Raleigh/Wake City-County
Bureau of Identification

Crime Laboratory Division

DWI BLOOD CHEMISTRY UNIT
TRAINING PROCEDURES

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1: DWI Drug Analysis - Training Procedure for Drug Classification and Pharmacology

1. **Forward** - The CCBI DWI Blood Chemistry Unit training program is a study of the concepts and analytical techniques used in the Unit to analyze evidence. The training is divided into two parts: Blood Alcohol Content Analysis and Drug Analysis. Each part covers the concepts and analytical techniques associated with each of these types of analyses. The two parts of the DWI Blood Chemistry Unit training program may be completed separately or together. 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 and estimate training time for each are detailed in the DWI Blood Chemistry Unit Drug Analysis 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 Toxicology.

   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 DWI Blood 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 Analysis will last for a minimum of ~~two~~ six months. Phase II - 100 % Technical Review training for Blood Alcohol Content Analysis will last for a minimum of ~~one~~ six months. Phase II training periods for each unit may overlap.

~~**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.~~

1.1. 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** - Most controlled substances and drugs with impairing effects act on the Central Nervous System (CNS). They can be generally characterized as having depressant, stimulatory, or hallucinogenic effects on the human body. Knowledge of the structure, pharmacokinetics, and pharmacodynamics of these compounds is essential for identifying drugs present in evidence and for forensic testimony. In this section, the trainee shall become familiar with commonly encountered drugs and metabolites and the basic principles of pharmacokinetics.

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

4. **Procedure**

4.1. Objectives

4.1.1. Become knowledgeable of forensic science.

4.1.2. Be knowledgeable of the drugs and metabolites commonly encountered in forensic evidence.

4.1.3. Be able to identify the general class of a drug.

4.1.4. Be knowledgeable of the effects of the general classes of drugs on human performance.

4.1.5. Be knowledgeable of the basic principles of pharmacokinetics.

4.1.6. Pass a written exam.

4.2. Study Questions

4.2.1. Define Toxicology.

4.2.2. Describe the uses and clinical signs/symptoms associated with the following classes of drugs: depressant, stimulant, hallucinogen, antidepressant, and analgesic.

4.2.3. List the chemical structure of the following substances. Identify the drug class. Describe the nature and effect each would have on the human body. List the major metabolites.

Identify the trade name and the schedule from North Carolina General Statutes, if applicable.

4.2.3.1. Alprazolam
4.2.3.2. α-hydroxyalprazolam
4.2.3.3. Amitriptyline
4.2.3.4. Benzoylecgonine
4.2.3.5. Butalbital
4.2.3.6. Bupropion
4.2.3.7. Caffeine
4.2.3.8. Carbamazepine
4.2.3.9. Carisoprodol
4.2.3.10. Clordiazepoxide
4.2.3.11. Chlorpheniramine
4.2.3.12. Citalopram
4.2.3.13. Clonazepam
4.2.3.14. 7-Aminoclonazepam
4.2.3.15. Cocaine
4.2.3.16. Codeine
4.2.3.17. Cyclobenzaprine
4.2.3.18. delta-9-tetrahydrocannabinol
4.2.3.19. 11-nor delta-9 tetrahydrocannabinol 9-carboxcylic acid
4.2.3.20. Diazepam
4.2.3.21. Dihydrocodeine
4.2.3.22. Diphenhydramine
4.2.3.23. Doxepin
4.2.3.24. Doxylamine
4.2.3.25. Ecgonine
4.2.3.26. Ecgonine Methyl ester
4.2.3.27. Ephedrine
4.2.3.28. Ethylbenzyolecgonine
4.2.3.29. Fluoxetine
4.2.3.30. Fentanyl
4.2.3.31. Flunitrazepam
4.2.3.32. Gabapentin
4.2.3.33. Gamma-butyrolactone
4.2.3.34. Gamma Hydroxybutyric Acid
4.2.3.35. Hexobarbital
4.2.3.36. Hydrocodone
4.2.3.37. Imipramine
4.2.3.38. Ketamine
4.2.3.39. Lamotrigine
4.2.3.40. Lidocaine
4.2.3.41. Lorazepam
4.2.3.42. MDPV (3, 4-Methylenedioxypyrovalerone)
4.2.3.43. Meclizine

4.2.3.44. Meprobamate
4.2.3.45. Metaxalone
4.2.3.46. Methadone
4.2.3.47. Mephedrone
4.2.3.48. Methamphetamine
4.2.3.49. Methaqualone
4.2.3.50. Methorphan
4.2.3.51. 3, 4-Methylenedioxyamphetamine
4.2.3.52. 3, 4-Methylenedioxymethamphetamine
4.2.3.53. Methylphenidate
4.2.3.54. Midazolam
4.2.3.55. Mirtazepine
4.2.3.56. 6-monoacetylmorphine
4.2.3.57. Morphine
4.2.3.58. Nitrazepam
4.2.3.59. Nordiazepam
4.2.3.60. Orphenadrine
4.2.3.61. Oxazepam
4.2.3.62. Oxycodone
4.2.3.63. Paroxetine
4.2.3.64. Pentobarbital
4.2.3.65. Pethidine
4.2.3.66. Phencyclidine
4.2.3.67. Phendimetrazine
4.2.3.68. Phenmetrazine
4.2.3.69. Phenobarbital
4.2.3.70. Phentermine
4.2.3.71. Phenytoin
4.2.3.72. Prazepam
4.2.3.73. Promethazine
4.2.3.74. Propoxyphene (levo & dextro)
4.2.3.75. Quetiapine
4.2.3.76. Secobarbital
4.2.3.77. Sertraline
4.2.3.78. Synthetic Cannabinoids (JWH-250, JWH-017, JWH-073)
4.2.3.79. Temazepam
4.2.3.80. Trazodone
4.2.3.81. Tramdol
4.2.3.82. Venalfaxine
4.2.3.83. Zolpidem
4.2.3.84. Zopiclone

4.2.4. Explain the term pharmacodynamics.

4.2.5. Explain the term pharmacokinetics.

4.2.6. Explain the following: Metabolism, Absorption, Distribution, Elimination, and Half-Life.

4.2.7. Give examples and explain at least three biotransformation reactions or pathways of drug metabolism.

4.2.8. Give the half-life, therapeutic levels and toxic levels for the following drugs.

4.2.8.1. Cocaine
4.2.8.2. Diazepam
4.2.8.3. Hydrocodone
4.2.8.4. Heroin
4.2.8.5. THC
4.2.8.6. Carisoprodol
4.2.8.7. Methamphetamine
4.2.8.8. Butalbital
4.2.8.9. Methadone

4.3. Practical/Laboratory Exercises

4.3.1. Your Laboratory report states that the analysis confirmed the presence of 11-nor-delta-9-tetrahydrocannabiniol-9-carboxycyclic acid (THCA). The DA calls and asks if THCA caused the impairment of a DWI suspect. What would you tell him/her?

4.4. Required Reading

4.4.1. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions,* Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapters 2, 5, 9, 11, 22, 23, 24, 26 and 28.

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

5. References

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

5.2. Baselt, Randall C. *Drug Effects on Psychomotor Perfomance*, Foster City, California: Biomedical Publications, 2001.

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

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

5.5. Williams, Phillip L., Robert C James and Stephen M Roberts. *Principles of Toxicology*. New York: John Wiley and Sons, 2000.

5.6. Levine, Barry ed., *Principles of Forensic Toxicology*, 3rd Ed., Washington DC: AAC Press, 2010.

5.7. Ellenhorn, Matthew J. and Donald G Bacrceloux, *Medical Toxicology Diagnosis and Treatment of Human Poisoning*, New York: Elsevier Science Publishing Co. Inc, , 1988.

5.8. North Carolina General Statutes.

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

6. Records

6.1. DWI Blood Chemistry Unit Drug Analysis 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 LAPM22

2: DWI Drug Analysis - Training Procedure for Immunoassays

1. **Purpose** - An Immunoassay (IA) is a biochemical test that measures the presence of an antigen or antibody. In Forensic Toxicology IAs are used to measure the presence of drugs in a biological fluid such as blood, serum or urine. An IA is generally considered a preliminary test, i.e., it lacks the specificity to be considered conclusive, and semi quantitative, i.e., there is some correlation between the amount of substance present and test response.

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

3. Procedure

3.1. Objectives

3.1.1. Review and understand the following Technical Procedures:

3.1.1.1. Quality Assurance
3.1.1.2. General Laboratory Equipment
3.1.1.3. TurboVap
3.1.1.4. Enzyme Linked Immunosorbent Assay (ELISA) as a Drug Screen
3.1.1.5. DWI Blood Chemistry Analysis

3.1.2. Be knowledgeable of the basic theory of an IAs.

3.1.3. Be knowledgeable of different types of IAs.

3.1.4. Understand the limitations of an IA.

3.1.5. Exhibit proficiency performing ELISA.

3.1.6. Pass a practical and written exam.

3.2. Study Questions

3.2.1. Explain the basic principle of IAs, including ELISA, used in Forensic Toxicology.

3.2.2. What is meant by a homogenous/heterogeneous assay?

3.2.3. Define the term cross reactivity as it applies to IAs. Can an IA be used to conclusively identify a drug or controlled substance?

3.2.4. Describe at least four common IA techniques, include EMIT and ELISA.

3.2.5. How are and calibrators and controls utilized in IA techniques?

3.2.6. Explain why an IA is considered semi-quantitative.

3.3. Practical/Laboratory Exercises

3.3.1. Analyze a set of known samples provided by the principal instructor using the DWI Blood Chemistry Unit Technical Procedure for Enzyme Linked Immunosorbent Assay (ELISA) as a Drug Screen.

3.3.1.1. Review the results with the Principal Instructor.

3.3.2. Your ELISA results show a significantly high positive result for benzodiazepines; however, in the course of your GC-MS analysis of the same sample you see very weak TIC peaks and MS's with only major ions for diazepam, nordiazepam, midazolam and alprazolam. Explain the IA results.

3.3.3. Practical Exam: Analyze a set of unknown samples provided by the principal instructor using the DWI Blood Chemistry Unit Technical Procedure for Enzyme Linked Immunosorbent Assay (ELISA) as a Drug Screen.

3.4. Required Reading

3.4.1. DWI Blood Chemistry Unit Technical Procedures and references

3.4.1.1. Quality Assurance
3.4.1.2. General Laboratory Equipment
3.4.1.3. TurboVap
3.4.1.4. Enzyme Linked Immunosorbent Assay (ELISA) as a Drug Screen
3.4.1.5. DWI Blood Chemistry Analysis

3.4.2. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions,* Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapter 31.

3.4.3. Levine, Barry ed., *Principles of Forensic Toxicology*. 3rd edition. AACC Press, 2009, 119-139. Chapter 8.

4. References

4.1. Levine, Barry ed., *Principles of Forensic Toxicology*. 3rd edition. AACC Press, 2009, 119-139.

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

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

4.4. Williams, Phillip L., et al. *Principles of Toxicology.* New York: John Wiley and Sons, 2000.

4.5. Ellenhorn, Matthew J. and Donald G Barceloux,. *Medical Toxicology – Diagnosis and Treatment of Human Poisoning*, New York: Elsevier Science Publishing Co. Inc., 1988.

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

4.7. Baselt, Randall C. *Drug Effects on Psychomotor Perfomance*, Foster City, California: Biomedical Publications, 2001.

4.8. Levine, Barry ed., *Principles of Forensic Toxicology*, 3rd Ed., Washington DC: AAC Press, 2010.

4.9. North Carolina General Statutes.

5. Records

5.1. DWI Blood Chemistry Unit Drug Analysis Training Schedule

Revision History

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

3: DWI Drug Analysis - 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 can be linked to distillation which dates into antiquity.

2. **Scope** - This procedure applies to Drug Analysis trainees without experience in the DWI Blood 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. Understand and be familiar with the data system settings of the gas chromatographs used in the DWI Blood Chemistry Unit.

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

3.1.5. Pass a written exam.

3.2. Study Questions

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

3.2.2. What is chromatography?

3.2.3. What is Gas Chromatography?

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

3.2.5. What is Headspace Gas Chromatography?

3.2.6. Define a split injection.

3.2.7. Define a splitless injection.

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

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. Describe two general types of GC columns. What is meant by the acronyms PLOT and WCOT?

3.2.12. Describe the three major parts of a fused capillary column and the chemical composition of a DB-5 stationary phase.

3.2.12.1. What types of columns are used in BAC analysis? What is the significance of using two columns?

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

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

3.2.15. List three types of GC detectors, how they work, and their advantages, include FID.

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

3.2.17. Explain what is meant by derivatization. What are the advantages of derivatizing a substance? List common derivatizing agents.

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

3.2.18.1. Signal to Noise Ratio. What value would differentiate between analyte and noise?

3.2.18.2. Resolution. Give a value for baseline separation

3.2.18.3. Number of Theoretical Plates (N).

3.2.18.4. Height Equivalent Theoretical Plate (HETP). What is the meaning of a higher v. lower value?

3.2.19. What is the difference between calibration and verification?

3.2.20. What is a response factor, and how is it used in quantitation? Give an example.

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

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

3.2.23. What is the DWI Blood 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 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 GCMS instruments used in the DWI Blood Chemistry Unit with the Principal Instructor.

3.4. Required Reading

3.4.1. DWI Blood Chemistry Unit Technical Procedure for Gas Chromatography / Mass Spectrometry

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

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

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

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

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

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

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. DWI Blood Chemistry Unit Drug Analysis Training Schedule

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

4: DWI Drug Analysis - 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 DWI Blood 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 Analysis trainees without experience in the DWI Blood Chemistry Unit of the CCBI Crime Laboratory.

3. **Procedure**

3.1. Objectives

3.1.1. Review and understand the following DWI Blood Chemistry Unit Technical Procedures:

3.1.1.1. Gas Chromatography / Mass Spectrometry
3.1.1.2. DWI Blood Chemistry Analysis
3.1.1.3. Solid Phase Extraction of THC and THC-COOH for GC-MS Analysis
3.1.1.4. Solid Phase Extraction of Acidic /Neutral Drugs for GC-MS Analysis
3.1.1.5. Solid Phase Extraction of Basic Drugs for GC-MS Analysis
3.1.1.6. Uncertainty of Measurement

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 three drugs 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?

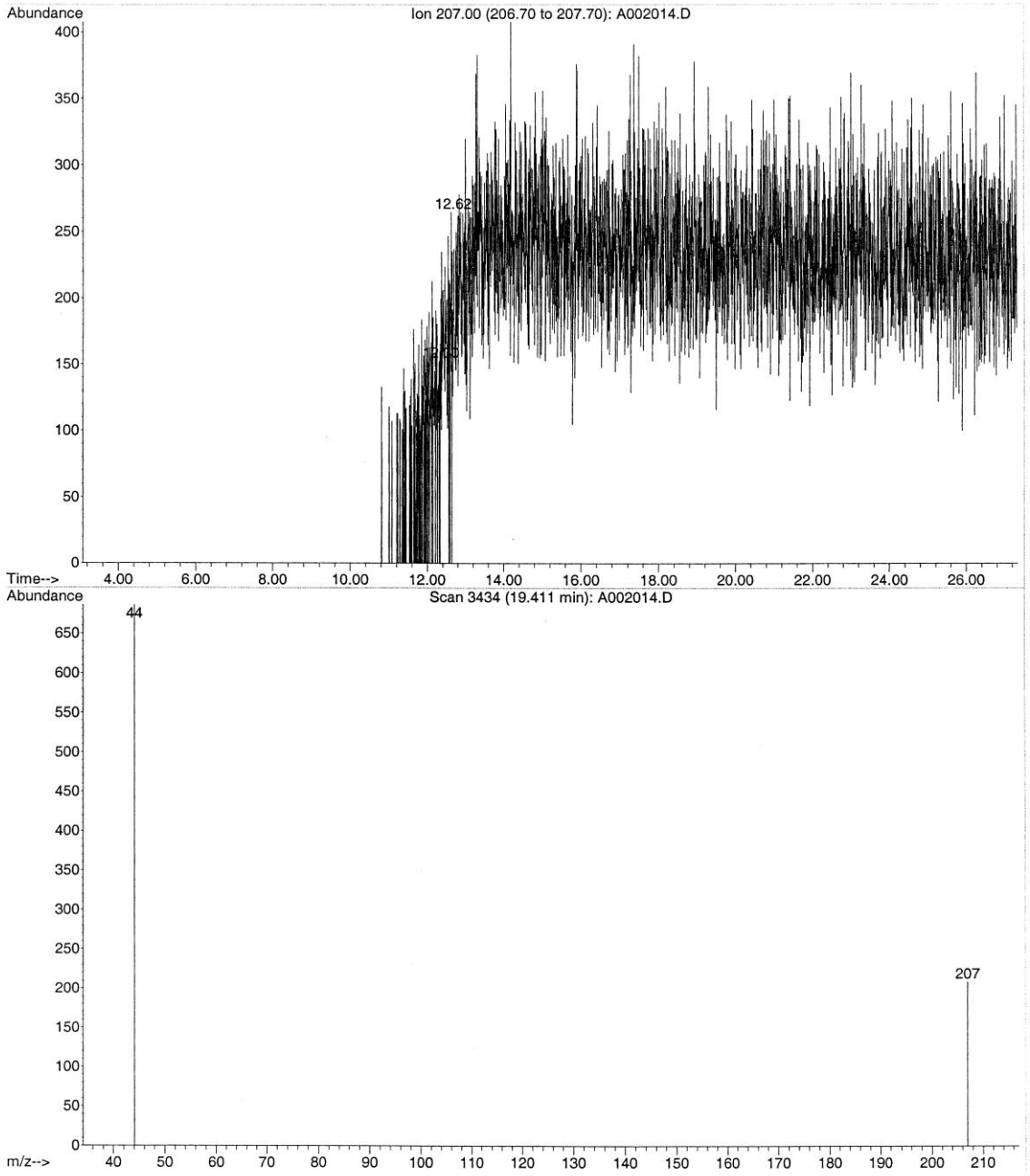
3.3.4. What change would occur in the TIC and the MS if the multiplier voltage were increased? The standard energy for the beam of ionizing electrons in EI MS is 70 eV. What would be the effect if the voltage of the ionizing source were changed?

3.3.5. Review the CANSIM acquisition method with the Principal Instructor.

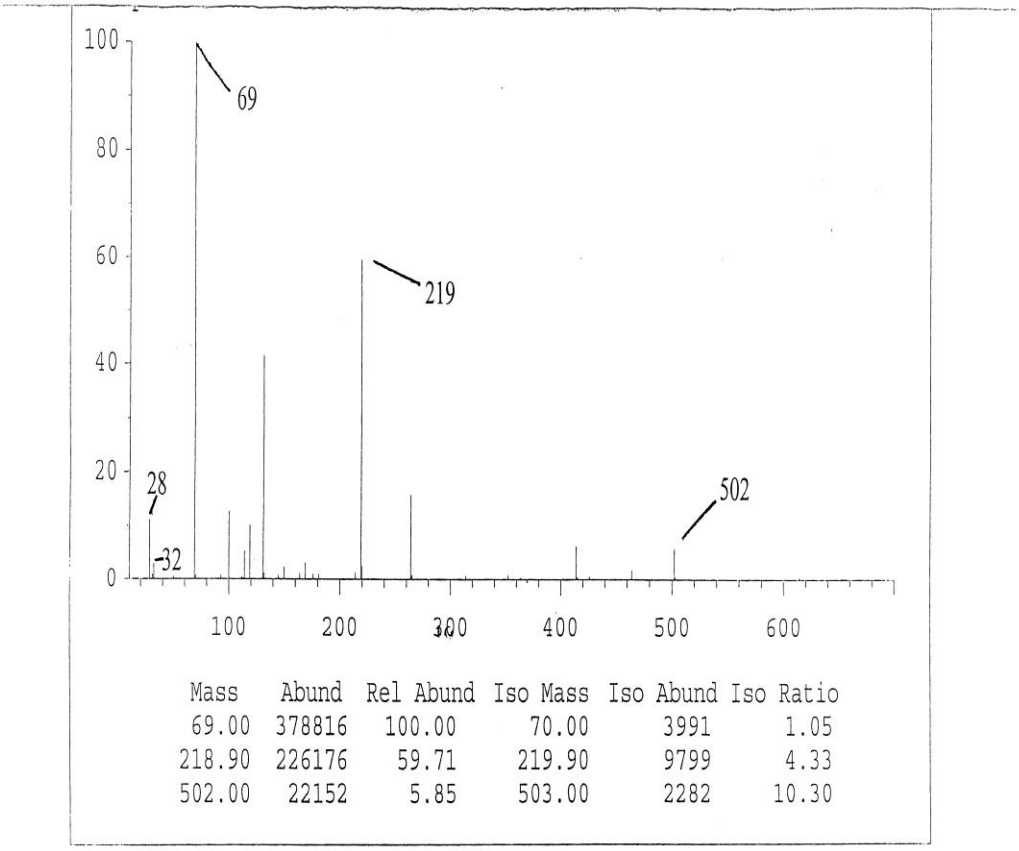
3.3.6. Propose molecular structures for m/e ions in the following mass spectra, and answer the questions.

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
```



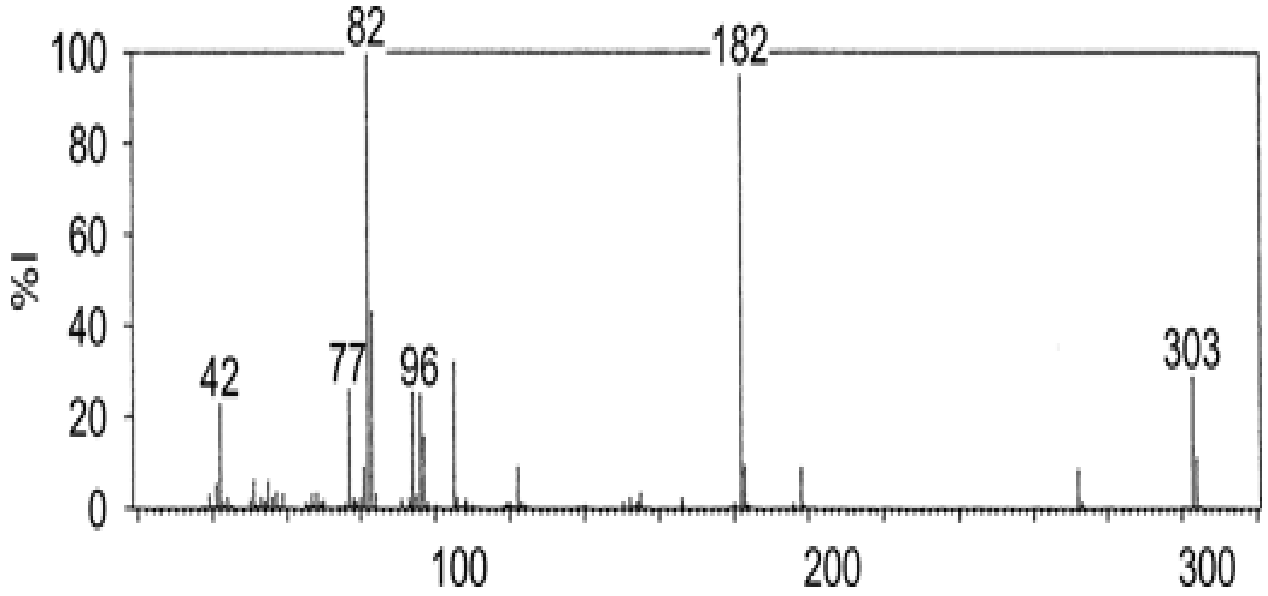
3.3.7. PFTBA - 69, 219, 502. The m/e 32 and 28 m/e ions are not ions of PFTBA. What would cause these ions?



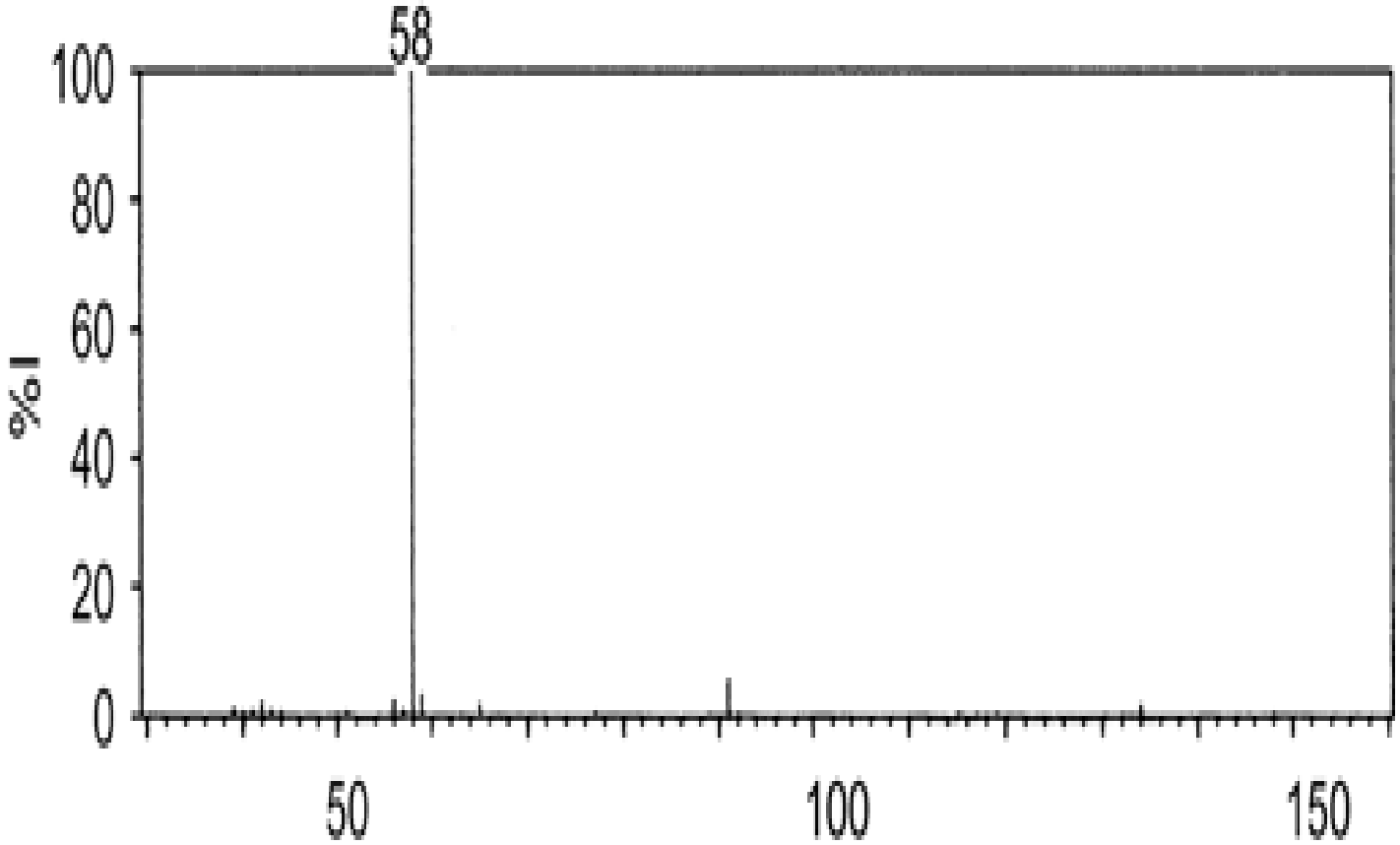
Mass	Abund	Rel Abund	Iso Mass	Iso Abund	Iso Ratio
69.00	378816	100.00	70.00	3991	1.05
218.90	226176	59.71	219.90	9799	4.33
502.00	22152	5.85	503.00	2282	10.30

Perfluorotributylamine (PFTBA or FC_{43})

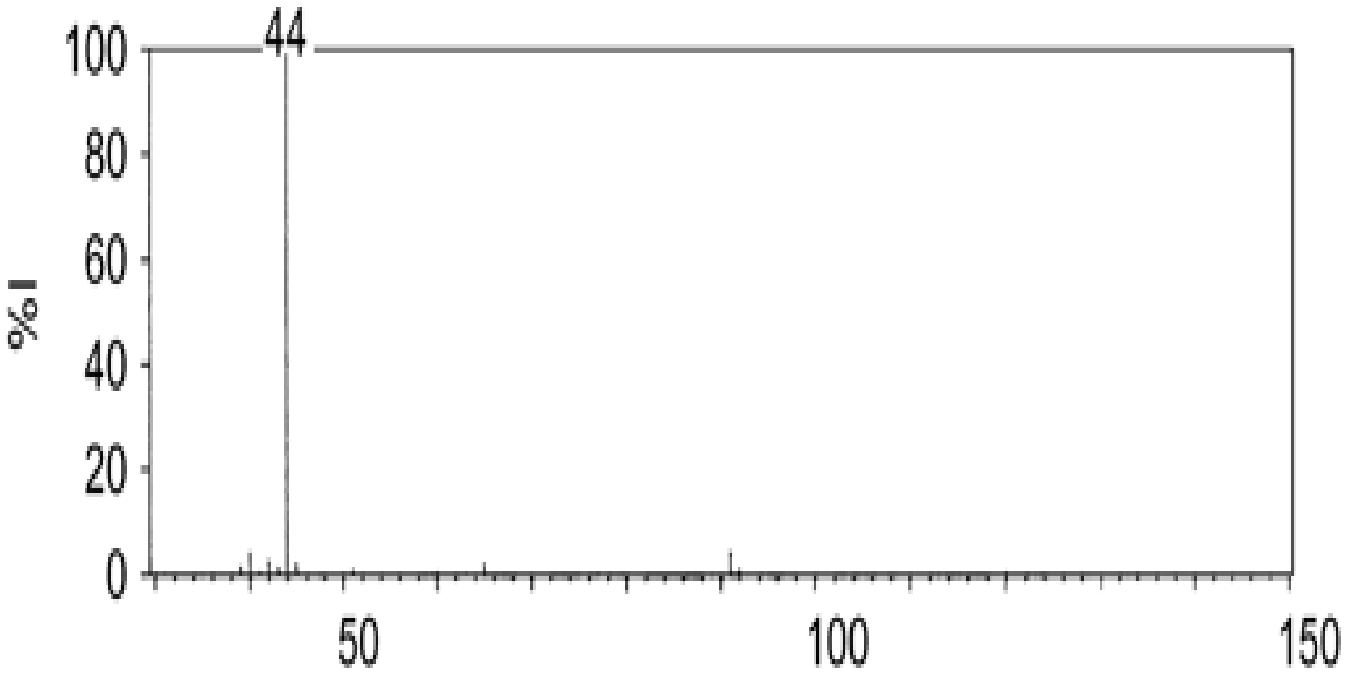
3.3.8.Cocaine - 105, 182



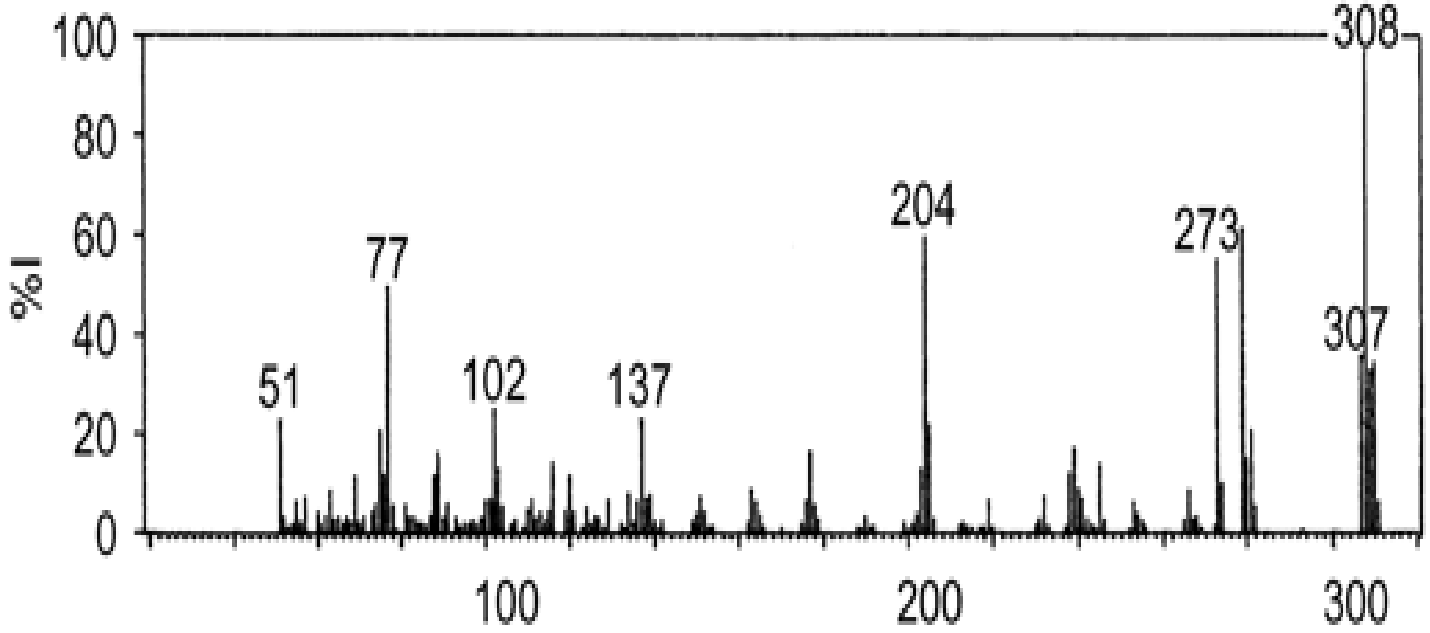
3.3.9.Methamphetamine - 58, 91. What is the name of the 91 m/e ion?


58
100
80
60
40
20
0
%I
50
100
150

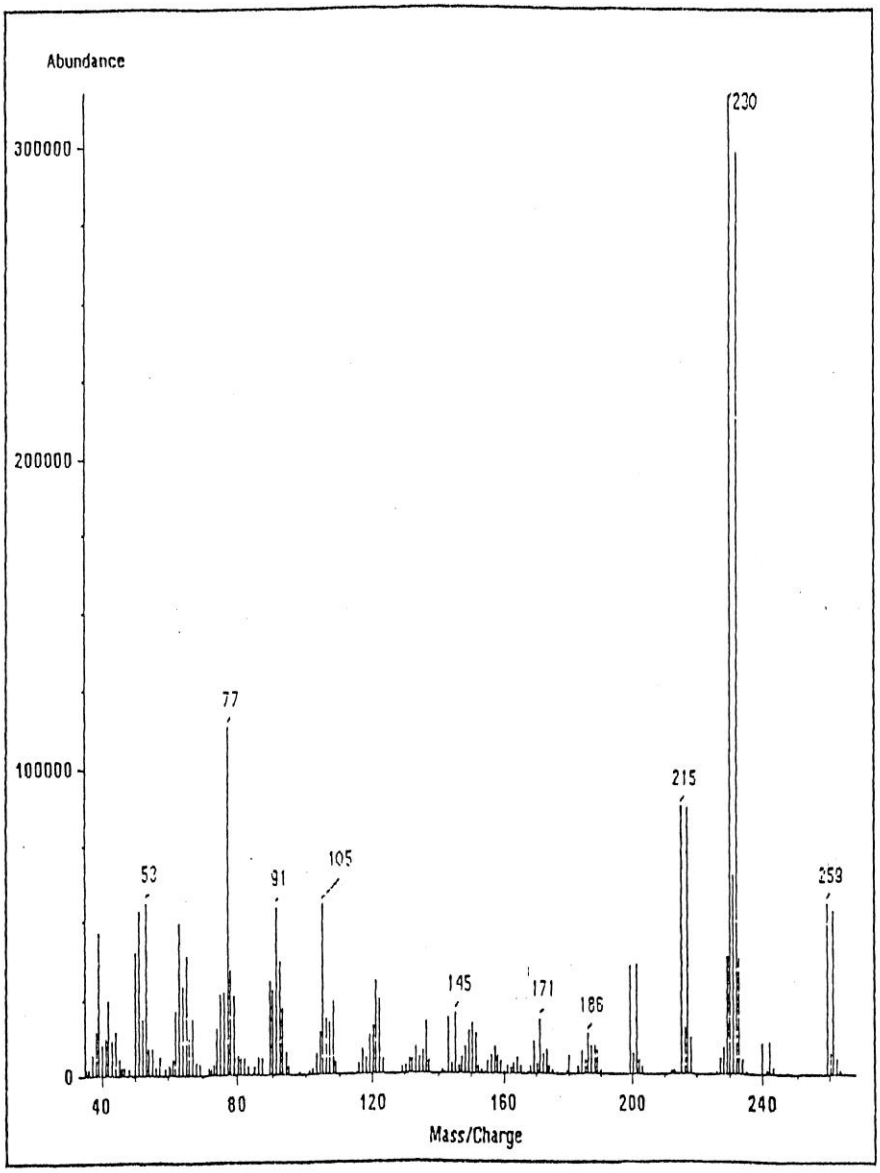
3.3.10. Amphetamine – 44, 91



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

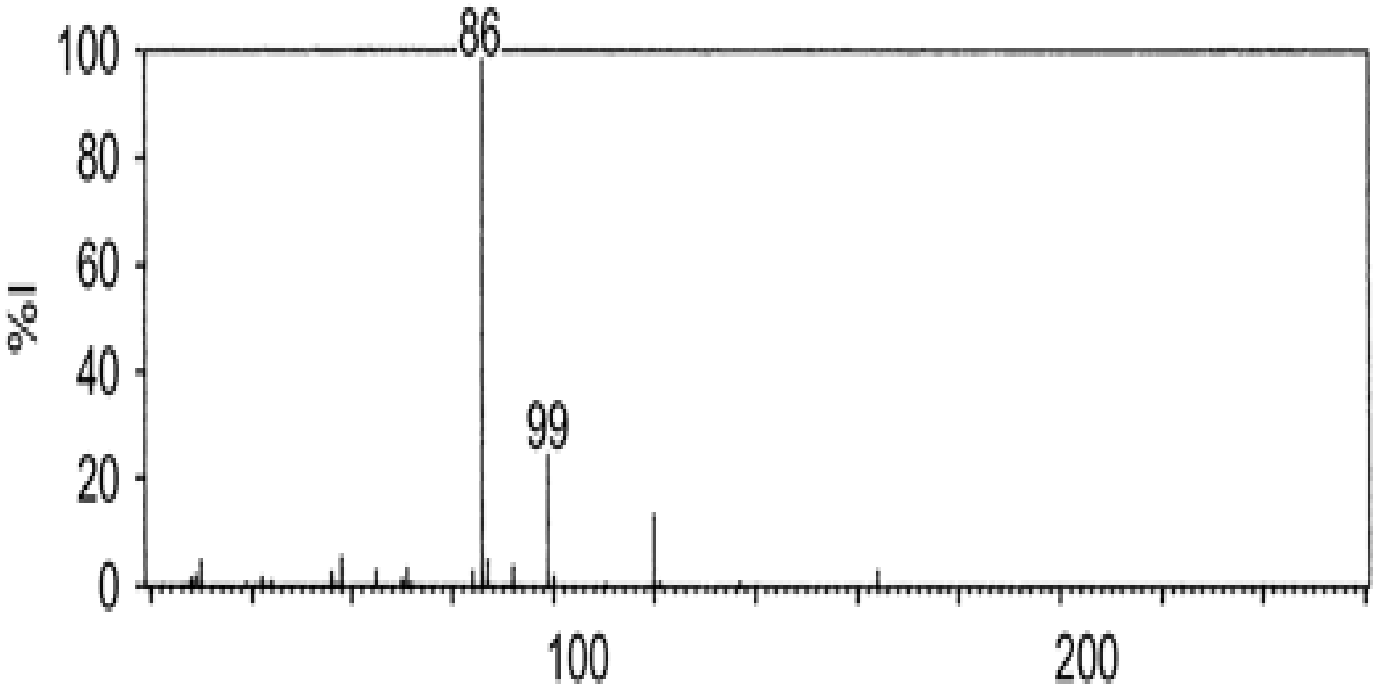


3.3.12. 4-bromo-2,5-dimethoxypenethylamine - 215. Explain the significance of the 215 / 217 m/e, 230 / 232 m/e, and 259 / 261 m/e pairs.

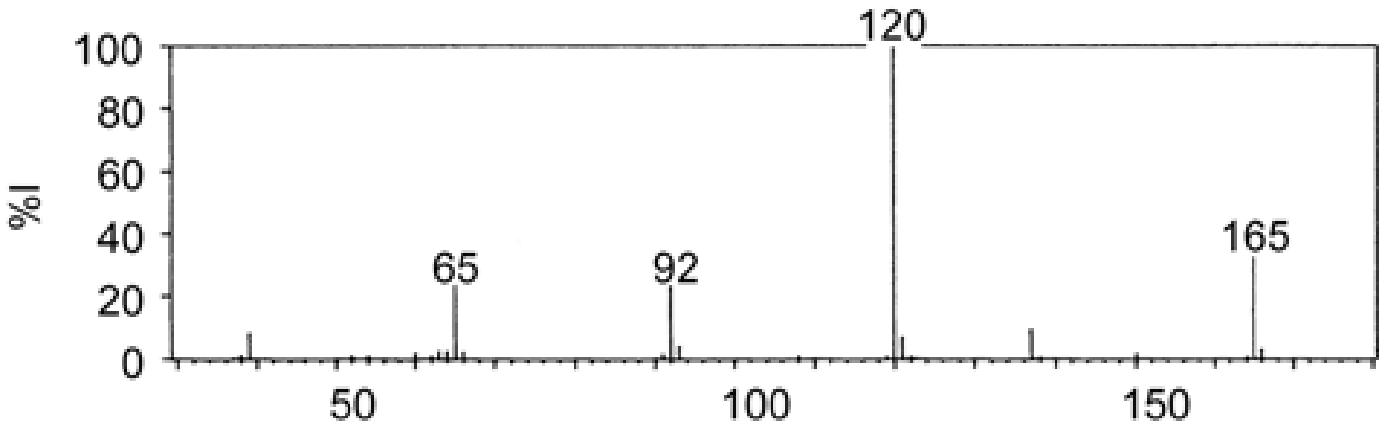


4-bromo-2,5-dimethoxyphenethylamine

3.3.13. Procaine – 86, 120



3.3.14. Benzocaine – 120, 92



3.4. Required Reading

3.4.1.DWI Blood Chemistry Unit Technical Procedures:

3.4.1.1. Gas Chromatography / Mass Spectrometry
3.4.1.2. DWI Blood Chemistry Analysis
3.4.1.3. Solid Phase Extraction of THC and THC-COOH for GC-MS Analysis
3.4.1.4. Solid Phase Extraction of Acidic /Neutral Drugs for GC-MS Analysis
3.4.1.5. Solid Phase Extraction of Basic Drugs for GC-MS Analysis
3.4.1.6. Uncertainty of Measurement

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 Poisions,* 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 Poisions,* 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. DWI Blood Chemistry Unit Drug Analysis Training Schedule

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

5: DWI Drug Analysis - Training Procedure for Extractions of Drugs

1. **Purpose** - There are two basic extraction techniques used in Forensic Toxicology; liquid extraction and solid phase extraction (SPE). This section will explore the origins of commonly encountered drugs and the extraction methods used to isolate them.

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

3. Procedure

3.1. Objectives

3.1.1. Review and understand the following DWI Blood Chemistry Unit Technical Procedures:

3.1.1.1. pH Meter
3.1.1.2. Gas Chromatography / Mass Spectrometry
3.1.1.3. DWI Blood Chemistry Analysis
3.1.1.4. Solid Phase Extraction of THC and THC-COOH for GC-MS Analysis
3.1.1.5. Solid Phase Extraction of Acidic /Neutral Drugs for GC-MS Analysis
3.1.1.6. Solid Phase Extraction of Basic Drugs for GC-MS Analysis
3.1.1.7. Uncertainty of Measurement

3.1.2. Understand the concepts of acid and bases, pH, solubility, partition coefficient and dissociation constant.

3.1.3. Be able to determine whether a drug has acid or base properties based on structure.

3.1.4. Be able to identify the solubility of different drug forms in different solvents.

3.1.5. Be knowledgeable of solid phase extraction principles.

3.1.6. Know the origins of some common controlled substances.

3.1.7. Become familiar with the extractions and GC/MS analyses performed in the Toxicology Unit.

3.1.8. Pass a written exam.

3.2. Study Questions

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

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

3.2.3. Explain the difference between a strong acid and a weak acid /strong base and a weak base. Give some examples of each. Include an explanation of pKa.

3.2.4. Generally what are the products when an acid is combined with a base?

3.2.5. Review the structures of drugs and controlled substances previously covered in the Training Procedure for Drug Classification and Pharmacology.Most are considered basic. What functional group imparts this characteristic? Some drugs are considered acids. Give some examples of acidic drugs and identify the functional group that imparts this characteristic.

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

3.2.7. Explain why a salt is soluble in water but not an organic solvent. Explain why a sugar such as Inositol is soluble in water but not in an organic solvent.

3.2.8. Describe a liquid – liquid chemical extraction of a drug.

3.2.9. Explain how Solid Phase Extraction techniques work. What is the importance of pH?

3.2.10. Describe some common SPE sorbents used in Forensic Toxicology. Which are used in the DWI Blood Chemistry Unit?

3.3. Practical/Laboratory Exercises

3.3.1. Determine which of the following organic solvents are miscible with water and which are not or give an explanation of why each is or is not miscible with water. (Methanol, ethanol, hexane, chloroform, acetone, ethyl ether, petroleum ether, ethyl acetate)

3.3.2. Poppy seeds are used as a culinary supplement. A DWI defendant claims his consumption of poppy seeds was the cause of a positive blood test for opiates. The analysis of his blood was positive for the presence of morphine and 6- MAM. What is the significance of 6-monoacetylmorphine (6-MAM) in a blood sample? Is his claim plausible?

3.3.3. Extract and analyze known samples provided by the Principal Instructor, to include all extraction procedures currently utilized in the unit.

3.3.3.1. Successfully perform all calibration and quality control procedures contained in all technical procedures used to prepare and analyze the known samples.

3.4. Required Reading

3.4.1.1.1. Telepchak, M.J. et al., *Forensic and Clinical Applications of Solid Phase Extraction*, Totowa, NJ, Humana Press, 2004. Chapters 1 -8.

3.4.1.1.2. DWI Blood Chemistry Unit Technical Procedures and references:

3.4.1.1.2.1. pH Meter
3.4.1.1.2.2. Gas Chromatography / Mass Spectrometry
3.4.1.1.2.3. DWI Blood Chemistry Analysis
3.4.1.1.2.4. Solid Phase Extraction of THC and THC-COOH for GC-MS Analysis
3.4.1.1.2.5. Solid Phase Extraction of Acidic /Neutral Drugs for GC-MS Analysis
3.4.1.1.2.6. Solid Phase Extraction of Basic Drugs for GC-MS Analysis
3.4.1.1.2.7. Uncertainty of Measurement

4. References

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

4.1.2. Baselt, Randall C., *Drug Effects on Psychomotor Performance*, Foster City, California: Biomedical Publications, 2001.

4.1.3. Moffat, A. C., et al., eds. *Clarke's Isolation and Identification of Drug.* 4th Edition. London: Pharmaceutical Press, 2011.

4.1.4. Levine, Barry, ed, *Principles of Forensic Toxicology*, AAC Press, Washington DC, 2010.

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

4.1.6. Ellenhorn, Matthew J. and Donald G., Bacrceloux. *Medical Toxicology Diagnosis and Treatment of Human Poisoning*, New York: Elsevier Science Publishing Co. Inc, 1988.

4.1.7. North Carolina General Statues Chapter 90.

4.1.8. Karch, Steven B. *The Pathology of Drug Abuse*, CRC Press, 1993.

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

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

5. Records

5.1. DWI Blood Chemistry Unit Drug Analysis Training Schedule

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

6: DWI Drug Analysis - 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 DWI Blood 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 Analysis trainees without experience in the DWI Blood 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 able to properly document casework. Review the acceptable abbreviations used in the DWI Blood Chemistry Unit.

3.1.3. Be able to explain scientific techniques in non-technical terms as well as technical terms.

3.1.4. Pass a written exam.

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

3.1.6. 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.

3.1.7. Obtain a permit from the NC DHHS.

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. How do you handle case inquiries?

3.2.8. How would you handle a discrepancy with evidence?

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

3.2.10. What precautions do you take working with blood?

3.2.11. 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 protect evidence from deleterious change.

3.2.12. 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.

3.3. 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 five 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 is your educational background?

3.3.6.6. Are you certified by the NC DHHS?

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

3.3.6.8. What are your duties as a Drug Chemist in the DWI Blood Chemistry Unit?

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

3.3.6.10. Did you receive blood evidence in this case?

3.3.6.11. From whom did you receive it?

3.3.6.12. How is blood evidence received and maintained at the CCBI Crime Laboratory?

3.3.6.13. What analysis did you perform on the blood?

3.3.6.14. What was the result of your analysis?

3.3.6.15. What did you do with the blood after you completed your analysis?

3.3.6.16. Define chemistry.

3.3.6.17. What is a controlled substance?

3.3.6.18. What is a metabolite?

3.3.6.19. What is a Forensic Chemist/ Drug Chemist?

3.3.6.20. What qualifies you as an expert in Forensic Chemistry?

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

3.3.6.22. Does the lab have policies and procedures governing the handling of evidence?

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

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

3.3.6.25. Could the evidence have been tampered with before you received it?

3.3.6.26. Have you ever made a mistake?

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

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

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

3.3.6.30. What is uncertainty of measurement?

3.3.6.31. What is the criterion for the identification of a substance?

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

3.3.6.33. What precautions are taken to guard against contamination?

3.3.6.34. What is a technical and administrative review?

3.3.6.35. What are:

- 3.3.6.35.1. Calibration
- 3.3.6.35.2. Quality control check
- 3.3.6.35.3. Reference material
- 3.3.6.35.4. Positive control
- 3.3.6.35.5. Negative control

3.3.6.36. What is an immunoassay?

3.3.6.37. What is ELISA?

3.3.6.38. How does ELISA work?

3.3.6.39. What is an extraction?

3.3.6.40. How do you perform an extraction?

3.3.6.41. How does solid phase extraction work?

3.3.6.42. Why do you perform an extraction?

3.3.6.43. What is GCMS?

3.3.6.44. How does GCMS work?

3.3.6.45. How do you know the GCMS was working properly?

3.3.6.46. How did you identify the substance?

3.3.6.47. Explain the markings on the GCMS printouts.

3.3.6.48. What is a metabolite?

3.3.6.49. What are metabolism, absorption, distribution, elimination?

3.3.6.50. How long ago was the drug taken?

3.3.6.51. What is half-life?

3.3.6.52. What is pharmacokinetics?

3.3.6.53. What is pharmacodynamics?

3.3.6.54. Was the defendant impaired?

3.3.6.55. Are you accredited?

3.3.6.56. Is your laboratory accredited?

3.3.6.57. What is ASCLD/LAB?

3.3.7. Apply for and obtain a permit from the NC DHHS.

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. DWI Blood Chemistry Unit Technical Procedures
3.4.5. CCBI Crime Laboratory Safety Manual

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. DWI Blood Chemistry Unit Technical Procedures and Training Procedures
4.5. CCBI Crime Laboratory Safety Manual

5. Records

5.1. DWI Blood Chemistry Unit Drug Analysis Training Schedule

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

7: DWI BAC Analysis – Training Procedure for Scientific and Legal Aspects of Blood Alcohol Content (BAC) Analysis

2. **Forward** - The CCBI DWI Blood Chemistry Unit training program is a study of the concepts and analytical techniques used in the Unit to analyze evidence. The training is divided into two parts: Blood Alcohol Content Analysis and Drug Analysis. Each part covers the concepts and analytical techniques associated with each of these types of analyses. The two parts of the DWI Blood Chemistry Unit training program may be completed separately or together. 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 estimate training time for each unit are detailed in the corresponding DWI Blood Chemistry Unit Training Schedule form. A training schedule ~~memorandum~~ is prepared by the Principal Instructor detailing the training schedule and estimated completion dates.

2.1. 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 Toxicology.

2.2. 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.

2.3. 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 DWI Blood Chemistry Unit Training Schedule and Section Completion Summary.

2.4. 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.

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

2.6. 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.

2.7. 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.

2.8. 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 discipline or category of testing. Notice of certification will be placed in the Analyst's permanent training file.

2.9. Phase II - 100 % Technical Review training for Drug Analysis will last for a minimum of ~~two~~ six months. Phase II - 100 % Technical Review training for Blood Alcohol Content Analysis will last for a minimum of ~~one~~ six months. Phase II training periods for each unit may overlap.

2.10. 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.~~

2.11. 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.

3. **Purpose –** Generally there are two types of witnesses in a judicial proceeding: a witness to fact and an expert witness. A fact witness' testimony is generally limited to what he / she did or observed. The expert witness is generally allowed to testify to fact, draw conclusions, and express opinions relative to his / her area of expertise. Thus, expert testimony as a Forensic Drug Chemist in BAC analysis goes beyond the work performed and includes an understanding of issues related to BAC analysis. In this section, the study questions are separated into scientific and legal aspects of BAC Analysis.

4. **Scope** - This procedure applies to DWI BAC analysis trainees without experience in the DWI Blood Chemistry Unit of the CCBI Crime Laboratory.

5. **Procedure**

5.1. Objectives

5.1.1. Become knowledgeable of forensic science.

5.1.2. Be able to describe the effects of alcohol on the human body.

5.1.3. Understand the BAC curve (i.e., absorption, distribution, metabolism, and elimination of ethanol.)

5.1.4. Understand and be able to accurately perform retrograde extrapolations of ethanol metabolism.

5.1.5. Understand and be able to utilize the Widmark equation.

5.1.6. Be able to describe the concerns related to the storage of blood alcohol samples.

5.1.7. Be knowledgeable of the NC General Statues relating to Blood Alcohol Content Analysis.

5.1.8. Pass a written exam.

5.2. Scientific Study Questions

5.2.1. Describe in general terms how alcoholic beverages are produced.

5.2.2. In general what is the alcohol concentration of the following?

5.2.2.1. Beer
5.2.2.2. Wine
5.2.2.3. Distilled liquor

5.2.3. Define the term "congener."

5.2.4. Is ethanol a depressant or a stimulant?

5.2.5. What Blood Alcohol Concentration (BAC) produces impairment? Explain your answer.

5.2.6. What BAC causes death? Explain your answer.

5.2.7. Give some examples of the effects of alcohol on driving.

5.2.8. What is the effect of the combined use of cocaine and ethanol?

5.2.9. Briefly describe the metabolic pathway of ethanol, methanol, and isopropanol.

5.2.10. Does ethanol have medicinal uses?

5.2.11. What is Disulfiram (Antabuse) and how does it work?

5.2.12. Define the terms: Metabolism, Absorption, Distribution, Elimination, Half-Life, and Volume of Distribution. What is the half-life of ethanol?

5.2.13. Ethanol is primarily absorbed in the ____ intestine.

5.2.14. What is the absorption rate of ethanol?

5.2.15. List several factors that can affect the absorption rate of ethanol.

5.2.16. Ethanol is primarily metabolized by the ___.

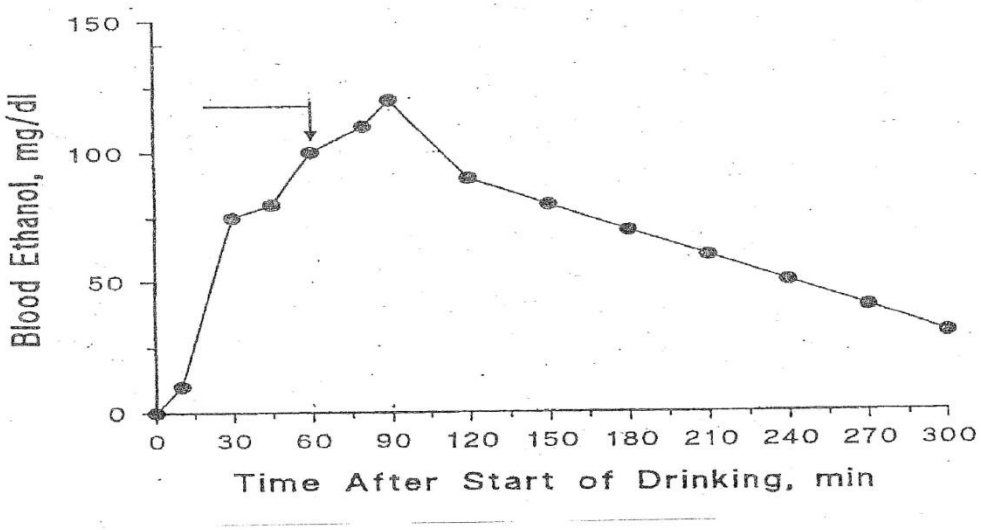
5.2.17. The average elimination rate of ethanol in a healthy adult is approximately ____ g/dl / hour, but literature values range from __ g/dl / hour to __ g/dl / hour.

5.2.18. List several factors that can affect the elimination rate of ethanol.

5.2.19. True or False - An individual's ethanol elimination rate can vary from day to day.

5.2.20. True or False - Endogenous daily production of ethanol results in a BAC.

5.2.21. Explain where the following would be found on BAC Curve: absorption time, elimination rate, peak BAC, time since last drink.



5.2.22. How does food affect the BAC curve?

5.2.23. What is the Widmark equation? Explain any limitations to calculating a person's BAC using the Widmark equation? Be able to calculate a person's BAC using the Widmark Equation.

5.2.24. What is an approximate Volume of Distribution (V_d) value for a man and a woman?

5.2.25. Explain what is meant by first pass metabolism. Is it a significant factor in calculating a BAC?

5.2.26. What is a retrograde extrapolation of ethanol? Explain how to perform a retrograde extrapolation.

5.2.27. Explain the difference between serum alcohol concentration (SAC) and BAC.

5.2.28. Give at least three possible explanations to explain the changes in ethanol concentration that can occur in stored blood samples and measures that can be taken to prevent them.

5.2.29. What is the significance of the different colored tops of vacutainers?

5.3. NC General Statutes Study Questions

5.3.1. Does the statutory definition of alcohol include methanol and IPA?

5.3.2. Is it more appropriate to report a blood alcohol concentration measured to be 0.0799 as 0.07 or 0.08 g/100 ml of whole blood?

5.3.3. An impairing substance as defined by NC statues includes:

a. Ethanol
b. Methanol
c. Any controlled substance
d. Any psychoactive substance capable of impairing a person's physical or mental faculties
e. Both a and b
f. All of the above

5.3.4. Can first degree murder be an offense involving impaired driving?

5.3.5. Define “implied consent offense.”

5.3.6. True or False

Any person who drives a vehicle on a highway or public vehicular area automatically gives consent to a chemical analysis if charged with an implied consent offense.

5.3.7. True or False

An officer shall request that a person charged with an implied consent offense submit to the type of chemical analysis designated, but if the person charged refuses, none may be given.

5.3.8. True or False

If an officer has reasonable grounds to believe that an unconscious person has committed an implied consent offense, the officer may direct a qualified person to take the blood without prior notification of rights.

5.3.9. Which of the following are false?

5.3.9.1. Results of an alcohol screening test may be used by a court to determine if there are reasonable grounds to believe that the driver has committed an implied consent offense.

5.3.9.2. Negative or low results of an alcohol screening test may be used by a court to determine whether a person's impairment is caused by an impairing substance other than alcohol.

5.3.9.3. Results of an alcohol screening test may be admitted as evidence in a court.

5.3.10. True or False

A blood alcohol level of at least 0.08 g per100 ml of whole blood is needed in order to commit the offense of impaired driving.

5.3.11. True or False

An adult driving a car, with a BAC of 0.07, may not be charged with impaired driving.

5.3.12. True or False

It is lawful to operate a motor vehicle so long as only the passengers are drinking.

5.3.13. True or False

When a blood test is specified as the type of chemical analysis by an officer, only a physician, registered nurse, or other qualified person may withdraw the blood sample.

5.3.14. Explain law regarding the admissibility of laboratory reports. 20-139.1(e1).

5.4. Practical/Laboratory Exercises

5.4.1. Use the Widmark equation to calculate the BAC of a 185 lb. man who has consumed three 12 oz. beers in one hour containing 4 percent ethanol. Show your work.

5.4.2. A female driver is known to have left a local bar at 2:00 PM. At 2:20 PM she runs a red light at an intersection and hits another car. She and the driver of the other car are transported by EMS to the hospital emergency room. The drunk driver suffers injuries but is coherent in the emergency room. The doctors at the emergency room indicate that she may have suffered from shock. Her blood is drawn at the emergency room at 4:00 PM and subsequently is measured by Forensic Scientist to be 0.05 g/100 ml of whole blood. The

Bartender tells the investigating officer that the woman entered the bar shortly after it opened at 11:30 AM and she had three margaritas while she was there. Show your work and explain your answers.

5.4.2.1. In your opinion, what would the BAC of the driver be at the time of the accident?

5.4.2.2. In your opinion, what would the BAC of the driver be at noon?

5.4.3. In your opinion, what is the average time needed to absorb a dose of ethanol (i.e., to reach a peak BAC)? Explain your answer.

5.4.4. An officer calls and asks if he needs to refrigerate the blood sample of a DWI suspect. He asks if it is ok to mail the sample or if it needs to be transported to the Lab. What would you tell him/her?

5.4.5. An assistant district attorney has called the Lab. An officer has told the ADA that he was unable to obtain a blood sample for Lab work; however, the ADA tells you the hospital measured the alcohol concentration of a DWI suspect to be "90 mg / dl". The ADA wants you to explain the hospital results. What would you tell him/her?

5.4.6. A DWI suspect is given IV solutions for injuries sustained in an accident. How could this affect his/her BAC?

5.4.7. If you determined from a BAC analysis that there was isopropanol (IPA) and acetone in the blood sample, what would your conclusion(s) be? Would your conclusion(s) change if you determined only IPA to be present in the blood sample? Explain.

5.4.8. In your opinion what are the ramifications of an expired BAC collection kit being used to collect blood for BAC analysis?

5.4.9. In your opinion, is a gain of ethanol likely or possible in stored blood samples? Explain – include salting out, bacteria, yeast, oxidation, storage conditions, and preservatives.

5.4.10. While the standard blood breath ratio is normally considered to be 1:2100, blood breath ratios range from 1:1900 to 1:3500. What is the effect if a person blows in to a breathalyzer calibrated at 1:2100, and he / she has a lower blood breath ratio?

5.5. Required Reading

5.5.1. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions*, 4th edition, Pharmaceutical Press, 2011. Chapter 4, 14 and 28.

5.5.2. Ellenhorn, Matthew J. and Donald G Bacrceloux, *Medical Toxicology Diagnosis and Treatment of Human Poisoning,* New York: Elsevier Science Publishing Co. Inc, 1988. Chapters 7 and 33.

5.5.3. James C. Garriott (Editor), *Medicolegal Aspects of Alcohol*, 5th Ed., 2008. Chapters 1, 2, 3, 4, 5, 7, 11, and 17.

5.5.4. North Carolina General Statutes Chapter 20 (Sections 4.01.(1a), (1b), (3a), (3b), (14a),(24a), (32); 16.2,16.3, 16.5(b), (b1); 138.1-138.7, 139.1)

5.5.5. Baselt, Randall C. *Disposition of Toxic Drugs and Chemicals in Man*, 8th Ed.. Foster City, California: Biomedical Publications, 2008. Ethanol, Methanol, Isopropanol, Acetone, Toluene, Ether.

5.5.6. State of NC v. Pamela J. Catoe, NC Court of Appeals, Filed Dec. 3, 1985.

5.5.7. State of NC v. Darryl Robin Taylor, NC Court of Appeals, Filed Aug. 17, 2004.

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

6. References

6.1. James C. Garriott (Editor), *Medicolegal Aspects of Alcohol*, 5th Ed., 2008.

6.2. Ellenhorn, Matthew J. and Donald G Barceloux. *Medical Toxicology – Diagnosis and Treatment of Human Poisoning*. Elsevier Science Publishing Co. Inc., 1988.

6.3. North Carolina General Statutes.

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

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

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

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

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

6.9. State of NC v. Pamela J. Catoe, NC Court of Appeals, Filed Dec. 3, 1985.

6.10. State of NC v. Darryl Robin Taylor, NC Court of Appeals, Filed Aug. 17, 2004.

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

7. Records

7.1. DWI Blood Chemistry Unit Drug Analysis 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 LAPM22

8: DWI BAC Analysis - 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 can be linked to distillation which dates into antiquity.

2. **Scope** - This procedure applies to DWI BAC Analysis trainees without experience in the DWI Blood 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. Understand and be familiar with the data system settings of the gas chromatographs used in the DWI Blood Chemistry Unit for BAC analysis.

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

3.1.5. Pass a written exam.

3.2. Study Questions

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

3.2.2. What is chromatography?

3.2.3. What is Gas Chromatography?

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

3.2.5. What is Headspace Gas Chromatography?

3.2.6. Define a split injection.

3.2.7. Define a splitless injection.

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

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. Describe two general types of GC columns. What is meant by the acronyms PLOT and WCOT?

3.2.12. Describe the three major parts of a fused capillary column and the chemical composition of a DB-5 stationary phase.

3.2.12.1. What types of columns are used in BAC analysis? What is the significance of using two columns?

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

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

3.2.15. List three types of GC detectors, how they work, and their advantages, include FID.

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

3.2.17. Explain what is meant by derivatization. What are the advantages of derivatizing a substance? List common derivatizing agents.

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

3.2.18.1. Signal to Noise Ratio. What value would differentiate between analyte and noise?

3.2.18.2. Resolution. Give a value for baseline separation

3.2.18.3. Number of Theoretical Plates (N).

3.2.18.4. Height Equivalent Theoretical Plate (HETP). What is the meaning of a higher v. lower value?

3.2.19. What is the difference between calibration and verification?

3.2.20. What is a response factor, and how is it used in quantitation? Give an example.

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

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

3.2.23. What is the DWI Blood Chemistry Unit criterion for ethanol identification?

3.2.24. Explain uncertainty of measurement. How is it determined?

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 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 GCMS instruments used in the DWI Blood Chemistry Unit for BAC analysis with the Principal Instructor.

3.4. Required Reading

3.4.1. DWI Blood Chemistry Unit Technical Procedures

3.4.1.1. Quality Assurance
3.4.1.2. Uncertainty of Measurement
3.4.1.3. General Laboratory Equipment
3.4.1.4. Hamilton Dilutor
3.4.1.5. Determination of Alcohol and Acetone in Blood by Headspace Gas Chromatography
3.4.1.6. DWI Blood Chemistry Analysis

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

3.4.3. Moffat, Anthony C. ed. *Clarke's Analysis of Drugs and Poisions,* Volume 1, 4th edition, Pharmaceutical Press, 2011. Chapters 22, 23 and 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. BSTFA & TMCS Product Specification, Sigma-Aldrich Co., 1997.

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

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

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

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

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. DWI Blood Chemistry Unit Drug Analysis Training Schedule

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

9: DWI BAC Analysis - 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 DWI BAC Analysis 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 DWI BAC Analysis trainees without experience in the DWI Blood 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. Review the acceptable abbreviations used in the DWI Blood Chemistry Unit.

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

3.1.5. Analyze a set of known samples.

3.1.6. Pass a written exam.

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

3.1.8. 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.

3.1.9. Obtain a permit from the NC DHHS.

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. How do you handle case inquiries?

3.2.8. How would you handle a discrepancy with evidence?

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

3.2.10. What precautions do you take working with blood?

3.2.11. 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 protect evidence from deleterious change.

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, observe the testimony of the Principal Instructor or another Drug Chemist.

3.3.5. Analyze known samples provided by the Principal Instructor. Document the analyses as you would in casework, including report generation.

3.3.5.1. Successfully perform all calibration and quality control procedures contained in all technical procedures used to prepare and analyze the known samples.

3.3.6. Using 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.

3.3.7. Complete a Mock Trial based upon the competency exam.

3.3.7.1. 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.

3.3.7.2. Please state your full name for the record.

3.3.7.3. How are you employed?

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

3.3.7.5. What is your educational background?

3.3.7.6. Are you certified by the NC DHHS?

3.3.7.7. What training and experience do you have in the analysis of blood for blood alcohol content?

3.3.7.8. What are your duties as a Drug Chemist in the DWI Blood Chemistry Unit?

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

3.3.7.10. Did you receive blood evidence in this case?

3.3.7.11. From whom did you receive it?

3.3.7.12. How is blood evidence received and maintained at the CCBI Crime Laboratory?

3.3.7.13. What analysis did you perform on the blood?

3.3.7.14. What was the result of your analysis?

3.3.7.15. What did you do with the blood after you completed your analysis?

3.3.7.16. Define chemistry.

3.3.7.17. What is a controlled substance?

3.3.7.18. What is a metabolite?

3.3.7.19. What is a Forensic Chemist/ Drug Chemist?

3.3.7.20. What qualifies you as an expert in Forensic Chemistry?

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

3.3.7.22. Does the lab have policies and procedures governing the handling of evidence?

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

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

3.3.7.25. Could the evidence have been tampered with before you received it?

3.3.7.26. Have you ever made a mistake?

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

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

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

3.3.7.30. What is uncertainty of measurement?

3.3.7.31. What is the criterion for the identification of alcohol?

3.3.7.32. Couldn't the alcohol have been produced from contamination?

3.3.7.33. What precautions are taken to guard against contamination?

3.3.7.34. What is a technical and administrative review?

3.3.7.35. What are:

3.3.7.35.1. Calibration
3.3.7.35.2. Quality control check
3.3.7.35.3. Reference material
3.3.7.35.4. Positive control

3.3.7.35.5. Negative control

3.3.7.36. What is a GC?

3.3.7.37. How does a GC work?

3.3.7.38. How do you know the GC was working properly?

3.3.7.39. Explain the markings on the GC printouts.

3.3.7.40. What are metabolism, absorption, distribution, elimination?

3.3.7.41. How long ago was the alcohol consumed?

3.3.7.42. What is half-life?

3.3.7.43. What is pharmacokinetics?

3.3.7.44. What is pharmacodynamics?

3.3.7.45. Was the defendant impaired?

3.3.7.46. Are you accredited?

3.3.7.47. Is your laboratory accredited?

3.3.7.48. What is ASCLD/LAB?

3.3.8. Apply for and obtain a permit from the NC DHHS.

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. DWI Blood Chemistry Unit Technical Procedures
3.4.5. CCBI Crime Laboratory Safety Manual

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. DWI Blood Chemistry Unit Technical Procedures and Training Procedures

4.5. CCBI Crime Laboratory Safety Manual

5. Records

5.1. DWI Blood Chemistry Unit Drug Analysis Training Schedule

Revision History

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