



## **DIPLOMATE EXAMINATIONS**

### **Study Guide for Examination Preparation**

Diplomate in Forensic Toxicology (D-ABFT-FT)  
Diplomate in Forensic Alcohol Toxicology (D-ABFT-FA)  
Diplomate in Forensic Drug Toxicology (D-ABFT-FD)

Examination Content Areas

Recommended References

Sample Questions

August 2022

## STUDY GUIDE FOR EXAMINATION PREPARATION

### Introduction

The ABFT diplomate examinations are discipline-focused and designed to challenge the candidate's mastery of fundamental concepts applied to the practice of the specialized areas of forensic toxicology. It is recommended that the candidate successfully complete an in-house training program prior to sitting for an examination.

Examination questions incorporate a variety of topics specific to each discipline. Detailed content areas are provided in this guide for each of the three examinations.

Each diplomate examination consists of 130 single answer, multiple-choice questions, distributed over the content areas as shown below. At least 70% of the questions must be answered correctly to pass the examination. Note that examples are provided for illustration only and should not be considered exhaustive.

Candidates will be given three hours to complete an examination.

### **Content Areas: Diplomate in Forensic Toxicology (D-ABFT-FT)**

#### Laboratory Practice

Laboratory organization, policy, and management; regulatory issues and guidelines; laboratory accreditation; expert testimony; laboratory procedures and calculations; statistics; quality control and quality assurance.

- Management
  - Responsibilities
  - Legal matters
    - Rules of evidence (Frye, Daubert, Melendez-Diaz)
    - DUI / DUID laws
  - Laboratory security
  - Chain of custody
- Quality assurance/quality control
  - Basic concepts
  - Statistics
  - Calculations
  - Corrective action
  - Documentation
  - Method validation
  - Control charts
- Regulatory oversight
  - Standards/practice guidelines
  - Accreditation
    - ABFT
    - ISO 17025/15189

- Privacy and confidentiality
  - HIPAA
- Expert testimony

### Basic Analytical Chemistry and Procedures

Basic principles and theory; separations; laboratory techniques and instrumentation; standardization; interferences; and method development and validation.

- Spectroscopy – Theory and Application
  - Colorimetry
  - Micro-diffusion
  - UV/VIS
  - IR/FTIR
  - Fluorescence
- Extractions – Theory and Application
  - SPE/SSE
  - Liquid/liquid
  - pH/pKa
- Immunoassays – Theory and Application
  - General
    - Homogeneous
    - Heterogeneous
  - Cross-reactivity/sensitivity/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 – Foundational

Nomenclature, chemical structure, classification of drugs and poisons; pharmacology; pharmacokinetics; and pharmacodynamics.

- Ethanol/other volatiles
  - Pharmacokinetics
  - Pharmacodynamics
- Carboxyhemoglobin/methemoglobin

- Cyanide
- Commonly encountered drugs
  - Opiates/opioids
  - Cannabinoids
  - Stimulants
    - Cocaine
    - Amphetamines
  - Hallucinogens
  - Sedative/hypnotics
    - Barbiturates
    - Benzodiazepines
    - “Z” Drugs
  - Psychotherapeutics
  - Novel psychoactive substances
- Metals – Organic and Inorganic
- Environmental and natural toxicants
  - Pesticides
  - Noxious gases
  - Venoms/antivenins

### Drugs, Xenobiotics, and Other Toxicants – Interpretative

Interpretation of therapeutic/toxic/lethal concentrations in body fluids and tissues; postmortem changes; mechanisms of toxicity, target organs, disposition of poisons, and systemic effects; effects of underlying disease; pharmacogenomics and drug interactions; and toxidromes.

- Ethanol/other volatiles
  - Pharmacodynamics
  - Disease states
  - Postmortem generation
- Commonly encountered drugs
  - Postmortem redistribution
  - *In-vitro* and *in-vivo* stability
- Metals – Organic and Inorganic
- Clinical toxicology
  - Treatment of common poisonings
    - Antidotes
  - Therapeutic drug monitoring
- DUI/DUID Testing
  - Blood alcohol
  - Breath alcohol

### Forensic Pathology/Toxicology Specimens

Pathological findings related to poisonings and drug overdose deaths; and toxicology specimen procedures and practices.

- Autopsy findings
  - Pulmonary edema
  - Hepatic necrosis
  - Cardiac pathology
  - Renal pathology
  - Neuropathology
  - Postmortem chemistries
- Specimens
  - Blood
  - Urine
  - Bile
  - Vitreous humor
  - Tissues
  - Hair/nails
  - Gastric contents
  - Decomposition

### History

- Poisoners and pioneers
- Postmortem detection of poisons
- Separation and detection methods
- Instrumentation

Preparation for the diplomate examination in forensic toxicology should include review of the content areas cited above. Numerous toxicology references and resources are available, to include general laboratory practice and methods, commonly encountered drugs and poisons, and regulatory issues. The most current information is found in peer-reviewed journals, workshops, and meetings. Table 1 illustrates the percent contribution of examination content areas.

Table 1: Percent Contribution of Content Areas

Content Area Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Drugs, Xenobiotics and Toxicants: Foundational	Drugs, Xenobiotics and Toxicants: Interpretative	Pathology and Specimens	Regulatory Issues	History
D-ABFT-FT	10%	35%	25%	15%	10%	3%	2%

## **Content Areas-Diplomate in Forensic Alcohol Toxicology (D-ABFT-FA)**

### Laboratory Practice

Laboratory organization, policy and management; regulatory issues and guidelines; laboratory accreditation; expert testimony; laboratory procedures and calculations; statistics; quality control and quality assurance; and breath and blood testing.

- Management
  - Responsibilities
  - Legal matters
    - Rules of evidence (Frye, Daubert, Melendez-Diaz)
    - DUI/DUID laws
- Quality assurance/quality control
  - Basic concepts
  - Statistics
  - Measurement of uncertainty
- Expert testimony

### Basic Analytical Chemistry and Procedures

Basic principles and theory; separations; laboratory techniques and instrumentation; standardization, interferences; and method development and validation.

- General chemistry of alcohols
- Wet Bath Simulators – Theory and Application
  - Partition ratio
  - Temperature
- Dry Gas – Theory and Application
  - Barometric pressure
  - Offset
- Blood alcohol
  - Antemortem and postmortem
  - Whole blood
  - Serum
- Chromatography/Headspace Autosamplers– Theory and Application
  - Columns
  - Gases
  - Detectors
  - Peak shape
- Breath alcohol/breath alcohol instrumentation
  - Theory
  - Blood/breath ratio
  - Detector types
  - Electronics

Ethanol Pharmacology and Pharmacokinetics – Foundational and Interpretative

- Pharmacology
- Pharmacokinetics
- Calculations
  - Widmark
  - Retrograde extrapolations

Alcohol and Drugs

- Common Drug – Ethanol Interactions
  - Synergistic effects
  - Additive effects

History

- Pioneers
- Evolution of breath testing

Preparation for the diplomate examination in forensic alcohol toxicology should involve review of the content areas cited above. Numerous forensic alcohol toxicology references and resources are available, to include general laboratory practice and methods, and medicolegal aspects. The most current information is found in peer-reviewed journals, workshops, and meetings. Table 2 illustrates the percent contribution of examination content areas.

Table 2: Percent Contribution of Content Areas

Content Area Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Pharmacology and Pharmaco- kinetics - Foundational	Pharmacology and Pharmaco- kinetics: Interpretative	Ethanol and Other Drugs	Regulatory Issues	History
D-ABFT-FA	10%	30%	25%	15%	10%	5%	5%

## Content Areas-Diplomate in Forensic Drug Toxicology (D-ABFT-FD)

### Laboratory Practice

Laboratory organization, policy, and management; regulatory issues and guidelines; laboratory accreditation; expert testimony; laboratory procedures and calculations; statistics; and quality control and quality assurance.

- Management
  - Responsibilities
  - Legal matters
  - Laboratory security
  - Chain of custody
- Quality assurance/quality control
  - Basic concepts
  - Statistics
  - Calculations
  - Corrective action
  - Documentation
  - Method validation
- Regulatory oversight
  - Accreditation
    - HHS/NLCP
    - CAP
    - State regulations
  - Privacy/confidentiality
    - HIPAA
- Rules of evidence (Frye, Daubert, Melendez-Diaz)
- Expert testimony

### Basic Analytical Chemistry and Procedures

Basic principles and theory; separations; laboratory techniques and instrumentation; standardization; interferences; and method development and validation.

- Spectroscopy – Theory and Application
  - Colorimetry
  - UV/VIS
  - IR/FTIR
  - Fluorescence
- Extractions – Theory and Application
  - SPE/SSE
  - Liquid/liquid
  - pH/pKa
- Immunoassays – Theory and Application
  - General
    - Homogeneous



- Heterogeneous
    - Cross-reactivity/sensitivity/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)
  - Interferences, suppression, and enhancement

### Drugs, Xenobiotics, and Other Toxicants – Foundational

Nomenclature, chemical structure, classification of drugs and poisons; pharmacology; and pharmacokinetics and pharmacodynamics.

- Commonly Encountered Drugs
  - Opiates/opioids
  - Cannabinoids
  - Stimulants
    - Cocaine
    - Amphetamines
  - Hallucinogens
  - Sedative/hypnotics
    - Barbiturates
    - Benzodiazepines
    - “Z” Drugs
  - Psychotherapeutics
  - Novel psychoactive substances

### Regulated Drug Testing

- HHS/NLCP
  - Cut-offs
  - Specimen validity testing
  - Security
  - Sample handling
  - Screening and confirmation
  - Interpretation/MRO

### History

- Separation and detection methods
- Workplace drug testing

Preparation for the diplomate examination in forensic drug toxicology should include review of the content areas cited above. Numerous toxicology references and resources are available, to include general laboratory practice and methods, and workplace drug testing. The most current information is found in peer-reviewed journals, workshops, and meetings. Table 3 illustrates the percent contribution of examination content areas.

Table 3: Percent Contribution of Content Areas

Content Area Certificant Category	Laboratory Practice	Analytical Procedures: Basic Chemistry	Drugs: Foundational and Interpretative	Workplace Drug Testing	History
D-ABFT-FD	15%	33%	15%	35%	2%

### Recommended References

The references provided below are intended to serve as a guide for examination preparation and are not exhaustive. Information may be common to several sources. Candidates are encouraged to access the most recent editions of each book cited. Books and journals should be used in conjunction with the candidate's training and practical experience.

### Books

#### Certification in Forensic Toxicology:

Baselt, R.C. (2020) *Disposition of toxic drugs and chemicals in man*, 12<sup>th</sup> edition. Biomedical Publications, Seal Beach, CA.

- Monographs on more than 2,000 substances regarding their occurrence/usage, blood concentrations, metabolism/excretion, toxicity, and analysis.

Baselt, R.C. (2001) *Drug effects on human performance*. Biomedical Publications, Foster City, CA.

- The psychomotor performance effects of 120 therapeutic substances and other drugs of abuse, organized in the Pharmacology, Laboratory Studies, Driving Studies, Epidemiology, and Conclusion sections.

Brunton, L.L., Hilal-Dandan, R., and Knollman, B.C. (2011) *Goodman and Gilman's the pharmacologic basis of therapeutics*, 13<sup>th</sup> edition. McGraw-Hill Education, New York, NY.

- Actions and uses of therapeutic substances in relation to physiology and pathophysiology; Section II, Neuropharmacology covers drugs of abuse frequently encountered in the forensic toxicology practice.

Caplan, Y.H. and Goldberger, B.A. (eds.) (2015) *Garriott's medicolegal aspects of alcohol*, 6<sup>th</sup> edition. Lawyers & Judges Publishing, Tucson, AZ.

- Alcohol in all parts of its involvement in forensic applications, including chemistry, pharmacology, toxicology, analysis, and interpretation of alcohol as well as quality, statistical, legal and clinical aspects of alcohol testing.

Kaplan, L.A. and Pesce A. J. (2010) *Clinical chemistry: theory, analysis, correlation*, 5<sup>th</sup> edition. C. V. Mosby, Co., St. Louis, MO.

- Laboratory technique and management (Part 1) as well as physiology and pathophysiology (Part 2) in the clinical chemistry practice. Chapter 55 covers toxicology.

Karch, S.B. (ed.) (2006) *Drug abuse handbook*, 2<sup>nd</sup> edition. CRC Press, Boca Raton, FL.

- Criminalistics, pathology, pharmacokinetics, neurochemistry, and treatment of drug abuse in addition to drug testing in sports, the workplace, and postmortem toxicology; the ethical, legal and practice issues are also discussed.

Karch, S.B. and Drummer, O.H. (2008) *Pathology of drug abuse*, 5<sup>th</sup> edition. CRC Press, Boca Raton, FL.

- Pathology, toxicology, and pharmacology of commonly abused 9 drug groups. The book focuses on the postmortem analysis and considerations for each of the drug groups.

Klaassen, C.D. (ed.) (2013) *Casarett & Doull's toxicology: the basic science of poisons*, 8<sup>th</sup> edition. McGraw-Hill, New York, NY.

- The general principles of toxicology (Unit I), disposition of toxicants (Unit II), toxicity (Units III-IV), relevant toxic agents (Chapters 22-24, 26), and application of toxicology (Unit VII) including an overview of analytical and forensic toxicology in Chapter 32.

LeBeau, M.A. and Mozayani, A. (2001) *Drug facilitated sexual assault: a forensic handbook*. Academic Press, Cambridge, MA.

- History of drug-facilitated sexual assaults and in-depth discussion of the drugs and drug classes used in the crime including the effects of the drugs, proper techniques in collecting and analyzing evidence, and challenges associated with investigations.

Levine, B. and Kerrigan, S. (eds.) (2020) *Principles of forensic toxicology*, 5<sup>th</sup> edition. AACC Press, Washington, DC.

- Comprehensive overview of all aspects in the forensic toxicology practice from forensic toxicology/pharmacology to methodologies, analytes, and special topics including drug stability, postmortem redistribution, alternative matrices, and pharmacogenomics.

Moffat, A.C., Osselton, M.D. and Widdop, B. (eds.) (2011) *Clarke's analysis of drugs and poisons*, 4<sup>th</sup> edition. Pharmaceutical Press, London, U.K.

- Monographs of over 2100 drugs on physical properties, analytical methods, pharmacokinetic data, ultraviolet, infrared and mass spectra, and therapeutic and toxicity effects.

Mozayani, A. and Raymon, L. (eds.) (2011) *Handbook of drug interactions: a clinical and forensic guide*. Humana Press, Totowa, NJ.

- Pharmacokinetic and pharmacodynamic drug interactions of psychoactive drugs, cardiovascular drugs, antibiotics, and anti-inflammatory drugs; pharmacogenomics, and legal aspects.

Rifai, N. (2022) *Tietz Textbook of Laboratory Medicine*, 7<sup>th</sup> edition. W. B. Saunders Co, Philadelphia, PA.

- Relevant parts include Section I, basics of laboratory medicine; Section II, analytical techniques and applications (chapters 16-20 discuss chromatography and mass spectrometry); and Section III analytes (chapter 41 discusses clinical toxicology).

Ropero Miller, J. D. and Goldberger, B.A. (eds.) (2008) *Handbook for workplace drug testing*, 2<sup>nd</sup> edition. AACC Press, Washington, DC.

- Analytical and application guide to the workplace drug testing with regard to analytical techniques, quality assurance, biological matrices, analytes, interpretation of test results, and laboratory accreditation/regulation.

Kwong, T.C., Magnani, B., Rosano, T.G. and Shaw, L.M. (eds.) (2013) *The clinical toxicology laboratory: contemporary practice of poisoning evaluation*, 2<sup>nd</sup> edition. AACC Press, Washington, DC.

- Epidemiology of poisoning, pharmacokinetics, pharmacogenetics, analytes and analytical techniques relevant to clinical toxicology.

Smith, F.P. and Siegel, J.A. (eds.) (2004) *Handbook of forensic drug analysis*. Elsevier Academic Press, New York, NY.

- Forensic and chemical analytical techniques for cannabis, hallucinogens, cocaine, opioids, and amphetamines.

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Karch, S.B. (ed.) (2006) *Drug abuse handbook*, 2<sup>nd</sup> edition. CRC Press, Boca Raton, FL.

- Chapter 5 - Alcohol.

LeBeau, M.A. and Mozayani, A. (2001) *Drug facilitated sexual assault: a forensic handbook*. Academic Press, Cambridge, MA.

- Chapter 3 - Ethanol.

Levine, B. and Kerrigan, S. (eds.) (2020) *Principles of forensic toxicology*, 5<sup>th</sup> edition. AACC Press, Washington, DC.

- Chapter 19 – Alcohol.

#### Certification in Forensic Drug Toxicology:

Baselt, R.C. (2020) *Disposition of toxic drugs and chemicals in man*, 12<sup>th</sup> edition. Biomedical Publications, Seal Beach, CA.

- Monographs on more than 2,000 substances regarding their occurrence/usage, blood concentrations, metabolism/excretion, toxicity, and analysis.

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- Analytical and application guide to the workplace drug testing with regard to analytical techniques, quality assurance, biological matrices, analytes, interpretation of test results, and laboratory accreditation/regulation.

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- Epidemiology of poisoning, pharmacokinetics, pharmacogenetics, analytes and analytical techniques relevant to clinical toxicology.

Smith, F.P. and Siegel, J.A. (eds.) (2004) *Handbook of forensic drug analysis*. Elsevier Academic Press, New York, NY.

- Forensic and chemical analytical techniques for cannabis, hallucinogens, cocaine, opioids, and amphetamines.

### Other resources

*Mandatory Guidelines for Federal Workplace Drug Testing Programs using Urine*, Federal Register. Substance Abuse and Mental Health Services Administration, Department of Health and Human Services

- Federal Register, 82 FR 7920 – 2017 (<https://www.govinfo.gov/content/pkg/FR-2017-01-23/pdf/2017-00979.pdf>).

*Mandatory Guidelines for Federal Workplace Drug Testing Programs using Oral Fluid*, Federal Register. Substance Abuse and Mental Health Services Administration, Department of Health and Human Services

- Federal Register, 84 FR 57554 (<https://www.govinfo.gov/content/pkg/FR-2019-10-25/pdf/2019-22684.pdf>).

General Chemistry: Any introductory college/university text intended for science majors.

Statistics: Any introductory college/university text intended for science majors.

Laboratory Safety and Chemical Hygiene: Any manual appropriate for a toxicology laboratory.

### Journals

Forensic Toxicology  
Forensic Science International

Journal of Forensic Sciences  
Journal of Analytical Toxicology

### Sample Questions

Multiple Choice. Choose the best answer:

1. Morphine is/has:
  - A. metabolized to codeine
  - B. readily extracted from a strong alkaline solution
  - \* C. urinary metabolites to include morphine-3-glucuronide
  - D. bio-transformed to 6-acetylmorphine
  - E. readily extracted from a strong acid solution
  
2. The Federal Custody and Control Form (CCF) is comprised of 5 copies. Which of the following is **NOT** included in the CCF?
  - \* A. Duplicate Copy – sent to 2<sup>nd</sup> lab when retesting is requested by Donor
  - B. MRO Copy – sent to the MRO
  - C. Collector Copy – retained by collector
  - D. Employer Copy – sent to Federal Agency
  - E. Donor Copy – given to donor when collection is complete
  
3. Which of the following has the longest retention time on a 50% phenylmethyl or HP-17 liquid phase chromatography column?
  - A. nicotine
  - B. meperidine
  - \* C. strychnine
  - D. diazepam
  - E. phentermine
  
4. A specimen of known concentration used to verify a calibration is a:
  - A. calibrator
  - \* B. control
  - C. reference
  - D. duplicate
  - E. blank

5. A 200-pound male consumes six 12-ounce beers and two 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 ethanol concentration range of (g/210 L):

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