

## WATER TREATMENT NEED TO KNOW GUIDE

### FORWARD

This guide was created to help trainers, supervisors and operators determine what topics to review while studying for operator certification exams. The guide breaks each exam into numerous topics and indicates the level of knowledge required for the exam.

In 2002-03 a committee of experienced operators and supervisors reviewed “Need-To-Know” and certification examinations. Based on this review, several revisions were made to both the “Need-to-Know” and the exams to reflect the changing operational needs of Ontario’s water and wastewater industry.

The following individuals were members of the Water Treatment Exam Review Committee:

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Brian Gildner – Ministry of the Environment  
Jamie Hennigar – Ontario Clean Water Agency  
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### ABOUT THE ASSOCIATION OF BOARDS OF CERTIFICATION

The Association of Boards of Certification (ABC) has been involved in developing water and wastewater operator certification programs, exams and support materials since 1966. ABC is a North American organization with members in 48 states and 9 provinces. Ontario became a full member of ABC in 1986 to support the introduction of the province’s voluntary certification program. ABC provides the province with testing services, support materials and expertise from across North America.

Ontario exams are developed with assistance from the ABC and are fully recognized by the ABC. For details on reciprocity of Ontario exams outside of the province, contact the authority responsible for certification in the province/state in which you are interested. Be sure to forward a copy of this “Need-To-Know”.

## INTRODUCTION

Before writing an exam, operators should be aware how each exam is developed. By understanding how the exams are made, it will be easier to study.

It is important to know that the exams are cumulative. This means that the knowledge required at a lower class is also required at higher classes. For example, a Class IV operator must know all Class IV topics as well as the Class I, II and III topics. Generally, questions on a Class IV exam will be more difficult than questions on the same topic on lower class exams.

Although the exams are cumulative, each exam will emphasize different topics. For example in the "Processes Module" of Water Treatment exams, Class I will emphasize disinfection systems; Class II will focus on filtration; Class III on coagulation-flocculation; and Class IV on full process/advanced treatment. Some questions dealing with processes normally found in higher Class Facilities will be included in lower Class exams. These questions will be asked at a very basic knowledge level. At the top level, a Class IV operator is expected to master all topics. Since each exam emphasizes different topics an operator is not allowed to 'skip' exam levels (i.e. go from a Class I to a Class IV without first going through Class II and III).

Developing fair exams for water operators is a challenge in a province containing relatively simple, small facilities along side large complex ones. Technologies which may be common in one size of facility may be absent in another. However, an operator who holds any Class of water treatment licence may operate in any water treatment system in the province. For this reason even at a Class I level operators will be expected to have a basic level of understanding or awareness in some of the common advanced processes or technologies (i.e. filtration). For this reason some of the questions on the exam may cover processes or technologies not used in the operator's facility. Although the question may not apply to your facility, it will be relevant for many other operators in the province.

The exams which are written in Ontario are similar to those in other provinces and states. Ontario uses the same format (multiple choice), same length (100 questions) and the same source of questions (the ABC question bank). By keeping the exams similar to the industry standard, the marks obtained by Ontario operators will be more readily accepted in other provinces and states.

## HOW TO USE THE “NEED- TO-KNOW”

The “Need-to-Know” is designed as an aid for operators and supervisors. It contains three sections to help users determine the topics and level of training required to meet the requirements of certification examinations. The three sections are:

- ❖ **“General Exam Modules”**, provides a broad overview of the exams (*page 3*).
- ❖ **“Detailed Topic Breakdown”**, provides a detailed breakdown of the topics covered on each exam. It also provides an indication of the level of knowledge required for each topic (*pages 6-9*).
- ❖ **“Task Analysis”**, provides a further definition of the tasks and knowledge required for each topic at each Class (*pages 14-22*).

Together these three sections will help guide the operator while studying. For more information on study materials and course offerings, refer to the booklet entitled **“Education & Certification Resource Guide for Water & Wastewater Utility Operators”**, available free from the Ministry of the Environment and Energy’s Certification Office.

Every exam is divided into 4 different modules. Each module is further divided into topics. Every question on the exam will fit into one of the topics. The 4 different modules are:

**General Module:** This module includes basic background knowledge and skills which are required by an operator to perform his/her duties. Some of the skills and knowledge may be obtained prior to becoming an operator, in school or at other work experiences. Others will be specific to the water/wastewater industry. This knowledge is applied on a routine basis by the operator to complete his/her job (i.e. arithmetic calculation of chemical feed rates).

**Support Systems Module:** This module includes the equipment/materials necessary to perform water/wastewater processes. Pumps, compressors and engines are some of the equipment covered. The module also includes conveyance (piping, fittings, valves joints etc.) and measuring and control systems. Operators will be expected to be familiar with the operation and troubleshooting aspects of this equipment. Detailed maintenance of the equipment is not covered in the exam.

**Processes Module:** This module focuses on the processes involved in water treatment. This module is the main focus for the exams, requiring the operator to demonstrate knowledge in the day to day operation of the processes at a facility. Included in this module are equipment specific to processes (i.e. chlorinators, filters etc.). Operators will be expected to know how to operate this equipment, its relationship to the overall treatment process and basic troubleshooting. Detailed maintenance of this equipment is beyond the scope of the exams.

## GENERAL EXAM MODULES

**Administrative Module:** This module covers administrative functions which support the on-going operation of a facility. Depending on the class of exam, operators will be expected to demonstrate basic knowledge and understanding of supervision, finance, communication, site security, information systems and emergency response procedures.

Below is a table indicating the percentage of questions in each of the modules:

<b>PERCENTAGE BREAKDOWN FOR EACH EXAM MODULE</b>				
	<b>CLASS I EXAM</b>	<b>CLASS II EXAM</b>	<b>CLASS III EXAM</b>	<b>CLASS IV EXAM</b>
<b>GENERAL MODULE</b>				
GENERAL MATH	10%	5%	0%	0%
SAFTEY	10%	5%	5%	3%
APPLIED SCIENCE	10%	10%	5%	5%
<b>SUPPORT SYSTEMS MODULE</b>				
PROCESS MODULE	45%	57%	61%	64%
<b>ADMINISTRATION MODULE</b>				
MANAGEMENT	1%	3%	7%	8%
ADMINISTRATION	6%	5%	7%	7%
<b>TOTAL:</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
<b>PERCENT QUESTIONS REQUIRING ARITHMETIC CALCULATIONS</b>				
CALCULATING	5 – 12%	5 – 12%	10 – 15%	10 – 16%
NON-CALCULATING	90 – 95%	90 – 95%	85 – 90%	85 – 90%

The above table also indicates the number of questions which will require arithmetic calculations. These questions will be scattered throughout the various modules. In Class I and II exams most of the questions will be in the General Module (General Math Section). In higher Classes the questions will be in the Support Systems Module (i.e. pump, chemical feeder questions), the Process Module (i.e. coagulation/flocculation, disinfection questions), or the Administration Module (i.e. finance questions). Generally the Class III and IV questions which require calculations are more difficult. These questions require problem solving abilities in addition to arithmetic skills.

## THE DETAILED TOPIC BREAKDOWN

The ***Detailed Topic Breakdown*** lists the skills, knowledge, equipment, processes, laboratory analysis, and administrative components of the operator's job. It is a table containing all of the examination topics. Each topic is also given a 'mastery rating'. This rating will give operators some indication of the level of difficulty for each topic. The mastery ratings are:

- Basic:*** Operators must understand the importance of the topic; and how it relates to the overall operation of the system. Basic terminology and concepts are covered.
- Intermediate:*** Operators must have working or functional knowledge /skill in the topic.
- Advanced:*** Operators must be able to evaluate the topic and fully understand the interaction of the topic with the overall operation of the system.

Intermediate levels include all *basic* levels. *Advanced* levels include all *intermediate* and *basic* levels.

Most of the topics in the ***Detailed Topic Breakdown*** have footnotes. On pages 10-12 the footnotes provide a more detailed description of the topic. Further detail is provided in the ***Task Analysis***.

## TASK ANALYSIS

The ***Task Analysis*** listings, which follows the ***Detailed Topic Breakdown***, lists the "performance objectives" for each topic. A performance objective are broken down into Basic, Intermediate and Advanced levels. These are the same levels of mastery which are listed in the ***Detailed Topic Breakdown***. The ***Task Analysis*** provides operators with greater detail on the learning objectives for each topic.

### Using the ***Detailed Topic Breakdown*** and the ***Task Analysis*** listings:

The objectives listed in the are used in combination with the topics in the ***Detailed Topic Breakdown***. These will help to define what an operator needs to know in each topic. The ***Detailed Topic Breakdown*** indicates the level of mastery of the exam topics. The ***Task Analysis*** state performance objectives for each topic by the difficulty level (Basic, Intermediate and Advanced).

To successfully complete an ABC examination, an operator must demonstrate knowledge of the ***Task Analysis*** performance objectives for each ***Detailed Topic Breakdown*** topic according to the rating assigned to the topic. Following is an example of how to use the ***Detailed Topic Breakdown*** and ***Task Analysis***.

An operator would like to know what information is required to pass the topic called Hydraulic Concepts on a Class I exam.

1. First the operator should look in the **Detailed Topic Breakdown** (the table starting on page 6) for the topic entitled “Hydraulic Concepts”.
2. For a Class II exam the rating assigned to Hydraulic is *Intermediate*.
3. The operator must know how to perform all *Intermediate* tasks for Hydraulic Concepts.
4. Next, the operator observes that a number<sup>6</sup> appears after the topic heading. This indicates that a more detailed description of the topic is given at the end of the **Detailed Topic Breakdown**. The operator turns to page 10 to read the description.
5. The operator now refers to the **Task Analysis** section.
6. In the left column of the General Module (page 13) it states that:  
 “A: The operator must complete the following performance objectives as indicated”:
7. Under Hydraulic Concepts (page 14-15) the *Intermediate* objectives are:
  - 6.3 Calculate pumping head, pressure head, static head
  - 6.4 Using hydraulic concepts and terms explain how a pump functions
8. The operator must also meet all of the objectives stated under the *Basic* level:
  - 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
  - 6.2 Explain the movement and properties of liquid under pressure.
9. The operator must be able to meet all of the stated objectives for the topic.

ONTARIO WATER TREATMENT EXAM DETAILED TOPIC BREAKDOWN						
GENERAL MODULE		Class I	Class II	Class III	Class IV	
100	General Math Section					
101		Basic & Applied Math <sup>1</sup>	Intermediate	Advanced	Advanced	Advanced
102		Units of Expression <sup>2</sup>	Advanced	Advanced	Advanced	Advanced
110	Applied Science Section					
111		Basic & Applied Science <sup>3</sup>	Basic	Intermediate	Advanced	Advanced
112		Public Health Principles <sup>4</sup>	Advanced	Advanced	Advanced	Advanced
113		Electrical Concepts <sup>5</sup>	Basic	Intermediate	Intermediate	Advanced
114		Hydraulic Concepts <sup>6</sup>	Basic	Intermediate	Intermediate	Advanced
115		Maps & Plans <sup>7</sup>	Basic	Intermediate	Intermediate	Advanced
120	Safety Section					
121		Safety Procedures <sup>8</sup>	Advanced	Advanced	Advanced	Advanced
122		Safety Equipment <sup>9</sup>	Advanced	Advanced	Advanced	Advanced

SUPPORT SYSTEMS MODULE		Class I	Class II	Class III	Class IV	
201	Electrical Controls <sup>10</sup> / Transformers		Basic	Intermediate	Advanced	Advanced
202	Battery Banks		Basic	Intermediate	Advanced	Advanced
203	Motors <sup>11</sup> / Drives <sup>12</sup>		Intermediate	Advanced	Advanced	Advanced
204	Pumps					
		Centrifugal	Intermediate	Advanced	Advanced	Advanced

		Positive Displacement <sup>13</sup>	Intermediate	Advanced	Advanced	Advanced
		Turbine	Intermediate	Advanced	Advanced	Advanced
		Metering	Advanced	Advanced	Advanced	Advanced
205	Blowers & Compressors <sup>14</sup>		Intermediate	Advanced	Advanced	Advanced
206	Generators <sup>15</sup>		Intermediate	Advanced	Advanced	Advanced
207	Engines <sup>16</sup>		Intermediate	Advanced	Advanced	Advanced
208	Pipes		Intermediate	Advanced	Advanced	Advanced
209	Joints <sup>17</sup>		Intermediate	Advanced	Advanced	Advanced
210	Valves <sup>18</sup>		Intermediate	Advanced	Advanced	Advanced
211	Fittings <sup>19</sup>		Intermediate	Advanced	Advanced	Advanced
212	Cathodic Protection Devices <sup>20</sup> / Corrosion Control <sup>21</sup>		Basic	Intermediate	Advanced	Advanced
213	Hydrants		Intermediate	Intermediate	Intermediate	Advanced
214	Measuring & Control Systems <sup>22</sup>		Basic	Intermediate	Advanced	Advanced
215	Chemical Feeders <sup>23</sup>		Basic	Intermediate	Advanced	Advanced
216	Cross-Connection & Backflow		Intermediate	Advanced	Advanced	Advanced
<b>PROCESSES MODULE</b>			<b>Class I</b>	<b>Class II</b>	<b>Class III</b>	<b>Class IV</b>
301	Sources & Characteristics <sup>24</sup>		Basic	Intermediate	Advanced	Advanced
302	Quality Control & Assurance <sup>25</sup>		Advanced	Advanced	Advanced	Advanced
303	Compliance <sup>26</sup>		Advanced	Advanced	Advanced	Advanced
304	Screening		Intermediate	Advanced	Advanced	Advanced
		Well Screens	Advanced	Advanced	Advanced	Advanced
		Intake Ports/Bar Screens	Basic	Intermediate	Advanced	Advanced
		Hand Cleaned Screens <sup>27</sup>	Basic	Intermediate	Advanced	Advanced
		Mechanically Cleaned Screens	Basic	Intermediate	Advanced	Advanced
305	Microscreens		Basic	Intermediate	Advanced	Advanced
306	Aeration <sup>28</sup>		Intermediate	Advanced	Advanced	Advanced
307	Coagulation & Flocculation <sup>29</sup>		Basic	Intermediate	Advanced	Advanced
308	Coagulant Aids		Basic	Intermediate	Advanced	Advanced
309	Clarification					
		Presedimentation	Basic	Intermediate	Advanced	Advanced
		Sedimentation Basins	Basic	Intermediate	Advanced	Advanced
		Upflow Solids Contractors	Basic	Intermediate	Advanced	Advanced
		Tube Settlers	Basic	Intermediate	Advanced	Advanced
310	Filtration					
		Rapid Sand	Basic	Advanced	Advanced	Advanced
		Mixed or Multimedia	Basic	Advanced	Advanced	Advanced
		Pressure	Basic	Advanced	Advanced	Advanced
		Diatomaceous Earth	Basic	Basic	Basic	Basic
		Granular Activated Sludge	Basic	Intermediate	Advanced	Advanced
		Slow Sand	Intermediate	Advanced	Advanced	Advanced
		Membrane Technology(s) <sup>30</sup>	Basic	Basic	Intermediate	Advanced
311	Disinfection					
		Gas Chlorinators	Intermediate	Advanced	Advanced	Advanced
		Ozonators	Basic	Intermediate	Advanced	Advanced
		Ammoniators	Basic	Intermediate	Advanced	Advanced
		Ultraviolet Units	Basic	Intermediate	Advanced	Advanced
		Chlorine Dioxide Feeders	Basic	Intermediate	Advanced	Advanced
		Hypochlorinators	Advanced	Advanced	Advanced	Advanced
		Iodination/Bromine		Basic	Basic	Basic

		Processors				
		Evaporators		Basic	Intermediate	Intermediate
312		Fluoridation	Intermediate	Advanced	Advanced	Advanced
313		Taste & Odour Control				
		Feeders	Basic	Intermediate	Advanced	Advanced
		Aerators/Oxidators	Intermediate	Advanced	Advanced	Advanced
		Contactors Beds	Basic	Intermediate	Advanced	Advanced
314		Storage				
		Ground Storage Tanks	Advanced	Advanced	Advanced	Advanced
		Elevated Tanks	Advanced	Advanced	Advanced	Advanced
		Standpipes	Advanced	Advanced	Advanced	Advanced
		Hydropneumatic Pressure Tanks	Basic	Intermediate	Intermediate	Intermediate
315		Chemical Precipitation Softening			Basic	Basic
316		Ion Exchange	Intermediate	Advanced	Advanced	Advanced
317		Iron & Manganese Removal <sup>31</sup>	Basic	Intermediate	Advanced	Advanced
318		Reverse Osmosis		Basic	Intermediate	Advanced
319		Demineralization		Basic	Intermediate	Intermediate
320		Dechlorination	Basic	Intermediate	Advanced	Advanced
321		Colour/Organic Removal	Basic	Intermediate	Advanced	Advanced
322		Recirculation <sup>32</sup>	Basic	Intermediate	Advanced	Advanced
323		Waste Treatment (Sludge Handling) <sup>33</sup>	Basic	Intermediate	Advanced	Advanced
326		Laboratory Plant Process Tests <sup>34</sup>				
		Alkalinity	Intermediate	Advanced	Advanced	Advanced
		Aluminum	Basic	Intermediate	Advanced	Advanced
		Chlorine	Advanced	Advanced	Advanced	Advanced
		Colour	Intermediate	Advanced	Advanced	Advanced
		Fluoride	Advanced	Advanced	Advanced	Advanced
		Iron	Basic	Intermediate	Advanced	Advanced
		Jar Test	Basic	Intermediate	Advanced	Advanced
		pH	Advanced	Advanced	Advanced	Advanced
		Temperature	Advanced	Advanced	Advanced	Advanced
		Total Hardness	Intermediate	Advanced	Advanced	Advanced
		Turbidity (NTU)	Advanced	Advanced	Advanced	Advanced
327		General Lab Tests <sup>35</sup>	Basic	Basic	Intermediate	Advanced
		<b>ADMINISTRATION MODULE</b>	<b>Class I</b>	<b>Class II</b>	<b>Class III</b>	<b>Class IV</b>
410		Management				
411		Planning <sup>36</sup>	Basic	Intermediate	Advanced	Advanced
412		Personnel <sup>37</sup>	Basic	Basic	Advanced	Advanced
413		Finances <sup>38</sup>	Basic	Intermediate	Advanced	Advanced
420		Administration				
421		Maintenance Management <sup>39</sup>	Basic	Intermediate	Advanced	Advanced
422		Information <sup>40</sup>	Basic	Intermediate	Advanced	Advanced
423		Emergency Response <sup>41</sup>	Basic	Intermediate	Advanced	Advanced
424		Public Relations <sup>42</sup>	Intermediate	Advanced	Advanced	Advanced
425		Security <sup>43</sup>	Intermediate	Advanced	Advanced	Advanced



In each exam, certain topics in the Processes Module are emphasized. In the table below the main topics for each class of exam are given. Only topics with at least 2 questions are included. The topics are listed in order of importance. For example on a Class 1 exam there are more questions on Disinfection than questions dealing with Laboratory knowledge. Likewise there are more questions on Storage than there are on Taste & Odour.

<b>PROCESSES MODULE – PRIORITY TOPICS</b>				
	<b>CLASS I</b>	<b>CLASS II</b>	<b>CLASS III</b>	<b>CLASS IV</b>
<b>Number of Questions</b> ↑ ↓	<b>Hi</b>	* Disinfection		*Coagulation & flocculation
				*Filtration
				* Coagulation & flocculation
			*Filtration	* Disinfection
		* Laboratory	*Disinfection	
			* Laboratory	* Laboratory
				* Compliance
				* Filtration
			* Clarification	* Compliance
			*Coagulation & flocculation	
		* Compliance		
			*Clarification	
			*Compliance	
		*Storage		* Waste treatment
		*Taste & odour		* Colour/organics
				* Advanced treatment
		* Source & characteristics	*Taste & odour	* Storage
			*Aeration	* Advanced treatment
			*Sources & characteristics	*Taste & odour
				*Sources & characteristics
		*QA/AC		
	*Fluoridation	*Storage		
<b>Low</b>	* Screening	*Screening		
		*Waste treatment		

## ENDNOTES: TOPIC DESCRIPTIONS

### General Module

The numbers below refer to the topics listed in the above table entitled “**Ontario Water Treatment Exam Detailed Topic Breakdown**” (pages 6-9). The below endnotes provide a greater description of the topic, by providing an indication of the equipment and processes involved.

1. **Basic and Applied Math** – Calculating volume, area, flow rates, feed rates, percentages, ratios, squares, cubes, roots, ability to calculate water/wastewater formulas.
2. **Units of Expression** – Imperial, metric, conversion between imperial and metric, common metric prefixes.
3. **Basic & Applied Science** – Chemistry (common water/wastewater chemicals, chemical reactions, basic chemistry terms: [pH and related concepts, oxidation/reduction, ionization, etc], mixtures and solutions) physical properties of liquids, solids and gases.
4. **Public Health Principles** – Microbiology (pathogens, nuisance organisms), microbiological testing (coliform testing), drinking water quality parameters, waterborne diseases.
5. **Electrical Concepts** – Electrical units (volt, amperes, ohms, watts), electrical circuits, electrical terminology.
6. **Hydraulic Concepts** – Rate of flow, pressure, head (static, friction, pressure), pump hydraulics (work, power, horsepower, efficiency).
7. **Maps and Plans** – Maps, blue prints, site diagrams, plans, equipment specifications.
8. **Safety Procedures** – Occupational Health and Safety Act, WHMIS, owner/operator responsibilities, construction safety, plant safety, electrical safety, infections and infectious diseases, hazardous gases, chemical handling, chemical labels, confined space entry, evacuation procedures.
9. **Safety Equipment** – Personal protection gear, traffic control/public safety (warning devices, barricades), hazard detection, first aid/hygiene, gas detection equipment.

### Support Systems Module

10. **Electrical Controls** – Electrical circuits, circuit testing, fuses, protective devices, circuit breakers, overload relays, motor starters.
11. **Motors** – Single Phase, Poly Phase, Variable Speed
12. **Drives** – Coupled, Direct (Shaft, Gear), Speed Reducer (Fixed, Variable), Right Angle
13. **Positive Displacement Pumps** – Piston Plunger, Progressive Cavity, Diaphragm
14. **Blowers & Compressors** – Centrifugal, Positive Displacement (Rotary, Piston)
15. **Generators** – AC, DC

**Processes  
Module**

16. **Engines** – Gasoline, Diesel, Gas
17. **Joints** – Flanged, Compression, Dresser, Victaulic, Fused, Threaded
18. **Valves** – Ball, Check, Globe, Gate, Plug Petcock, Pressure Control, Vacuum Relief, Aud, Butterfly, Multiport, Telescoping Sluice Gate, Air Release, Foot, Altitude
19. **Fittings** – Coupling Union, Plug/Caps, Special
20. **Cathodic Protection Devices** – Anode Rod/Bags, Cathode Rod/Bags, Rectifiers, Potentiometers
21. **Corrosion Control**- Feeders, reaction basins
22. **Measuring and Control** – Signal Generators (Kennison Nozzle, Magnetic Flowmeter, Parshall Flume, Proportional Weir, Rectangular Weir, Venturi, Propeller Meter, Ultrasonic, Pitot Tube), Signal Transmitters (Electric, Pneumatic, Hydraulic, Mechanical, Telemetry), Signal Receivers (Counters, Indicators, Log Scale Indicators, Totalizers, Recorders, Combination Recorders), Meters (Hydraulic-Rotameter, Electrical-Amp, Electrical-Watt [Watt Hour Meter], Electrical-Multitester [VOM], Electrical-Megger, Mechanical-RPM), Alarms, Controls (Pneumatic, Float, Hydraulic, Electrical, Telemetry, Timers)
23. **Chemical Feeders** – Solids, Liquids, Evaporators, Gas, Slurry
24. **Sources & Characteristics** – Characteristics of ground and surface waters, seasonal and daily quality changes, seasonal and daily demands.
25. **Quality Control & Assurance (QA/QC)** – Indicators of process/effluent quality, quality control procedures.
26. **Compliance** – Ontario environmental legislation affecting water treatment plants, safe drinking water, scope and authority of certificates of approval, owner/operator responsibilities.
27. **Hand Cleaned Screens** – Fine mesh, secondary screens.
28. **Aeration** – Diffused aerators, mechanical aerators-mixer, cascade aerators
29. **Coagulation & Flocculation** – Mixer (flash, high speed), air injector/diffuser, hydraulic (static mixer), baffles.
30. **Membrane Technology(s)** – Microfiltration, ultrafiltration
31. **Iron & Manganese Removal** – Chemical precipitation units, aerators, filter units.
32. **Recirculation** – Water and sludge recirculation systems.
33. **Waste Treatment** – Sludge conditioning, sludge drying beds, sludge vacuum filters, sludge filter press, sludge belt press, sludge centrifuges, landfill solids, land application of solids.
34. **Laboratory – Plant Process Tests** – Tests routinely conducted on site by operators, often using portable equipment. Includes alkalinity, chlorine residual, colour, fluoride, iron, jar test, pH, temperature, total hardness and turbidity.

**Administration  
Module**

35. **General Lab Tests** – Lab tests conducted by laboratory technicians (Includes algae, ammonia, biomass, calcium, chloride, coliforms, manganese, nitrate, orthophosphate, particle count, phosphate, specific conductance, sulphate, sulphide, threshold odour number, TOC, total solids), basic understanding of test purpose, acceptable ranges, meaning of lab results.
36. **Planning** – Facility planning, decision making.
37. **Personnel** – Supervision/management, hiring, disciplining, interview, communication,
38. **Finances** - Budgets, procurement, purchasing, inventory control/management.
39. **Maintenance Management** – Maintenance procedures (general),
40. **Information** – Record keeping, computer systems, reports.
41. **Emergency Response** – Spill response, fire, explosion, bomb threat, natural emergencies, hydraulic overload, slug loads, process failure.
42. **Public Relations** – Communication with public, complaint investigation, disclosure of information.
43. **Security** – Security of facility and property, prevention of vandalism, theft, security of staff, security of product.

## TASK ANALYSIS General Module

The listing below provides more detail on the types and level of knowledge required for each of the topics for each Class of exam.

A. Operator must complete the following performance objectives as indicated.

### **Basic and Applied Math (Topic 101)**

#### **Basic & Intermediate Tasks:**

- 1.1 Perform addition, subtraction, multiplication and division of whole numbers and decimals.
- 1.2 Square and cube whole numbers, proper fractions, improper fractions, mixed numbers and decimals.
- 1.3 Using conventional formulas, calculate area of rectangles, triangles and circles; surface area and volume of cylinders, cones and spheres.

#### **Advanced Tasks – Basic tasks plus:**

- 1.4 Convert fractions to percentage and vice-versa
- 1.5 Plot and interpret graphs, including line, bar, percentage, and broken line
- 1.6 Develop and read tables
- 1.7 Using conventional formulas, solve for direct and inverse proportions
- 1.8 Using conversion reference, convert from English to metric and vice-versa
- 1.9 Calculate percent removal
- 1.10 Interpret word problems, obtaining the required values and formulas
- 1.11 Use standard water/wastewater formulas

### **Units of Expression (Topic 102)**

#### **Basic, Intermediate & Advanced Tasks:**

- 2.1 Define terms of expression, such as ppm, mg/L, MG/d
- 2.2 Convert from one unit to another using appropriate references or formulas; convert from imperial to metric units

### **Basic and Applied Science (Topic 111)**

#### **Basic Tasks:**

- 3.1 Define concepts in basic chemistry
- 3.2 Identify and describe chemicals used in water treatment
- 3.3 Define and describe the significance of basic concepts in water chemistry
- 3.4 Define and describe the significance of basic concepts in microbiology, including viruses, bacteria and algae

**Intermediate Tasks – Basic tasks plus:**

- 3.5 Read common water chemical formulas and equations.
- 3.6 Explain the factors, which effect the safety of drinking water.
- 3.7 Explain remedial measures which can ensure safe drinking water

**Advanced Tasks – Basic and Intermediate tasks plus:**

- 3.8 Describe and explain the significance of common chemical reactions in water treatment.
- 3.9 Describe the properties and movement of gas under pressure.

**Public Health Principles (Topic 112)****Basic & Intermediate Tasks:**

- 4.1 Describe public health principles, laws and regulations
- 4.2 Identify common pathogens within raw water
- 4.3 Identify common chemicals contained in raw water and their effect on human health
- 4.4 Identify the control methods to eliminate the spread of pathogens through drinking water.

**Electrical Concepts (Topic 113)****Basic Tasks:**

- 5.1 Identify the basic electrical units and explain their meaning
- 5.2 Identify the safety requirements when working on electrical equipment
- 5.3 Using basic electrical concepts explain the safety hazards associated with electricity

**Intermediate Tasks – Basic tasks plus:**

- 5.4 Identify the types of electrical circuits found in water facilities.

**Advanced Tasks – Basic and Intermediate tasks plus:**

- 5.5 Explain the basic principles of common electrical circuits
- 5.6 Identify the electrical requirements of different types of equipment

**Hydraulic Concepts (Topic 114)****Basic Tasks:**

- 6.1 Define basic hydraulic concepts (head, pressure, rate of flow)
- 6.2 Explain the movement and properties of liquid under pressure

**Intermediate Tasks – Basic tasks plus:**

- 6.3 Calculate pumping head, pressure head, static head
- 6.4 Using hydraulic concepts and terms explain how a pump functions

**Advanced Tasks – Basic and Intermediate tasks plus:**

- 6.5 Describe the relationship between pumping head, horsepower and pump efficiency
- 6.6 Calculate horsepower and pumping efficiencies
- 6.7 Understand the basic hydraulic principles behind common flow measurement devices

**Maps and Plans (Topic 115)****Basic Tasks:**

- 7.1 Interpret and use maps and plans

**Intermediate and Advanced Tasks – Basic tasks plus:**

- 7.2 Calculate grades and changes in elevation

**Safety Procedures and Equipment (Topic 121/122)****Basic, Intermediate & Advanced Tasks:**

- 8.1 Identify basic categories of safety hazards
- 8.2 Identify basic safety procedures
- 8.3 Identify violations of personal hygiene
- 8.4 Describe personal safety procedures
- 8.5 Describe fire safety procedures
- 8.6 Describe chemical safety procedures
- 8.7 Describe confined space safety procedures

**Support Systems  
Module****Support Systems Modules (Topics 201-213)****Basic Tasks:**

- 9.1 Identify safety hazards
- 9.2 Identify correct safety procedures
- 9.3 Perform necessary calculations
- 9.4 Record necessary information
- 9.5 Describe purpose of system/equipment/components
- 9.6 Relate necessary information to others

**Intermediate Tasks – Basic tasks plus:**

- 9.7 Recognize indicators of normal and abnormal conditions
- 9.8 Perform actions at appropriate time, location and frequency
- 9.9 Use necessary tools/test equipment/reference manuals

A. Perform operating procedures associated with the normal and abnormal conditions for support systems/equipment.

	<p><b>Advanced Tasks – Intermediate tasks plus:</b></p> <p>9.10 Identify causes of abnormal conditions using proper troubleshooting techniques</p> <p>9.11 Explain reasons for taking these actions, including consequences of not taking action</p> <p>9.12 Explain interaction with other support systems/equipment and the total treatment process</p> <p>9.13 Identify the applicable standards imposed by process parameters, laws and regulators</p>
<p>B. Perform start-up/ shut-down procedures on support systems/ equipment.</p> <p><b>Processes Module</b></p>	<p><b>Basic Tasks:</b></p> <p>10.1 Identify safety hazards</p> <p>10.2 Identify correct safety procedures</p> <p>10.3 Perform necessary calculations</p> <p>10.4 Record necessary information</p> <p>10.5 Relate necessary information to others</p> <p><b>Intermediate Tasks – Basic tasks plus:</b></p> <p>10.6 Identify conditions requiring start-up/shut-down of the support system/equipment</p> <p>10.7 Perform necessary actions at appropriate time, location and frequency</p> <p>10.8 Use necessary tools/test equipment/reference manuals</p> <p><b>Advanced Tasks – Intermediate tasks plus:</b></p> <p>10.9 Explain reasons for taking these actions including consequences of not taking action</p> <p>10.10 Explain interaction with other support systems/equipment and the total treatment process</p> <p>10.11 Identify the applicable standards imposed by process parameters, laws and regulations</p>
<p>A. Operator must complete the following performance objectives indicated:</p>	<p><b><u>Sources and Characteristics (Topic 301)</u></b></p> <p><b>Basic and Intermediate Tasks:</b></p> <p>11.1 Identify raw water sources</p> <p>11.2 Describe source quality and quantity</p> <p><b>Advanced Tasks – Intermediate tasks plus:</b></p> <p>11.3 Identify physical, chemical and biological characteristics</p> <p>11.4 Describe basic principles in well operation</p>



### **Quality Control and Assurance (Topic 302)**

#### **Basic, Intermediate & Advanced Tasks:**

12.1 Perform quality control and assurance procedures

### **Compliance (Topic 303)**

#### **Basic, Intermediate & Advanced Tasks:**

13.1 List the relevant regulations, acts and other legal documents

13.2 Perform all tasks in compliance with legislation and Certificates of Approval

13.3 List the common Ontario Drinking water Objectives

B. Perform operating procedures associated with normal and abnormal conditions for processes/units

### **Unit Processes (Topics 304-325)**

#### **Basic Tasks:**

14.1 Identify safety hazards

14.2 Identify correct safety procedures

14.3 Perform necessary calculations

14.4 Record necessary information

14.5 Sketch and describe each element

14.6 Describe purpose of the process/units/components

14.7 Relate necessary information to others

#### **Intermediate Tasks – Basic tasks plus:**

14.8 Recognize indicators of normal and abnormal conditions

14.9 Perform necessary actions at appropriate time, location and frequency

14.10 Use necessary tools/test equipment/reference manuals

#### **Advanced Tasks – Intermediate tasks plus:**

14.11 Identify causes of abnormal conditions using proper troubleshooting techniques

14.12 Explain reasons for taking these actions, including consequences of not taking action

14.13 Explain interaction with other processes/units and the total treatment process

14.14 Identify the applicable standards imposed by process parameters, legislation and Certificate of Approval

C. Perform start-up/shut-down procedures on processes/units

#### **Basic Tasks:**

15.1 Identify safety hazards/safety procedures

15.2 Perform necessary calculations

15.3 Record and relate necessary information to others

	<p><b>Intermediate Tasks – Basic tasks plus:</b></p> <p>15.4 Identify conditions requiring start-up/shut-down of the process/unit</p> <p>15.5 Perform necessary actions at the appropriate location and frequency</p> <p>15.6 Use necessary tools/test equipment/reference manuals</p> <p><b>Advanced Tasks – Intermediate tasks plus:</b></p> <p>15.7 Explain reasons for taking these actions, including consequences of not taking action</p> <p>15.8 Explain interaction with other processes/units and the total treatment process</p> <p>15.9 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval</p>
<p>D. Perform construction and installation procedures for processes/ units</p>	<p><b>Basic Tasks:</b></p> <p>16.1 Identify safety hazards</p> <p>16.2 Identify correct safety procedures</p> <p>16.3 Perform necessary calculations</p> <p>16.4 Record necessary information</p> <p><b>Intermediate Tasks – Basic tasks plus:</b></p> <p>16.5 Perform actions at appropriate time, location and frequency</p> <p>16.6 Use necessary tools/test equipment/reference manuals</p> <p><b>Advanced Tasks – Intermediate tasks plus:</b></p> <p>16.7 Interpret plans specifications, and other references</p> <p>16.8 Explain reasons for taking these actions including consequences of not taking action</p> <p>16.9 Explain interaction with other processes/unit and the total treatment process</p> <p>16.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval</p> <p>16.11 Perform inspection procedures</p>
<p>E. Operator must complete the following performance objectives as indicated:</p>	<p><b><u>Laboratory – Plant Process Tests (Topic 326)</u></b></p> <p><b>Basic Tasks:</b></p> <p>17.1 Interpret chemical labels and standard shipping label of chemicals</p> <p>17.2 Label containers</p> <p>17.3 Describe proper use and care of laboratory/sampling/testing equipment.</p> <p>17.4 Take samples using proper procedures</p> <p>17.5 Transport samples using proper procedures</p> <p>17.6 Store samples using proper procedures</p>

- 17.7 Identify safety hazards
- 17.8 Identify correct safety procedures
- 17.9 Perform necessary calculations
- 17.10 Record necessary information on all required logs/reports
- 17.11 Relate necessary information to others

**Intermediate Tasks – Basic tasks plus:**

- 17.12 Prepare sample containers using proper procedures
- 17.13 Specify time and frequency for taking samples
- 17.14 Select sample location using proper procedures
- 17.15 Analyze sample using proper procedures
- 17.16 Interpret test results
- 17.17 Use Lab/sampling/testing equipment and related manuals
- 17.18 Describe purpose of test/procedure

**Advanced Tasks – Basic and Intermediate tasks plus:**

- 17.19 Prepare or obtain reagents using proper procedures
- 17.20 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 17.21 Explain reasons for using proper procedures and the consequences of not using these procedures
- 17.22 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

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## **General Lab Tests (Topic 327)**

**Basic Tasks:**

- 18.1 Label containers
- 18.2 Take samples using proper procedures
- 18.3 Transport samples using proper procedures
- 18.4 Store samples using proper procedures
- 18.5 Identify safety hazards
- 18.6 Identify correct safety procedures
- 18.7 Perform necessary calculations
- 18.8 Record necessary information on all required logs/reports
- 18.9 Relate necessary information to others

**Intermediate Tasks – Basic tasks plus:**

- 18.10 Prepare sample containers using proper procedures
- 18.11 Specify time and frequency for taking samples
- 18.12 Select sample location using proper procedures
- 18.13 Interpret test results
- 18.14 Describe purpose of test/procedure

<b>Administration Module</b>	<p><b>Advanced Tasks – Basic and Intermediate tasks plus:</b></p> <p>18.15 Make appropriate decision(s) concerning results which indicate abnormal conditions</p> <p>18.16 Identify applicable standards imposed by system parameters, legislation and Certification of Approval</p>
<p>A. Develop master plan to include objectives (short and long term, review, update), strategies, financial support and presentation to key personnel; prepare management practices to implement the master plans objectives and strategies; implement the management practices to accomplish master plan objectives to organize, coordinate and direct and control; and evaluate the effectiveness of the master plan and management practices</p>	<p><b><u>Management (Topics 411-413)</u></b></p> <p><b>Basic Tasks:</b></p> <p>19.1 Perform necessary financial calculation (basic budget, accounts payable, calculation of unit costs)</p> <p>19.2 Describe the importance of documenting meetings, management decisions, dealing with staff</p> <p>19.3 Describe the purpose of good management practices</p> <p>19.4 Describe the elements of an effective office communication strategy</p> <p>19.5 Define and use basic financial/purchasing terms and concepts</p> <p>19.6 Define and differentiate basic management/supervisory terms and concepts</p> <p>19.7 Describe the components of a short/long term plan</p> <p><b>Intermediate Tasks – Basic tasks plus:</b></p> <p>19.8 Recognize indicators of good management practices</p> <p>19.9 Relate management systems to others within the plant</p> <p>19.10 Evaluate the effectiveness of master plans for meeting facility objectives</p> <p>19.11 Describe good task coordination and delegation techniques/methods</p> <p><b>Advanced Tasks – Basic and Intermediate tasks plus:</b></p> <p>19.12 Differentiate between appropriate and inappropriate actions with subordinates and the consequences of each</p> <p>19.13 Explain the interaction of different management practices</p> <p>19.14 Set facility objectives based upon facility performance and resources</p> <p>19.15 Set goals, overall objectives and identify methods to obtain the goals/ objectives</p>
	<p><b><u>Administration (Topics 421-425)</u></b></p> <p><b>Basic Tasks:</b></p> <p>20.1 Take appropriate actions to maintain facility security</p> <p>20.2 Record necessary information</p> <p>20.3 Use necessary reference materials</p> <p>20.4 Communicate effectively with the public</p> <p>20.5 Describe appropriate actions which should be completed during various types of emergency situations</p>

- 20.6 Explain the purpose for maintaining logs and records
- 20.7 Explain the purpose of an effective maintenance management system
- 20.8 Describe routine maintenance procedures for common Facility processes

**Intermediate Tasks – Basic tasks plus:**

- 20.9 Develop an effective public relations policy
- 20.10 Develop an effective maintenance management program
- 20.11 Perform necessary actions (reporting, maintenance management, planning) at appropriate time, location and frequency

**Advanced Tasks – Intermediate tasks plus:**

- 20.12 Conform to all legislation and Certificates of Approval during a spill or other emergency