FELLOW EXAMINATION

Study Guide for Examination Preparation

Fellow in Forensic Toxicology (F-ABFT)

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STUDY GUIDE FOR EXAMINATION PREPARATION

Introduction

The ABFT fellow examination is designed to challenge the candidate's mastery of fundamental concepts applied to the practice of forensic toxicology. It is recommended that the candidate successfully complete an in-house training program prior to sitting for the examination.

Postmortem toxicology, human performance toxicology, and workplace drug testing form the basis of this examination. Questions include driving-under-the-influence of alcohol and drugs; drug overdose and other poisonings; testing in sports; alternate matrices; case interpretation and expert opinion, as well as other forensic toxicology issues. Concepts from analytical chemistry, human physiology and pathology, pharmacology, and laboratory practice and management are addressed, as these relate to the practice of forensic toxicology.

The fellow 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 the examination.

Content Areas: Fellow in Forensic Toxicology (F-ABFT)

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
        - SAMHSA
    - Privacy/confidentiality
        - HIPAA
- Expert testimony

Basic Analytical Chemistry and Procedures

Basic principles and theory; separations; laboratory techniques and instrumentation; standardization; interferences; 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

<u>Drugs, Xenobiotics and Other Toxicants – Interpretative</u>

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; 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
    - Drug intoxication

Forensic Pathology/Toxicology Specimens

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

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

Regulated Drug Testing

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

History

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

Preparation for the fellow 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: Interpretation	Pathology and Specimens	Regulatory Issues	History
F-ABFT	10%	30%	20%	25%	10%	3%	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 edition of each book cited. Books and journals should be used in conjunction with the candidate's training and practical experience.

Books

Baselt, R.C. (2020) *Disposition of toxic drugs and chemicals in man*, 12th 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 pharmacological basis of therapeutics*, 13th 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 forensic toxicology practice.

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

- Alcohol in all parts of 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*, 5th edition. C. V. Mosby, Co., St. Louis, MO.

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

Karch, S.B. (ed.) (2006) *Drug abuse handbook*, 2nd 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*, 5th 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.) (2018) *Casarett & Doull's toxicology: the basic science of poisons*, 9th 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*, 5th edition. AACC Press, Washington, DC.

- Comprehensive overview of all aspects of 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*, 4th 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, legal aspects, and other topics are discussed.

Rifai, N. (2022) *Tietz Textbook of Laboratory Medicine*, 7th 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 chromatography and mass spectrometry); and Section III analytes (chapter 41 clinical toxicology).

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

- Analytical and application guide to 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*, 2nd 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.

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 – Fellow Examination

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. What enzyme is responsible for the detoxification of cyanide?

* A. rhodanese
B. creatine kinase
C. acid phosphatase
D. alkaline phosphatase
E. cyano chelatase

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. You have been hired to review a toxicology report in which an employee has been accused of urinating into the water bottle of a 2nd employee. Which of the following suggest the presence of urine?

A. Calcium perchlorate
* B. Creatinine
C. Chloride
D. Chlorate
E. Chloroform

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