The Chemical Examination of Urine

Part 1 Overview of Procedures & pH
1. Evaluate each of the following constituents that may appear in urine to determine: appropriate level in urine, significance of increased levels, their origin, and the methodology of routine and confirmatory testing:

   - glucose
   - ketones
   - bilirubin
   - blood &/or RBCs
   - leukocyte esterase
   - galactose
   - protein
   - urobilinogen
   - myoglobin
   - nitrite

2. Describe and demonstrate the proper technique for performing urine reagent dipstick testing.
3. Examine sources of error in the handling and use of urine reagent dipsticks and identify means to prevent, reduce or eliminate those errors.
4. Identify the effect(s) of the passage of time has on the urine sample: and on the UA chemical and microscopic results.
5. Identify the major reactive components and/or the reaction principle(s) of the dipstick chemistries and back-up procedures.
6. State normal pH values for blood and freshly collected urine.
7. List the six (6) factors that cause fluctuation in urine pH and describe how each causes the fluctuation.
8. Evaluate four (4) methods that can be used to measure urine pH to determine which is best for routine use.
9. Identify the indicators used in dipstick methods to determine urine pH of normal urine.

Part 2 Carbohydrates
10. Describe the storage form of glucose found in the liver and muscle.
11. Define the following terms:
    - glycogenes (gluconeogenesis)
    - glycogenolysis
    - glycosuria
12. Review the pathway of glucose as it is filtered and reabsorbed in the nephron in normal and abnormal concentrations.
13. Describe the concept known as “renal threshold.”
14. Explain the service insulin performs in the metabolism of glucose.
15. List three (3) groups of persons who should be screened for diabetes.
16. Differentiate diabetes mellitus and diabetes insipidus as to hormone deficiency, urine volume, and urine specific gravity.
17. List three (3) reasons for increased urine glucose other than diabetes mellitus.
18. Define "reducing substances" and explain how they can affect certain glucose testing methods.
19. From a listing of commonly encountered dietary sugars, identify and group those which are reducing substances/sugars, those which are not reducing substances, and which can be found in the urine.
20. Identify the most important non-glucose sugar to be found in the urine and explain its significance.
21. List two (2) non-sugar reducing substances.
22. Evaluate the Clinitest procedure to identify the major reactive components, the basic chemical reaction and precautions to follow.
23. Describe "pass-through" phenomenon including how it is identified and prevented.
24. Compare and contrast Clinitest and enzyme dipstick method of glucose detection as to sensitivity and specificity.
25. Briefly describe false positive and false negative Clinitest and enzyme dipstick methods.
Part 3 Ketones
26. Discuss "ketone bodies" to include: their formation and route(s) of elimination, the three (3) chemical types, why they would be produced in excess, and what physiological effect(s) they have on the body and urine produced.
27. Describe the major reactive component used in most tests for ketones.
28. Identify and explain the purposes of the component reagents of the Acetest tablets.
29. Provide two (2) reasons each for false negative and false positive results in ketone tests.
30. Compare and contrast Rothera’s test, Acetest, dipstick method, Gerhardt’s test, and Hart’s test for ketone detection.
31. Define the following terms including relationship to the effects on the body:
   - ketonuria
   - ketonemia
   - ketosis
   - acidosis & ketoacidosis

Part 4 Protein
32. Identify which protein fraction(s) would be most likely to slip into the urine.
33. Define "proteinuria" including: reasons it can occur, importance of detecting persistent proteinuria, and five (5) conditions associated with proteinuria.
34. Define "orthostatic proteinuria" in terms of when it is seen and when it is not seen in urine.
35. Describe how urine protein testing is used to detect and predict problems in pregnant women.
37. Analyze Bence-Jones protein including the condition with which it is associated, how it is detected and confirmed and six (6) characteristics associated with it.
38. Evaluate the precipitation and coagulation protein back-up tests including the reactive components, what protein groups are detected, performance and interpretation of the tests, and three (3) possible sources of error.
39. Summarize the principle behind the dipstick reaction for urinary protein.
40. Evaluate four (4) sources of error that may affect dipstick method for urinary protein including possible ways to prevent them.
41. Identify two (2) quantitative methods of urine protein concentration including the classical/reference method of Kjeldahl.

Part 5 Bilirubin & Urobilinogen
42. Briefly describe the formation of bilirubin, including its site, and the metabolism of bile pigments including urobilinogen and stercobilinogen.
43. Compare and contrast the characteristics of indirect and direct bilirubin.
44. Define the following terms: jaundice, steatorrhea and urobilin.
45. State alternative names used to describe indirect and direct bilirubin.
46. Produce a brief clinical picture for each of the three (3) types of jaundice.
47. List and briefly describe the test methods for urine bilirubin by the dipstick and the Ictotest methods.
48. Identify the major reactive component of Ehrlich’s reagent.
49. Describe the proper collection of urine to test for urobilinogen.
50. Describe the purpose and reagents used in the Watson-Schwartz test.

Part 6 Blood, Nitrite, Leukocyte Esterase, Specific Gravity by dipstick, & Ascorbic Acid
51. Define or differentiate the terms: hemoglobinuria, hematuria and hemosiderin; including possible causes.
52. List two (2) exogenous and two (2) endogenous causes for hemoglobinuria.
53. Briefly identify the purpose of the Prussian blue reaction.
54. Identify the principle of the 'blood' portion of the urine dipstick and the substances that will cause a positive reaction.
55. Briefly compare and contrast RBCs, hemoglobin and myoglobin as to their origin in urine and laboratory detection.
56. List and briefly describe three (3) methods each to test for hemoglobin and myoglobin.
57. Discuss urinary nitrate including: the dipstick principle and reaction, the significance of a positive test, why a negative test does not rule out urinary tract infection (UTI) and how the test is reported.
58. Discuss urinary leukocyte esterase test including: the principle of the test, the significance of positive reaction and correlation of the results with the urine microscopic.
59. Describe how specific gravity is determined on the urine dipstick.
60. Explain the usefulness of testing for the presence of ascorbic acid in urine and what a positive result could mean.

Part 7 Automated UA, Kidney Function tests, Renal Calculi & Overview of Renal Disorders

61. State the principle, advantages and limitations of urinalysis instruments.
62. State the principles of operation of automated urinalysis instruments, specifically reflectance photometry and automated microscopy.
63. Describe the methods used by the Sysmex UF-100, and the Yellow IRIS™ automated UA systems.
64. Describe the formation, composition and analysis of renal calculi and patient treatment options.
65. Compare and contrast upper and lower urinary tract infections based on causes, severity of illness, and expected urinalysis results.
66. Describe the physiology, symptoms and urinalysis results for patients with diabetes mellitus, diabetes insipidus, hepatitis, urinary tract infections, glucosuria, and porphyrin disorders.
67. Describe the significant clinical symptoms, etiology and characteristic urinalysis findings for urinary tract diseases covered within the lecture guide.
68. Analyze patient urinalysis with or without other laboratory data and correlate results with suspected diagnosis.
69. Identify renal function tests used to evaluate glomerular filtration, tubular re-absorption and secretion functions, and renal blood flow.
70. Describe how glomerular filtration rate tests are used to evaluate the health of the kidneys - using the creatinine clearance test as a model and including its reference range.