STUDY GUIDE

LABORATORY

ADVANCED

SUBCLASS J

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF INTEGRATED SCIENCE SERVICES
P. O. BOX 7921
MADISON, WI 53707

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PREFACE

This operator's study guide represents the results of an Ambitious program. Operators of wastewater facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subgrade.

The objectives in this study guide have been organized into modules, and within each module they are grouped by major concepts.

HOW TO USE THESE OBJECTIVES WITH REFERENCES

In preparation for the exams, you should:

1. Read all the objectives that apply to the grade level desired and write down the answers to the objectives that readily come to mind.

2. Use the references at the end of the study guide to look-up answers you don't know. This one set of references covers all of the objectives.

3. Write down the answers found in the references to those objectives you could not answer from memory.

4. Review all answered objectives until you can answer each from memory.

IT IS ADVISABLE THAT YOU ATTEND SOME FORM OF FORMAL TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.

Choosing A Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates can be found in the annual DNR " Certified Operator," or by contacting your DNR District operator certification coordinator.

ADVANCED ON-SITE LABORATORY TESTING

MODULE A: LABORATORY EQUIPMENT AND OPERATION

CONCEPT: LABORATORY EQUIPMENT

1. Explain why and how laboratory thermometers are calibrated.

2. Describe the spectrophotometer and it's operating procedure.

3. Explain how to accurately check the calibration on an analytical balance.

CONCEPT: OPERATION

4. Discuss the tests in which spectrophotometers are commonly used.

5. Discuss what effect a low or high oven temperature will have on the sample results.

MODULE B: CHEMICALS AND LABORATORY WATER ANALYSIS

CONCEPT: CHEMICALS

6. Calculate how much water and how much chemical should be used to obtain a specific normality when using a dry chemical reagent.

7. Calculate the volume of a 1.0N solution needed to make 1 liter of a 0.025N solution.

8. Explain the procedure to standardize sodium thiosulfate (thio).

CONCEPT: LABORATORY WATER ANALYSIS

9. List the quality control tests to be conducted on laboratory water.

10. Describe how to run a potassium permanganate ($KMnO_4$) test and interpret the results.

11. Identify the laboratory tests affected if the following problems occur with the laboratory distilled water:

A. High Copper or Chrome levels.
B. Dissolved Biodegradable Solids.
C. Excess Conductivity.

12. List the sources of oxygen demand in dilution water.

13. Explain resistivity and conductivity as they relate to the grades of laboratory water.

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MODULE C: TROUBLESHOOTING AND SAMPLING

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CONCEPT: TROUBLESHOOTING

14. Explain what can happen if a sample, plus dilution water, is significantly colder than 20°C. before being placed in the incubator.

15. Discuss the effect on the results of a BOD analysis if the incubator temperature was changed to 22°C during the analysis.

16. Outline a troubleshooting procedure to determine the cause of an apparent blank depletion.

17. List the possible causes of INCREASED dissolved oxygen in a dilution water blank.

18. Describe how a partially nitrified sample may affect the BOD analysis results.

CONCEPT: SAMPLING

19. Define how each of the following are measured:

A. Total Kjeldahl Nitrogen.
B. Ammonia Nitrogen.
C. Nitrate Plus Nitrite Nitrogen.

20. Explain how to make serial dilutions of a sample.

21. Explain the items to consider in preparing a portable sampler for collection system monitoring.

22. Explain why the filter-plus-sample should be dried to a constant weight.

23. Explain how the following sampling errors might alter laboratory results:

A. Poor Sampling Location.
B. Improper Use of Grab Vs. Composite Sampling.
C. Sampling Equipment Not Properly Cleaned.
D. Composite Sampler Not Cold Enough For Storage.
E. Improper or Lack of Chemical Preservation.
F. Composite Sampler Not Set Properly.

24. Given data, calculate the concentration of spike added to a sample.

25. Given a spiked sample analysis, calculate its percent recovery.

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MODULE D: LABORATORY ANALYSIS

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CONCEPT: pH ANALYSIS

26. Describe how to inspect, predict useful life, and store a Ph electrode.

27. Explain why the fill hole on a reference electrode should be open when testing for pH, and closed when the probe is not in use.

28. Discuss the advantages and disadvantages of a gel-filled pH electrode.

29. Identify the possible causes and corrective actions for the following pH meter problems:

A. The Instrument Does Not Give A Reading.
B. The Two-Point Calibration Differs By More Than .1 pH Unit.
C. There Is A Slow Response Time.
D. The Needle Will Not Stabilize.
E. The Reference Junction Is Plugged.
F. There Is A Crystal Formation Inside The Probe.

30. Describe the function of a shorting strap on a pH meter.

CONCEPT: DISSOLVED OXYGEN (D.O) ANALYSIS

31. Identify the possible causes and corrective actions for the following Dissolved Oxygen (D.O.) meter problems:

A. The Meter Will Not Redline.
B. The Meter Is Slow To Reach Endpoint.
C. There Is A Darkened Gold Electrode.
D. There Is A Darkened Silver Electrode.

32. Describe the Winkler Dissolved Oxygen procedure.

33. Identify the reasonable limits of accuracy and precision for a properly operating Winkler titration.

CONCEPT: BIOCHEMICAL OXYGEN DEMAND (BOD) ANALYSIS

34. Outline the acceptable seeding procedures for a BOD reference sample.

35. Explain where seed for the BOD analysis should be collected, and how it should be handled.

36. Given data, calculate BOD of a seeded sample.

37. Discuss the process used to dechlorinate the final effluent for a BOD test.

38. Discuss how to select appropriate dilutions based on approximate BOD values.

39. Given bench sheet data, determine which aliquot's values should be accepted and which should be averaged if more than one value is acceptable.

40. Describe how to determine if there is a potential problem with sample toxicity during a BOD analysis.

41. Discuss a procedure to identify the cause of the following problems in the BOD test:

A. Toxic Dilution Water.
B. Organic Contaminants In Dilution Water.

CONCEPT: SOLIDS ANALYSIS (TOTAL AND SUSPENDED)

42. List the purposes of running a blank filter through the suspended solids analysis procedure along with the samples.

43. Explain why it is recommended to heat a total solids sample on a steam bath until it appears dry before putting it in a drying oven.

44. Discuss the procedure for total and volatile solids, determination for sludge, and give an examples where its use would be appropriate.

CONCEPT: LABORATORY QUALITY ASSURANCE(QA)

45. Define the following as they relate to laboratory quality assurance:

A. Precision.
B. Accuracy.
C. Quality Control Analysis.
D. Blind Standards.
E. Reference Standards.
F. Spiked Samples.
G. Range.
H. Significant Figures.
I. Outlier.

46. Describe the techniques laboratory analysts use to determine accuracy and precision of data.

47. List the elements of a Quality Assurance program.

48. Explain how an acceptable performance for a reference sample is determined, and discuss actions to be taken if a plant fails a reference sample test.

49. Look at a series of sample control charts and be able to state:

A. Which results are in control.
B. What actions or remedial steps are required of the operator in problem situations.

CONCEPT: LABORATORY QUALITY CONTROL(QC)

50. Describe how to find the average range, set a warning limit, and a control limit for quality control.

51. Explain how to calculate the following:

A. Spike Added Concentration.
B. Percent Recovery.
C. Standard Deviation of a Recovery.
D. Control and Warning Limits for QC.

52. Explain which results should be excluded from a data base when computing control limits.

53. Explain why re-evaluation of control chart limits may be necessary more or less often than once every six months as suggested in the EPA Quality Control manual.

RESOURCES

1. **A USER'S GUIDE TO LABORATORY SERVICES**. (1989). Arneson, Ronald. Wisconsin Department of Natural Resources, Office of Technical Services, P.O. Box 7921, Madison , WI 53707.

2. **CONTROLLING WASTEWATER TREATMENT PROCESSES**. (1984). Cortinovis, Dan. Ridgeline Press, 1136 Orchard Road, Lafayette, CA 94549.

3. **HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION OF WATER AND WASTEWATER**. EPA-600/4-82-029 (1982). U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

4. **LABORATORY SAFETY MANUAL**. Mallinckrodt Chemical Works, Science Products Division, St.Louis, MO 63160.

5. **OPERATION OF MUNICIPAL WASTEWATER TREATMENT PLANTS**. Manual of Practice No.11(MOP 11), 2nd Addition (1990), Volumes I,II,andIII. Water Environment Federation (Old WPCF), 601 Wythe Street, Alexandria, VA 22314-1994. Phone (800) 666-0206.

6. **OPERATION OF WASTEWATER TREATMENT PLANTS**. 3rd Edition (1990), Volumes 1 and 2, Kenneth D. Kerri, California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.

7. **OPERATION OF WASTEWATER TREATMENT PLANTS**. Manual of Practice No.11 (MOP 11)(1976). Water Pollution Control Federation, 601 Wythe Street, Alexandria, VA 22314-1994. Phone (800) 666-0206. (Probably Out-Of-Print, See Reference Number 5).

8. **QUALITY ASSURANCE DOCUMENT FOR A SMALL WASTEWATER LAB**. 2nd Edition (1992). Department of Natural Resources, Office of Technical Services, P.O. Box 7921, Madison, WI 53707.

9. **SIMPLIFIED LABORATORY PROCEDURES FOR WASTEWATER EXAMINATION**. (1985). Water Environment Federation (Old WPCF), 601 Wythe Street, Alexandria, VA 22314-1994, Phone (800) 666-0206.

10. **STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER**. 17th Edition (1989), 18th Edition (1992). Joint Publication of: American Public Health Association; American Water Works Association; and, Water Environment Federation (Old WPCF). Publication Office: American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.

11. **WISCONSIN ADMINISTRATIVE CODE, NR 149, LABORATORY CERTIFICATION AND REGISTRATION**. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison, WI 53707.

12. **WISCONSIN ADMINISTRATIVE CODE, NR 218, METHOD AND MANNER OFSAMPLING**. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison, WI 53707.

13. **WISCONSIN ADMINISTRATIVE CODE, NR 219, ANALYTICAL TEST METHODS AND PROCEDURES**. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison, WI 53707.