procedures

3.4.4.1. Drug Chemistry Analysis

3.4.4.2. Color Tests

4. References

4.1. Clarke, E.G.C. and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969, 129-130, 1183.

4.2. Moffat, A.C., et.al. eds. *Clarke's Isolation and Identification of Drugs*. 2nd Edition, London: Pharmaceutical Press, 1986: 133, 139-140.

4.3. Moffat, A.C., et al., eds. *Clarke's Analysis of Drugs and Poisons.* 4rd Edition. London: Pharmaceutical Press, 2011.

4.4. Bailey, Keith, M.A. and D. Phil. "The Value of the Duquenois Test for Cannabis – A Survey." *Journal of Forensic Sciences.* Volume 24, Issue 4 (October, 1979): 817-841

4.5. Butler, William P. *Methods of Analysis for Alkaloids, Opiates, Marihuana, Barbiturates, and Miscellaneous Drugs. Publication #341*. Washington, D.C.: U.S. Treasury Department, Internal RevenueService, June, 1967: 105-107,136-137.

4.6. Feigel, Fritz. *Spot Tests in Organic Analysis*. Elsevier Publishing Co.: 1956, 251.

4.7. Johns, S.H. "Spot Tests: A Color Chart Reference for Forensic Chemists." *Journal of Forensic Sciences*, Volume 24. Issue 3 (July, 1979): 631-649.

4.8. Jungreis, Ervin. *Spot Test Analysis - Clinical, Environmental, Forensic, and Geochemical Applications*, New York: John Wiley & Sons, 1985, 80.

4.9. Pitt, C.G. et. al. "The Specificity of the Duquenois Color Test for Marijuana and Hashish." *Journal of Forensic Sciences*. Volume 17, Issue 4 (Oct. 1972): 693-700.

4.10. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997: 58.

4.11. Toole, K.E. et. al. "Color Tests for the Preliminary Identification of Methcathinone and Analogues of Methcathinone." *Microgram Journal.* Volume 9, Number 1: 27-32.

4.12. O'Neal, C.L. et. al. "Validation of Twelve Chemical Spot Tests for the Detection of Drugs of Abuse." *Forensic Science International.* Volume 109 (2000): 189-201.

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

3: Training Procedure for Ultraviolet Spectroscopy

1. **Purpose** - This section will introduce the principles of Ultraviolet (UV) Spectrophotometry. The technique works on the principle that substances absorb at different wavelengths in the ultraviolet / visible region of the electromagnetic spectrum. A spectrophotometer is an instrument used to measure the transmittance or absorbance of a substance as a function of the wavelength of electromagnetic radiation. The energy absorbed by a substance may be recorded as a UV spectrum and used to quantitate a substance. The trainee shall become familiar with the basic principles of UV Spectrophotometry through the completion of study questions and practical exercises.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Be knowledgeable of the principles of UV spectrophotometry.

3.1.2. Successfully perform all quality control checks in the Drug Chemistry Unit Technical Procedure for Ultraviolet Spectroscopy.

3.1.3. Use the UV Spectrophotometer to analyze substances.

3.1.4. Pass a competency exam using color tests, pharmaceutical identifiers and UV to correctly identify a set of unknowns.

3.2. Study Questions

3.2.1. Summarize the electromagnetic radiation (ER) spectrum. What is the UV range?

3.2.2. Characterize ER and the potential energy of a molecule.

3.2.3. Explain what happens when UV ER impinges on a molecule?

3.2.4. What are chromophores and auxochromes?

3.2.5. Describe the components of UV spectrophotometer.

3.2.6. Draw a simple diagram of a UV spectrophotometer. Be able to describe how it works.

3.2.7. Explain a red/blue shift or hyperchromic/hypochromic effect.

3.2.8. Explain the Beers Lambert Law.

3.2.9. What is the difference between the molar absorptivity constant and the specific absorbance constant?

3.3. Practical/Laboratory Exercises

3.3.1. Using the UV spectrophotometer, test a set of known samples provided by the Principal Instructor and record the results as you would in casework. Be able to recognize specific spectra and UV spectra characteristic of classes of compounds, e.g., mono or di-substituted benzene derivatives and opiates.

3.3.1.1. Examples of samples to test using the UV spectrophotometer

3.3.1.1.1. Amphetamine sulfate (Crushed tablets)
3.3.1.1.2. Aspirin
3.3.1.1.3. "BC" Powder
3.3.1.1.4. BDMA
3.3.1.1.5. Caffeine
3.3.1.1.6. Cocaine base
3.3.1.1.7. Cocaine HCl
3.3.1.1.8. Codeine
3.3.1.1.9. Creatine
3.3.1.1.10. Diazepam (Note: absorbs below the baseline)
3.3.1.1.11. Dimethylsulfone
3.3.1.1.12. Diphenhydramine
3.3.1.1.13. Ephedrine HCl
3.3.1.1.14. "Goody's" powder
3.3.1.1.15. Guaifenesin
3.3.1.1.16. Heroin HCl
3.3.1.1.17. Inositol
3.3.1.1.18. Lactose
3.3.1.1.19. Methamphetamine HCl
3.3.1.1.20. MDA
3.3.1.1.21. MDMA
3.3.1.1.22. Morphine base
3.3.1.1.23. Oxycodone
3.3.1.1.24. PCP
3.3.1.1.25. Phendimetrazine
3.3.1.1.26. Procaine HCl
3.3.1.1.27. Procaine and benzocaine in acid and H_2O
3.3.1.1.28. d-Propoxyphene
3.3.1.1.29. Quinine (Note: absorbs below the baseline)
3.3.1.1.30. Butalbital (add NaOH)
3.3.1.1.31. Hexabarbital (add NaOH)
3.3.1.1.32. Secobarbital (add NaOH)

3.3.2. Prepare a 0.25 g/100 mL solution of methamphetamine in 0.1 N HCl from a sample provided by the Principal Instructor. Prepare at least five serial dilutions of the methamphetamine solution. Determine the absorbance of each concentration in a 0.1 N HCl solution at λ 257 nm. Plot a curve of concentration v. absorbance at λ 257 nm. Calculate A^1_1 for methamphetamine at λ 257 nm. *(Use at least 25ml class A volumetric flask, not 10ml flasks, to accomplish this task.)*

3.3.2.1. Given a solution of unknown methamphetamine concentration, determine the amount of methamphetamine in solution.

3.3.3. Use color tests, pharmaceutical identifiers, and UV spectrophotometry to identify a set of unknown substances provided by the Principal Instructor. Record the results of all tests as you would casework.

3.4. Required Reading

3.4.1. Skoog, D. A., Holler, F. J., Nieman, T. A., *Principles of Instrumental Analysis*. 5th ed. Harcourt, Brace & Company, 1998. Chapters 13 and 14.

3.4.2. Anthony C. Moffat et al., *Clarke's Analysis of Drugs and Poisons*. 4th ed. London, UK: Pharmaceutical press, 2011. Chapter 32.

3.4.3. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997. Chapter 7.

3.4.4. *Lambda 20 UV/Vis Installation, Maintenance, System Description Part Number 0993-5055*, Revision A. USA: Perkin-Elmer Corporation, 1996.

3.4.5. *Lambda 20 UV/Vis Operation and Parameter Description Part Number 0993-5056*, Revision A. USA: Perkin-Elmer Corporation, 1996.

3.4.6. *Standard Practice for Monitoring the Calibration of Ulraviolet – Visible Spectrophotometers whose Spectral Bandwidth does not Exceed 2nm*, ASTM:E925-09.

3.4.7. Allen, D. W., *Holmium Oxide Glass Wavelength Standards*. J. Res. Natl. Inst. Stand. Technol. 112, 303-306 (2007).

4. References

4.1. Skoog, D. A., Holler, F. J., Nieman, T. A., *Principles of Instrumental Analysis*. 5th ed. Harcourt, Brace & Company, 1998.

4.2. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997.

4.3. Anthony C. Moffat et al., *Clarke's Analysis of Drugs and Poisons*. 4th ed. London, UK: Pharmaceutical press, 2011.

4.4. *Lambda 20 UV/Vis Installation, Maintenance, System Description Part Number 0993-5055*, Revision A. USA: Perkin-Elmer Corporation, 1996.

4.5. *Lambda 20 UV/Vis Operation and Parameter Description Part Number 0993-5056*, Revision A. USA: Perkin-Elmer Corporation, 1996.

4.6. *Standard Practice for Monitoring the Calibration of Ulraviolet – Visible Spectrophotometers whose Spectral Bandwidth does not Exceed 2nm*, ASTM:E925-09.

4.7. Allen, D. W., *Holmium Oxide Glass Wavelength Standards*. J. Res. Natl. Inst. Stand. Technol. 112, 303-306 (2007).

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History

Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

4: Training Procedure for Infrared Spectroscopy

1. **Purpose –** This section will introduce the principles of Infrared (IR) Spectrophotometry. The technique works on the same principles as UV Spectrophotometry. The IR spectrometer measures the reflectance, transmittance or absorbance of a substance as a function of wavelength of infrared light. The energy absorbed or reflected by a substance can be recorded as an IR spectrum which can be used to identify a substance (e.g., different drugs absorb at different wavelengths of the electromagnetic spectrum). IR can be used as a Category A Technique in the identification of controlled substances, refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis. The trainee shall become familiar with the basic principles of IR Spectrophotometry through the completion of study questions and the analysis of a set of known substances.

2. **Scope -** This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Be knowledgeable of the principles of IR spectrophotometry.

3.1.2. Successfully perform all quality control procedures contained in the Drug Chemistry Unit Technical Procedure for Infrared Spectroscopy.

3.1.3. Use the IR spectrophotometer to identify controlled substances.

3.1.4. Successfully complete a written exam on spectrophotometry.

3.2. Study Questions

3.2.1. Characterize the infrared region of the electromagnetic radiation spectrum.

3.2.2. Explain what happens when infrared electromagnetic radiation impinges on a molecule.

3.2.3. How does infrared differ from ultraviolet electromagnetic radiation?

3.2.4. Draw a simple diagram of an IR spectrophotometer and describe the basic components.

3.2.5. Explain how the Fourier Transform Infrared (FT-IR) spectrophotometer differs from a dispersive/grating infrared spectrophotometer.

3.2.6. Explain how an interferometer works.

3.2.7. What is an interferogram?

3.2.8. What is the function of the laser in the FT-IR spectrophotometers?

3.2.9. Explain how an ATR (Attenuated Total Reflectance) Infrared Spectrophotometer works.

3.2.10. Explain the steps in the FT-IR macro used in the Drug Chemistry Unit.

3.2.11. Can spectra from an ATR be compared to ordinary absorption spectra for purposes of identification?

3.2.12. Where do the following functional groups absorb in the infrared spectrum?

3.2.12.1. C-H Aliphatic
3.2.12.2. C-H Aryl
3.2.12.3. O-H
3.2.12.4. C=O
3.2.12.5. Secondary amine (N-H)

3.2.13. What is a wave number?

3.2.14. How do you convert the wave number 4000 cm^{-1} to a wave length in microns (*u)*?

3.2.15. What is the fingerprint region in IR spectrophotometry?

3.2.16. What region of the IR does a sulfate group show absorption? Why is it important to recognize sulfate groups in unknown samples?

3.2.17. What region of the IR shows the difference between salt and base forms of drugs?

3.3. Practical/Laboratory Exercises

3.3.1. Review the ATR tutorial supplied by the instrument manufacturer.

3.3.2. Using the IR Spectrophotometer, test a set of known samples provided by the Principal Instructor and record the results as you would in casework. Be able to recognize specific spectra, the difference between IRs of the base and the salt forms of drugs, and identify the functional groups associated with IR peaks.

3.3.2.1. Example of samples to test using the infrared spectrophotometer

3.3.2.1.1.1. Amphetamine HCl
3.3.2.1.1.2. “BC” Powder
3.3.2.1.1.3. Cocaine base
3.3.2.1.1.4. Cocaine HCl
3.3.2.1.1.5. Codeine with aspirin
3.3.2.1.1.6. Codeine sulfate
3.3.2.1.1.7. Creatine

3.3.2.1.1.8. Diltiazem
3.3.2.1.1.9. Dimethylsulfone
3.3.2.1.1.10. Ephedrine HCl
3.3.2.1.1.11. GHB
3.3.2.1.1.12. "Goody's" powder
3.3.2.1.1.13. Heroin base
3.3.2.1.1.14. Heroin HCl
3.3.2.1.1.15. Inositol
3.3.2.1.1.16. Ketamine HCl
3.3.2.1.1.17. Lactose
3.3.2.1.1.18. Lidocaine HCl
3.3.2.1.1.19. Mannitol
3.3.2.1.1.20. Methamphetamine HCl
3.3.2.1.1.21. MDA HCl
3.3.2.1.1.22. MDMA
3.3.2.1.1.23. Oxycodone
3.3.2.1.1.24. Phentermine
3.3.2.1.1.25. Pseudoephedrine
3.3.2.1.1.26. Sodium bicarbonate (baking soda)

4. Required Reading

4.1. Skoog, D. A., Holler, F. J., Nieman, T. A., *Principles of Instrumental Analysis*. 5th ed. Harcourt, Brace & Company, 1998. Chapters 16 and 17.

4.2. Anthony C. Moffat et al., *Clarke's Analysis of Drugs and Poisons*. 4th ed. London, UK: Pharmaceutical press, 2011. Chapter 33.

4.3. Smith, Brian. *Infrared Spectral Interpretation: A Systematic Approach.* CRC Press LLC: 1999. Chapter 1.

5. References

5.1. Skoog, D. A., Holler, F. J., Nieman, T. A., *Principles of Instrumental Analysis*. 5th ed. Harcourt, Brace & Company, 1998.

5.2. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997.

5.3. Anthony C. Moffat et al., *Clarke's Analysis of Drugs and Poisons*. 4th ed. London, UK: Pharmaceutical press, 2011.

5.4. Smith, Brian. *Infrared Spectral Interpretation: A Systematic Approach.* CRC Press LLC: 1999.

5.5. Smith, Brian. *Fundamentals of Fourier Transform Infrared Spectroscopy.* CRC Press LLC: 1996.

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6. Records

6.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

5: Training Procedure for Extractions

1. **Purpose –** This section will explore the origins and synthesis of commonly encountered controlled substances and the extraction methods used to isolate them from non-controlled cutting agents, diluents, and adulterants. When it becomes necessary to isolate components of a mixture in order to identify the controlled substance(s), considering the chemical properties, e.g., solubility, partition coefficient and dissociation constant, of the sample and the medium, e.g., pH, is useful in determining the extraction technique. The stability and volatility, especially when applying heat and/or strong acids or bases must also be considered. Typically basic and acidic drugs are extracted at a pH 2 to 3 units above and below, respectively, the pK_a values of the drugs. A liquid extraction utilizes an organic solvent alone or in combination with an inorganic acid or base. Occasionally, it is possible to physically separate a controlled substance(s) from a mixture based on appearance.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Be familiar with the Drug Chemistry Unit Technical Procedure for Extractions and be able to explain expiration dates and quality control checks of prepared reagents used in extraction procedures.

3.1.2. Understand the concepts of acid and base.

3.1.3. Be able to identify whether a substance has acidic or basic properties based on structure.

3.1.4. Be able to identify the solubility of base and salt forms of drugs in various solvents.

3.1.5. Be able to develop extraction techniques and extract controlled substances from mixtures.

3.1.6. Be able to explain the origin and illicit syntheses of common controlled substances.

3.1.7. Successfully complete a written exam.

3.2. Study Questions

3.2.1. What is an acid? What is a base? List some examples of each. Explain pH.

3.2.2. What are a conjugate acid and a conjugate base?

3.2.3. Explain partition coefficient, dissociation constant and pKa.

3.2.4. Explain the difference between strong/weak acids and strong/weak bases. Give some examples of each.

3.2.5. Explain normality and molarity. Explain how you would prepare 500 ml of 1N HCl and 500 ml of saturated sodium hydroxide.

3.2.6. What is produced when equimolar amounts of a strong acid is combined with a strong base?

3.2.7. Most controlled substances are considered basic. What functional group imparts this characteristic?

3.2.8. Some drugs are considered acids. Give some examples of acidic drugs and identify the functional group that imparts this characteristic.

3.2.9. What generally occurs when an inorganic acid is added to the base form of a drug?

3.2.10. Explain why a salt is soluble in water, but not in an organic solvent.

3.2.11. Explain why a sugar such as inositol is soluble in water, but not in an organic solvent.

3.2.12. Describe what happens during the liquid–liquid chemical extraction of a drug.

3.2.13. Where does cocaine originate and how is it manufactured?

3.2.14. What is the difference between cocaine base and cocaine hydrochloride?

3.2.15. Name some impurities that might be present in illicit samples of cocaine.

3.2.16. Where does heroin originate and how is it made?

3.2.17. What artifacts can be present from heroin synthesis?

3.2.18. What is a piperazine? What is BZP and how is it made?

3.2.19. Where does LSD originate and how is it made?

3.2.20. How is methamphetamine manufactured?

3.2.21. What is GHB? Explain the relationship between GBL and GHB.

3.2.22. What happens when an acid or base is added to GHB?

3.2.23. What is Safrole and what drug can be synthesized from it?

3.2.24. What does the term hygroscopic mean?

3.3. Practical/Laboratory Exercises

3.3.1. Determine by experimentation, or give an explanation as to which of the following organic solvents are miscible with water and which are not.

3.3.1.1. Methanol
3.3.1.2. Ethanol
3.3.1.3. Hexane
3.3.1.4. Chloroform
3.3.1.5. Acetone
3.3.1.6. Ethyl ether
3.3.1.7. Petroleum ether
3.3.1.8. Ethyl acetate

3.3.2. Propose an extraction scheme to separate the controlled substances from a set of known mixtures provided to you by the Principal Instructor. Review your proposed extraction techniques with the Principal Instructor, then isolate the controlled substance(s) and analyze using IR Spectrophotometry, if a sufficient amount of material is recovered. If sufficient material is not recovered for IR analysis, label the vial of material and reserve for further analysis in the GC-MS Section of the Drug Chemistry Unit Training Program.

3.3.2.1. Example set of mixtures to extract and identify

3.3.2.1.1. Cocaine HCl / inositol
3.3.2.1.2. MDMA tablet
3.3.2.1.3. Lidocaine HCl / Cocaine base
3.3.2.1.4. Diazepam tablet
3.3.2.1.5. Hydrocodone salt / acetaminophen tablet
3.3.2.1.6. Methamphetamine HCl / pseudoephedrine HCl
3.3.2.1.7. Barbiturate salt tablet
3.3.2.1.8. Methamphetamine salt from tablet
3.3.2.1.9. Convert cocaine base to cocaine HCl / vice versa
3.3.2.1.10. Cocaine / benzocaine
3.3.2.1.11. Cocaine base / procaine base
3.3.2.1.12. Barbiturate salt/cocaine base/methamphetamine HCl
3.3.2.1.13. Aqueous ketamine sample
3.3.2.1.14. Psilocybin mushroom

4. Required Reading

4.1. Moffat, A. C., et al., eds. *Clarke's Analysis of Drugs and Poisons.* 4th Edition. London: Pharmaceutical Press, 2011. Chapter 29.

4.2. Liu, R. H. and Gadzala, D. E. Handbook of Drug Analysis. Washington DC: American Chemical Society, 1997. pp 35 – 38.

5. References

5.1. Liu, R. H. and Gadzala, D. E. Handbook of Drug Analysis. Washington DC: American Chemical Society, 1997.

5.2. Butler, William P. *Methods of Analysis for Alkaloids, Opiates, Marihuana, Barbiturates, and Miscellaneous Drug, Publication #341*. Washington, D.C.: U.S. Treasury Department, Internal Revenue Service, December, 1966: 64.

5.3. Casale, J. "An Aqueous-Organic Extraction Method for the Isolation and Identification of Psilocin from Hallucinogenic Mushrooms." *Journal of Forensic Science* (January, 1985).

5.4. Casale, J.F., and R.F.X. Klein. "Illicit Production of Cocaine." *Forensic Science Review*, Volume 5, Issue 2 (1993): 95-107.

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5.6. Clarke, E.G.C. and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969.

5.7. Moffat, A. C., et al., eds. *Clarke's Isolation and Identification of Drug.* 2nd Edition. London: Pharmaceutical Press, 1986.

5.8. Moffat, A. C., et al., eds. *Clarke's Analysis of Drugs and Poisons.* 4th Edition. London: Pharmaceutical Press, 2011.

5.9. Sarwar, Mohammad and John McDonald. "A Rapid Extraction and GC-MS Methodology for the Identification of Psilocyn in Mushroom/Chocolate Concoctions." *Microgram Journal*, Volume , Issue 3-4 (July-December 2003).

5.10. Suzuki, E.M. and W.R. Gresham. "Identification of Some Interferences in the Analysis of Clorazepate." *Journal of Forensic Sciences*, Volume 28, Issue 3 (July 1983): 655-682.

5.11. O'Neil, M. J. ed. *The Merck Index,* 14th Edition. Whitehouse Station, NJ: Merck & Co., Inc. 2006.

5.12. Cantrell, T.S., John Boban, Leroy Johnson and A.C. Allen. "A Study of Impurities Found in Methamphetamine synthesized From Ephedrine." *Forensic Science International*, 39 (1988): 39-53.

5.13. Casale, John F. and Richard W. Waggoner. "A Chromatographic Impurity Signature Profile Analysis for Cocaine Using Capillary Gas Chromatography." *Journal of Forensic Sciences*. Vol. 36, No. 5, (Sept. 1991): 1312-1330.

5.14. Couper, Fiona J. and Barry K. Logan. "Determination of Gamma Hydroxybutyrate (GHB) in Biological Specimens by Gas Chromatograpy-Mass Spectrometry." *Journal of Analytical Toxicology*. Vol 24, (Jan-Feb 2000): 1-6.

5.15. Brown, T.L., et al, *Chemistry the Central Science.* 5th Ed., Prentice-Hall, 1991.

5.16. McMurry, John. *Organic Chemistry,* Brooks/Cole Publishing Co., 1992.

6. Records

6.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

6: Training Procedure for Marijuana Identification and Microscopy

1. **Purpose –** With origins dating back to the late 1500's, the microscope is one of the oldest tools of science. Now in the twenty-first century, it is still a valuable tool used in Forensic Drug Chemistry. The stereomicroscope or dissecting microscope is used in the Drug Chemistry Unit primarily to identify the morphological characteristics of marijuana. The polarizing light microscope is used in the Drug Chemistry Unit to observe microcrystals and hashish characteristics. This section will cover the identification of marijuana with the stereomicroscope, the use of microcrystalline tests with the polarizing microscope and the use of the polarizing microscope to observe hashish characteristics.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Be able to successfully use and perform the quality control procedures of the Drug Chemistry Unit Technical Procedure for Microcrystalline Tests.

3.1.2. Be able to give a definition of marijuana.

3.1.3. Be able to identify and describe the morphological characteristics of marijuana.

3.1.4. Be familiar with crystals of sugars using the polarizing light microscope.

3.1.5. Successfully complete a written exam.

3.1.6. Pass a competency exam using color tests, pharmaceutical identifiers, ultraviolet spectroscopy, infrared spectroscopy, extractions and microscopy to correctly identify a set of unknowns.

3.2. Study Questions

3.2.1. What is a microscope?

3.2.2. Name the basic parts of a microscope.

3.2.3. What is the difference between a compound microscope and a stereomicroscope?

3.2.4. What is polarized light?

3.2.5. How does the polarizing light microscope work?

3.2.6. What is a birefringent crystal?

3.2.7. Explain what happens when a drug is mixed with a microcrystalline reagent.

3.2.8. What would you expect to happen when a combination of substances is mixed with a microcrystalline reagent? Why?

3.2.9. Can the gold chloride 20 % acetic acid microcrystalline test be used as a confirmatory test for cocaine?

3.2.10. What is the definition of marijuana in Chapter 90 of the *North Carolina General Statutes*?

3.2.11. How many species are there of marijuana?

3.2.12. What is sinsemilla?

3.2.13. What is hashish and how is made?

3.2.14. What are the macroscopic and microscope characteristics of hashish?

3.3. Practical/Laboratory Exercises

3.3.1. Using the appropriate microscope and the necessary microcrystalline reagents, test a set of known samples provided by the Principal Instructor and record the results as you would in casework.

3.3.1.1. Marijuana

3.3.1.1.1. Identify and describe all macroscopic characteristics.
3.3.1.1.2. Using the stereomicroscope, identify and describe all microscopic characteristics.
3.3.1.1.3. Using the polarizing light microscope, be able to identify hairs associated with marijuana/hashish.

3.3.1.2. Examples of samples to analyze using the stereomicroscope

3.3.1.2.1. Mixture of marijuana and non-marijuana
3.3.1.2.2. Hashish
3.3.1.2.3. Spearmint
3.3.1.2.4. Peppermint
3.3.1.2.5. Tobacco
3.3.1.2.6. Oregano
3.3.1.2.7. Rosemary
3.3.1.2.8. Marjoram
3.3.1.2.9. Thyme
3.3.1.2.10. Parsley

3.3.1.2.11. Bay leaf
3.3.1.2.12. Tarragon
3.3.1.2.13. Sage
3.3.1.2.14. Dill
3.3.1.2.15. Basil
3.3.1.2.16. Celery seed
3.3.1.2.17. Coriander seed
3.3.1.2.18. Chives
3.3.1.2.19. Catnip
3.3.1.2.20. Alfalfa

3.3.1.3. Examples of samples to analyze using the polarizing light microscope and water

3.3.1.3.1. Inositol
3.3.1.3.2. Mannitol
3.3.1.3.3. Lactose
3.3.1.3.4. Sucrose
3.3.1.3.5. Starch

3.3.1.4. Examples of samples to analyze using the polarizing light microscope and the gold chloride reagent

3.3.1.4.1. Cocaine
3.3.1.4.2. Cocaine and procaine
3.3.1.4.3. Cocaine and benzocaine

3.3.1.5. Examples of samples to analyze using the polarizing light microscope and the mercuric chloride reagent

3.3.1.5.1. Heroin
3.3.1.5.2. Caffeine
3.3.1.5.3. Heroin and procaine

3.4. Using color tests, pharmaceutical identifiers, ultraviolet spectroscopy, infrared spectroscopy, extractions and microscopy, successfully identify a set of unknowns provided by the Principal Instructor.

3.4.1. Record the results of all analyses as you would in casework.

3.5. Required Reading

3.5.1. *Marihuana Its Identification*. Washington, D.C.: U.S. Treasury Department Bureau of Narcotics, United States Printing Office, 1948.

3.5.2. *Recommended Methods for the Identification and Analysis of Cannabis and Cannabis Products.* New York: Laboratory and Scientific Section United Nations Office on Drugs and Crime, United Nations, 2009.

3.5.3. Clarke, E.G.C., and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969: 135-141, 801

3.5.4. Allen, A. C., Copper, D. A., Kiser, W. O., Cottrell, R. C., "The Cocaine Diastereoisomers," *Journal of Forensic Sciences*, Vol. 26, No.1, Jan. 1981, pp. 12–26.

3.5.5. *Nikon Polarizing Microscope Eclipse E400Pol Instructions*, Nikon Inc, Melville, NY, M216E 98.8.VF.1.

3.5.6. Drug Chemistry Unit Technical Procedures

3.5.6.1. Identification of Marijuana
3.5.6.2. Microcrystalline Tests
3.5.6.3. Drug Chemistry Analysis

4. References

4.1. *Marihuana Its Identification*. Washington, D.C.: U.S. Treasury Department Bureau of Narcotics, United States Printing Office, 1948.

4.2. *Recommended Methods for the Identification and Analysis of Cannabis and Cannabis Products.* New York: Laboratory and Scientific Section United Nations Office on Drugs and Crime, United Nations, 2009.

4.3. *North Carolina General Statutes* §90-87 (16) and §90-95(d)(4).

4.4. *Nikon Polarizing Microscope Eclipse E400Pol Instructions*, Nikon Inc, Melville, NY, M216E 98.8.VF.1.

4.5. Clarke, E.G.C., and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969: 135-141, 801.

4.6. Allen, A. C., Copper, D. A., Kiser, W. O., Cottrell, R. C., "The Cocaine Diastereoisomers," *Journal of Forensic Sciences*, Vol. 26, No.1, Jan. 1981, pp. 12–26.

4.7. Smith, F.P., ed. *Handbook of Forensic Drug Analysis.* Boston, Massachusetts: Elsevier Academic Press, 2005: 238.

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History

Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

7: Training Procedure for Gas Chromatography

1. **Purpose –** The Gas Chromatograph is useful in identifying and quantitating substances. Gas Chromatography (GC) dates back to the early 1900's and may be linked to distillation which dates into antiquity.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Become familiar with the components of the GC.

3.1.2. Understand basic GC theory and concepts.

3.1.3. Be able to explain the use of GC data to quantitate controlled substances.

3.1.4. Successfully complete a written exam on chromatography.

3.2. Study Questions

3.2.1. Name six components of a GC and describe how each component works.

3.2.2. What is chromatography?

3.2.3. What is gas chromatography?

3.2.4. Explain how the GC stationary phase and a mobile phase function. Give an example of each.

3.2.5. Define a split injection.

3.2.6. Define a splitless injection.

3.2.7. Explain what is meant by the term "split ratio." Give an example.

3.2.8. Why are Drug Chemistry samples run with split injections?

3.2.9. Describe the function of the septum purge vent on a GC injector.

3.2.10. What is the function of an injection liner?

3.2.11. What would happen if the sample vapor volume exceeded the volume of the injection liner?

3.2.12. Describe two general types of GC columns.

3.2.13. What is meant by the acronyms PLOT and WCOT in relation to GC columns?

3.2.14. Describe the three major parts of a fused capillary column.

3.2.15. What is the chemical composition of a DB-5 stationary phase?

3.2.16. Explain what is meant by constant flow and constant pressure.

3.2.17. Explain the difference in an isothermal program and a temperature program.

3.2.18. List three types of GC detectors (include FID). Explain how they work and their advantages.

3.2.19. Can decomposition occur in gas chromatography? If so, how can it be avoided?

3.2.20. Explain what is meant by derivatization in relation to gas chromatography.

3.2.21. What are advantages of derivatizing a substance?

3.2.22. List common derivatizing agents.

3.2.23. The theory surrounding separation via gas chromatography is well studied and can be described mathematically. Define the following:

3.2.23.1. Signal to noise ratio. What value would differentiate between analyte and noise?

3.2.23.2. Resolution. Give a value for baseline separation.

3.2.23.3. Number of theoretical plates (N).

3.2.23.4. Height equivalent theoretical plates (HETP). What is the meaning of a higher v. lower value?

3.2.24. Define the difference between calibration and verification.

3.2.25. What is a response factor and how is it used in quantitative analysis? Give an example.

3.2.26. What is the difference between quantitation using external and internal standards?

3.2.27. What is the advantage of using an internal standard for quantitation?

3.2.28. What is the Drug Chemistry Unit criterion for a positive GC RRT comparison?

3.3. Practical/Laboratory Exercises

3.3.1. Describe the effect of the change in oven temperature on a chromatogram.

3.3.2. Describe the effect of change in flow rate on a chromatogram.

3.3.3. Given a set of chromatograms of an internal standard and known analyte concentration, plot a concentration curve using an internal standard method.

3.3.3.1. Given data for an unknown, determine the concentration of the solution using the concentration curve you plotted.

3.3.4. Replace the septum, syringe and injection liner of a GCMS. Discuss changing a column with the Principal Instructor.

3.3.5. Review the data system settings of the GCs used in the Drug Chemistry Unit with the Principal Instructor.

3.4. Required Reading

3.4.1. Drug Chemistry Unit Technical Procedure for Gas Chromatography Mass Spectrometry.

3.4.2. "Quantitation Methods in Gas Chromatography." Alltech Associates, Inc.: 1998. Refer to Attachment A.

3.4.3. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions,* Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapter 40.

3.4.4. Skoog, Douglas, et al, *Principles of Instrumental Analysis*, 5th Ed., USA: Harcourt Brace & Co., 1998. Chapters 26 and 27.

4. References

4.1. *Quantitation Methods in Gas Chromatography*, Alltech Associates, Inc., 1998.

4.2. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions,* Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapter 40.

4.3. Skoog, Douglas, et al, *Principles of Instrumental Analysis*, 5th Ed., USA: Harcourt Brace & Co., 1998. Chapters 26 and 27.

4.4. BSTFA & TMCS Product Specification, Sigma-Aldrich Co., 1997.

4.5. Guide to Derivatization Reagents for GC, Bulletin 909A, Sigma-Aldrich Co., 1997.

4.6. *Derivatization of Drugs Prior To GC/MS Analysis*, Varian Application Note Number 69, Varian Inc.

4.7. http://www.sepscience.com

4.8. http://www.chem.agilent.com

4.9. http://www.academysavant.com/products.html

5. Records

5.1. Drug Chemistry Unit Training Schedule

6. Attachments

6.1. "Quantitation Methods in Gas Chromatography." Alltech Associates, Inc.: 1998.

GC Education

Quantitation Methods in Gas Chromatography

Gas Chromatography is a useful tool that allows us to identify and quantitate individual components in a mixture. Using individual standards and reproducible conditions enables peak identification by retention time. In most cases this is absolute, that is unless there are two peaks with exactly the same retention time under the analysis conditions. This same "absolute" property cannot be applied to quantitation which is affected by numerous variables.

Quantitation uses chromatographic data to determine the amount of a given component in a mixture. This data can be in the form of either peak height or peak area which is obtained from an integrated chromatogram. It is very important that this data is gathered accurately. It is best if the peak is totally resolved from any neighboring peaks. A co-elution or other anomalies such as tailing or fronting will distort or obscure the beginning and ending points of the peak making it difficult to accurately determine the size of the peak.

Quantitation Methods

There are several types of quantitation methods commonly used. The five most common are area percent, single point external standard, multiple point external standard, single point internal standard, and multiple point internal standard.

Area Percent Method

Area percent is the simplest quantitation method. This method assumes that the detector responds identically to all compounds. This assumption, however, is not valid. This method provides a rough estimate of the amounts of analytes present.

To calculate area percent take the area of an analyte and divide it by the sum of areas for all peaks. This value represents the percentage of an analyte in the sample.

Single Point External Standard

Unlike the area percent method, the Single Point External Standard method requires the analysis of more than just the sample of interest. Analyze a sample containing a known amount of analyte or analytes and record the peak area. Then calculate a response factor using **Equation 1.**

EQUATION 1

$$\text{response factor} = \frac{\text{peak area}}{\text{sample amount}}$$

Inject a sample with the unknown analyte concentration and record the peak area. Then calculate the amount of analyte using **Equation 2.**

EQUATION 2

$$\text{amount of analyte} = \frac{\text{peak area}}{\text{response factor}}$$

Calculate an individual response factor for each compound of interest.

SINGLE PT. EXT. STD. EXAMPLE

An injection containing benzene at a concentration of 2,000 µg/ ml is made and results in a peak area of 100,000. Calculate the response factor for benzene using **Equation 1.**

$$\text{response factor} = \frac{100{,}000}{2{,}000} = 50$$

An injection of the sample with the unknown concentration of benzene has a peak area of 57,000. Calculate the amount of benzene present using **Equation 2.**

$$\text{amount of benzene} = \frac{57{,}000}{50} = 1{,}140\ \mu g$$

Multiple Point External Standard

The Single Point External Standard method assumes analyte response to be linear over a range of concentrations. (**Figure 1**). Use the Multiple Point External Standard method when the concentration range is large or if the single point external standard method is not linear (**Figure 2**). The samples used in this method cover the expected analyte concentration range. Use a line fitting algorithm such as point to point, linear least squares, or quadratic least squares to produce a calibration curve. See **Figure 2**. Most modern data systems include one or all of these algorithms.

FIGURE 1

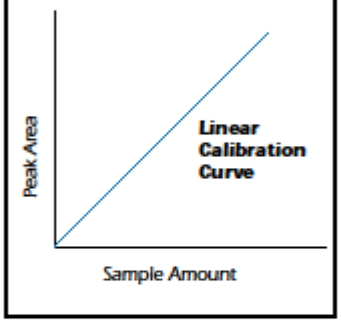
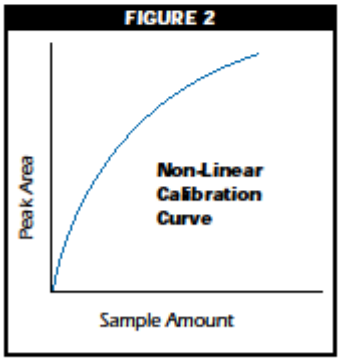


FIGURE 2



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Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

8: Training Procedure for Mass Spectrometry

1. **Purpose** - The beginning of Mass Spectrometry (MS) date to before 1920, but mass spectrometers were not produced commercially until around 1940. Today the mass spectrometer is one of the most widely used instruments in analytical chemistry. It has both qualitative and quantitative applications in Forensic Drug Chemistry. There are different types of mass spectrometers in use. Ion Trap Mass Spectrometers, Time of Flight Mass Spectrometers (TOF), Quadrapole Mass Spectrometers, Laser Ionization Mass Spectrometers, Chemical Ionization Mass Spectrometers, and Liquid Chromatograph Mass Spectrometers are among many examples. This section will familiarize the trainee with MS basics and the hardware configuration of the Electron Impact (EI) Mass Selective Detector (MSD) through the answer of study questions. The trainee will gain knowledge of the operation and maintenance of the GC-MS's used in the Drug Chemistry Unit through experimental/practical exercises and use the GC-MS to identify a set of unknown substances.

2. Scope - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. Procedure

3.1. Objectives

3.1.1. Review and understand the Drug Chemistry Unit Technical Procedures for Gas Chromatography / Mass Spectrometry.

3.1.2. Become familiar with the components of the GC/MS.

3.1.3. Understand MS theory and concepts.

3.1.4. Gain practical knowledge of the operation of the GC/MS.

3.1.5. Use the GC/MS to identify substances.

3.1.6. Pass a written exam.

3.2. Study Questions

3.2.1. Describe the components of a GC/MSD system.

3.2.2. What is the difficulty in interfacing a GC with a MSD?

3.2.3. Name the three major functional components of the MSD, and describe how each function.

3.2.4. Explain the term "mean free path." How is this achieved in a mass spectrometer?

3.2.5. Define the term "base peak" with respect to a mass spectrum.

3.2.6. Define the term "molecular ion" with respect to a mass spectrum.

3.2.7. Explain the term mass defect.

3.2.8. What does tuning the mass spectrometer do?

3.2.9. What is the difference between full scan and selected ion monitoring (SIM) mode?

3.2.10. Explain the phenomenon of "spectral tilting."

3.2.11. Most MS systems have sophisticated search algorithms which perform mass spectral searches of unknown mass spectra. No search routine can provide conclusive identification 100 % of the time. Interpretation and identification is the responsibility of the analyzing scientist. What are some factors that would affect a library search?

3.2.12. Explain the "Nitrogen Rule."

3.2.13. Explain McLafferty rearrangement.

3.2.14. Define the terms nominal mass and resolving power, and explain the concept of resolution in mass spectrometry.

3.2.15. Describe how decomposition can occur in GC/MS analysis. Give examples.

3.2.16. What is derivatization? When would it be useful in GC/MS? List common derivatizing agents and their applications.

3.2.17. What functional groups are typically derivatized by BSTFA with 1% TMCS? List a drug where derivatization by BSTFA with 1% TMCS may be useful in GC/MS identification.

3.2.18. What is the requirement for a positive mass spectral comparison?

3.3. Practical/Laboratory Exercises

3.3.1. Tune a MS. Compare the tune report for the MSD with the requirements stated in the Technical Procedure for GC/MS. What is the significance of each tune requirement?

3.3.2. Observe the Principal Instructor or another Drug Chemist prepare to use a GC/MS, setup a sequence, run a sequence and analyze data files. Using the GC/MS, review data files provided by the Principal Instructor. The data files consist of sets of substances that produce similar mass spectra. Attempt to group the substances into pairs and identify each substance. Describe the criteria used to differentiate between the substances.

3.3.3. Review the mass spectra for dextromethorphan and dextropropoxyphene. Is it possible to identify optical isomers using mass spectral data?

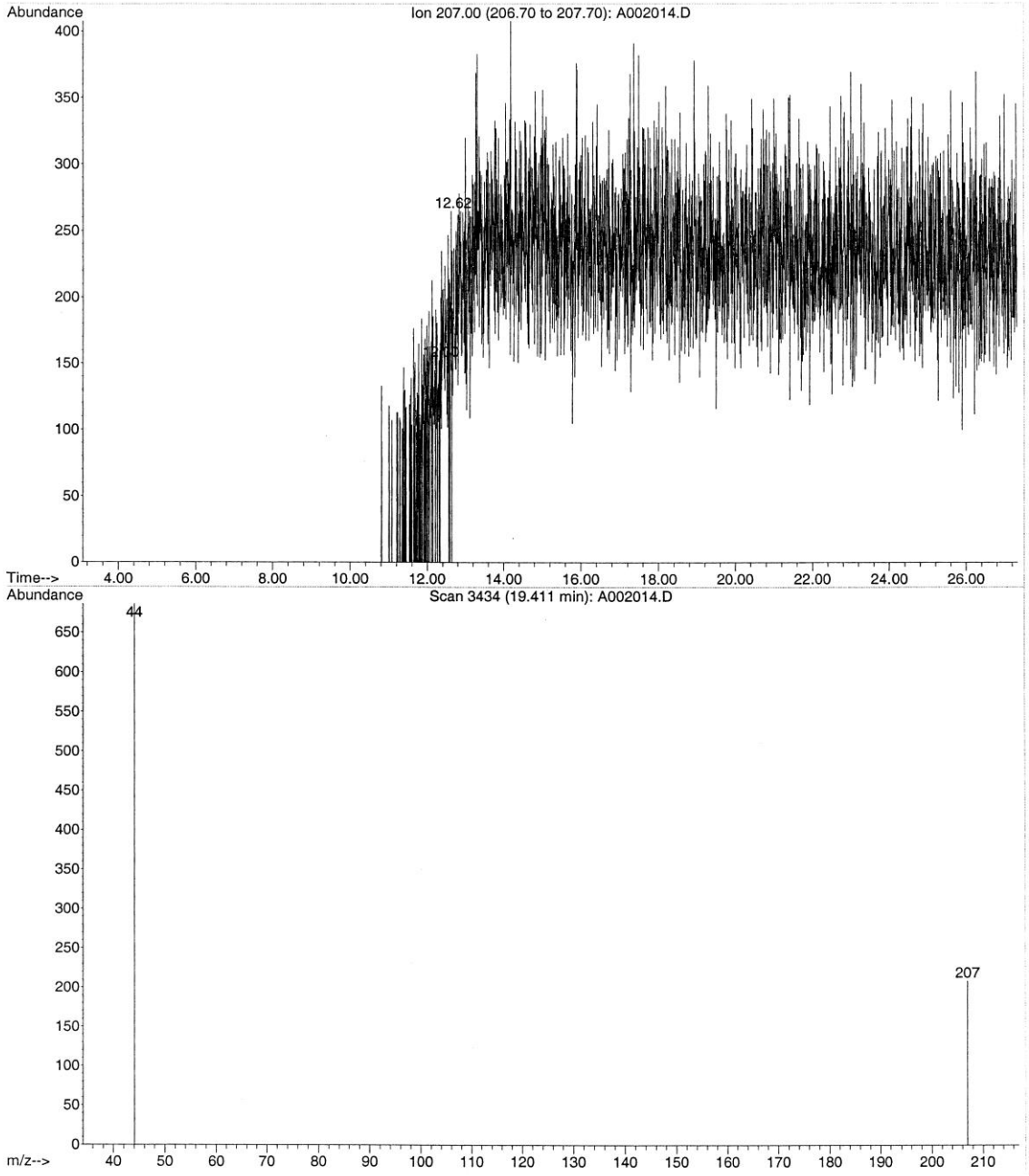
3.3.4. What change would occur in the TIC and the MS if the multiplier voltage were increased? The standard energy for the beam of ionizing electrons in EI MS is 70 eV. What would be the effect if the voltage of the ionizing source were changed?

3.3.5. Review the CANSIM acquisition method of the DWI Blood Chemistry Unit with the Principal Instructor.

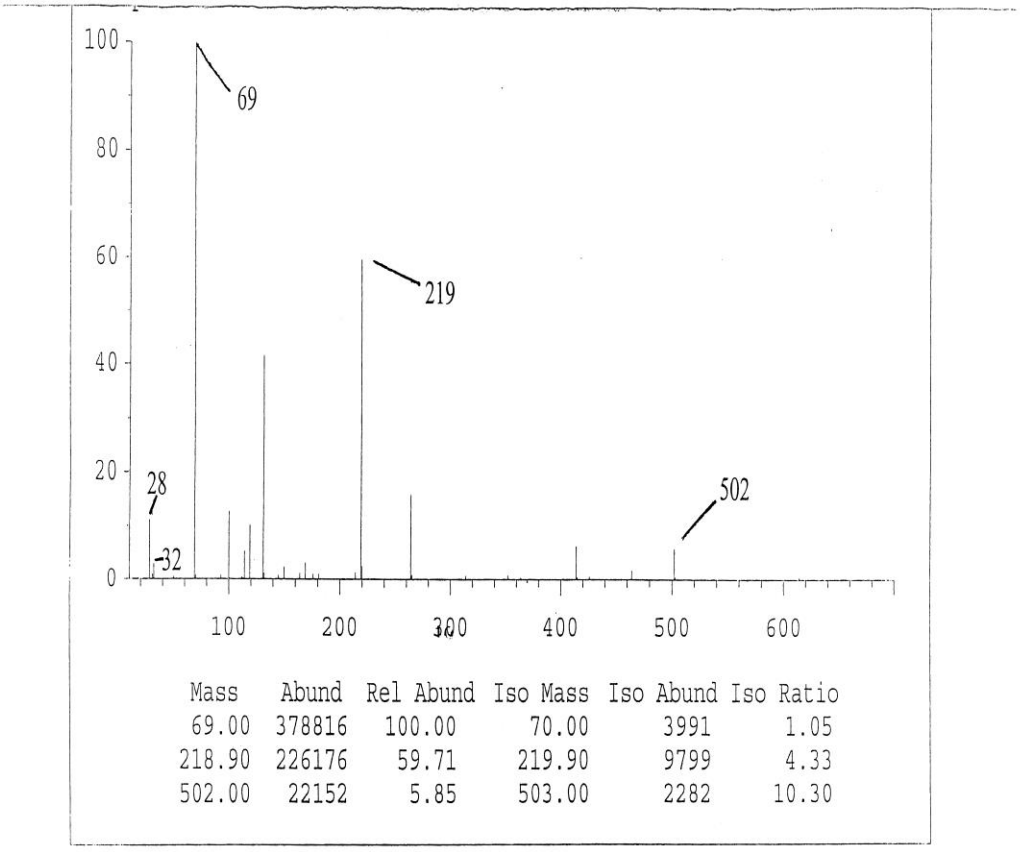
3.3.6. Propose molecular structures for m/e ions in the following mass spectra, and answer the questions.

3.3.6.1. Blank /baseline – 44. What is the origin of the 207 m/e ion?

```
File       : D:\DATA\OCTOBER2006\A002014.D
Operator   : Serial # US21863672
Acquired   : 16 Oct 2006  17:50     using AcqMethod 20HIGH
Instrument :    US2186367
Sample Name: MeOH
Misc Info  :
Vial Number: 100
```



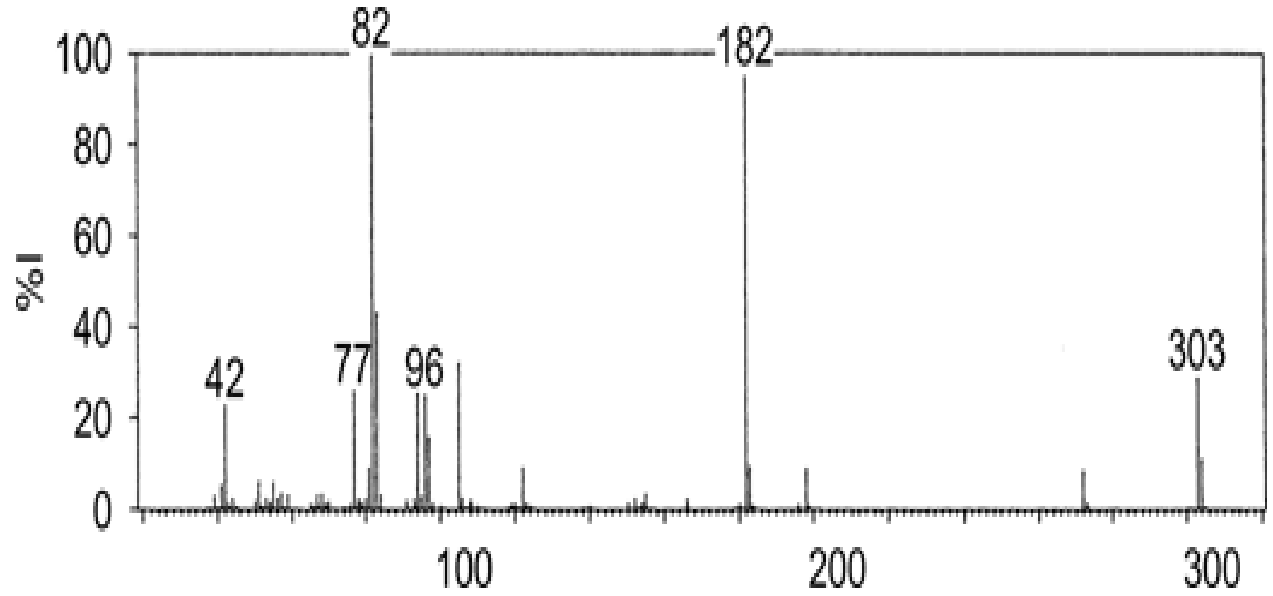
3.3.7. PFTBA - 69, 219, 502. The m/e 32 and 28 m/e ions are not ions of PFTBA. What would cause these ions?



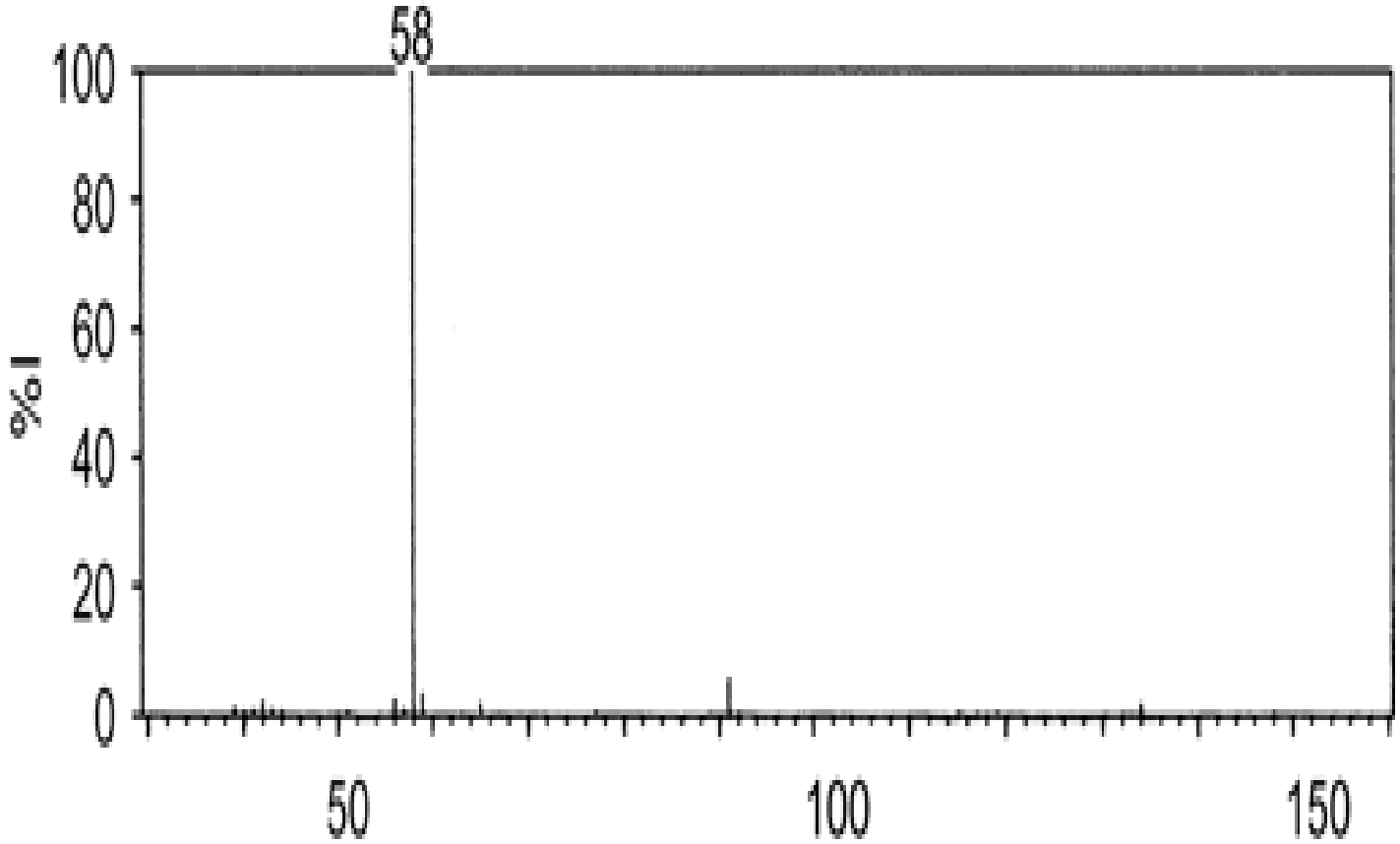
Mass	Abund	Rel Abund	Iso Mass	Iso Abund	Iso Ratio
69.00	378816	100.00	70.00	3991	1.05
218.90	226176	59.71	219.90	9799	4.33
502.00	22152	5.85	503.00	2282	10.30

Perfluorotributylamine (PFTBA or FC_{43})

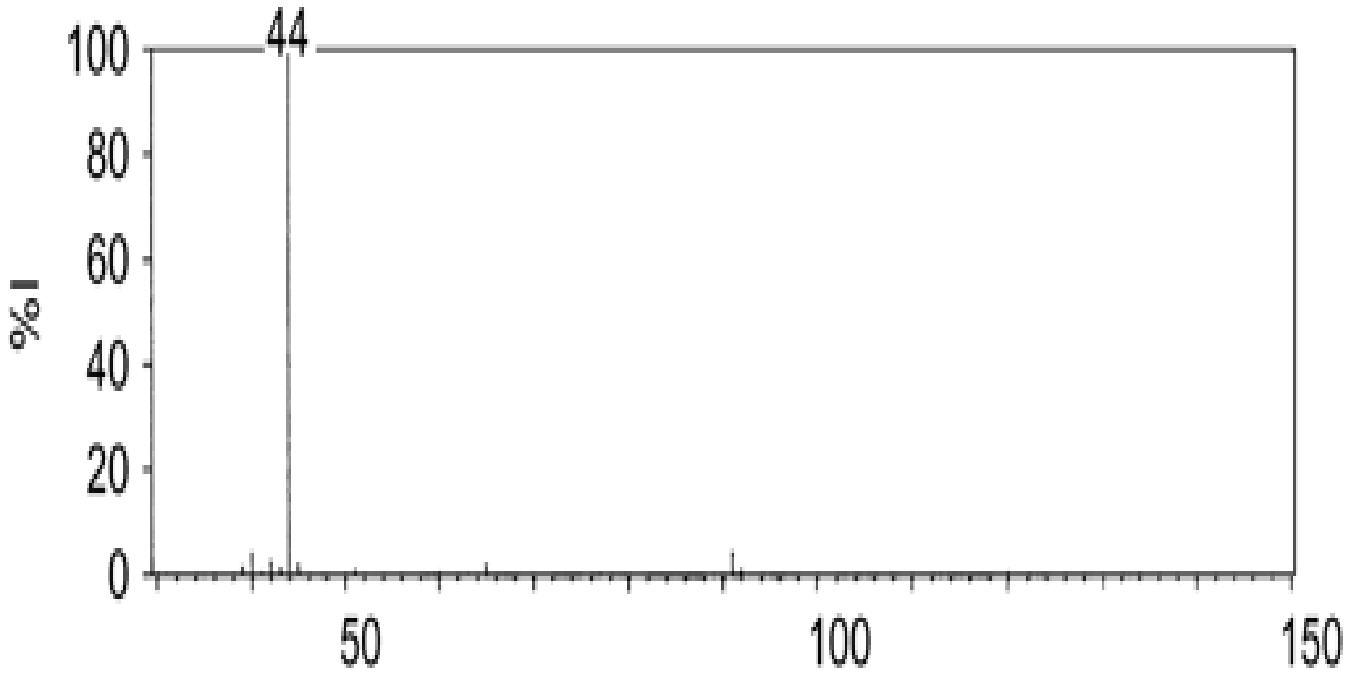
3.3.8. Cocaine - 105, 182



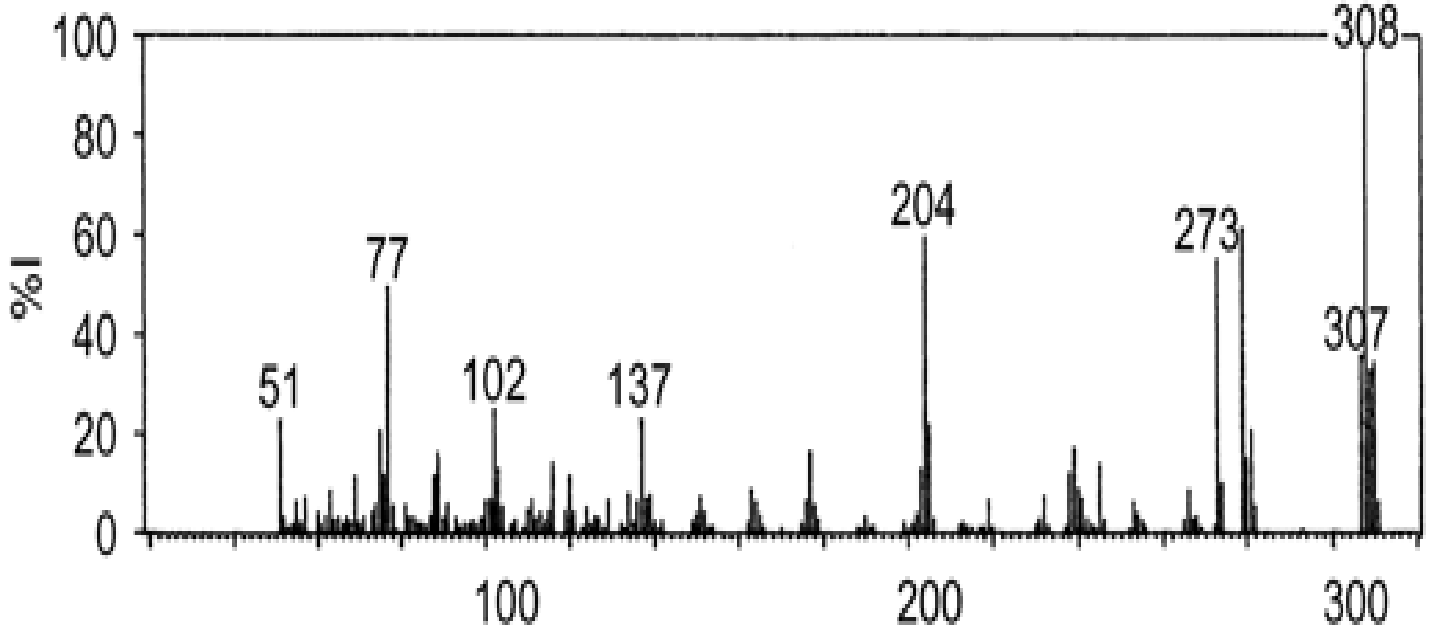
3.3.9. Methamphetamine - 58, 91. What is the name of the 91 m/e ion?



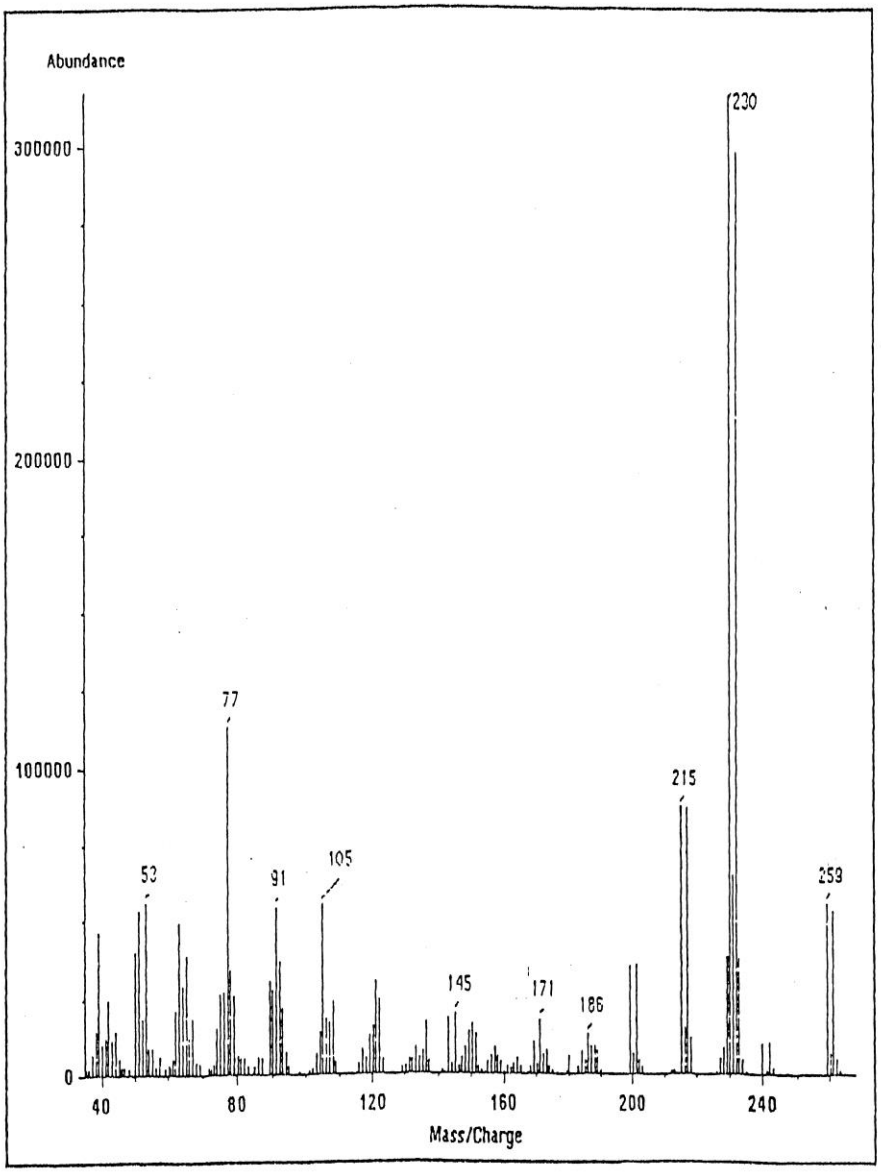
3.3.10. Amphetamine – 44, 91



3.3.11. Alprazolam – 77. Explain the significance of the 279 / 281 m/e pair and the 308 / 310 m/e pair.

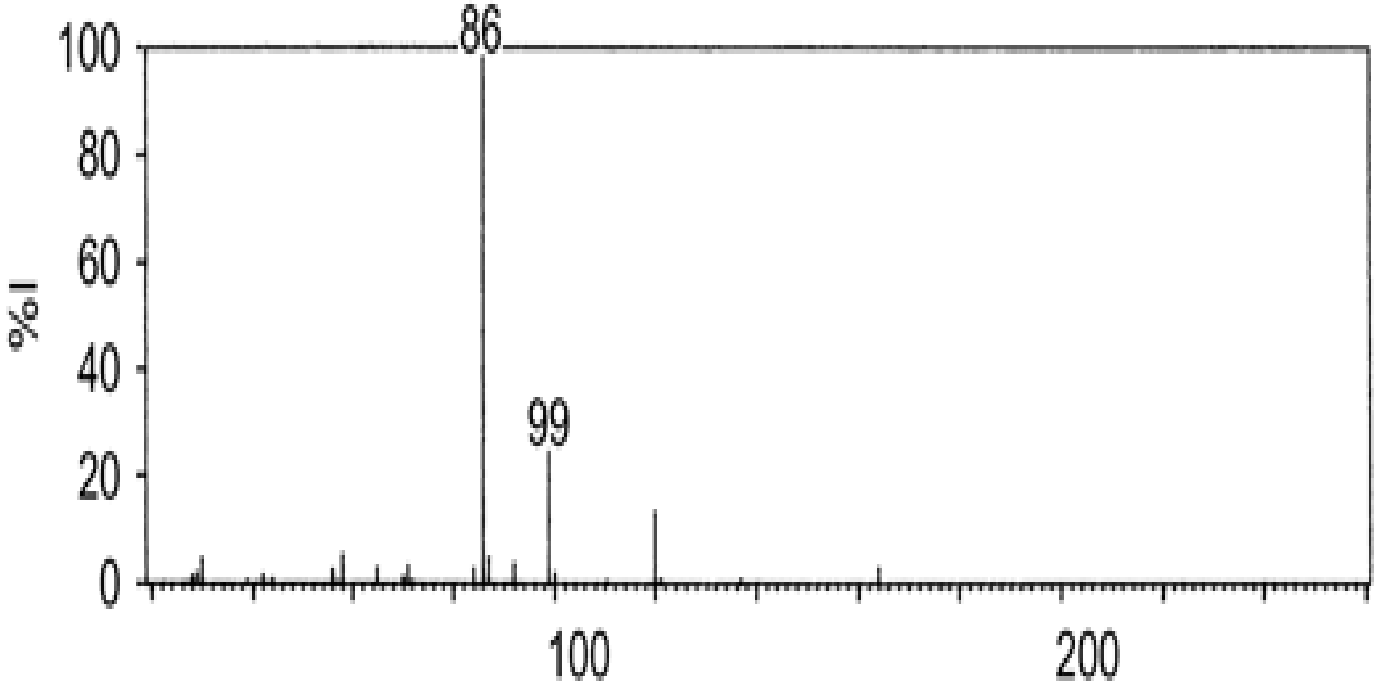


3.3.12. 4-bromo-2,5-dimethoxypenethylamine - 215. Explain the significance of the 215 / 217 m/e, 230 / 232 m/e, and 259 / 261 m/e pairs.

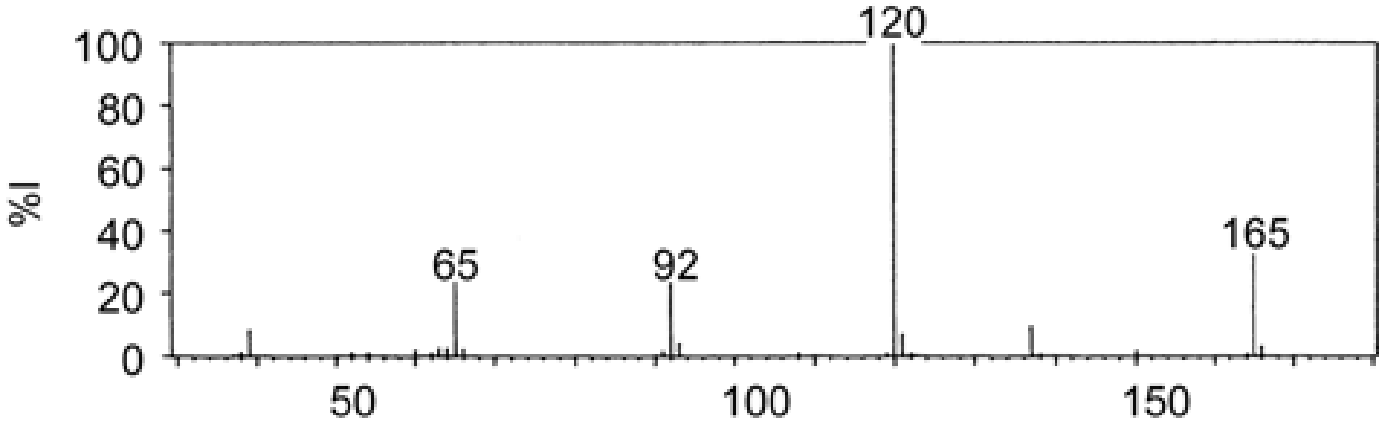


4-bromo-2,5-dimethoxyphenethylamine

3.3.13. Procaine – 86, 120


86
99
100
80
60
40
20
0
%I
100
200

3.3.14. Benzocaine – 120, 92



3.4. Required Reading

3.4.1. Drug Chemistry Unit Technical Procedures:

3.4.1.1. Gas Chromatography / Mass Spectrometry
3.4.1.2. Drug Chemistry Analysis

3.4.2. Agilent GC/MSD ChemStation and Instrument Operation Student Manual Course Number H4043A Volume 1, Revision E.02.xx, printed February 2008, Agilent Technologies, pp 1-32, 39-73, 81-122.

3.4.3. Interpretation of Mass Spectra Student Manual Course Number H4063A, printed June 2000, Agilent Technologies.

3.4.4. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisons*, Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapter 37.

3.4.5. Skoog, Douglas, et al, *Principles of Instrumental Analysis*, 5th Ed., USA: Harcourt Brace & Co., 1998. Chapter 20.

3.4.6. F.W. McLafferty. *Interpretation of Mass Spectra*, 4th Ed., University Science Books, 1993. Chapters 1 – 5.

4. References

4.1. Hewlett Packard / Agilent Technologies. *GC MSD ChemStation and Instrument Operation Student Manual, Vol. I & II, (Manual Part Number H4043-90000)*. Hewlett Packard, April 1997.

4.2. Interpretation of Mass Spectra Student Manual Course Number H4063A, printed June 2000, Agilent Technologies

4.3. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisons*, Volume 1, 4th edition, Pharmaceutical Press, 2011

4.4. F.W. McLafferty. *Interpretation of Mass Spectra*, 4th Ed., University Science Books, 1993.

4.5. Skoog, Douglas, et al, *Principles of Instrumental Analysis*, 5th Ed., USA: Harcourt Brace & Co., 1998.

4.6. *BSTFA with 1 % TMCS Product Specification*, Sigma-Aldrich Co, 1997.

4.7. *Guide to Derivatization Reagents for GC*, Bulletin 909A, Sigma-Aldrich Co., 1997.

4.8. Derivatization of Drugs Prior To GC/MS Analysis, Varian Application Note Number 69, Varian Inc.

4.9. http://www.chem.agilent.com

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

9: Training Procedure for Sampling

1. **Purpose** - This procedure specifies the required elements for training on the Drug Chemistry Section Technical Procedure for Sampling.

2. **Scope** - This procedure applies to trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Understand and use the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis.

3.1.2. Successfully complete a written exam.

3.2. Study Questions

3.2.1. Define:

3.2.1.1. Population

3.2.1.2. Sample Selection

3.2.1.3. Sampling Procedure

3.2.1.4. Sampling

3.2.1.5. Sampling Plan

3.2.1.6. Homogenous

3.2.1.7. Administrative Sample Selection

3.2.1.8. Threshold Sample Selection

3.2.1.9. Hypergeometric Sampling Plan

3.2.2. Under what sampling plan may an inference may be made about the whole population?

3.2.3. What is the minimum number of units that must be present in a population to use Hypergeometric Sampling?

3.2.4. When are net and gross weights used in analysis?

3.2.5. How are net and gross weights reported?

3.2.6. Explain an example of when to use the following:

3.2.6.1. Administrative Sample Selection

3.2.6.2. Threshold Sample Selection

3.2.6.3. Hypergeometric Sampling Plan

3.3. Practical/Laboratory Exercises

3.3.1. Review and discuss the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis with the Principal Instructor.

3.3.2. Using the example below, show the calculations and the report wording used to convey results as you would in casework.

3.3.2.1. Use the Hypergeometric Sampling Plan and estimate the weight of additional glassine bags needed due to a threshold amount of material present.

3.3.2.1.1. Make up any weight numbers not provided that are needed to complete this exercise.

3.3.2.1.2. Assume all bags chemically analyzed confirmed the presence of heroin.

Item 1: 4525 glassine bags containing tan powder.
Number of bags to be individually analyzed = _____
Net Weight of Hypergeometric number of bags = 0.8236 grams

3.4. Required Reading

3.4.1. Drug Chemistry Section Unit Technical Procedure for Drug Chemistry Analysis and its references.

4. References

4.1. ASTM Standard E2329-09. "Identification of Seized Drugs." ASTM International: West Conshohocken, PA, 2009, www.astm.org.

4.2. "Part III B – Methods of Analysis/Drug Identification." *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 5th Edition. January 29, 2010.

4.3. *Guidelines on Representative Drug Sampling*. United Nations, New York: United Nations Office on Drugs and Crime, 2009.

4.4. Frank, Richard S., et. al. "Representative Sampling of Drug Seizures in Multiple Containers." *Journal of Forensic Sciences,* Volume 36, Issue 2 (March 1991), 350-357.

4.5. "PART III A - Methods of Analysis/Sampling Seized Drugs for Qualitative Analysis." *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 5th ed.: January 29, 2010.

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements

10: Training Procedure for Policy Review, Report Writing, and Courtroom Testimony

1. **Purpose –** All casework must conform to laboratory policies and procedures. This section will focus on the policies and procedures governing casework. As a final test, the Drug Chemistry trainee will analyze a series of mock case samples and testify to the analysis of one or more of the samples in a mock trial.

2. **Scope** - This procedure applies to Drug Chemistry trainees without experience in the Drug Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Know and understand the Laboratory policies and procedures governing evidence handling, note taking, and report writing.

3.1.2. Be knowledgeable of the ethical responsibilities of a Forensic Chemist.

3.1.3. Be able to properly document casework.

3.1.4. Be able to explain scientific techniques in non-technical terms and technical terms.

3.1.5. Pass a written exam.

3.1.6. Pass a competency exam comprised of analysis and report generation for one or more mock cases.

3.1.7. Successfully testify to the analysis of one or more of the competency exam mock cases chosen by the Principal Instructor in a mock trial. An Employee Testimony Evaluation form will be used to evaluate the testimony.

3.2. Study Questions

3.2.1. How is an improper seal remediated?

3.2.2. What is a proper seal?

3.2.3. True or False: For evidence received by personal delivery, it is the responsibility of the Laboratory employee receiving evidence directly to ensure the evidence packages are properly sealed and identified.

3.2.4. When and how is evidence secured?

3.2.5. How much detail must be recorded during an analysis?

3.2.6. How are corrections or changes on case notes or any other document in the case file made?

3.2.7. What are the criteria for reporting and noting the weights of controlled substances?

3.2.8. What must be done to packages upon receipt or return of evidence?

3.2.9. How do you handle case inquiries?

3.2.10. How would you handle a discrepancy with evidence?

3.2.11. What is included in a reagent log and on the reagent bottle?

3.2.12. What are the minimum criteria for identification of a controlled substance?

3.2.13. How is the number of items to be analyzed determined in a multi-item case?

3.2.14. What special steps should be taken for a biohazard type of case?

3.2.15. True or False: It is the responsibility of all Laboratory personnel to be aware of possible sources of contamination between items in the same case, between items from different cases, and to prevent evidence from deleterious change.

3.2.16. True or False: It is unadvisable to have more than one case open at a time. Each individual case should be completed before opening another case.

3.2.17. Review the acceptable abbreviations used in the Drug Chemistry Unit.

3.3. Practical/Laboratory Exercises

3.3.1. Complete online or other ethics training approved by the Forensic Quality Manager.

3.3.2. Prepare a Statement of Qualifications, also known as a Curriculum Vitae (CV).

3.3.3. Observe the Principal Instructor or another Drug Chemist analyzing, documenting and preparing reports for ten cases.

3.3.4. Review courtroom testimony with the Principal Instructor. If possible, observer the testimony of the Principal Instructor or another Drug Chemist.

3.3.5. Using all the techniques and principles presented in training, complete the analysis of a competency exam consisting of a set of unknown samples, document the analyses as if they were casework and prepare laboratory reports.

3.3.6. Complete a Mock Trial based upon the competency exam,

3.3.6.1. Prepare answers to the following questions in preparation for the mock trial. Discuss the answers with the Principal Instructor, answers do not need to be written or maintained in the training file

3.3.6.2. Please state your full name for the record.

3.3.6.3. How are you employed?

3.3.6.4. How long have you been employed with the CCBI Crime Laboratory?

3.3.6.5. What are your job duties?

3.3.6.6. What is your educational background?

3.3.6.7. What training and experience do you have in the analysis of controlled substances?

3.3.6.8. How many times have you been qualified as an expert in forensic chemistry?

3.3.6.9. Can you tell the jury what State's Exhibit # 1 is and how you recognize it?

3.3.6.10. Is State's Exhibit # 1 in substantially the same condition as when you last saw it?

3.3.6.11. When did you receive State's Exhibit #1?

3.3.6.12. From whom did you receive it?

3.3.6.13. Can you explain to the jury how evidence is received and maintained at the CCBI Crime Laboratory?

3.3.6.14. Did there come a time when you opened State's Exhibit # 1 to examine the contents?

3.3.6.15. When was that?

3.3.6.16. What analysis did you perform on the contents of States Exhibit # 1?

3.3.6.17. What did you do after you completed your analysis?

3.3.6.18. In your opinion, what were the contents of State's Exhibit # 1?

3.3.6.19. What did you do with the contents of State's Exhibit # 1 when you completed your analysis?

3.3.6.20. Define chemistry.

3.3.6.21. What is a controlled substance?

3.3.6.22. What is a Forensic Chemist/Forensic Scientist/Forensic Drug Chemist?

3.3.6.23. What skills do you possess that relate to the duties of a Forensic Chemist?

3.3.6.24. What qualifies you as an expert in Forensic Drug Chemistry?

3.3.6.25. Outline the training you received at the CCBI Crime Laboratory.

3.3.6.26. Does the Lab have policies and procedures governing the handling of evidence?

3.3.6.27. What is the policy if you find a discrepancy?

3.3.6.28. Do you have any knowledge of evidence prior to receipt?

3.3.6.29. Could it have been tampered with before you received it?

3.3.6.30. Have you ever made a mistake?

3.3.6.31. What would you do if it came to your attention that there was an error in your analysis?

3.3.6.32. What security measures are in place at the CCBI Crime Laboratory?

3.3.6.33. What is the uncertainty of measurement in your analysis?

3.3.6.34. What is uncertainty of measurement?

3.3.6.35. What is the criteria for the identification of a controlled substance?

3.3.6.36. What is the difference between a screening test and confirmatory test?

3.3.6.37. What precautions are taken to guard against contamination?

3.3.6.38. What are a technical and an administrative review?

3.3.6.39. Be able to explain:

3.3.6.39.1. Calibration
3.3.6.39.2. Quality control check
3.3.6.39.3. Reference material
3.3.6.39.4. Positive control

3.3.6.39.5. Negative control

3.3.6.40. Be able to generally explain each technique covered in the training program, for example:

3.3.6.40.1. What causes a color test to change color?
3.3.6.40.2. What causes the peaks in IR and UV spectra?
3.3.6.40.3. How does an IR work?
3.3.6.40.4. What happens when you extract a drug?
3.3.6.40.5. What causes drugs to separate in an extraction?
3.3.6.40.6. What is the difference between a stereomicroscope and polarizing microscope?
3.3.6.40.7. How does a GC-MS work?
3.3.6.40.8. How do you know the GCMS was working properly?
3.3.6.40.9. What do the markings on the data mean?

3.3.6.41. Know the origins of drugs commonly analyzed, for example:

3.3.6.41.1. Where does LSD originate?
3.3.6.41.2. How is Cocaine made?
3.3.6.41.3. What is the difference in Cocaine Hydrochloride and Cocaine Base, or "crack"?

3.3.6.42. Are you accredited?

3.3.6.43. Is your laboratory accredited?

3.3.6.44. What is ASCLD/LAB?

3.4. Required Reading

3.4.1. CCBI Crime Laboratory Forensic Science Quality Manual
3.4.2. CCBI Crime Laboratory Administrative Procedure Manual
3.4.3. CCBI Crime Laboratory Evidence Submission Manual
3.4.4. CCBI Crime Laboratory Safety Manual
3.4.5. All Drug Chemistry Unit Technical Procedures

4. References

4.1. CCBI Crime Laboratory Forensic Science Quality Manual
4.2. CCBI Crime Laboratory Administrative Procedure Manual
4.3. CCBI Crime Laboratory Evidence Submission Manual
4.4. Drug Chemistry Unit Technical Procedures and Training Procedures
4.5. CCBI Crime Laboratory Safety Manual

5. Records

5.1. Drug Chemistry Unit Training Schedule

Revision History		
Effective Date	Version Number	Reason
2/8/13	1	Compliance with ASCLD/LAB requirements
7/14/14	2	Ethics training to be approved by Quality Manager