AMERICAN BOARD OF CRIMINALISTICS

"Professional Competency Certification in Criminalistics"

Study Guide for Drug Analysis Examination

Introduction

Your study guide consists of a Job Description, a list of Knowledge, Skills, and Abilities (KSAs), References, and a 10 Sample Question primer for the exam.

- The **Job Description** describes the education, background, training, and specific duties of an analyst in each discipline.
- The **KSAs** have ten major sections. Sections I-IX covers the core knowledge and skills expected of every forensic scientist and comprise 40% of the examination. Section X, consisting of the specific, discipline related, in-depth, upper level knowledge, skills, and abilities will make up 60% of the examination. Please note that the sub-categories listed under the capital letters in the KSAs are examples and are not meant to be all-inclusive, or to indicate that there will necessarily be a question on the exam from every sub-category.
- The **References** are broken into core references and discipline-related references. The core references are identical for all the ABC examinations. The discipline-related references are specific to each discipline.
- There are ten S**ample Questions** to give you an idea of the range of content and difficulty that will appear on the exam. For further information, please see "Introduction to ABC Certification Examinations."

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Job Description

A qualified forensic drug analyst must be able to:

- Perform analysis on seized illicit and pharmaceutical drugs and related materials.
- Perform qualitative analyses of evidential materials using established chemical, physical and instrumental techniques.
- Perform quantitative analysis of seized drugs using established analytical techniques.
- Develop, validate, and/or verify analytical methods to address new analytical challenges and improves upon established methods when possible.
- Maintain, optimize, calibrate, and utilize laboratory supplies, equipment, and analytical instruments.
- May provide assistance in seizure of clandestine laboratories and other drug scene investigations.
- Recognize, collect, secure, and preserve physical evidence.
- Recognize the potential for other forensic examinations in areas outside an area of specialization, prioritize the sequence of examinations, and handle evidence accordingly.
- Observe safe practices to insure the safety of analyst and co-workers.
- Engage in impartial and ethical work practices.
- Are proficient in the use and maintenance of laboratory instrumentation.
- Evaluate and interpret results of physical and instrumental analysis.
- Thoroughly and accurately produce documentation to support results and conclusions.
- Testify under oath as to analytical processes, results, and conclusions.
- Recognize and employ quality assurance measures to ensure the integrity of the analyses.

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Knowledge, Skills, and Abilities

I. History
   A. Evolution of practice
   B. Significant historical figures (e.g., Locard, Gross, Orfila, Kirk)

II. Crime Scene Preservation
   A. Securing
   B. Isolating
   C. Recording
   D. Searching
   E. Recognition of evidentiary value
   F. Safety

III. Crime Laboratory Operations-Overview
   A. Laboratory Disciplines
      1. Forensic biology
      2. Controlled substances
      3. Trace analysis
      4. Toxicology
      5. Latent fingerprints
      6. Questioned documents
      7. Fire debris
      8. Firearms/Toolmarks
      9. Digital evidence
   B. Evidence associated with each discipline

IV. QA/QC
   A. Accreditation, Certification, Standardization
      1. Laboratory accreditation
         a. Audit trails
         b. Accrediting bodies
         c. ISO 17025
         d. DNA Quality Assurance Standards (QAS)
         e. ASCLD/LAB
      2. Personnel certification
         a. ABC
         b. IAAI
         c. IAI
         d. ABFT
         e. FTCB
         f. AFTE
         g. ABFDE

h. BFDE
i. IACIS

3. Standardization
   a. ASTM
   b. UN
   c. TWG/SWG

B. QA/QC Application
   1. Noncompliant data
   2. Documentation evaluation
   3. Validation and verification
   4. Linearity
   5. Limits of detection
   6. Limits of quantitation
   7. Limits of reporting
   8. Negative and positive controls
   9. Calibrators / Standard Reference Material
   10. Measurement of Uncertainty
   11. Traceability
   12. Corrective and preventative actions
   13. Proficiency testing
   14. Confidence interval/confidence limits
   15. Sampling Plans / sample selection

C. Document/Data Management
   1. Databases
   2. LIMS
   3. Case document preservation/integrity

V. Safety

A. Chemical Hygiene
   1. Safety labeling (SDS)
   2. Globally Harmonized System of Classification and Labeling of Chemicals (GHSCLC)
   3. Communication plans

B. Universal Precautions
   1. Blood-borne pathogens
   2. Personal protective equipment

C. Hazardous Waste/Biohazardous Waste Handling
   1. Spill control

VI. Legal

A. Decisions/laws
   1. Frye
   2. Daubert/Kumho
   3. Brady
   4. Melendez-Diaz

B. Legal terms
   1. Chain of custody
   2. Discovery
   3. Voir dire
   4. Duces tecum
   5. Subpoena
C. Court Testimony
   1. Monitoring
   2. Courtroom etiquette
D. Procedural Law
   1. Hearings, trials, appeals
   2. Advocacy, burden of proof
   3. Subpoenas and affidavits
   4. Rules of evidence

VII. Ethics
   A. ABC Code of Professional Ethics
      1. Conflict of interest
      2. Professional integrity
      3. Objectivity
      4. Professional obligations

VIII. Evidence Handling
   A. Evidence Recognition and Collection
      1. Prioritization based on circumstance
      2. Sampling
      3. Preservation
   B. Evidence Classes (Class/Individual)
      1. Exclusionary evidence
      2. Identification
      3. Direct vs. indirect evidence
      4. Tangible vs. latent evidence
   C. Evidence Preservation
      1. Chain of custody
      2. Alteration/degradation
      3. Storage(long term/short term)
   D. Evidence Packaging
      1. Proper sealing
      2. Types of packaging

IX. General Science Terms and Principles
   A. Definitions and applications
      1. Scientific method
   B. General Chemistry Concepts
      1. Nomenclature (IUPAC)

2. Type of molecules (e.g., aromatics, isoalkanes)
3. Atomic, molecular weights
4. Acids/bases
5. Periodic Table
6. Elemental composition
7. Bonding
   a. Ionic
   b. Covalent
   c. Hydrogen
   d. Van der Waals
   e. Stereoisomer
   f. Enantiomer

C. General Biology Concepts
1. Cell structure
2. Genetics
3. Botany
4. Characteristics of body fluids

D. General Physics Concepts
1. Energy
2. Electromagnetic spectrum
3. Force

E. General Physiology and Anatomy Concepts

F. General Statistics (S)
1. Mean
2. Median
3. Mode
4. Standard deviation
5. Variability
6. Population characteristics
7. Confidence Interval
8. Bayesian Theory

G. Stoichiometry

H. Logic
1. Critical thinking
2. Inductive and deductive reasoning
3. Contextual bias

I. Metric System
1. Metric to metric conversion
2. Metric to English conversion

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X. Forensic Science Applications for forensic drug analyst
   A. Principles and concepts
      1. Drug Classes
         a. Stimulants
         b. Depressants/Tranquillizers
         c. Narcotics
         d. Hallucinogens
         e. Steroids
      2. Drug Laws
         a. Scheduling Criteria
         b. Drug trafficking
         c. Common Drug Schedules (i.e Cocaine, CII)
         d. Analogues

   B. Types of drug evidence/composition
      1. Seized Drug Evidence Preservation
         a. Illicit preparations
         b. Pharmaceutical Preparations
         c. Botanicals
         d. Paraphernalia
      2. Production of Common Illicit Drugs
         a. Cocaine
         b. Methamphetamine/Amphetamine
         c. MDMA
         d. Heroin
         e. PCP
         f. LSD
         g. Common adulterants
   C. Evolution of the seized drug analysis
      1. Controlled Substances Act
      2. Instrumentation development
   D. Accepted standards and practices
      1. SWG-DRUG Recommendations
      2. ASTM Standards
   E. Results and Conclusions
      1. Process Analysis
      2. QA/QC
      3. Reporting
      4. Case Management
   F. Analysis of Botanicals
      1. Cannabis
      2. Psilocin mushrooms
      3. Opium Poppy

4. Coca leaf
5. Khat
6. Peyote

G. Qualitative Analysis of Controlled Substances
1. Pharmaceuticals
2. Illicit drugs

H. Quantitative Analysis

I. Separation Techniques
1. Dilute and shoot
2. Liquid/Liquid
3. Effects of pH and solvent polarity
4. Solid phase extractions
5. Prep TLC

J. Color Tests
1. Theory
2. Application/Processes
   a. Marquis
   b. Mecke
   c. Colbalt thiocynate
   d. Dille Kopannyi
   e. p-DAB
   f. Duquenois/Levine
   g. Sodium Nitroprusside
   h. Ferric Chloride
3. Interpretation
4. QA/QC

K. Thin Layer Chromatography
1. Theory
2. Application/Processes
3. Interpretation
4. QA/QC

L. Microscopy
1. Types
   a. Stereo
   b. Polarizing light
2. Uses
3. Crystal tests
   a) Theory
   b) Application/Processes
   c) Interpretation
   d) QA/QC

M. (intentionally left blank)

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N. Instrumentation
    1. Qualitative Non-structure confirming
    2. Structure confirming
    3. Qualitative vs. Quantitative applications
    4. Nuclear Magnetic Resonance Spectroscopy (NMR)
        a) Theory
        b) Application/Processes
            01. Qualitative
            02. Quantitative
        c) Interpretation
            01. Qualitative
            02. Quantitative

O. Gas Chromatography
    1. Theory
    2. Application/Processes
        a. Qualitative
        b. Quantitative
    3. Interpretation
        a. Qualitative
        b. Quantitative
    4. QA/QC

P. High Pressure Liquid Chromatography
    1. Theory
    2. Application/Processes
        a. Qualitative
        b. Quantitative
    3. Interpretation
        a. Qualitative
        b. Quantitative
    4. QA/QC

Q. Ultraviolet Spectrophotometer
    1. Theory
    2. Application/Processes
        a. Qualitative
        b. Quantitative
    3. Interpretation
        a. Qualitative
        b. Quantitative
    4. QA/QC

R. Raman Spectrometry
    1. Theory
    2. Application/Processes
        a. Qualitative

b. Quantitative
3. Interpretation
a. Qualitative
b. Quantitative

S. Mass Spectrometry
1. Theory
2. Application/Processes
a. Qualitative
b. Quantitative
3. Interpretation
a. Qualitative
b. Quantitative
4. QA/QC

T. Infrared Spectroscopy
1. Theory
2. Application/Processes
a. Qualitative
b. Quantitative
3. Interpretation
a. Qualitative
b. Quantitative
4. QA/QC

U. Capillary Electrophoresis
1. Theory
2. Application/Processes
a. Qualitative
b. Quantitative
3. Interpretation
a. Qualitative
b. Quantitative
4. QA/QC

V. (Intentionally left blank)

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References

Listed below are the references for the Drug Analysis certification exam. Small numbers of exam questions may have been drawn from a variety of other sources including general instrumental or chemistry text. Similar information may be obtained by studying earlier or later editions of the listed works, as well as other works covering the same topics.

Core (40% of Exam Content)

The following texts were used for the generation of test questions for the CORE knowledge, applicants are encouraged to familiarize themselves with information provided by these texts as that information relates to the KSA (knowledge, skills, and abilities) outlined in this study guide.

Techniques of Crime Scene Investigation, 7th Edition, by Fisher, B.J. (Boca Raton: CRC Press, 2004) ISBN 0-8493-1691-X.

Criminalistics, An Introduction to Forensic Science, 7th Edition (or higher), by Saferstein, R. (Upper Saddle River, NJ: Prentice Hall, 1998) ISBN 0-13-592940-7.

Forensic Science Handbook, Volume I, 2nd Edition, edited by Saferstein, R. (Englewood Cliffs, NJ: Prentice Hall, 2002) ISBN 0-13-091058-9.

Forensic Science Handbook, Volume II, 2nd Edition, edited by Saferstein, R. (Englewood Cliffs, NJ: Prentice Hall, 2005) ISBN 0-13-112434-X.

Forensic Science Handbook, Volume III, edited by Saferstein, R. (Englewood Cliffs, NJ: Prentice Hall, 1993) ISBN 0-13-325390-2.

Fundamentals of Forensic Science, by Houck, M., Siegel, J. (Burlington, MA: Elsevier Academic Press, 2006) ISBN 0-12-356762-9.

Forensic Chemistry, by Bell, S., (Upper Saddle River, NJ: Pearson Prentice Hall, 2006) ISBN 0-13-147835-4.

"The Rule of Professional Conduct" supplied by the American Board of Criminalistics. www.criminalistics.com

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories. International Organization of Standards, (ISO copyright office, Switzerland, 2005)

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Discipline-Specific (60% of Exam Content)

In addition to the core drug chemistry information provided in the text above, the following texts were specifically used for development of the discipline specific (drug analysis) portion of this exam.

Clarke's Analysis of Drugs and Poisons, 3rd edition, Volume 1. Edited by Moffat, A.C. Osselton, M. and Widdop, B. (Chicago: Pharmaceutical Press, 2004).

Forensic Science Handbook, Volume I, 2nd Edition, edited by Saferstein, R. (Englewood Cliffs, NJ: Prentice Hall, 2002) ISBN 0-13-091058-9.

Chapter 2- Forensic Applications of HPLC and CE
Chapter 3- Forensic Applications of Mass Spectrometry
Chapter 5- Foundations of Forensic Microscopy

Forensic Science Handbook, Volume II, 2nd Edition, edited by Saferstein, R. (Englewood Cliffs, NJ: Prentice Hall, 2005) ISBN 0-13-112434-X.

Chapter 3-Forensic Capillary Gas Chromatography
Chapter 4-Forensic Identification of Illicit Drugs

Handbook of Drug Analysis, Edited by Smith F., Series Editor Jay A Siegel, (New York: Elsevier Academic Press, 2005)

Principles of Instrumental Analysis, 6th edition, Skoog, Douglas, James Holler, Stanley R. Crouch. (Brooks/Cole 2007) ISBN-13: 978-0-495-01201-6

Any collegiate level Instrumental Analysis Textbook which addresses the instrumentation detailed in the KSAs above

Andy collegiate level Chemistry Text which address the chemistry concepts detailed in the KSAs above

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Sample Questions

1. The primary reason for proving "chain of custody" on a particular item in court is to:

   A. authenticate the item.
   B. Show how many people handled the item.
   C. Show how long it was in each person's possession.
   D. Deter or prevent unauthorized individuals from handling the evidence.

2. Human genomic DNA is not found in:

   A. White blood cells.
   B. Red blood cells.
   C. Spermatozoa.
   D. Epithelial cells.

3. How will the Rf values for eluents most likely be affected if a TLC tank is not kept saturated with the developing solvent?

   A. They will increase.
   B. They will decrease.
   C. They will increase or decrease unpredictably.
   D. They will not be affected.

4. You receive an envelope containing a semi-automatic pistol for an operability check. You open the envelope to examine the weapon. You first remove a fully loaded magazine. The weapon is now:

   A. Potentially still loaded and unsafe.
   B. Unloaded and safe.
   C. Potentially still loaded but safe.
   D. Rendered safe because of a magazine disconnect.

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5. If the IR absorbance spectrum for a previously unidentified drug matches that of an l-amphetamine HCL standard, which of the following would be a justifiable conclusion?

   A. The unknown is l-amphetamine hydrochloride.
   B. The unknown could be d-amphetamine hydrochloride.
   C. The unknown could be l-amphetamine sulfate.
   D. The unknown could be methamphetamine hydrochloride.

6. Which of the following actions is NOT forbidden by the ABC Code of Professional Conduct?

   A. Embellishing one's qualifications when testifying.
   B. Utilizing a secret method.
   C. Refusing to honor a subpoena duces tecum.
   D. Interpreting equivocal results based only on an employer's wishes.

7. With which one of the following drugs will the Marquis reagent *NOT* produce a colored reaction product?

   A. morphine
   B. mescaline
   C. amphetamine
   D. barbiturate

8. The term "theoretical plate" refers to which one of the following parameters in gas chromatography?

   A. retention time
   B. polarity
   C. efficiency
   D. stationary phase thickness

9. In microscopy, which one of the following terms describes the relationship between retardation and thickness?

   A. Aberration
   B. Dispersion
   C. Scattering
   D. Birefringence

10. The equivalent weight of a compound is 60. How much of this compound (in pure form) will be needed to make a 100mL solution of 0.1 N strength?
   A. 600 mg
   B. 6.0 g
   C. 0.06 g
   D. 60.0 g