AMERICAN BOARD OF FORENSIC TOXICOLOGY

Study Guide for Examination Preparation

Examination Content

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STUDY GUIDE FOR EXAMINATION PREPARATION

The ABFT examinations challenge examinees with the fundamental information used in the practice of forensic toxicology. Examination questions cover the areas of postmortem toxicology, human performance toxicology and workplace drug testing. Included in these areas of toxicology are topics such as driving under the influence of alcohol and drugs, drug overdose deaths, employee drug testing, athletic drug testing, urine and alternate matrices drug testing, interpretation and expert opinion; and other related forensic toxicology issues. In addition, related analytical, physiological, pathological, pharmacological, and laboratory practice and management concepts are included.

Each examination consists of 130 single answer, multiple choice questions relating to basic, general and specific information, and has a time limit of 3 hours. Each examination is listed below along with the areas covered by that examination.

Subject areas for the General Toxicology Exams: FELLOW and DIPLOMATE

Laboratory Practice

Laboratory organization, policy and management; governmental and other regulations and guidelines; laboratory accreditation; expert testimony, laboratory procedures and calculations; statistics; quality control and quality assurance:

- Management
    - Responsibilities
    - Legal interactions
        - Rules of Evidence (Frye, Daubert)
        - DUID laws
    - Laboratory security
    - Chain of custody
- Quality Assurance and Quality Control
    - Basic concepts
    - Statistics
    - Calculations
    - Corrective action
    - Documentation
    - Method validation
    - Control charts
- Regulatory Oversight
    - Standards and guidelines of practice
    - Accreditation
        - ABFT
        - ISO 17025/15189
        - SAMHSA
    - Privacy and Confidentiality
        - HIPAA
- Expert Testimony

Analytical Procedures and Basic Analytical Chemistry

Basic principles and theory, separations, instrumentation, methodology, laboratory techniques, standardization, interferences, and methods development and validation for specific analytes:

- Spectrophotometry – Theory and Application
    - Color reactions
    - Microdiffusion
    - UV/VIS
    - IR/FTIR
    - Fluorescence
- Extraction – Theory and Application
    - SPE/SSE
    - Liquid/Liquid
    - pH/pKa
- Immunoassay – Theory and Application
    - General
        - Homogeneous
        - Heterogeneous
    - Cross-reactivity/Specificity
- Chromatography – Theory and Application
    - TLC
    - GC
    - LC
    - Detectors (Non-MS)
- Mass Spectrometry – Theory and Application
    - Ionization techniques (EI, CI, ICP, Electrospray)
    - Mass discrimination (Tandem MS, TOF, Quadrupole, Ion Trap)
    - Interferences, suppression and enhancement
- Other – Theory and Application
    - Capillary electrophoresis
    - AAS/OES
    - Breath alcohol testing

Drugs, Xenobiotics, and Other Toxicants – Factual

Nomenclature, chemical structure, composition and classification of drugs and poisons; theory of pharmacology; mechanism of drug action and disposition, absorption, distribution, metabolism, and excretion; pharmacokinetics and effects of physiological variables (examples below are not exhaustive):

- Ethanol and Other Volatiles
    - Metabolism
    - Pharmacokinetics
- Carboxyhemoglobin
    - Methemoglobin
    - Poisoning
    - Fire deaths

- Cyanide
    - Poisoning
    - Fire deaths
- Commonly Encountered Drugs
    - Opiates/Opioids
    - Cannabinoids
    - Stimulants
        - Cocaine
        - Amphetamines
    - Hallucinogens
    - Sedative/Hypnotics
        - Barbiturates
        - Benzodiazepines
    - Antidepressants
    - Antipsychotics
    - Novel Psychoactive Substances
        - Designer stimulants
        - Synthetic cannabinoids
        - Others
- Metals – Organic and Inorganic
    - Arsenic, Lead, Mercury, Thallium, Cadmium
- Environmental and Natural Toxicants
    - Pesticides (insecticides, rodenticides, fungicides, herbicides, fumigants)
    - Gases (cyanide, sulfide, etc.)
    - Venoms and antivenins

Drugs, Xenobiotics and Other Toxicants – Interpretative

Interpretation of toxic/lethal concentrations of substances in body tissues and fluids; postmortem changes; mechanisms of toxicity and antidote therapy; target organs, disposition of poisons, and systemic effects; effects of underlying disease, drug interactions; interpretation of signs and symptoms associated with poisoning:

- Ethanol and Other Volatiles
    - Pharmacological action and effects
    - Disease state (ketone bodies)
- Commonly Encountered Drugs
    - Post-mortem redistribution
    - In-vitro and in-vivo instability
    - Therapeutic concentrations
    - Pharmaco-/Toxicokinetic calculations on post-mortem blood
    - Body burden
    - Drug interactions
    - Pharmaco-/Toxicogenetics
- Metals
- Clinical Toxicology
    - Treatment of Common Poisoning
        - Anitdotes

    - Therapeutic drug monitoring
    - Drug intoxication

Pathology and Specimens

Pathological findings related to death in poisonings and drug overdose; appropriateness of specimens:

- Common Autopsy Findings
    - Pulmonary edema
    - Hepatic necrosis
    - Cardiac pathology
    - Postmortem chemistries
- Specimens
    - Blood, postmortem and antemortem
    - Urine
    - Bile
    - Vitreous humor
    - Tissues (liver, kidney, etc.)
    - Hair and nails
    - Gastric contents
    - Decomposed specimens

Regulated Drug Testing

- HHS Regulations
    - Cut-offs
    - Specimen validity testing
    - Security
- Interpretation/MRO
- DUI/DUID Testing

History

- Poisoners and pioneers
- History of postmortem detection of poisons
- History of separation and detection methods
- History of instrumentation

Preparation for the Examination in Forensic Toxicology (Fellow and Diplomate) should involve both review and updating of information in the areas cited above. Numerous books devoted to toxicology are now available. In addition to those that cover methodology and general laboratory practice, there are several that cover specialty areas. The most current information is found in appropriate journals and at meetings and workshops. The general breakdown of questions can be seen in Table 1.

Table 1: Percent Contribution of Subject Areas

Subject Area / Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Drugs, Xenobiotics and Toxicants: Facts	Drugs, Xenobiotics and Toxicants: Interpretation	Pathology and Specimens	Regulations	History
F-ABFT	10%	30%	20%	25%	10%	3%	2%
D-ABFT-FT	10%	35%	25%	15%	10%	3%	2%

Legend: F-ABFT = Fellow; D-ABFT-FT = Forensic Toxicology Diplomate

Subject Areas for the Forensic Alcohol Exam: DIPLOMATE

Laboratory Practice

Laboratory organization, policy and management; governmental and other regulations and guidelines; laboratory accreditation; expert testimony, laboratory procedures and calculations; statistics; quality control and quality assurance as it pertains to alcohol; both breath and blood testing.

- Management
  - Responsibilities
  - Legal interactions
    - Rules of Evidence (Frye, Daubert)
    - DUID laws
- Quality Assurance and Quality Control
  - Basic concepts
  - Statistics
  - Measurement of uncertainty
  - Calculations
- Expert Testimony

Analytical Procedures and Basic Analytical Chemistry

Basic principles and theory, instrumentation, methodology, laboratory techniques, standardization, interferences;

- General chemistry of alcohols
- Wet Bath Simulators – Theory and Application
  - Partition ratio
  - Temperature
- Dry Gas – Theory and Application
  - Barometric pressure
  - Offset
- Blood Alcohol
  - Postmortem and antemortem
  - Whole blood
  - Serum

- Chromatography / Headspace Autosamplers– Theory and Application
    - Columns
    - Gases
    - Detectors
    - Peak shape
- Breath Alcohol and Breath Alcohol Instrumentation
    - Theory
    - Blood/Breath Ratio
    - Detector types
    - Electronics

Pharmacology and Pharmacokinetics of Ethanol – Factual and Interpretive

- Pharmacology of alcohol
- Pharmacokinetics of alcohol
- Pharmacokinetic calculations
    - Widmark
    - Extrapolation

Related Drugs

- General Interactions of Common Drugs with Ethanol
    - Synergistic effects
    - Additive effects

History

- Pioneers in the field of alcohol
- General perspective and understanding of the different types of instruments in breath alcohol testing thru time

Preparation for the Examination in Forensic Alcohol Toxicology should involve both review and updating of information in the areas cited above. Numerous books devoted to Forensic Alcohol are now available. In addition to those that cover methodology and general laboratory practice, there are several that cover specialty areas. The most current information is found in appropriate journals and at meetings and workshops. The general breakdown of questions can be seen in Table 2.

Table 2: Percent Contribution of Subject Areas

Subject Area / Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Pharmacology and Pharmaco-kinetics of Ethanol	Pharmacology and Pharmaco-kinetics: Interpretation	Ethanol and other Drugs	Regulations	History
D-ABFT-FA	10%	30%	25%	15%	10%	5%	5%

Legend: D-ABFT-FA = Forensic Alcohol Diplomate

Subject areas for the General Forensic Drug Toxicology Exam: DIPLOMATE

Laboratory Practice

Laboratory organization, policy and management; governmental and other regulations and guidelines; laboratory accreditation; expert testimony, laboratory procedures and calculations; statistics; quality control and quality assurance:

- Management
  - Responsibilities
  - Legal interactions
    - Rules of Evidence (Frye, Daubert)
  - Laboratory security
  - Chain of custody
- Quality Assurance and Quality Control
  - Basic concepts
  - Statistics
  - Calculations
  - Corrective action
  - Documentation
  - Method validation
- Regulatory Oversight
  - Accreditation
    - HHS/NLCP
    - CAP
    - State regulations
  - Privacy and Confidentiality
    - HIPAA
- Expert Testimony

Analytical Procedures and Basic Analytical Chemistry

Basic principles and theory, separations, instrumentation, methodology, laboratory techniques, standardization, interferences, and methods development and validation for specific analytes:

- Spectrophotometry – Theory and Application
  - Color reactions
  - UV/VIS
  - IR/FTIR
  - Fluorescence
- Extraction – Theory and Application
  - SPE/SSE
  - Liquid/Liquid
  - pH/pKa
- Immunoassay – Theory and Application
  - General
  - Cross-reactivity/Specificity
- Chromatography – Theory and Application

    - TLC
    - GC
    - HPLC
    - Detectors (Non-MS)
- Mass Spectrometry – Theory and Application
    - Ionization Techniques (EI, CI, ICP, Electrospray)
    - Mass Discrimination (Tandem MS, TOF, Quadrupole, Ion Trap)

Drugs, Xenobiotics, and Other Toxicants – Factual

Nomenclature, chemical structure, composition and classification of drugs and poisons; theory of pharmacology; mechanism of drug action and disposition, absorption, distribution, metabolism, and excretion; pharmacokinetics and effects of physiological variables (examples below are not exhaustive):

- Commonly Encountered Drugs
    - Opiates/Opioids
    - Cannabinoids
    - Stimulants
        - Cocaine
        - Amphetamines
    - Hallucinogens
    - Sedative/Hypnotics
        - Barbiturates
        - Benzodiazepines
    - Antidepressants
    - Antipsychotics
    - Novel Psychoactive Substances
        - Designer stimulants
        - Synthetic cannabinoids
        - Others

Regulated Drug Testing

- HHS Regulations
    - Cut-Offs
    - Specimen validity testing
    - Security
    - Sample handling
- Interpretation/MRO

History

- Poisoners and pioneers
- History of separation and detection methods
- History of workplace drug testing

Preparation for the Examination in Forensic Toxicology (Diplomate) should involve both review and updating of information in the areas cited above. Numerous books devoted to toxicology are now available. In addition to those that cover methodology and general laboratory practice, there are several that cover specialty areas. The most current information is found in appropriate journals and at meetings and workshops. The general breakdown of questions can be seen in Table 3.

Table 3: Percent Contribution of Subject Areas

Subject Area / Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Drugs, Xenobiotics, and Other Toxicants – Factual and Interpretation	Regulated Drug Testing	History
D-ABFT-FD	15%	33%	15%	35%	2%

Legend: D-ABFT-FD = Forensic Drug Testing Diplomate

Study Guide References – All Examinations

These suggested references only represent a guide to information available to prepare for the examinations. It is not intended to list the only references for study purposes. Some information is common to several sources. An individual's study should be conditioned by his or her own experience and knowledge. Some examination questions are based on practical laboratory experience rather than textbook information. The most recent edition of each reference listed is recommended, which may be later than the edition cited.

Key References

Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. R.C. Baselt. Biomedical Publications, 2014.

Clarke's Analysis of Drugs and Poisons, 4th edition. A.C. Moffat, Pharmaceutical Press, 2011.

Garriott's Medicolegal Aspects of Alcohol, 6th edition, Y.H. Caplan and B.A. Goldberger, Lawyers & Judges Publishing, 2015.

Principles of Forensic Toxicology. 4th edition, B. Levine, AACC Press, 2013.

The Clinical Toxicology Laboratory, Contemporary Practice of Poisoning Evaluation, 2nd edition, Edited by L.M. Shaw, T.C. Kwong, T.G. Rosano, P.J. Orsulak, B.A. Wolf and B. Magnani, AACC Press, 2013.

Drug Abuse Handbook. 2nd edition, Steven B. Karch, CRC Press, 2006.

Other References

Casarett & Doull's Toxicology: The Basic Science of Poisons, 8th edition. C.D. Klaassen. McGraw-Hill, 2013.

Clinical Chemistry: Theory, Analysis, Correlation, 5th edition. L.A. Kaplan and A.J. Pesce. Mosby, 2010.

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Drug Effects on Psychomotor Performance. R.C. Baselt, Biomedical Publications, 2001.

Drug Facilitated Sexual Assault: A Forensic Handbook. M.A. LeBeau and A. Mozayani, Elsevier, 2001.

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Goodman and Gilman's the Pharmacological Basis of Therapeutics, 12th edition. L. Brunton, B. Chabner and B. Knollman. McGraw-Hill, 2010.

Handbook for Workplace Drug Testing. 2nd edition, J.D. Ropero-Miller and B.A. Goldberger. AACC Press, 2008.

Handbook of Forensic Drug Analysis. F.P. Smith and J.A. Siegel, Academic Press, 2004.

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Karch's Pathology of Drug Abuse, 4th. edition, S. Karch, CRC Press, 2008.

Poison Detection Human Organs, 4th Edition. A. S. Curry, Charles Thomas Publisher, 1988.

Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 5th edition. C.A. Burtis, E.R. Ashwood and D.E. Bruns, W.B. Saunders Co., 2013.

HHS Mandatory Guidelines for Federal Workplace Drug Testing Programs.

JOURNALS:

Forensic Toxicology

Journal of Analytical Toxicology

Journal of Forensic Sciences

Forensic Science International

Sample Questions

Multiple Choice. Choose the best answer:

Concerning Morphine

A. an active metabolite of hydromorphone
B. readily extracted from strong alkaline solution
* C. urinary metabolites include morphine-glucuronide
D. biotransformed to 6-acetylmorphine
E. readily extracted from strong acid solution

Oxazepam is a metabolite of which of the following?

* A. diazepam
B. alprazolam
C. lorazepam
D. flurazepam
E. flunitrazepam

In gas chromatography, which of the following has the longest retention time on a 50% phenylmethyl or HP-17 liquid phase?

A. nicotine
B. meperidine
* C. strychnine
D. diazepam
E. phentermine

A specimen of known concentration used to verify a calibration is:

A. calibrator
* B. control
C. reference
D. standard
E. blank

A 200 pound man consumes 6x 12-ounce beers and 2x 1-ounce shots of whiskey (100 proof) between 9:00 PM and 11:00 PM. A breath alcohol test performed at 1:00 AM would be expected to give an alcohol concentration in the following range (g/210 L):

A. 0.04 to 0.06
B. 0.07 to 0.09
C. 0.13 to 0.15
D. 0.16 to 0.18
* E. 0.10 to 0.12