Department of Environment & Conservation

OPERATOR EXAMS

Jenny Dodd

3/6/2024

Why having good exams matters

- First and foremost, the operator is protecting public health
- Secondly, the operator is protecting the environment
- They have to be ready to deal with emergency situations
- They need to have the ability to problem solve
- New EPA requirements (lead and copper, PFAS, microplastics, etc.)
- Large numbers of operators expected to retire – need new operators in the pipeline
- Have to meet EPA requirements

It's important because these jobs are important

Background

- Once upon a time, Tennessee had state specific exams, which became compromised
- Moved to customized ABC exams
- Pass rates dropped at first
- The Operator Board contemplated moving to the ABC standardized exams
- A few years ago, the Operator Board agreed to develop new state exams
  - Have to meet EPA requirements, including analysis by a psychometrician
  - Could not go back to compromised previous exam
  - MTSU was awarded the contract

MTSU exam development

- Over 3 years of work
- MTSU did not have water and wastewater experts
- Struggled to meet deadlines
- Fleming struggled to get enough operators to help with exam development
- Pilot tested all certification – 0.9% pass rate

WPI standardized exams

- ABC = WPI (Water Professional International)
- WPI standardized exam questions less confusing than customized exam
- Trick questions are not the intent

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JOB ANALYSIS – INDUSTRY SURVEYS

- Web-Based Surveys
  - Nearly 20,000 operators completed these job analysis surveys
  - Analyses were conducted based on geographic location as well as years of experience
    - 54 US states and territories
    - 11 Canadian provinces & territories
  - Results determined the content of the following examinations
    - Wastewater Collection Operator, Classes 1-4
    - Wastewater Treatment Operator, Classes 1-4
    - Water Treatment Operator, Classes 1-4
    - Water Distribution Operator, Classes 1-4

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NTK - EXAM CONTENT OUTLINE

Exam Content Outline

Number of Items	Content Area	Job Task Complexity Levels
33	Treatment Process	5 19 9
13	Laboratory Analysis	3 7 3
21	Equipment Operation & Maintenance	4 11 6
9	Source Water Characteristics	2 5 2
24	Security, Safety, Compliance, and Administrative Procedures	6 9 9
100*	Total	20 51 29

This exam includes 15 calculation items

*Your exam may contain up to 10 extra unscored pre-test questions (see *Before You Dive In* for more details).

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RECALL

Although the required contact time for chlorine to kill bacteria may vary depending on certain water characteristics, the typical industry standard is

A. 15 minutes.
B. 30 minutes.
C. 45 minutes.
D. 60 minutes.

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APPLICATION

In the activated sludge process, some of the activated sludge MUST be wasted to

A. increase digester gas production
B. prevent excessive solids build-up.
C. prevent clogging of the sludge return line.
D. prevent overloading of sludge return pumps.

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ANALYSIS

A single-phase 50 KVA transformer, having a primary voltage of 480 volts and a secondary voltage of 115\230 volts, is supplied on the primary side through a circuit protected at the distribution panel by a 250 amperes circuit breaker. Which of the following is the minimum additional overcurrent protection needed by the transformer?

A. a 125 amperes circuit breaker at the secondary of the transformer

B. a 225 amperes circuit breaker at the secondary of the transformer

C. a 225 amperes circuit breaker located in the distribution panel

D. a 250 amperes circuit breaker at the secondary and a 125 amperes circuit breaker at the primary of the transformer

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NEED-TO-KNOW / INTRODUCTION

Water Treatment Operator Class IV *Need-to-Know Criteria*

Exam Content

The Water Treatment Operator Class IV exam will test you on essential job tasks. These job tasks have been categorized into the Content Areas detailed in the following pages. The table below summarizes the Content Areas that are included on the exam, the number of test questions in each of these Areas, and the complexity of the test questions in each Area.

Just as water treatment operator job duties vary in their complexity, so will the questions you are asked on the exam. Some will be more simple and routine, whereas others will be more complex, or cognitively demanding. The following three levels are used to describe the complexity of the questions you will encounter on this exam:

Recall – tasks at this level typically require the simple recall or recognition of specific facts, concepts, processes, or procedures, with little to no problem-solving involved. You may be asked to identify, illustrate, recall, and/or recognize specific information.

Application – tasks at this level will involve some basic problem solving, calculations, or the interpretation and application of data. You may be asked to calculate, categorize, classify, compare, differentiate, explain, specify, translate, and/or apply knowledge.

Analysis – tasks at this level may involve higher level problem solving, evaluation, or the fitting together of a variety of elements into a meaningful whole; they will usually require many steps in the thought process. You may be asked to analyze, evaluate, formulate, generalize, judge, predict, and/or use inductive or deductive reasoning to arrive at a solution.

Exam Content Outline

Number of Items	Content Area	Job Task Complexity Levels
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This exam includes up to 15 calculation items

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NTK / SUPPORTING KNOWLEDGE

Supporting Knowledge

The chart below outlines several types of knowledge that support the performance of the job tasks on which you may be tested. These types of knowledge are rated at one of three levels to represent the extent of knowledge needed to perform the job tasks assigned to each Content Area:

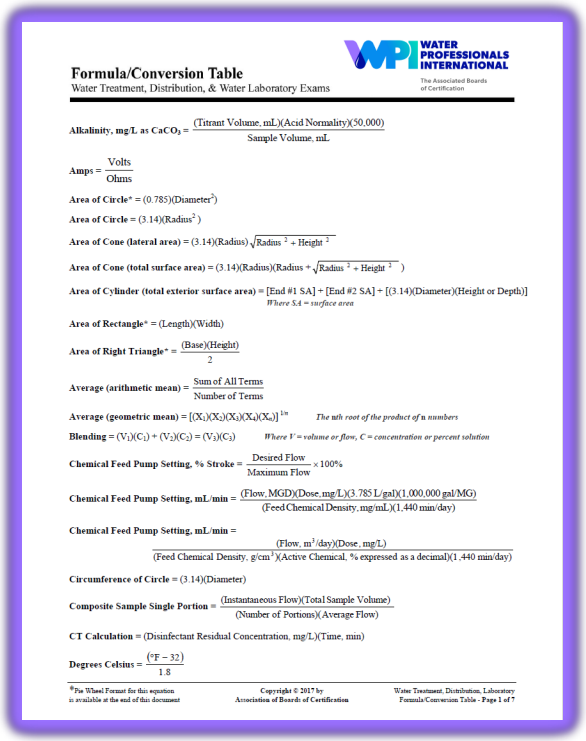
Basic – A fundamental or lower level of knowledge is required. Operators performing tasks requiring this level of knowledge will be able to do so with some training; this level of knowledge may also be acquired and developed through job experience. Such tasks may be routine, utilizing established procedures, and have a low level of complexity. Not having this level of knowledge will have minimal impact or significance on the performance of the tasks listed in the Content Area, or on public safety and welfare.

Intermediate – A level of knowledge beyond the basic level is required. Operators performing tasks requiring this level of knowledge will be able to do so with training beyond that of the basic level. The operator will not only be able to apply required fundamental concepts, but will be able to understand and discuss the application and implications of changes to processes, policies, and procedures within the Content Area. Not having this level knowledge will have a significant impact on the performance of the job and on public safety and welfare.

Advanced – A very high level of knowledge/job expertise is required and the operator will be functioning at an expert level. The operator can apply all fundamental, as well as highly developed or complex concepts, and will be able to design, review, and evaluate processes, policies, and procedures within the Content Area. Not having this level knowledge will have a serious impact on the performance of the job and will be very harmful to public safety and welfare.

Supporting Knowledge Type	Treatment Process (33)	Laboratory Analysis (13)	Equipment Operation & Maintenance (21)	Source Water Characteristics (9)	Security, Safety, Compliance, & Administrative Procedures (24)
Arithmetic (e.g., measurements and calculations)	Advanced	Advanced	Advanced	Advanced	Advanced
Biology (e.g., pathogenic organisms)	Advanced	Advanced		Advanced	
Chemistry (e.g., water chemistry)	Advanced	Advanced		Advanced	
Chemical dosing (coagulants, oxidants, disinfectants, acids and bases)	Advanced				
Chemical feed equipment (e.g., liquid, solid, gases)			Advanced		
Chemical properties (e.g., reactivity, compatibility, pH)	Advanced	Advanced	Intermediate		
Contaminants (e.g., organic, inorganic)	Advanced	Advanced		Advanced	
Disciplinary procedures					Intermediate
General electrical principles (e.g., troubleshooting breakers, relays, circuits)			Intermediate		
Internal combustion engines			Intermediate		
Laboratory equipment (e.g., glassware)		Advanced			
Laboratory instrumentation (e.g., operation and calibration)		Advanced			

FORMULA/CONVERSION TABLES



Formula/Conversion Table
Water Treatment, Distribution, & Water Laboratory Exams

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Alkalinity, mg/L as $CaCO_3$ = $\frac{(\text{Titrant Volume, mL})(\text{Acid Normality})(50{,}000)}{\text{Sample Volume, mL}}$

Amps = $\frac{\text{Volts}}{\text{Ohms}}$

Area of Circle* = (0.785)(Diameter^2)

Area of Circle = (3.14)(Radius^2)

Area of Cone (lateral area) = (3.14)(Radius)$\sqrt{\text{Radius}^2 + \text{Height}^2}$

Area of Cone (total surface area) = (3.14)(Radius)(Radius + $\sqrt{\text{Radius}^2 + \text{Height}^2}$)

Area of Cylinder (total exterior surface area) = [End #1 SA] + [End #2 SA] + [(3.14)(Diameter)(Height or Depth)]
Where SA = surface area

Area of Rectangle* = (Length)(Width)

Area of Right Triangle* = $\frac{(\text{Base})(\text{Height})}{2}$

Average (arithmetic mean) = $\frac{\text{Sum of All Terms}}{\text{Number of Terms}}$

Average (geometric mean) = $[(X_1)(X_2)(X_3)(X_4)(X_n)]^{\frac{1}{n}}$ *The nth root of the product of n numbers*

Blending = $(V_1)(C_1) + (V_2)(C_2) = (V_3)(C_3)$ *Where V = volume or flow, C = concentration or percent solution*

Chemical Feed Pump Setting, % Stroke = $\frac{\text{Desired Flow}}{\text{Maximum Flow}} \times 100\%$

Chemical Feed Pump Setting, mL/min = $\frac{(\text{Flow, MGD})(\text{Dose, mg/L})(3.785\ \text{L/gal})(1{,}000{,}000\ \text{gal/MG})}{(\text{Feed Chemical Density, mg/mL})(1{,}440\ \text{min/day})}$

Chemical Feed Pump Setting, mL/min =
$\frac{(\text{Flow, m}^3\text{/day})(\text{Dose, mg/L})}{(\text{Feed Chemical Density, g/cm}^3)(\text{Active Chemical, \% expressed as a decimal})(1{,}440\ \text{min/day})}$

Circumference of Circle = (3.14)(Diameter)

Composite Sample Single Portion = $\frac{(\text{Instantaneous Flow})(\text{Total Sample Volume})}{(\text{Number of Portions})(\text{Average Flow})}$

CT Calculation = (Disinfectant Residual Concentration, mg/L)(Time, min)

Degrees Celsius = $\frac{(°\text{F} - 32)}{1.8}$

*Pie Wheel Format for this equation is available at the end of this document

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Water Treatment, Distribution, Laboratory Formula/Conversion Table - Page 1 of 7

- Merged US & Metric
- Reviewed feedback
- Checked for relevancy to NTK
- Cross-referenced tables

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CALCULATION FORMAT

If a water reservoir 12 ft (4m) in diameter has a static water level of 21 ft (7m) what is the pressure on the bottom of the tank?

A. 6 psi (46 kPa)
B. 9 psi (69 kPa)
C. 12 psi (92 kPa)
D. 21 psi (161 kPa)

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REFERENCE MATERIAL

Approved reference sources for WPI's standardized exams:

- American Water Works Association
- Water Environment Federation
- California State University, Sacramento Foundation, Office of Water Programs
- Association of State Drinking Water Administrators
- National Rural Water Association
- Occupational Safety and Health Administration
- American Public Health Association
- United States Environmental Protection Agency
- The Water Research Foundation
- Foundation for Cross-Connection Control and Hydraulic Research

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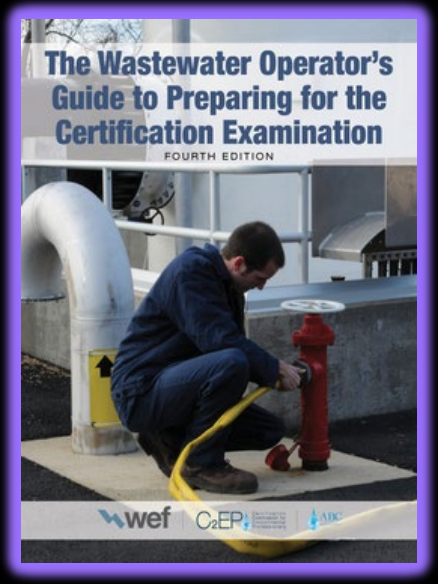

STUDY MATERIALS

WPI works with AWWA and WEF to develop guides to help operators prepare for taking a certification exam. These guides are available for purchase.

Water Treatment and Distribution Operators

- ✓ **Purchase from: American Water Works Association Bookstore (800) 926-7337**

Wastewater Treatment, Collection, and Wastewater Lab

- ✓ **Purchase from: Water Environment Federation Bookstore (800) 666-0206**
- ✓ **Wastewater and Laboratory practice questions developed by WEF are available in the Skills Builder section of WEF's website.**

Very Small Water Systems Operators

- ✓ **Available for download at www.gowpi.org**

Biosolids Land Applier Operators

- ✓ **Purchase from: Water Environment Federation Bookstore (800) 666-0206**

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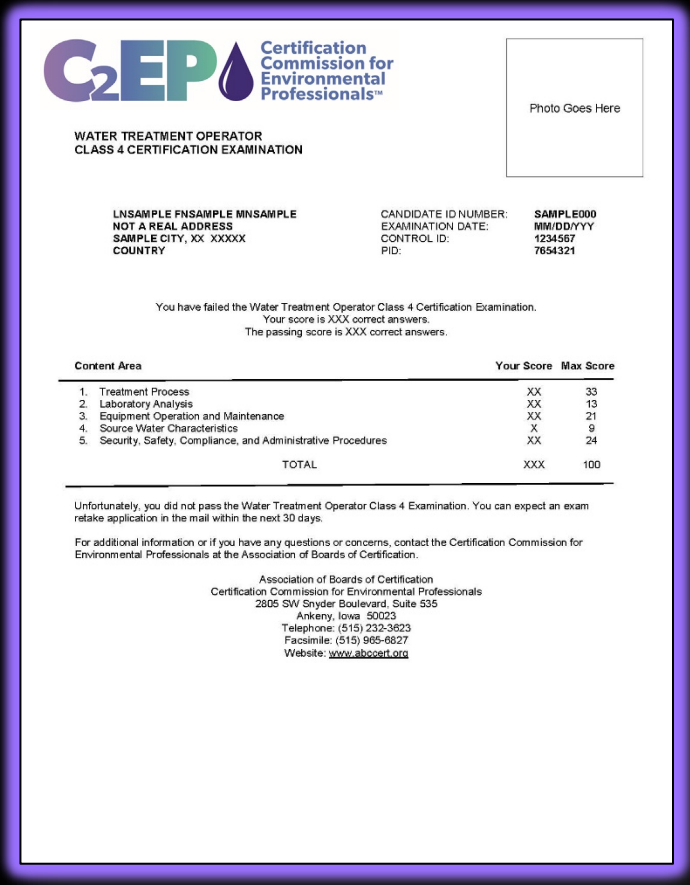
INDIVIDUAL SCORE REPORT



C2EP Certification Commission for Environmental Professionals™

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WATER TREATMENT OPERATOR
CLASS 4 CERTIFICATION EXAMINATION

LNSAMPLE FNSAMPLE MNSAMPLE
NOT A REAL ADDRESS
SAMPLE CITY, XX XXXXX
COUNTRY

CANDIDATE ID NUMBER: SAMPLE000
EXAMINATION DATE: MM/DD/YYY
CONTROL ID: 1234567
PID: 7654321

You have failed the Water Treatment Operator Class 4 Certification Examination.
Your score is XXX correct answers.
The passing score is XXX correct answers.

Content Area	Your Score	Max Score
1. Treatment Process	XX	33
2. Laboratory Analysis	XX	13
3. Equipment Operation and Maintenance	XX	21
4. Source Water Characteristics	X	9
5. Security, Safety, Compliance, and Administrative Procedures	XX	24
TOTAL	XXX	100

Unfortunately, you did not pass the Water Treatment Operator Class 4 Examination. You can expect an exam retake application in the mail within the next 30 days.

For additional information or if you have any questions or concerns, contact the Certification Commission for Environmental Professionals at the Association of Boards of Certification.

Association of Boards of Certification
Certification Commission for Environmental Professionals
2805 SW Snyder Boulevard, Suite 535
Ankeny, Iowa 50023
Telephone: (515) 232-3823
Facsimile: (515) 965-6827
Website: www.abccert.org

INDIVIDUAL SCORE REPORT

Content Area	Your Score	Max Score
1. Treatment Process	XX	33
2. Laboratory Analysis	XX	13
3. Equipment Operation and Maintenance	XX	21
4. Source Water Characteristics	X	9
5. Security, Safety, Compliance, and Administrative Procedures	XX	24
TOTAL	XXX	100

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Superior Water Starts Here™

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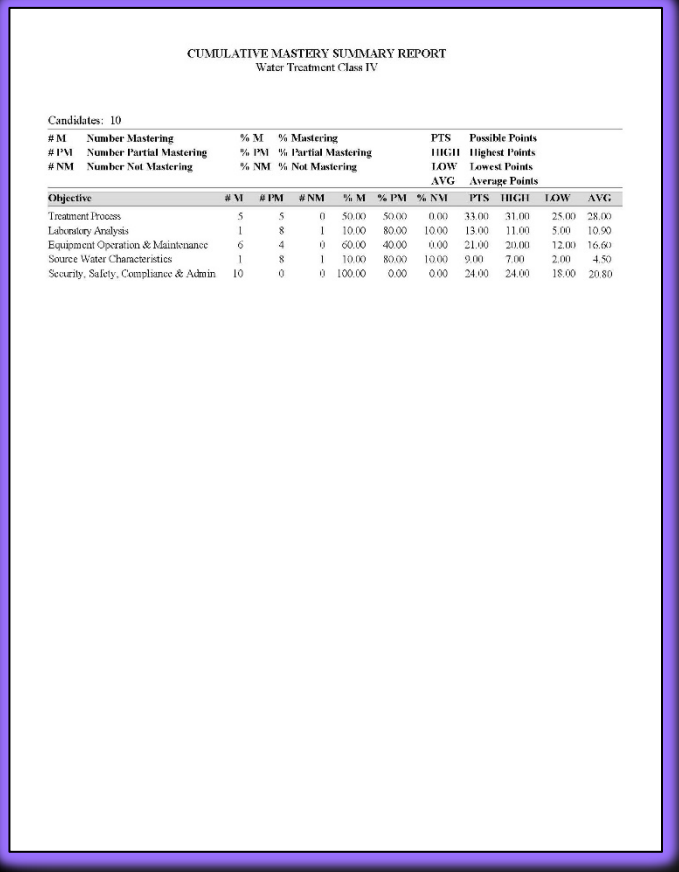
MASTERY SUMMARY REPORT



CUMULATIVE MASTERY SUMMARY REPORT
Water Treatment Class IV

Candidates: 10

# M	Number Mastering	% M	% Mastering	PTS	Possible Points
# PM	Number Partial Mastering	% PM	% Partial Mastering	HIGH	Highest Points
# NM	Number Not Mastering	% NM	% Not Mastering	LOW	Lowest Points
				AVG	Average Points

Objective	# M	# PM	# NM	% M	% PM	% NM	PTS	HIGH	LOW	AVG
Treatment Process	5	5	0	50.00	50.00	0.00	33.00	31.00	25.00	28.00
Laboratory Analysis	1	8	1	10.00	80.00	10.00	13.00	11.00	5.00	10.90
Equipment Operation & Maintenance	6	4	0	60.00	40.00	0.00	21.00	20.00	12.00	16.60
Source Water Characteristics	1	8	1	10.00	80.00	10.00	9.00	7.00	2.00	4.50
Security, Safety, Compliance & Admin	10	0	0	100.00	0.00	0.00	24.00	24.00	18.00	20.80

Other initiatives at Fleming

- Small group tutoring sessions – limited to 5 operators, 4 hours total
  - First tutoring group resulted in 4 out of the 5 passing the exam
- The biggest weaknesses on exams are process and lab questions
  - Changing lab classes – reduced class size to 10 and offering more classes
  - Lab classes now give everyone hands on practice (2 people per station max)
  - Lab classes now solely taught in the lab, no more lecture in classroom
  - Math and processes stressed in tutoring sessions
  - Looking at other ways to increase instruction on processes
- New equipment – roughly $1M (ability to test for PFAS and microplastics)
- Designing a basic science class for operators (focus on microbiology in the system)

Goal - Cultivating confident and competent operators

THANK YOU