

# Maryland Certification Examinations for Water and Wastewater Operators and Superintendents

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*A Guide to the Maryland Certification Process and Preparing for and Taking  
the Examinations*

## Application Process

The first step in the exam process is applying to take the exam. However, prior to applying you must have one of the various types of Maryland certificates from the Board (for example, a temporary certificate).

[Examination Application – Click Here.](#)

Fill in the Examination Application and return it to MDE along with the appropriate fees. Your completed application and payment must be postmarked or delivered to the Board at least 21 days before the date of the exam for which application is made (for example, if you want to test on May 22, your application must be received by May 1). The Board cannot accept applications or money at the exam site, so you must make sure your application and fee are received by the Board's deadline.

As previously noted, the exams are usually given once each month, except during the months of May and November, when they're offered several times. The exam schedule is available from the Board, and exam dates are also identified in MCET's training announcements. Because the certification exams are offered in the morning, afternoon, and evening, at locations around the State, if you plan well you'll probably be able to test at a place and time that's convenient to you. You can expect to take the exam in a public facility; for example, the Maryland Department of the Environment, the Maryland Department of Transportation, etc. The exam will be administered (proctored) by a representative from the Board.

After the Board has processed your application form and fee payment, they will send you an Examination Invitation Letter. This letter specifies the date, time and location of the examination you are authorized to take. Check this letter carefully, to make sure that all information, including your name and address, is correct. Call the Board well in advance of the exam date: if any corrections are needed; you have any questions, or if you will need any special assistance at the exam site due to a disability.

When the Board sends you the exam invitation letter package, they will also send you the [General Examination Rules](#). See **FIGURE 1**. Read these carefully so that you know what to bring with you, what the test will be like and what violations will disqualify you from examining and may result in disciplinary action.

In addition, the exam invitation letter package will also include directions to your exam site and the inclement weather cancellation policy. The Board cancels exams if the State government adopts a liberal leave policy due to inclement weather. If your exam is cancelled due to inclement weather, you can make it up on any other scheduled exam date on a space-available basis. With the exception of inclement weather, there is no cancellation or postponement policy. If you are unable to test on your exam date due to a personal emergency you will need to notify the Board. The Board makes decisions on a case-by-case basis. See [Examination Cancellation Due to Inclement Weather](#).

In general, if you have a serious emergency you will be allowed to postpone your exam until a later date. If you decide to cancel (i.e. you don't want to take the exam at all), you will probably lose any exam fees you've paid since according to State regulations, the Board is under no obligation to refund your fees.

★ Be sure to bring your examination invitation letter, along with a valid photo ID and non-programmable calculator, to the exam site on the date of your exam.

**Figure 1      General Examination Rules**

**Board of Waterworks and Waste Systems Operators Examination Rules**

1. Each examinee must bring to the exam both the authorization letter from the Board, and positive identification that includes a photo (preferably a driver's license).
2. Notebooks or reference material are not allowed in the exam rooms. All work must be done on materials provided by the exam proctor, and these materials must be returned to the proctor intact.
3. Calculators are permitted; however, programmable calculators are not permitted.
4. No examinee will be admitted to the exam later than 15 minutes after the exam has started.
5. Examinees are not permitted to:
  - a. Assist or receive assistance from another examinee;
  - b. Talk with another examinee during the exam session;
  - c. Use unauthorized material;
  - d. Leave the exam room without permission from the exam proctor;
  - e. Talk to anyone while outside the room during the exam, whatever the reason. An examinee who violates a. through e. above will not be allowed to complete the exam and that person's name will be forwarded to the Board for disciplinary action.
6. No cell phones, tablets or other electronic devices are permitted

## **Examination Guidelines**

1. All examinations, except industrial 1 and 2, consist of multiple-choice questions.
2. Each multiple choice question has only one correct answer. If more than one answer seems to be correct, the best answer for the given situation should be selected.
3. The exam proctor will provide equivalents, conversion factors and formulas.

## **Examination Cancellation Due to Inclement Weather**

A scheduled examination will be cancelled if weather conditions cause the State Government to adopt a liberal leave policy on the exam date. Those who were scheduled to take an exam that was cancelled will be given an opportunity to take a future exam offering on a date of their choice (on a space-available basis). A new application for examination will not be required.

## **Preparing for the Written Exam**

Physical and mental preparation has an important impact on your ability to take any written examination. In just the way you are starting technical preparation months in advance, you should also start ahead of time to prepare yourself physically and mentally for the stresses of taking a demanding written exam. Here are some suggestions on how you can “get in training” before the exam.

### **Physical Preparation**

1. Eat properly. Eat a variety of foods, so that you get the right balance of proteins, carbohydrates and fats, with plenty of vitamins and minerals. Don't forget to drink plenty of water. Consult your doctor if you have particular nutritional or medical needs. Avoid excessive caffeine and high fat or sugar foods before the exam. Eat balanced meals on the day of the exam and have a healthy snack just before you start your exam. Being well-fed will help you to focus better and feel less stress during the exam. Don't show up late with a cup of coffee and a doughnut and expect to do your best.
2. Rest adequately before you take the exam. Pace yourself so that you are studying in the weeks and months before the exam date. Don't stay up late the night before the exam and try to cram months of studying into a few hours. Get eight hours sleep (or whatever is best for you).
3. Take up or continue an exercise regimen. Walking, stretching, jogging and lifting weights are among the many forms of exercise which can relieve stress, increase your physical stamina and even improve your ability to focus on tasks. Try team sports or individualized activities, depending on which suits your personality. Of course, you should always get your doctor's okay before starting any exercise program.
4. Try to stay healthy. It's hard enough to take the exam under the best of circumstances, but it may be excessively difficult if you're sick, run down or just generally feeling under the weather.
5. Practice sitting for an extended period. Three hours can seem like a really long time. Try to keep your body in good shape and flexible so that you won't be distracted by aches and stiff muscles while you are taking the exam.

## **Mental and Emotional Preparation**

Be aware of how you deal with stress and try to find healthy ways to reduce your anxiety. You may find some of the following tips helpful.

1. Don't be too hard on yourself. Don't carry extra emotional baggage or put too much pressure on yourself to succeed. Remember that your ability to pass the certification exam is only one measure of your knowledge. Try not to obsess about the exam in an unhealthy way.
2. Visualize success. Think about the whole exam process. In your mind's eye, see yourself arriving early, being relaxed, answering questions easily, finishing in plenty of time and receiving your passing score. Positive thinking reduces stress and enhances your ability to actually succeed.
3. Similarly, avoid negative thoughts and feelings. Negative self-talk, like "I can't pass this exam," can distract you and produce more anxiety about the test. Instead, engage in positive self-talk.
4. Set realistic goals and expectations for yourself. Remember that you can really only pay attention to one thing at a time. Focus on the task at hand. Take breaks from tasks so that you can refocus your attention. Reduce distractions in your life. Don't over schedule yourself. When you are scheduling activities, remember to also schedule some "down" time for yourself.
5. Learn techniques for managing stress. Don't be afraid to experiment to see what works for you. Techniques you might try include exercise, yoga, meditation, prayer and deep breathing techniques.
6. Finally, be aware of the fact that the stress you feel can be made to work to your advantage. Feeling a reasonable level of anxiety before the exam can help you achieve. Sometimes people need the extra drive or rush that a little stress gives to them.

## Studying for the Exams

To pass the certification exam you need to know the technical material inside and out, forward and backward. Plan to spend months or even years preparing for the exam. Take an exam prep course. MCET and other local training providers offer these courses at times which correspond to the examination offerings. Here are some tips to help you with the technical preparation.

1. Don't expect the exam to reflect your specific job experiences. The exam is process specific, not job specific. The exam may ask you questions about tasks you've never carried out, equipment you don't have to maintain, or responsibilities you haven't been given by your particular employer. Be prepared for this, so that it doesn't shake your confidence. The exam is designed to test you on specific processes not measure your ability to do your particular job. You may know exactly how to do your job, and yet still struggle with some of the exam questions. Many different conditions affect what you actually do on a day-to-day basis (for example, your employer, the size of your plant, the size and type of the population you serve). **So use the information in this publication to find out what the exam is going to test you on, and then spend extra time learning about those topics with which you are less familiar.**
2. Find a mentor. Talk to people who have taken and passed the exam. Get tips from them about how to prepare. See if they will help you prepare.
3. Try different study approaches: write concepts, terms, and definitions that are critical to the entire subject in an outline form; read books and highlight important sections or take notes; answer and check review questions; take prep courses; study independently; or study in groups. Any one or combination of these approaches may work well for you. Experiment to see what is most useful to you. Whatever approach you take, be sure to study in a quiet, well lighted area with enough room to spread out.

For each examination, the Board has specified an Exam Prescription. This [Exam Prescription](#) specifies the total number of questions, as well as the number of questions to be asked about each topic for every examination classification. The Board gives the Exam Prescription to the Association of Boards of Certification (or "ABC"), a testing service which provides certification exams and other certification-related services to many of the certifying boards in the US and other countries. ABC uses the Board's Exam Prescriptions to put together certification exams for all the water and wastewater operator classifications, except for a couple of the industrial wastewater treatment exams, which are developed by the Maryland Board and do not fit the same format as the ABC-developed exams. The exams contain questions about the processes included in the specific classification, as well as about generic topics such as safety, math and equipment maintenance.

To help you get used to reading the Exam Prescriptions, you should refer first to the [Sample Exam Prescription with Explanations](#). Key components of the Exam Prescription are labeled with numbers that correspond to descriptive text. For example, you'll find basic information about the "objectives," or topics, covered on the exam.

After you're familiar with the layout of a typical Exam Prescription, check out the actual Exam Prescription for the exam you are preparing to take. A set of specific Exam Prescriptions, one for each exam classification offered, follows the Sample Exam Prescription with Explanations.

For each of the topical areas, we've added a description of the types of questions that might be asked. These descriptions are provided as examples only and are not comprehensive. Use the information on the Exam Prescription to determine what topics you need to focus on while you're studying.

**Example:** If you're preparing for the Water Treatment Class 4 exam, you can check the Exam Prescription to find out that 11 of the 100 questions are on disinfection. So for that exam classification, questions on disinfection processes make up 11% of your exam's final grade.

**Hint:** You also need to know that about 15% of the questions on every exam involve calculations. These may be generic water or wastewater calculations, or they may be related to specific processes or support systems for your exam classification.

**Calculation errors are one of the biggest reasons for exam failure.** Take a substantial amount of time to refresh or improve your ability to do calculations. Consider taking a math course to prepare for the exam. It will be time well spent.

## Exam Prescriptions for Water and Wastewater Classifications

<b>Category and Classification</b>
<b><i>Sample Exam Prescription with Explanations</i></b>
<b><i>Water Distribution</i></b>
Water Distribution
<b><i>Water Treatment</i></b>
Water Treatment Class 1
Water Treatment Class 2
Water Treatment Class 3
Water Treatment Class 4
<b><i>Wastewater Collection</i></b>
Wastewater Collection System Class 2
<b><i>Wastewater Treatment</i></b>
Wastewater Treatment Class 1
Wastewater Treatment Class 2
Wastewater Treatment Class 3
Wastewater Treatment Class 4
Wastewater Treatment Class 5
Wastewater Treatment Class 6
Wastewater Treatment Class A
Wastewater Treatment Class S
<b><i>Industrial Wastewater Treatment</i></b>
Industrial Wastewater Treatment Class 3
Industrial Wastewater Treatment Class 4
Industrial Wastewater Treatment Class 5
Industrial Wastewater Treatment Class 6

# Sample Exam Prescription with Explanations

## Exam Prescription for WASTEWATER TREATMENT CLASS 5

Specifies the number of “objectives,” or topics, for the particular exam category and classification.

Specifies the number of questions on each topic.

# OF OBJECTIVES: 23	# OF ITEMS
Plumbing	3 items
Primary Treatment	5 items
Disinfection	6 items
Safety	9 items
Activated Sludge	26 items
Chemical	3 items
Sludge Digestion	5 items
Motors	2 items
Pumps	12 items
Sludge Dewatering	6 items
Grit Removal	2 items
Filtration	2 items
Blowers	1 items
Sludge Thickening	5 items
Characteristics	2 items
Lab Tests	1 items
Screening	1 items
Drives	2 items
Math	2 items
Lab Skills	1 items
Chemical Pretreatment	2 items
Hydraulic Concepts	1 items
Physical	1 items
<b>OVERALL</b>	<b>100 items</b>

Lists the major topics covered. These are broad topics that test for underlying skills and knowledge and an understanding of the duties and tasks required for operation and maintenance of equipment, operation of plant processes, and administration of a treatment plant, such as rules and regulations.

Shows the total number of questions on the exam

## Exam Prescriptions for Each Classification

### Exam Prescription for WATER DISTRIBUTION

**CHECK BACK SOON!**

### Exam Prescription for WATER TREATMENT CLASS 1

<b># OF OBJECTIVES: 14</b>	<b># OF ITEMS</b>
Plumbing (pipes, valves)	5 items
Disinfection (chlorination)	15 items
Math	3 items
Storage (tanks, reservoirs)	3 items
Electrical/Mechanical Equipment (motors, pumps, controls)	8 items
Measuring Systems (instrumentation)	2 items
Rules and Regulations (EPA SDWA, MDE regs.)	2 items
Sources (hydrology)	1 items
Characteristics (of raw water)	2 items
Lab Skills (sample collection, analysis)	1 items
Lab Tests (sampling, analysis)	3 items
Intake (bar screens, travelling screens)	1 items
Hydraulic Concepts (flow, pressure)	1 items
Safety	3 items
<b>OVERALL</b>	<b>50 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WATER TREATMENT CLASS 2**

<b># OF OBJECTIVES: 16</b>	<b># OF ITEMS</b>
Disinfection (chlorination)	17 items
Plumbing (pipes, valves)	8 items
Storage (tanks, reservoirs)	5 items
Math	3 items
Electrical/Mechanical Equipment (motors, pumps, controls)	13 items
Rules and Regulations (EPA SDWA, MDE regs)	5 items
Stabilization (pH adjustment, lead residual control)	1 items
Characteristics (of raw water)	4 items
Safety	4 items
Chemical Feeders (dry feeders, metering pumps)	2 items
Fluoridation (fluoridation equipment , chemicals)	4 items
Measuring Systems (instrumentation)	2 items
Lab Skills	1 items
Lab Tests (sampling, analysis)	4 items
Intake (bar screens, travelling screens)	1 items
Sources (hydrology)	1 items
<b>OVERALL</b>	<b>75 items</b>

**Exam Prescription for  
WATER TREATMENT CLASS 3**

<b># OF OBJECTIVES: 21</b>	<b># OF ITEMS</b>
Disinfection (chlorination)	17 items
Characteristics (of raw water)	7 items
Fluoridation (fluoridation equipment, chemicals)	1 items
Clarification (sedimentation)	4 items
Iron and Manganese Removal (softening and green sand)	7 items
Math	3 items
Filtration	6 items
Plumbing (pipes, valves)	6 items
Electrical/Mechanical Equipment (motors, pumps, controls)	19 items
Lab Tests (sampling, analysis)	7 items
Stabilization (pH adjustment, lead residual control)	3 items
Residues (sludge processing)	1 items
Processes	1 items
Safety	6 items
Sources (hydrology)	2 items
Control Systems (automatic process control)	1 items
Hydraulic Concepts (flow, pressure)	1 items
Storage (tanks and reservoirs)	3 items
Rules and Regulations (EPA SDWA, MDE regs)	1 items
Measuring Systems (instrumentation)	2 items
Chemical Feeders (dry feeders, metering pumps)	2 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WATER TREATMENT CLASS 4**

<b># OF OBJECTIVES: 24</b>	<b># OF ITEMS</b>
Filtration	9 items
Electrical/Mechanical Equipment (motors, pumps, controls)	17 items
Lab Skills (sample collection, analysis)	3 items
Iron and Manganese Removal (softening and green sand)	3 items
Disinfection (chlorination)	11 items
Measuring Systems (instrumentation)	2 items
Chemical Feeders (dry feeders, metering pumps, chlorinators)	4 items
Coagulation (rapid mix—destabilization)	5 items
Hydraulic Concepts (flow, pressure)	3 items
Fluoridation (fluoridation equipment, chemicals)	3 items
Rules and Regulations (EPA SDWA, MDE regs)	2 items
Storage (tanks and reservoirs)	2 items
Sources (hydrology)	4 items
Characteristics (of raw water)	2 items
Stabilization (pH adjustment, lead residual control)	3 items
Processes	1 items
Plumbing (pipes and valves)	7 items
Clarification (sedimentation)	5 items
Safety	3 items
Flocculation (mixing—floc building)	3 items
Lab Tests (sampling, analysis)	4 items
Math	2 items
Intake (bar screens, travelling screens)	1 items
Taste and Odor Control (PAC—KMnO)	1 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER COLLECTION SYSTEM CLASS 2**

<b># OF OBJECTIVES: 15</b>	<b># OF ITEMS</b>
Characteristics (of raw wastewater)	2 items
QC/Surveillance (video/TV inspection)	1 items
Collection (pipes, manholes)	21 items
Sewer Equipment (cleaning, repairing)	9 items
Chemical Addition (root control, H S control)	11 items
Math (generic wastewater calculations)	3 items
Hydraulic Concepts (flow, pressure)	2 items
Pumping	12 items
Pump Station (pumps, motors, air compressors)	22 items
Safety (traffic, confined spaces, gases)	8 items
Maps and Plans (blueprints, surveying)	1 items
Sources (of raw wastewater)	3 items
I/I (sources, repairs)	1 items
Public Health	2 items
Monitoring (flow, atmospheres)	2 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for WASTEWATER TREATMENT CLASS 1**  
**updated (2105)**

<b># OF OBJECTIVES 17</b>	<b># OF ITEMS</b>
Collect Samples	2
Effluent Discharge	2
Evaluate Equipment	2
Evaluate Waste-streams	3
Interpret Lab Analyses	4
MEA Disinfection	5
MEA Secondary Math	2
MEA Chemical Addition	1
MEA Preliminary Treatment	1
MEA Secondary TTMT (Lagoons)	10
MEA Tertiary TTMT (Lagoons)	2
Operate Equipment	6
Perform Lab Analyses	2
Perform Maintenance	3
Safety Procedures	3
Security	1
Waste-stream Math	1
<b>OVERALL</b>	<b>50</b>

**Exam Prescription for  
WASTEWATER TREATMENT CLASS 2**

<b># OF OBJECTIVES: 20</b>	<b># OF ITEMS</b>
Grinding (grinding, comminutors)	1 items
Disinfection (chlorination, UV)	5 items
Safety (traffic, confined spaces, gases)	4 items
Pumps (centrifugal, positive displacement)	13 items
Sludge Dewatering (vacuum filters, centrifuges)	2 items
Flow Measurement (Parshall flumes, venturi meters, weirs)	2 items
Screening	1 items
Chemical Pretreatment (prechlorination)	1 items
Primary Treatment (clarifiers)	19 items
Characteristics (of raw wastewater)	4 items
Motors (electric)	1 items
Math (generic wastewater calculations)	5 items
Valves	3 items
Electrical/Mechanical Equipment	1 items
Sludge Digestion (aerobic, anaerobic)	7 items
Control Systems (bubbler systems, level sensors)	1 items
Grit Removal	2 items
Processes (of raw wastewater)	1 items
Drives (chain, belt, variable speed)	1 items
Sources (of raw wastewater)	1 items
<b>OVERALL</b>	<b>75 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS 3**

<b># OF OBJECTIVES: 25</b>	<b># OF ITEMS</b>
Pumps (centrifugal, positive displacement)	14 items
Math (generic wastewater calculations)	3 items
Valves	3 items
Processes	1 items
Activated Sludge (including clarification)	30 items
Safety (traffic, confined spaces, gases)	4 items
Disinfection (chlorination, UV)	11 items
Primary Treatment (clarifiers)	3 items
Lab Skills (equipment, practices)	1 items
Characteristics (of raw wastewater)	6 items
Sludge Digestion (aerobic, anaerobic)	2 items
Screening	1 items
Plumbing (piping, backflow prevention)	1 items
Control Systems (bubbler systems, level sensors)	2 items
Sludge Dewatering (vacuum filters, centrifuges)	1 items
Lab Tests (DO, pH, Cl residuals)	1 items
Motors (electric)	2 items
Flow Measurement (Parshall flumes, venturi meters, weirs)	1 items
Common Parameters	1 items
Blowers	2 items
Electrical/Mechanical Equipment	3 items
Drives (chain, belt, variable speed)	1 items
Sources (of raw wastewater)	1 items
Electrical Concepts	2 items
Hydraulic Concepts (flow, pressure)	1 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS 4**

<b># OF OBJECTIVES: 25</b>	<b># OF ITEMS</b>
Safety (traffic, confined spaces, gases)	2 items
Primary Treatment (clarifiers)	7 items
Trickling Filters (including clarification)	27 items
Math (generic wastewater calculations)	2 items
Grit Removal	2 items
Pumps (centrifugal, positive displacement)	11 items
Sources (of raw wastewater)	1 items
Sludge Digestion (aerobic, anaerobic)	6 items
Sludge Dewatering (vacuum filters, centrifuges)	5 items
RBC (including clarification)	7 items
Characteristics (of raw wastewater)	5 items
Hydraulic Concepts (flow, pressure)	1 items
Plumbing (piping, backflow prevention)	1 items
Valves	1 items
Blowers	1 items
Lab Tests (DO, pH, Cl residuals)	2 items
Sludge Thickening (gravity and air flotation)	3 items
Lab Skills (equipment, practices)	1 items
Disinfection (chlorination, UV)	5 items
Common Parameters	2 items
Control Systems (bubbler systems, level sensors)	3 items
Engines (internal combustion)	1 items
Motors (electric)	2 items
Goals	1 items
Drives (chain, belt, variable speed)	1 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS 5**

<b># OF OBJECTIVES: 23</b>	<b># OF ITEMS</b>
Plumbing (piping, backflow prevention)	3 items
Primary Treatment (clarifiers)	5 items
Disinfection (chlorination, UV)	6 items
Safety (traffic, confined spaces, gases)	9 items
Activated Sludge (including clarification)	26 items
Chemical (flocculation)	3 items
Sludge Digestion (aerobic, anaerobic)	5 items
Motors (electric)	2 items
Pumps (centrifugal, positive displacement)	12 items
Sludge Dewatering (vacuum filters, centrifuges)	6 items
Grit Removal	2 items
Filtration (gravity filtration)	2 items
Blowers	1 items
Sludge Thickening (gravity, air flotation)	5 items
Characteristics (of raw wastewater)	2 items
Lab Tests (DO, pH, Cl residuals)	1 items
Screening	1 items
Drives (chain, belt, variable speed)	2 items
Math (generic wastewater calculations)	2 items
Lab Skills (equipment, practices)	1 items
Chemical Pretreatment (prechlorination)	2 items
Hydraulic Concepts (flow or pressure)	1 items
Physical (tertiary clarification)	1 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS A**

<b># OF OBJECTIVES: 10</b>	<b># OF ITEMS</b>
Physical (tertiary clarification)	2 items
Chemical (pH control, coagulation/flocculation)	10 items
Filtration (gravity filtration)	8 items
Phosphorus Removal (chemical precipitation, luxury uptake)	9 items
Nitrification	7 items
Activated Sludge (including clarification)	5 items
Processes	3 items
Biological (denitrification)	4 items
Microscreens	1 items
Chemical Feeders (feed pumps)	1 items
<b>OVERALL</b>	<b>50 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS S**

<b># OF OBJECTIVES: 22</b>	<b># OF ITEMS</b>
Plumbing (piping, backflow prevention)	1 items
Pumps (centrifugal, positive displacement)	15 items
Sludge Thickening (gravity, air flotation)	10 items
Sludge Digestion (aerobic, anaerobic)	19 items
Lab Tests (DO, pH, Cl residuals)	6 items
Valves	2 items
Sludge Dewatering (vacuum filters, centrifuges)	9 items
Characteristics	5 items
Sources	1 items
Math (generic wastewater calculations)	2 items
Processes	4 items
Drives (chain, belt, variable speed)	2 items
Hydraulic Concepts (flow, pressure)	1 items
Motors (electric)	4 items
Solids Disposal (land application, composting)	1 items
Safety (traffic, confined spaces, gases)	6 items
Chemical Feeders (feed pumps)	1 items
Sludge Conditioning (chemical addition, elutriation)	1 items
Common Parameters	1 items
Electrical/Mechanical Equipment	1 items
<b>OVERALL</b>	<b>92 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
WASTEWATER TREATMENT CLASS 6—Site Specific\*  
Septic Tank/Sand Filter\***

<b># OF OBJECTIVES: 13</b>	<b># OF ITEMS</b>
Primary Treatment (clarifiers)	11 items
Pumps (centrifugal, positive displacement)	8 items
Control Systems (bubbler systems, level sensors)	1 items
Characteristics (of raw wastewater)	5 items
Filtration (gravity filtration)	6 items
Disinfection (chlorination, UV)	4 items
Lab Tests (DO, pH, Cl residuals)	2 items
Preventive Maintenance	1 items
Plumbing (piping, backflow prevention)	1 items
Nitrification	5 items
Safety (traffic, confined spaces, gases)	3 items
Flow Measurement (Parshall flumes, venturi meters, weirs)	2 items
Valves	1 items
<b>OVERALL</b>	<b>50 items</b>

\*Wastewater Treatment Class 6 is a “site specific” classification. It covers facilities that use alternative technology systems that are not included in any of the other wastewater treatment classifications. Currently, the only examination available for any Class 6 facility is one specifically created for plants that use septic tanks and sand filters, which is the exam prescription listed above. For other types of Class 6 facilities, different exams will need to be created that possibly will not contain topics similar to those in the above prescription. Contact the Board for additional information on this.

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
INDUSTRIAL WASTEWATER TREATMENT CLASS 3**

<b># OF OBJECTIVES: 25</b>	<b># OF ITEMS</b>
Disinfection (chlorination, UV)	4 items
Valves	1 items
Units of Expression – Math	1 items
Laboratory (terms, concepts, sampling techniques)	3 items
Electrical Controls	1 items
Cathodic Protection Devices	1 items
Math	3 items
Land Treatment	4 items
Sources and Characteristics (of raw wastewater)	6 items
Soil Characteristics	2 items
Science (coagulation)	1 items
Motors	2 items
General Safety (traffic, confined spaces, gases)	3 items
Pipes	2 items
Clarification	1 items
Drives	1 items
Maintenance Management	1 items
Measuring and Control (meters, pump operation)	3 items
Clarification – Math	2 items
Pumps	1 items
Screening	3 items
Pumps – Math	1 items
Electrical Controls – Math	1 items
Engines (gasoline, diesel)	1 items
Joints	1 items
<b>OVERALL</b>	<b>50 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
INDUSTRIAL WASTEWATER TREATMENT CLASS 4**

<b># OF OBJECTIVES: 13</b>	<b># OF ITEMS</b>
Lagoons (characteristics, O&M, troubleshooting problems)	19 items
Disinfection (chlorination, UV)	1 items
Plumbing (valves, piping)	3 items
Lab Tests (terms, concepts, sampling techniques)	4 items
Measuring Systems (meters, pump operation)	1 items
Safety (traffic, confined spaces, gases)	2 items
Electrical Equipment (includes drives, motors, blowers, and pumps: chain, belt, variable speed; centrifugal, positive displacement)	8 items
Characteristics (of raw wastewater)	3 items
Math	2 items
Processes (natural and waste treatment)	3 items
Engines (gasoline, diesel)	1 items
Control Systems (meters, pump operation)	2 items
Chemical Addition (effects on waste characteristics)	1 items
<b>OVERALL</b>	<b>50 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
INDUSTRIAL WASTEWATER TREATMENT CLASS 5  
(No industrial exam—uses Wastewater Treatment Class 5)**

<b># OF OBJECTIVES: 23</b>	<b># OF ITEMS</b>
Plumbing (piping, backflow prevention)	3 items
Primary Treatment (clarifiers)	5 items
Disinfection (chlorination, UV)	6 items
Safety (traffic, confined spaces, gases)	9 items
Activated Sludge (including clarification)	26 items
Chemical (flocculation)	3 items
Sludge Digestion (aerobic, anaerobic)	5 items
Motors (electric)	2 items
Pumps (centrifugal, positive displacement)	12 items
Sludge Dewatering (vacuum filters, centrifuges)	6 items
Grit Removal	2 items
Filtration (gravity filtration)	2 items
Blowers	1 items
Sludge Thickening (gravity, air flotation)	5 items
Characteristics (of raw wastewater)	2 items
Lab Tests (DO, pH, Cl residuals)	1 items
Screening	1 items
Drives (chain, belt, variable speed)	2 items
Math (generic wastewater calculations)	2 items
Lab Skills (equipment, practices)	1 items
Chemical Pretreatment (prechlorination)	2 items
Hydraulic Concepts (flow or pressure)	1 items
Physical (tertiary clarification)	1 items
<b>OVERALL</b>	<b>100 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

**Exam Prescription for  
INDUSTRIAL WASTEWATER TREATMENT CLASS 6**

<b># OF OBJECTIVES: 23</b>	<b># OF ITEMS</b>
Plumbing	3 items
Sources and Characteristics (of raw wastewater)	3 items
Clarification (sedimentation)	2 items
Coagulation and Flocculation (chemical addition to aid settling)	8 items
Pumps–Math	2 items
Laboratory (sampling techniques, supplies, equipment)	8 items
Chemical Feeders–Math	1 items
Pumps (centrifugal, positive displacement)	4 items
Measuring and Control (bubbler systems, level sensors)	3 items
Chemical Addition-Math	1 items
Coagulation/Flocculation–Math	1 items
Clarification–Math	1 items
General Safety (personal safety)	2 items
Chemical Additions	3 items
Chemical Feeders (dry feeders, metering pumps, chlorinators)	2 items
Screening	1 items
Laboratory–Math	1 items
Flow Measurement–Math	2 items
Drives (chain, belt, variable speed)	1 items
Cross Connection Control (CCC) and Backflow	1 items
<b>OVERALL</b>	<b>50 items</b>

**Note:** The descriptions in parentheses above are examples of what you are likely to see on the exam. These are not ABC-supplied descriptions.

# Taking the Exam

## Distribution of Exam Materials and Instructions

When you arrive at the exam site on test day, the Board's representative (the "proctor") will hand out the following materials. These materials will all be collected from you after you've finished the exam.

**Exam Booklet** with questions unique to your exam. Follow the proctor's instructions to check it carefully to make sure that it's not marked up or damaged in any way. If the exam booklet seems to be compromised, immediately bring this to the proctor's attention so that the booklet's condition will not affect your examination success.

**Exam Answer Sheet** to mark all of your answers. These answer sheets are graded by computer, so it is very important to mark your answer sheets carefully and completely, according to the instructions which the proctor will go over with you.

**Scratch Paper** on which to work out the answers to questions. You will give it to the exam proctor with the rest of your materials at the end of the exam.

**Formula/Conversion Table** provides *all* of the standard formulas and conversion information that may be needed to perform calculations on the water or wastewater exams. See [Formulas and Conversion Factors, FIGURE 2](#).

**Note:** While the sheet gives all the standard formulas and conversion information you may need only a handful of them for your particular exam, but you'll have to know which formula fits which question

After the materials are handed out, the exam proctor will go over instructions for filling out the answer sheet. Items like your name, social security number and exam type are required. There is a section on the answer sheet which asks for personal background information; however, you are not required to provide this personal information.

Before the exam begins, you will be given an opportunity to ask general questions about the exam or about operator certification. This is a good opportunity to get information from a representative of the Board.

**Figure 2 Formulas and Conversion Factors**

<b>BOARD OF WATERWORKS AND WASTE SYSTEMS OPERATORS</b>			
<b>FORMULA/CONVERSION TABLE</b>			
CIRCUMFERENCE OF A CIRCLE = $2\pi R$	$\pi$	=	3.14
AREA OF A CIRCLE = $\pi R^2$ or $0.785 \times D^2$	R	=	Radius
VOLUME OF A CYLINDRICAL TANK = $\pi R^2 H$ or $0.785 \times D^2 H$	D	=	Diameter
AREA OF A RECTANGLE = $LW$	H	=	Height
VOLUME OF A RECTANGULAR TANK = $LWH$	L	=	Length
AREA OF A TRIANGLE = $BH \times \frac{1}{2}$	W	=	Width
VOLUME OF A TRIANGULAR TANK = $BHL \times \frac{1}{2}$	B	=	Base
AREA OF A SPHERE = $\pi D^2$ or $4\pi R^2$	Q	=	Flow
VOLUME OF A SPHERICAL TANK = $\frac{4}{3} \pi R^3$ or $\frac{1}{6} \pi D^3$			

  

FLOW = Area  $\times$  Velocity or  $\frac{\text{Volume}}{\text{Time}}$

GALLONS PER CAPITA PER DAY =  $\frac{\text{Gallons Per Day (GPD)}}{\text{Population}}$

LOADING (lbs./day) = Dosage (mg/L)  $\times$  8.34  $\times$  Flow (MGD)

DETENTION TIME =  $\frac{\text{Volume}}{\text{Flow}}$                       SURFACE LOADING RATE =  $\frac{\text{Flow}}{\text{Area}}$

WEIR OVERFLOW RATE =  $\frac{\text{Flow}}{\text{Weir Length}}$                       VELOCITY =  $\frac{\text{Distance or Flow}}{\text{Time Area}}$

SLOPE =  $\frac{\text{Drop or Rise}}{\text{Distance}}$                       HORSEPOWER =  $\frac{\text{Flow (GPM)} \times \text{Head (ft.)}}{3960}$

EFFICIENCY (%) =  $\frac{\text{In} - \text{Out} \times 100}{\text{In}}$                       FILTER BACKWASH RATE =  $\frac{\text{Flow}}{\text{Filter Area}}$

HYDRAULIC LOADING RATE =  $\frac{\text{Flow}}{\text{Area}}$                       ORGANIC LOADING RATE =  $\frac{\text{lbs. BOD/day}}{\text{Volume}}$

F/M =  $\frac{\text{Organic Loading (lbs. BOD/day)}}{\text{Mixed Liquor Solids (lbs.)}}$                       OXYGEN UPTAKE =  $\frac{\text{Oxygen Usage}}{\text{Time}}$

MCRT =  $\frac{\text{Suspended Solids in the Aeration and Clarifier (lbs.)}}{\text{SS Wasted (lbs. /day) + SS Lost in Clar. Effluent (lbs./day)}}$

VOLATILE SOLIDS REDUCTION EFFICIENCY (%) =  $\frac{\% \text{ VSS (raw)} - \% \text{ VSS (digested)} \times 100}{\% \text{ VSS (raw)} - [\% \text{ VSS (raw)} \times \% \text{ VSS (digested)]}$

**Figure 2 Formulas and Conversion Factors (continued)**

$$\text{SVI} = \frac{\text{Settleable Solids (\%)} \times 10,000}{\text{MLSS (mg/L)}}$$

$$\text{SOLIDS CONCENTRATION} = \frac{\text{Weight}}{\text{Volume}}$$

$$\text{SLUDGE AGE} = \frac{\text{Mixed Liquor Solids (lbs.)}}{\text{Primary Effluent Solids (lbs./day)}}$$

$$\text{SLUDGE INDEX} = \frac{\% \text{ Settleable Solids}}{\% \text{ Suspended Solids}}$$

$$\text{SOLIDS (mg/L)} = \frac{\text{Dry Solids} \times 1,000,000}{\text{mL of Sample}}$$

$$\text{ALKALINITY} = \frac{\text{mL of Titrant} \times \text{Acid Normality} \times 50,000}{\text{mL of Sample}}$$

$$\text{HARDNESS} = \frac{\text{mL of Titrant} \times 1,000}{\text{mL of Sample}}$$

$$\text{WASTE MILLIEQUIVALENT} = \text{mL} \times \text{Normality}$$

$$\text{WASTE NORMALITY} = \frac{\text{Titrant Volume} \times \text{Titrant Normality}}{\text{Sample Volume}}$$

$$\text{ACID FEED RATE} = \frac{\text{Waste Flow} \times \text{Waste Normality}}{\text{Acid Normality}}$$

$$\% \text{ REDUCTION IN FLOW} = \frac{(\text{Original Flow} - \text{Reduced Flow}) \times 100}{\text{Original Flow}}$$

$$\% \text{ DIGESTED SLUDGE REMAINING} = \frac{\text{Raw Dry Solids} \times \text{Ash Solids} \times 100}{\text{Digester Dry Solids} \times \text{Digested Ash Solids}}$$

$$\text{CHEMICAL FEED PUMP SETTING (\% STROKE)} = \frac{\text{Desired Flow} \times 100}{\text{Maximum Flow}}$$

$$\text{COMPOSITE SAMPLE SINGLE PORTION} = \frac{\text{Instantaneous Flow} \times \text{Total Sample Volume}}{\text{Average Flow} \times \text{Number of Samples}}$$

$$\text{DEGREES CENTIGRADE (}^\circ\text{C)} = (\text{}^\circ\text{F} - 32)(5/9)$$

$$\text{DEGREES FAHRENHEIT (}^\circ\text{F)} = (\text{}^\circ\text{C})(9/5) + 32$$

**Conversion Factors**

7.48 gal/cu ft.	8.34 lb./gal	2.31 ft./PSI	1 KW = 1.34 HP
0.433 PSI/ft.	1 Acre = 43,560 sq. ft.	1 ft. = 12 inches	1 HP = 0.746 KW
1 lb. = 454 grams	1 cu ft. = 28.32 liters	1 gal = 3.785 liters	3.28 ft. = 1 meter
1 yd. = 3 ft.	1 mile = 5280 ft.		

The proctor will stay in the room during the exam to monitor the exam and to be available in case you have any questions. You may ask questions about exam procedures or even about specific questions that don't seem clear. The proctor will not be able to give you technical information or information that could otherwise help you correctly answer a question, but he or she can help to clarify a question if you need help.

For every classification except some of the industrial wastewater treatment exams, all questions are multiple choice. Each multiple choice question has four possible answers, but only one right answer. Most of the exams have 100 questions, although that number varies. See [Exam Prescriptions](#). Some of the [industrial wastewater treatment exams](#) are structured differently than the other exams, and may consist of essay-type questions.

The time allowed to complete an exam is 3 hours for the 100 question and 75 question exams, and 2 hours for the 50 question exams. Therefore, if you are taking a 100 question exam, you'll have more than 1½ minutes for each question. You'll probably have plenty of time to finish before time is up.

**Remember:** Although you can make arrangements to take more than one exam on a given exam date, you may not exceed the maximum time limit of 3 hours regardless of how many exams you are taking at one sitting.

## Test-Taking Strategies

Use these general test taking tips and any others you come across to ensure your success.

- 1) **Get to the test site early** so that you can relax for a few minutes before the test starts. You will not be admitted to the exam site if you show up more than 15 minutes after the time the exam is scheduled to begin.
- 2) **Pace yourself.** Know how long you have to finish the test and make sure you are “keeping up.” While you are taking the test, periodically check your time and progress. Also confirm that you’re filling in the number on the answer sheet that corresponds to the question you’re answering.
- 3) **Read all instructions carefully.** The General Examination Rules are available in advance, so there’s no excuse for not being familiar with them.
- 4) The answer sheet and exam are two-sided. Don’t forget to **look at both sides of each page.**
- 5) **Answer what you know first.** If math is a serious problem for you, as it is for many people, plan to answer all of the (generally) easier and quicker “word” (non-math) questions first. Then go back and do all the math questions at the end of the exam. This approach allows you to “get in the math mode” and stay in it, instead of breaking up your concentration. It also ensures that you have answered all the less time-consuming questions first. **Remember each question is worth an equal number of points** - regardless of whether it’s a non-math question that takes you 30 seconds or a math question that takes you 15 minutes.
- 6) **Read questions carefully** with the intention of determining the correct answer for yourself before you even look at the choices offered. You’ll be more likely to select the correct answer if you’ve thought about what it should be before you start looking at the options. If you’re having trouble picking the right answer, reread the question a couple of times. Watch out for double negatives (like “not uncommon”) and other difficult language or sentence structures.
- 7) **Watch for question clues.** When you’re stuck on a question, look for information in other questions. Sometimes you’ll be able to jog your memory or find clues to the right answer as you read through other exam questions. Also, review questions containing extreme modifiers (like “always,” “only,” “never,” and “none”) as these are often less likely to be correct. However, answers with qualifiers (like “seldom,” “usually,” “many,” and “some”) and answers that are very descriptive or specific **may be** more likely to be correct.

- 8) **Read all of the answers so you can pick the best answer.** Sometimes an answer will appear to be correct until you read the rest of the options and discover that another answer offers more information or coincides better with the information in the question. Sometimes an answer will be only partially correct or will contain “misleading” information to draw you to it.  
**Remember: there’s only one right answer.**
- 9) **Eliminate obviously wrong answers before guessing.** When you have to guess, you can improve your odds of picking the right answer by eliminating obviously wrong answers immediately and then choosing among the remaining ones. Remember that if you have four answers to choose from, you automatically have a 25% chance of guessing the right one. If you can eliminate just one of the possible answers, you increase your odds of picking the right answer to 33%. And if you can eliminate two of the possible answers, your odds improve to 50%. Obviously, it’s worth looking carefully at each possible answer to see if you can eliminate any. Look for anything in an answer that will make it incorrect.
- 10) **Answer every question.** There’s no penalty for wrong answers so even if you aren’t sure of the correct answer fill in an answer. Guess wisely and mark your answer on the answer sheet. Then write a note on your scratch paper to remind yourself to recheck that question. Don’t forget to go back through to check your answers.
- 11) **Struggling? Take a break.** When the exam becomes too much, the best strategy is often not to push to concentrate harder, but to back off and rest for a few moments. Put down your pencil and take a few deep breaths. Thirty seconds of rest will seem like thirty minutes in the middle of the exam but it can help you refocus. If you really need a longer break, you can ask the proctor to let you leave the room to get a drink, walk around, or even go outside for some fresh air. You’ll probably find that when you return to the exam, your anxiety will be lower and the questions will make more sense.
- 12) **After you have finished the whole exam, recheck your answers.** Be especially careful to recheck those math questions and any questions whose answers you had to guess. Don’t be afraid to take a hard look at your answers. However, if you’ve taken the time to think through them, your first choice is often the correct one. Only change those questions that you are certain you’ve marked incorrectly.

★ Many people who failed the exam needed only a few points more to pass, so picking up a couple of points here and there can make the difference between passing and failing.

## Sample Questions to Illustrate Test-Taking Strategies

Probably the best way to try out these various strategies and to get familiar with the format of the test questions is to look at a few sample questions. The first sample question is general, the second, support systems, third, unit process/process control and the final sample is a calculation question. These questions are generic (could apply to water or wastewater) and were developed to demonstrate how to use the different strategies that have been discussed. Each question includes a discussion of the possible approaches to finding the right answer.

**Note:** Although these look like the questions you'll see when you take the exam, these are not actual exam questions.

### **Sample Question and Discussion—General**

***When you arrive at work, you observe a circuit breaker padlocked in the “off” position with a tag attached. You also see that a valve is closed, chained and locked. What safety standard do these conditions illustrate?***

- a) plant safety program
- b) hydraulic flow control program
- c) lockout/tagout standard
- d) HazCom labeling

Read the question thoroughly. Be careful of distracting information such as “when you arrive at work...,” which doesn’t affect the answer. Look for clues in the question, such as in this case the words “padlocked” and “with a tag attached” that can help you determine the best answer. Other clues in the question, such as “What safety *standard*...” can help you look for an answer that is directly related to the question, such as, in this example, the “Controlling Hazardous Energies” standard, commonly called “Lockout/Tagout.”

Also be sure to read all of the answers carefully, so that you can pick the *best* answer. In this example, answer a) “plant safety program” is partially correct, but it’s not the *best* answer. You might be distracted by answer d) “HazCom labeling” because it also appears to be safety related. Try to eliminate any answers you can determine are not the *best* answer. For example, some of the conditions described in the question might be recognized as things that control flow, making answer b) “hydraulic flow control program” a potential selection. But it is not the best answer. Use the clues you identified in the question to help direct you to the *best* answer, which is c) “lockout/tagout standard.”

## **Sample Question and Discussion—Support Systems**

**Which answer below best describes the differences between a positive displacement pump and a centrifugal pump?**

- a) centrifugal pumps move fluids by the action of an impeller; positive displacement pumps move fluids by the action of a piston or other device which displaces volume.
- b) centrifugal pumps are always used for pumping large volumes of clear fluids such as drinking water; positive displacement pumps can be used to pump anything.
- c) positive displacement pumps can create dangerous line pressures if operated while discharge valves are closed; centrifugal pumps never exhibit this trait.
- d) positive displacement pumps should not be used in a flooded suction application; centrifugal pumps can only be used in this type of application.

The correct answer is “a”—both statements about the two different types of pumps are true. However, even though you may have recognized “a” as the correct answer as soon as you read it, be sure to read *all* of the offered answers before making your selection. Remember, you are supposed to select the *best* answer, so when more than one answer provided may be correct—you must decide which one *best* answers the question.

Answer “b” can easily be misleading. In your particular job, you may have only experienced centrifugal pumps used to pump clear fluids and perhaps even only in large volumes. So at first glance, this answer looks promising. Your experience may also have shown that positive displacement pumps have the ability to pump a variety of fluids, including sludges with relatively high concentrations of solids. However, the extreme modifier, “...pump *anything...*” should be examined carefully. “Anything” would include literally anything...water, sludges, dry chemicals, bricks, plywood, etc. Obviously they can’t. This makes this answer unlikely to be the correct one—certainly not the best one since “a” appears much better.

Although answer “c” is partially true, answer “a” is better. The statement about positive displacement pumps creating high line pressures when valves are closed is certainly correct. But the claim that centrifugal pumps *never* exhibit this trait is simply not true. Many centrifugal pumps can generate dangerously high pressures if operated against throttled or closed valves. The extreme modifier, “never,” in this statement should be a flashing light to warn you of a probably “wrong” distractor.

Answer “d” should be an easy elimination. “A flooded suction application” is simply where the fluid on the suction side of the pump is at a higher elevation than the centerline of the pump. Both positive displacement and centrifugal pumps can easily pump fluids when installed in this type of application. So the statement the “positive displacement pumps should not be used...” disqualifies this answer immediately. Another reason to reject this answer is the further statement “centrifugal pumps can *only* be used in this type of application.” Centrifugal pumps can easily lift water from elevations lower than their centerline (although there is a practical limit of approximately 25 feet).

### **Sample Question and Discussion—Unit Process/Process Control**

***A flow proportional gas chlorinator system with a feed capacity of 500 pounds per day uses plant process water to generate the needed system vacuum. Which component of the chlorination system generates this vacuum?***

- a) the vacuum regulator
- b) the chlorinator
- c) the pressure regulator
- d) the chlorine ejector

In this example, much of the information is excessively technical and specific, and it can distract you from zeroing in on the important data. The fact that this chlorinator is “flow proportional” with a “500 pound per day feed capacity” and that it uses “plant process water” is totally irrelevant to the question being asked. Basically, the question is simply asking, “what creates the vacuum in a chlorinator system?”

Obviously, you must know the names and functions of the various components of a typical chlorinator system to determine the answer to this question. The ejector feed water flowing through the chlorine ejector creates the vacuum that draws the chlorine gas from the chlorinator. The chlorine gas dissolves into the ejector water and this chlorine solution is applied to the flow, typically through a diffuser. Therefore “d) the chlorine ejector” is the correct answer.

Even if you are familiar with only a few of the parts of a chlorinator system, you can attempt to eliminate some of the possible answers, in order to narrow your choices down to fewer than four. For example, the question asks about “generating vacuum.” You may know that the pressure regulator does just that—regulates pressure—and has nothing to do with generating vacuum. This knowledge should allow you to eliminate the pressure regulator as a possible correct answer.

Also, just because the word “vacuum” is in answer “a,” don’t automatically assume it’s the correct answer.

Another resource you may discover for answering questions that prove difficult is...other questions in the exam! Many times a question will state information that can provide you with clues to help answer other, related questions. For example, if a question elsewhere in the exam asks: “If the water to the ejector is shut off, causing a loss of vacuum, what can the operator do to continue to apply chlorine?” Well, if you didn’t know that the ejector created the vacuum, you do now! Use this information to your advantage. (NOTE: don’t expect clues to be as obvious as this—we’re simply trying to make a point here.)

**Sample Question and Discussion—Calculations**

**An above ground circular settling tank has 1½ inch thick steel walls, a depth of 8 feet 6 inches, a diameter of 14 feet and a total weir length of 31 feet. At a flow of 150,000 gallons per day, which of the following detention times does the tank have?**

- a) 0.0156 days
- b) 1.56 hours
- c) 0.156 hours
- d) 15.6 minutes

As in all exam questions, math or otherwise, accept the basic information provided in the question. Don't try to include additional information that you may feel makes the question more realistic or more like your particular job or work place.

Look at the problem to determine the geometric shape described. In this example, the words “circular” and “diameter” indicate that the tank is a cylinder. Draw a diagram of the tank and label its dimensions from the data supplied in the question.



Next, use the question to determine the type of math problem being asked. Once determined, you can select the correct formula to use from the Formula/ Conversion sheet. In this question, “...which of the following detention times...” tells you to use the detention time formula. Write this formula on your scratch paper, making sure that the formula is arranged to solve for the particular answer you need—in this case detention time. Rearrange the formula if necessary.

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow}}$$

Plug any data provided in the question into the appropriate part of the formula. The only data provided in this example is the flow.

$$\text{Detention Time} = \frac{\text{Volume}}{150,000 \frac{\text{gal}}{\text{day}}}$$

There may be more data in the question than you need for the formula. In this example, the “1½ inch thick steel walls” and the “total weir length of 31 feet” are only distractors—they don’t have any impact on detention time. Let the formula components dictate the data or information that you take from the question. In this example, you need the tank “volume” and the “flow” going through it.

The other component of the formula you need, the “volume,” is not provided in the question. However, somewhere in the question will be data that will allow you to come up with the missing info. In this example, you will need to do a preliminary calculation using the tank dimensions to solve for volume. From the Formula/ Conversion sheet, select the “Volume of a Cylindrical Tank” formula. Write the formula on your scratch paper, plugging in the dimensions from the question. Convert all tank dimensions into “feet” for volume calculations, so the answer will be in “cubic feet.” You can convert to “gallons” later. You will want the volume expressed in gallons since the flow provided in the question is in “gallons per day.” In this example, the tank height of 8 feet 6 inches converts to 8.5 feet (NOT 8.6 feet—a common mistake).

**Note:** Some of the geometric shapes on the Formula/Conversion sheet have two different formulas provided, separated by an equal sign (=). Both are correct and you may choose to use either one.

$$\text{Volume of a Cylindrical Tank} = 0.785 D^2 H$$

$$\text{Volume} = 0.785 (14 \text{ feet} \times 14 \text{ feet}) 8.5 \text{ feet}$$

$$\text{Volume} = 1307.8 \text{ cubic feet}$$

Now convert this volume into gallons. From the Formula/Conversion sheet use the “7.48 gallons/cubic foot” conversion factor.

$$1307.8 \text{ cubic feet} \times 7.48 \frac{\text{gallons}}{\text{cubic foot}} = 9782 \text{ gallons}$$

Plug this volume into the Detention Time formula.

$$\text{Detention Time} = \frac{9782 \text{ gal}}{150,000 \frac{\text{gal}}{\text{day}}}$$

Now that all the needed data is plugged into the formula, solve for the answer.

$$\text{Detention Time} = \frac{9782 \text{ gal}}{150,000 \frac{\text{gal}}{\text{day}}} = 0.065 \text{ days}$$

Pay close attention to the units of measurement you are using. If your answer doesn't match any of the possible answers provided in the question, convert to another unit of measurement. In this example, the detention time has been calculated as "0.065 days." This doesn't match any of the possible answers, so your answer needs to be converted to another unit of time. In this example, since there are two "hour" answers, a logical first conversion would be to hours.

$$0.065 \text{ days} \times 24 \frac{\text{hours}}{\text{day}} = 1.56 \text{ hours}$$

This matches answer "b."

Finally, in many cases you will be able to check your answer by plugging it into the original formula to see if it works out correctly.

Remember that all of your long, hard work answering a math question could be for nothing if you aren't careful about:

- Plugging in accurate numbers into your calculator.
- Reading the correct placement of decimal points in the data you use, as well as in the answers from your calculator. Notice how in this example the figures "1," "5," and "6" appear in all four possible answers.
- Using correct units of measurement.

## **Reporting of Exam Results**

After you finish the certification exam, the Board sends your answer sheet to ABC for computerized grading (except for some of the industrial wastewater exams, which are graded by the Board). ABC returns your results to the Board, and the Board then sends you a letter stating whether you have passed or failed. In either case, you will receive an Examinee Report, which includes information showing your specific performance (the number and percentage of correct responses) for each of the topical areas on the exam. You will typically receive your results within 4–6 weeks following the exam.

The minimum passing score for all exams is 70%. If you pass, the Board will send to you, along with your Examinee Report, a letter notifying you of your success and an application for an operator certificate, for you to submit when you've met all of the certification requirements.

If you fail, the Board will send you a letter, an Examinee Report, the ABC Study Reference Codes, another exam application and an exam schedule.

Before retaking the exam, look at your Examinee Report to check your performance on each topic of the exam. Study those topics in which you need improvement. Choose courses and references which will help you really prepare in those areas of study where you had the most difficulty.

And remember, if you failed the exam, you are not alone. You are almost certain to pass if you keep trying. There are plenty of good resources to help you. The certification exam is designed to ensure that operators are technically qualified. Studying and passing the exam are critical steps in the qualification process for professional operators.