Drinking Water Treatment Exams
Expected Range of Knowledge

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**Source Water**
Watershed Protection, Wells / Groundwater, Surface Water / Reservoirs, Raw Water Storage, Clear Well Storage

**Water Treatment Processes**
Coagulation/Flocculation/ Sedimentation, Filtration, Disinfection, Corrosion Control, Taste and Odor, Iron and Manganese removal, Fluoridation, BAT (Best Available Technology)

**Operation / Maintenance**
Chemical feeders, Pumps and Motors, Blowers and Compressors, Water meters, Pressure gauges, Instrumentation, Electrical generators

**Laboratory Procedures**
Sampling, General Lab Practices, Disinfectant analysis, Alkalinity analysis, pH analysis, Turbidity analysis, Specific Conductance, Hardness, Fluoride analysis, Color analysis, Taste and Odor analysis, Microbiological analysis

**Regulations/ Administrative Duties**
Safety, Planning, Organizing, Directing, Controlling, Implementing Regulations, Record keeping, California Waterworks Standards, Safe Drinking Water Act and amendments, Surface Water Treatment Rule and amendments, Primary Contaminants, Secondary Contaminants, Lead and Copper Rule, Total Coliform Rule, Operator Certification Regulations
EXPECTED RANGE OF KNOWLEDGE  
WATER TREATMENT EXAMS

(Items marked “T1-T4” may be on the T1 – T4 exams)
(Items marked “T2-T4” may be on the T2 – T4 exams but not on the T1 exam)

Source Water

T1 - T4  Ability to calculate flow rates and water velocity
T1 - T4  Ability to calculate the volume of water in a storage facility
T1 - T4  Ability to calculate well drawdown
T1 - T4  Ability to calculate detention time
T1 - T4  Ability to calculate well specific capacity
T1 - T4  Ability to calculate well head pressure
T1 - T4  Ability to convert common water units, (gallons per minute to MGD, etc…)
T1 - T4  Ability to convert head pressure to water elevation
T1 - T4  Ability to convert units of length, volume, flow and pressure
T1 - T4  Ability to determine water level in a storage tank, reservoir or well
T1 - T4  Ability to recognize abnormal chemical characteristics of water
T1 - T4  Ability to recognize abnormal odors or colors
T1 - T4  Ability to recognize abnormal well operations
T1 - T4  Ability to recognize potential security risks
T1 - T4  Ability to recognize potential sources of contamination in surface water
T1 - T4  Ability to recognize the influence of surface water on a groundwater source
T1 - T4  Knowledge of chemicals that contribute alkalinity and hardness to water
T1 - T4  Knowledge of common chemical and microbial contaminants in raw water
T1 - T4  Knowledge of flow measurement devices
T1 - T4  Knowledge of potential microbial and chemical contamination sources in groundwater and surface water
T1 - T4  Knowledge of problems caused by hard water
T1 - T4  Knowledge of storage tank disinfection procedures
T1 - T4  Knowledge of the characteristics of aquifers
T1 - T4  Knowledge of the chemical components of groundwater and surface water
T1 - T4  Knowledge of the hydrologic cycle
T1 - T4  Knowledge of visual signs of contamination in a surface water reservoir
T1 - T4  Knowledge of well components
T1 - T4  Knowledge of well depth measurement procedures
T1 - T4  Knowledge of well disinfection procedures
T1 - T4  Knowledge of well drawdown measurement techniques
T2 - T4  Ability to discriminate between normal and abnormal conditions of a surface water reservoir
T2 - T4  Ability to recognize hydrological changes
T2 - T4  Knowledge of how reservoir intake level effects water quality
T2 - T4  Knowledge of the effects of seasonal changes on water reservoirs
T2 - T4  Knowledge of pretreatment procedures
T3 - T4  Knowledge of surface water reservoir stratification
T3- T4  Ability to recognize head loss across an intake screen
T3- T4  Knowledge of groundwater treatment procedures

Water Treatment Processes

Coagulation/Flocculation/Sedimentation

T3- T4  Ability to calculate a coagulant dose from a jar test
T3- T4  Ability to perform a jar test
T3- T4  Ability to recognize and correct abnormal conditions in a sedimentation basin
T3- T4  Ability to recognize normal and abnormal floc formation
T3- T4  Knowledge of flocculation tanks
T3- T4  Knowledge of chemical coagulants and coagulant aids
T3- T4  Knowledge of coagulation/flocculation start up/shut down and adjustment procedures
T3- T4  Knowledge of enhanced coagulation
T3- T4  Knowledge of sedimentation basins
T3- T4  Knowledge of the coagulation/ flocculation process
T3- T4  Knowledge of the effects of temperature, alkalinity and pH on flocculation
T3- T4  Knowledge of the flash mixing process
T3- T4  Knowledge of the jar testing procedure
T3- T4  Knowledge of the sedimentation process
T3- T4  Knowledge of tube settlers
T4  Knowledge of water gradient velocities
T4  Knowledge of the zeta potential
T4  Knowledge of Van Der Waals forces
T4  Knowledge of ballasted flocculation procedures

Filtration

T1- T4  Ability to interpret turbidity information
T1- T4  Knowledge of turbidity causing matter
T2- T4  Ability to calculate daily filter production
T2- T4  Ability to calculate filter backwash rate
T2- T4  Knowledge of head loss effects on filters
T2- T4  Knowledge of filter surface washing methods
T2- T4  Knowledge of filtration mechanisms, (absorption, adsorption)
T3- T4  Ability to calculate a filter-aid dosage
T3- T4  Ability to calculate a filtration rate
T3- T4  Ability to calculate filter loading rate
T3- T4  Ability to recognize and correct problems in gravity filters
T3- T4  Ability to recognize and correct problems in multimedia filters
T3- T4  Knowledge of backwash sequencing
T3- T4  Knowledge of filter media types and uses
T3- T4  Knowledge of maximum filtration rates
T3- T4  Knowledge of normal and abnormal filter media conditions
T3 - T4  Ability to calculate filter media volume and capacity
T4  Ability to conduct a comprehensive performance evaluation of a filter
T4  Ability to operate an air scour system
T4  Ability to perform a filter assessment surveillance program
T4  Ability to perform a filter profile analysis
T4  Ability to recognize and correct problems in granular activated carbon filters
T4  Knowledge of air scouring systems
T4  Knowledge of filter media replacement requirements and techniques
T4  Knowledge of filter porosity

**Disinfection**

T1 - T4  Ability to calculate a chemical dosage
T1 - T4  Ability to calculate a chemical solution concentration
T1 - T4  Ability to calculate chlorine demand and chlorine residual
T1 - T4  Knowledge of acceptable chlorine residual levels
T1 - T4  Knowledge of breakpoint chlorination chemistry
T1 - T4  Knowledge of chlorine chemistry
T1 - T4  Knowledge of common chlorine compounds used for disinfection
T1 - T4  Knowledge of disinfectant byproduct formation
T1 - T4  Knowledge of disinfectant properties and uses
T1 - T4  Knowledge of disinfection residual requirements
T1 - T4  Knowledge of MCL’s and MRDL’s of disinfectants
T2 - T4  Ability to calculate a CT value
T2 - T4  Ability to choose an appropriate disinfectant for a particular microbial problem
T2 - T4  Knowledge of chloramine chemistry
T2 - T4  Knowledge of disinfectant byproduct reduction procedures
T2 - T4  Knowledge of TOC/Disinfection byproduct correlation

**Corrosion Control**

T1 - T4  Ability to recognize corrosion problems
T1 - T4  Knowledge of pH adjustment procedures
T1 - T4  Knowledge of corrosion causes
T2 - T4  Knowledge of corrosion reduction methods
T3 - T4  Knowledge of C-factor
T3 - T4  Knowledge of the cathodic protection process
T3 - T4  Knowledge of corrosion control inhibitors
T3 - T4  Knowledge of the Langelier Index
T3 - T4  Knowledge of corrosion control chemical reactions
T4  Ability to choose the proper corrosion control chemical for a specific problem

**Taste and Odor**

T1 - T4  Knowledge of abnormal taste and odors
T1 - T4  Knowledge of chemicals that contribute taste and odor
T1 - T4  Knowledge of taste and odor treatment processes
Iron and Manganese

T1 - T4  Ability to recognize an iron and manganese problem
T3 - T4  Knowledge of iron and manganese oxidation chemistry
T3 - T4  Knowledge of iron and manganese removal techniques

Fluoridation

T4  Knowledge fluoridation chemicals
T4  Knowledge of fluoride chemistry
T4  Knowledge of optimal fluoride level range
T4  Knowledge of the health effects of fluoride

Best Available Technology

T1 - T4  Knowledge of health effects of lead and copper
T1 - T4  Knowledge of adverse health effects caused by common contaminants
T2 - T4  Knowledge of BAT, (Best Available Technology) for common water contaminants
T2 - T4  Knowledge of effective removal techniques for common contaminants
T3 - T4  Ability to perform blending calculations
T3 - T4  Knowledge of the aeration process
T4  Knowledge of chemical oxidation techniques and uses
T4  Knowledge of granular activated carbon, (GAC)
T4  Knowledge of nitrate removal processes

Operation / Maintenance

Chemical Feeders

T1 - T4  Ability to calculate a dosage for a chemical feeder
T1 - T4  Ability to calibrate and adjust a chemical feeder pump
T1 - T4  Ability to operate a chemical feeder system
T1 - T4  Ability to replace components of a chemical feeder system
T1 - T4  Ability to set proper chemical feed rate
T1 - T4  Knowledge of chemical feeder calibration and adjustment
T1 - T4  Knowledge of the components of chemical feeder systems
T1 - T4  Knowledge of the operation of chemical feeder systems

Pumps, Motors and Gearboxes

T1 - T4  Ability to discriminate between normal and abnormal operation of a water pump
T1 - T4  Knowledge of pump types and uses
T1 - T4  Knowledge of the components of a water pump
T1 - T4  Knowledge of the operation of a water pump
T1 - T4  Knowledge of valve types and uses
T1 - T4  Ability to replace components of a water pump
T2 - T4  Knowledge of pump installation procedures

Blowers and Compressors

T3 - T4  Knowledge of the operation of blowers and compressors
T3 - T4 Ability to discriminate between normal and abnormal operation of blowers and compressors
T4 Ability to replace components of blowers and compressors
T4 Knowledge of the components of blowers and compressors

Water Meters
T1 - T4 Ability to read and interpret water meter readings
T1 - T4 Knowledge of the components of water meters
T1 - T4 Knowledge of the operation of water meters
T1 - T4 Knowledge of water meter types and uses
T2 - T4 Ability to calibrate a water meter

Pressure Gauges
T1 - T4 Knowledge of head pressure
T1 - T4 Knowledge of the operation of pressure gauges
T2 - T4 Ability to replace pressure gauges
T3 - T4 Knowledge of the components of pressure gauges

Instrumentation
T1 - T4 Knowledge of basic SCADA system components
T2 - T4 Ability to determine normal operation of a SCADA system
T2 - T4 Knowledge of the components of on-line analyzers
T3 - T4 Ability to recognize analytical interferences in on-line analyzers
T3 - T4 Ability to repair or replace defective parts of an on-line analyzers
T3 - T4 Knowledge of the operation of on-line analyzers

Electrical Generators
T3 - T4 Knowledge of the operation of an electrical generator
T3 - T4 Knowledge of the components of an electrical generator

Laboratory Procedures
Sampling
T1 - T4 Ability to collect a water sample
T1 - T4 Ability to determine a proper sampling site
T1 - T4 Ability to follow chain of custody
T1 - T4 Knowledge of appropriate sample containers and sample sizes
T1 - T4 Knowledge of maximum holding times
T1 - T4 Knowledge of proper sampling and preservation techniques
T1 - T4 Knowledge of well sampling techniques

General Laboratory Practices
T1 - T4 Ability to calculate a chemical solution concentration
Knowledge of chemical hazards
Ability to calculate a dilution factor
Ability to mix chemicals and prepare reagents
Ability to perform dilutions

Disinfectant Analysis
- Ability to analyze a water sample for free and total chlorine
- Ability to read and interpret a colorimeter
- Knowledge of approved analytical procedures for chlorine analysis
- Knowledge of chlorine chemistry

Alkalinity Analysis
- Knowledge of chemicals that contribute alkalinity to water
- Ability to use a titrator
- Ability to recognize a titration end-point
- Knowledge of abnormal alkalinity levels

pH Analysis
- Ability to read and interpret a pH meter
- Knowledge of acids and bases
- Knowledge of acceptable water pH range
- Knowledge of chemicals that effect the pH of water
- Knowledge of the effects of pH on water quality
- Knowledge of the pH scale
- Ability to analyze a water sample for pH
- Ability to calibrate a pH meter

Turbidity Analysis
- Ability to analyze a water sample for turbidity
- Ability to read and interpret a turbidimeter
- Knowledge of the NTU scale, (Nephelometric Turbidity Unit)
- Knowledge of turbidimeter instrumentation
- Knowledge of turbidity causing matter
- Knowledge of turbidity level requirements
- Ability to prepare and calibrate turbidimeter with Primary standard (Formazin)

Specific Conductance
- Ability to analyze a water sample for specific conductance
- Ability to read and interpret a specific conductance meter
- Ability to calculate a TDS value from a specific conductance reading
- Knowledge of EC/TDS ratio
- Ability to calibrate a specific conductance meter
Hardness
- T1 - T4 Knowledge of chemicals that contribute hardness to water
- T2 - T4 Ability to analyze a water sample for water hardness
- T2 - T4 Knowledge of hardness removal processes

Fluoride
- T4 Ability to operate an ISE, (Ion Specific Electrode)
- T4 Knowledge of optimal fluoride level range

Color Analysis
- T2 - T4 Ability to recognize abnormal colors in water
- T3 - T4 Knowledge of abnormal color levels
- T4 Knowledge of color analysis scale
- T4 Knowledge of true and apparent color

Taste and Odor
- T1 - T4 Ability to identify an objectionable taste or odor in water
- T1 - T4 Knowledge of chemicals that contribute taste and odor to water
- T4 Knowledge of odor analysis protocol

Microbiological Analysis
- T1 - T4 Knowledge of the presence/absence test method
- T1 - T4 Knowledge of approved analytical procedures for coliform analysis
- T1 - T4 Knowledge of common microbial contaminants in raw water
- T2 - T4 Knowledge of HPC, (Heterotrophic Plate Count)
- T3 - T4 Ability to distinguish between presumptive and confirmed coliform results
- T3 - T4 Knowledge of the multiple tube fermentation method
- T3 - T4 Knowledge of the membrane filtration method

Safety
- T1 - T4 Ability to demonstrate safe work habits
- T1 - T4 Ability to identify potential safety hazards
- T1 - T4 Ability to recognize unsafe working conditions
- T1 - T4 Ability to select and utilize safety equipment
- T1 - T4 Knowledge of chemical hazards
- T1 - T4 Knowledge of compressed gas safety procedures
- T1 - T4 Knowledge of confined space safety procedures
- T1 - T4 Knowledge of electrical safety
- T1 - T4 Knowledge of hazardous chemical handling
- T1 - T4 Knowledge of incompatible chemicals
- T1 - T4 Knowledge of lock-out/tag-out procedures
- T1 - T4 Knowledge of MSD sheets
T1 - T4  Knowledge of personal protective equipment, (PPE)
T1 - T4  Knowledge of proper chemical handling techniques
T1 - T4  Knowledge of safe working practices
T1 - T4  Knowledge of the use of safety equipment
T2 - T4  Knowledge of HAZWOPER guidelines
T3 - T4  Ability to administer a safety plan
T3 - T4  Ability to generate a written safety plan

**Administrative Duties / Regulations**

T1 - T4  Ability to interpret water quality characteristics, (hardness, turbidity, pH)
T1 - T4  Knowledge of basic unit processes used in treating drinking water
T1 - T4  Knowledge of corrective actions to take when regulations are violated
T1 - T4  Knowledge of drinking water monitoring and reporting requirements
T1 - T4  Knowledge of drinking water regulations
T1 - T4  Knowledge of notification protocol and procedures
T1 - T4  Knowledge of NSF Standards
T1 - T4  Knowledge of operator certification requirements
T1 - T4  Knowledge of Primary and Secondary Drinking Water Standards
T1 - T4  Knowledge of public notification procedures
T1 - T4  Knowledge of record keeping requirements
T1 - T4  Knowledge of California Waterworks Standards
T1 - T4  Knowledge of the Consumer Confidence Report, (CCR)
T1 - T4  Knowledge of the Disinfectants and Disinfection Byproduct Rule and amendments
T1 - T4  Knowledge of the Groundwater Rule
T1 - T4  Knowledge of the Lead and Copper Rule
T1 - T4  Knowledge of the Surface Water Treatment Rule and amendments
T1 - T4  Knowledge of the Total Coliform Rule and amendments
T1 - T4  Knowledge of waterborne pathogens
T1 - T4  Ability to interpret water quality reports
T1 - T4  Ability to research and interpret Maximum Contaminant Levels, (MCL’s)
T2 - T4  Ability to administer a maintenance program
T2 - T4  Knowledge of cryptosporidium action plan
T2 - T4  Knowledge of pending regulations
T2 - T4  Knowledge of performance standards and removal requirements for surface water treatment
T2 - T4  Knowledge of the Filter Backwash Rule
T2 - T4  Knowledge of routine sampling requirements
T3 - T4  Ability to administer a regulatory compliance program
T3 - T4  Ability to calculate percent or log removal of contaminants from water
T3 - T4  Ability to calculate the cost of water treatment operations
T3 - T4  Ability to develop an operational site sampling plan
T3 - T4  Ability to develop an operations plan
T3 - T4  Ability to evaluate treatment facility performance
T3 - T4  Knowledge of facility operation and maintenance
T3 - T4  Knowledge of management principles
T3 - T4  Knowledge of permit requirements for water operations
T3 - T4  Knowledge of principles of supervision
T3 - T4  Knowledge of public relations principles
T3 - T4  Knowledge of pump to waste discharge environmental regulations
T3 - T4  Knowledge of regulatory primacy issues
T3 - T4  Knowledge of source water replenishment processes
T3 - T4  Knowledge of the Sanitary Survey process
T4    Ability to interpret historical water use data
T4    Knowledge of the role of Regional Boards in managing contamination sources
T4    Knowledge of the Source Water Assessment Program
T4    Knowledge of the Watershed Survey process
T4    Knowledge of the vulnerability assessment process

Water Treatment Exam Math

T1 - T4  Ability to calculate flow rates and water velocity
T1 - T4  Ability to calculate the volume of water in a storage facility
T1 - T4  Ability to calculate well drawdown
T1 - T4  Ability to calculate detention time
T1 - T4  Ability to calculate well specific capacity
T1 - T4  Ability to calculate well head pressure
T1 - T4  Ability to convert common water units, (gallons per minute to MGD, etc…)
T1 - T4  Ability to convert head pressure to water elevation
T1 - T4  Ability to convert units of length, volume, flow and pressure
T1 - T4  Ability to determine water level in a storage tank, reservoir or well
T1 - T4  Ability to calculate a chemical dosage
T1 - T4  Ability to calculate a chemical solution concentration
T1 - T4  Ability to calculate chlorine demand and chlorine residual
T1 - T4  Ability to calculate a dosage for a chemical feeder
T1 - T4  Ability to calculate a chemical solution concentration
T2- T4  Ability to calculate daily filter production
T2- T4  Ability to calculate filter backwash rate
T2 - T4  Ability to calculate a CT value
T2 - T4  Ability to calculate a dilution factor
T2 - T4  Ability to perform dilutions
T3- T4  Ability to calculate a coagulant dose from a jar test
T3- T4  Ability to calculate a filter-aid dosage
T3- T4  Ability to calculate a filtration rate
T3- T4  Ability to calculate filter loading rate
T3 - T4  Ability to calculate percent or log removal of contaminants from water
T3 - T4  Ability to calculate the cost of water treatment operations