

State Water Resources Control Board

Water Distribution Exams Expected Range of Knowledge

| Exam Content Grade | number of questions | | | | |
|--|---------------------|------------|------------|------------|------------|
| | D1 | D2 | D3 | D4 | D5 |
| DISINFECTION | 15 | 20 | 20 | 15 | 10 |
| DISTRIBUTION SYSTEM DESIGN / HYDRAULICS | 20 | 20 | 15 | 10 | 10 |
| EQUIPMENT OPERATION / MAINTENANCE / INSPECTIONS | 20 | 20 | 25 | 20 | 15 |
| WATER REGULATIONS / MANAGEMENT / SAFETY | 15 | 10 | 15 | 35 | 45 |
| WATER MAINS AND PIPING | 20 | 20 | 15 | 5 | 5 |
| WATER QUALITY/WATER SOURCE | 10 | 10 | 10 | 15 | 15 |
| | 100 | 100 | 100 | 100 | 100 |

Disinfection

Water Main Disinfection, Well Disinfection, Disinfectant By-Products, Chloramination, Chlorine Curve Chemistry, Storage Reservoir Disinfection, Types of Disinfectants

Distribution System Design / Hydraulics

System Layout, Storage Facilities, Cross-Connection and Backflow Devices, Service Connections, Systems Map, Assess System Demand, Flow Rates and Velocity, Head Loss, Cavitation, Water Hammer, Water Pressure and Volume, Static and Dynamic Pressure

Drinking Water Regulations/Management / Safety

Disinfection-By-Product Rule, Lead and Copper Rule, MCLs, Monitoring and Sampling Requirements, Public Notification, Safe Drinking Water Act, Total Coliform Rule, Operator Certification Regulations, Administer Compliance, Budgets, Emergency Response Planning, Future Planning, Maintenance Plan, Safety Plan, Water Conservation Planning, Water Rates

Equipment Operation / Maintenance / Inspections

Valves, Water Meters, Hydrants, Chemical Feeders, Corrosion, In-Line Sensors, Power Generators, SCADA, Pump Types, Uses, and Sizes, Troubleshoot and Repair Pumps and Motors, Water Horsepower, Inspection of Water Mains, Piping, Storage Tanks, and Equipment Installation and Repair, Wells (new and abandoned)

Water Mains and Piping

Cleaning and Maintenance, Excavation, Installation, and Repair, Joints and Fittings, Leak Detection and Repair, Pipe Selection, Service Line Installation

Water Quality / Water Sources

Coliform Group, Corrosivity, Heterotrophic Bacteria, Organic and Inorganic Contaminants, pH, Conductivity, Hardness, and Turbidity, Unidirectional Flushing, Waterborne Diseases, Groundwater, Wells, Sanitary Survey

(Items marked "D1-D5" may be on the D1 – D5 exams)

(Items marked "D2-D5" may be on the D2 – D5 exams but not on the D1 exam)

Disinfection

Water Main Disinfection

- D1-D5 Knowledge of water main disinfectant techniques
- D1-D5 Knowledge of de-chlorination techniques
- D1-D5 Ability to apply disinfectant
- D1-D5 Knowledge of AWWA disinfection standards for water mains

Well Disinfection

- D1-D5 Knowledge of contamination sources in a well
- D1-D5 Ability to calculate a disinfectant dosage
- D1-D5 Knowledge of well disinfection techniques
- D1-D5 Knowledge of water depth measurement techniques
- D1-D5 Knowledge of AWWA disinfection standards for wells
- D1-D5 Ability to measure the water depth in a well
- D1-D5 Ability to calculate the volume of a well

Storage Reservoir Disinfection

- D1-D5 Knowledge of water storage contamination sources
- D1-D5 Ability to calculate the volume of a storage reservoir
- D1-D5 Knowledge of storage reservoir disinfection techniques
- D1-D5 Knowledge of AWWA disinfection standards for storage facilities
- D1-D5 Ability to calculate a disinfectant dosage
- D2-D5 Ability to choose the proper disinfectant technique
- D2-D5 Ability to calculate the surface area of the interior walls of a storage reservoir
- D3-D5 Ability to calculate CT

Disinfectant By-Products

- D2-D5 Knowledge of the causes of DBPs
- D3-D5 Knowledge of DBP reduction methods
- D3-D5 Knowledge of DBP formation
- D3-D5 Knowledge of DBP compounds
- D3-D5 Ability to recognize abnormal levels DBPs in the water distribution system

Chloramination

- D1-D5 Ability to measure total chlorine
- D2-D5 Knowledge of the chlorine curve
- D2-D5 Knowledge of advantages/disadvantages of chloramination
- D2-D5 Knowledge of chloramine compounds
- D2-D5 Ability to calculate chlorine/ammonia ratio for chloramination

Chlorine Curve Chemistry

- D2-D5 Knowledge of the definition of breakpoint chlorination
- D2-D5 Knowledge of the chlorine curve
- D2-D5 Ability to recognize when breakpoint has been met

Types of Disinfectants

- D1-D5 Knowledge of the purpose of disinfection
- D1-D5 Knowledge of contact time
- D1-D5 Knowledge of causes of chlorine demand
- D1-D5 Ability to monitor and interpret chlorine residual
- D1-D5 Ability to calculate a dosage
- D2-D5 Knowledge of disinfectant types and characteristics
- D2-D5 Knowledge of factors affecting chlorine disinfection
- D2-D5 Knowledge of chlorine analysis techniques
- D3-D5 Knowledge of chlorine chemistry

Distribution System Design / Hydraulics

Assess System Demand

- D1-D5 Knowledge of unit conversions
- D2-D5 Knowledge of the terms "peak demand," "peak hour demand," "maximum daily demand," and "per-capita demand"

Cross-Connection and Backflow Devices

- D1-D5 Knowledge of conditions that cause backflow
- D1-D5 Knowledge of available backflow prevention methods
- D1-D5 Knowledge of "back-pressure" and back-siphonage" conditions
- D1-D5 Ability to recognize a potential backflow hazard
- D1-D5 Ability to recognize a cross-connection

Service Connections

- D1-D5 Knowledge of service connection materials and fittings
- D1-D5 Ability to tap a water main
- D2-D5 Knowledge of record keeping requirements

Storage Facilities

- D1-D5 Ability to calculate the volume of a storage facility
- D1-D5 Ability to calculate flow rates for a storage facility
- D2-D5 Knowledge of the types of storage facilities and their applications
- D2-D5 Knowledge of storage facility corrosion control methods
- D2-D5 Knowledge of storage facility components
- D2-D5 Ability to drain, clean and disinfect a storage facility

System Layout

- D1-D5 Knowledge of "grid," "tree," "arterial," and "dead end" water systems
- D2-D5 Ability to differentiate between a "trunk" line and a "transmission" line
- D4-D5 Ability to calculate the hydraulic gradient

System Maps

- D1-D5 Knowledge of pressure / elevation relationships
- D2-D5 Knowledge of map types
- D2-D5 Ability to interpret map symbols
- D2-D5 Ability to convert a scale to actual distance

Flow Rates and Velocity

- D1-D5 Ability to convert units of volume, area, and time
- D1-D5 Ability to calculate the volume of a pipe
- D1-D5 Ability to calculate the area of a pipe cross-section
- D1-D5 Ability to calculate a flow rate
- D2-D5 Ability to calculate water velocity

Head Loss

- D2-D5 Knowledge of the relationship between head loss and friction
- D3-D5 Knowledge of the effect of corrosion on head loss

Cavitation

- D2-D5 Knowledge of the causes of cavitation
- D2-D5 Ability to recognize the signs of cavitation

Water Hammer

- D1-D5 Knowledge of water hammer reduction techniques
- D1-D5 Knowledge of the definition of water hammer
- D1-D5 Knowledge of the causes of water hammer
- D1-D5 Ability to calculate the surface area of a valve face
- D2-D5 Ability to calculate total force on a valve

Water Pressure and Volume

- D1-D5 Ability to convert units of volume, pressure, and area
- D1-D5 Ability to calculate the volume of a cylinder, rectangle and square

Static and Dynamic Pressure

- D1-D5 Knowledge of the relationship between water velocity and water pressure
- D1-D5 Ability to recognize abnormal pressure readings, (too high or too low)
- D1-D5 Ability to read and interpret a pressure gauge
- D1-D5 Ability to convert pressure to feet of head

Drinking Water Regulations / Management / Safety

Disinfection-By-Product Rule

- D2-D5 Knowledge of the Disinfectant By-Product Rule sampling requirements
- D3-D5 Knowledge of Disinfectant By-Product Rule reporting requirements
- D3-D5 Knowledge of Disinfectant By-Product Rule MCL requirements

Lead and Copper Rule

- D1-D5 Ability to take a lead and copper sample
- D3-D5 Knowledge of lead and copper sampling requirements
- D3-D5 Knowledge of lead and copper rule reporting requirements
- D4-D5 Ability to recognize a lead and copper rule violation

Maximum Contaminant Levels (MCL)

- D1-D5 Knowledge of the definition of MCL
- D2-D5 Knowledge of maximum disinfectant residual level for chlorine
- D2-D5 Ability to differentiate between a primary and secondary MCL
- D2-D5 Ability to recognize MCL violations

Monitoring and Sampling Requirements

- D1-D5 Ability to read a sample siting plan
- D1-D5 Knowledge of water sampling techniques for bacteriological, organic, and inorganic constituents
- D1-D5 Knowledge of holding times (e.g., preservatives)

Operator Certification Regulations

- D1-D5 Knowledge of certification requirements

Public Notification

- D1-D5 Knowledge of acute violations
- D1-D5 Knowledge of when public notification is required
- D4-D5 Knowledge of required language to use
- D4-D5 Knowledge of notification paths (e.g., newspaper, electronic)

Safe Drinking Water Act

- D1-D5 Knowledge of the purpose of the SDWA
- D1-D5 Knowledge of the major components of the SDWA
- D2-D5 Knowledge of reporting and recordkeeping requirements
- D3-D5 Knowledge of non-compliance penalties

Total Coliform Rule

- D1-D5 Knowledge of Total Coliform Rule sampling requirements
- D1-D5 Knowledge of Total Coliform Rule reporting requirements

Administer Compliance, Budgets

- D1-D5 Knowledge of OSHA / Cal-OSHA safety regulations
- D1-D5 Knowledge of CDPH Water Quality regulations
- D3-D5 Ability to calculate the cost of water production
- D5 Knowledge of RWQCB discharge requirements
- D5 Knowledge of Air Quality Management regulations
- D5 Knowledge of the components of a budget (e.g., revenues, expenditures, risk management, insurance costs, depreciation)
- D5 Knowledge of O & M budget components (e.g., labor, professional services, supplies, energy, water, capital improvement)

Emergency Response Planning

- D1-D5 Knowledge of the components of the Emergency Response Plan
- D1-D5 Knowledge of system pressure zones
- D2-D5 Knowledge of AWWA disinfection standards
- D3-D5 Knowledge of the vulnerability assessment
- D3-D5 Knowledge of public notification requirements
- D3-D5 Ability to train personnel on emergency response procedures
- D3-D5 Ability to perform damage assessment and recovery planning

Future Planning

- D4-D5 Knowledge of long-term water availability
- D4-D5 Knowledge of capital improvement / capital replacement requirements
- D4-D5 Ability to estimate future water needs

Maintenance Plan

- D1-D5 Knowledge of predictive, preventive, and corrective maintenance
- D1-D5 Knowledge of maintenance record keeping
- D2-D5 Knowledge of fire hydrant testing program
- D2-D5 Knowledge of valve exercise program

Safety Plan

- D1-D5 Knowledge of the elements of a safety program (e.g., policy statement, training, promotion, accident investigation, reporting)
- D1-D5 Knowledge of safety regulation requirements (e.g., IIPP)
- D3-D5 Knowledge of record keeping / reporting requirements to OSHA
- D4-D5 Ability to develop and implement a safety plan

Water Conservation Planning

- D3-D5 Knowledge of energy conservation methods
- D4-D5 Ability to conduct a water audit
- D4-D5 Ability to calculate water production costs
- D4-D5 Ability to calculate a water loss rate

Water Rates

- D5 Knowledge of water use projection methods
- D5 Knowledge of water rate structures, water rate setting methods
- D5 Knowledge of local water usage patterns
- D5 Ability to calculate annual expenditures

Safety

- D1-D5 Knowledge of trenching safety equipment and procedures
- D1-D5 Knowledge of traffic control procedures
- D1-D5 Knowledge of personal safety equipment and procedures
- D1-D5 Knowledge of hazardous material safety equipment and handling
- D1-D5 Knowledge of fire safety equipment and procedures
- D1-D5 Knowledge of electrical safety equipment and procedures
- D1-D5 Knowledge of confined space safety equipment and procedure
- D1-D5 Knowledge of chemical handling safety equipment and procedures
- D1-D5 Knowledge of AC pipe handling procedures
- D1-D5 Knowledge of the relapse cycle
- D1-D5 Ability to recognize a confined space

Equipment Operation / Maintenance / Inspections

Valves

- D1-D5 Knowledge of proper valve installation
- D1-D5 Knowledge of valve types and applications
- D1-D5 Knowledge of the principles of operation of valves
- D1-D5 Knowledge of pressure regulating valve maintenance
- D1-D5 Ability to recognize a malfunctioning valve
- D2-D5 Knowledge of pressure ratings

Water Meters

- D1-D5 Knowledge of water meter types and purposes
- D1-D5 Ability to convert water units
- D1-D5 Ability to choose the correct meter size
- D2-D5 Knowledge of mechanical parts of water meter

Hydrants

- D1-D5 Knowledge of thrust blocks
- D1-D5 Knowledge of pressure requirements
- D1-D5 Knowledge of mechanical parts of hydrants
- D1-D5 Knowledge of hydrant types
- D1-D5 Ability to flush using a hydrant

Chemical Feeders

- D1-D5 Ability to read a graduated cylinder
- D1-D5 Ability to calculate a dosage
- D2-D5 Knowledge of chemical feeder types
- D2-D5 Knowledge of chemical feeder components
- D2-D5 Ability to troubleshoot a chemical feeder

Corrosion

- D2-D5 Knowledge of type and applications of cathodic protection devices
- D3-D5 Knowledge of the galvanic series
- D3-D5 Knowledge of principles of operation of cathodic protection devices

In-Line Sensors

- D2-D5 Knowledge of required reagents and standards
- D2-D5 Knowledge of analysis methods
- D2-D5 Ability to recognize normal operation of in-line sensors

Power Generators

- D1-D5 Knowledge of start-up procedures
- D1-D5 Knowledge of basic operation
- D4-D5 Knowledge of power requirements (e.g., efficiency)

SCADA

- D2-D5 Knowledge of the components of a SCADA system
- D2-D5 Knowledge of communication techniques
- D2-D5 Ability to interpret SCADA information

Pump Types, Uses, and Sizes

- D1-D5 Knowledge of pump types
- D2-D5 Knowledge of operational principles of a water pump
- D3-D5 Ability to match pump type to application
- D3-D5 Ability to interpret a pump curve

Troubleshoot and Repair Pumps and Motors

- D1-D5 Ability to recognize abnormal pump operating conditions
- D2-D5 Knowledge of the mechanical components of pumps and motors
- D2-D5 Knowledge of pump maintenance procedures

- D2-D5 Ability to repair and replace pump and motor system components
- D3-D5 Knowledge of record keeping requirements
- D3-D5 Knowledge of when to "MEG" a motor

Water Horsepower

- D3-D5 Ability to calculate pump efficiency
- D3-D5 Ability to calculate brake-horsepower
- D4-D5 Ability to calculate the cost of pumping water

Inspection of Water Mains and Piping

- D1-D5 Knowledge of proper backfill procedures and compaction
- D1-D5 Knowledge of proper bedding techniques
- D1-D5 Knowledge of pipe connectors and applications
- D1-D5 Knowledge of compatible materials
- D1-D5 Ability to recognize faulty or damaged pipe
- D1-D5 Ability to recognize abnormal operating conditions
- D2-D5 Knowledge of proper thrust restraint
- D2-D5 Knowledge of proper disinfection techniques
- D2-D5 Knowledge of allowable leak loss

Inspection of Storage Tanks

- D1-D5 Knowledge of security procedures / measures
- D1-D5 Knowledge of safety equipment requirements
- D3-D5 Knowledge of storage tank corrosion control measures

Inspection of Equipment Installation and Repair

- D1-D5 Knowledge of proper valve installation
- D1-D5 Knowledge of proper hydrant installation
- D1-D5 Knowledge of hydrant valve operation/testing
- D2-D5 Knowledge of thrust restraint requirements
- D2-D5 Knowledge of packing gland settings
- D3-D5 Knowledge of proper pump alignment
- D3-D5 Knowledge of proper phase balance

Inspection of Wells (New and Abandoned)

- D1-D5 Ability to calculate draw down
- D2-D5 Knowledge of proper installation of a sanitary seal on a well
- D3-D5 Ability to calculate specific yield
- D4-D5 Knowledge of well abandonment procedures and permit requirements
- D4-D5 Knowledge of proper gravel packing and screen depth
- D5 Knowledge of permit requirements

Water Mains and Piping

Cleaning and Maintenance

- D1-D5 Knowledge of proper flushing procedures
- D1-D5 Knowledge of notification requirements
- D1-D5 Ability to set up a temporary service line
- D2-D5 Knowledge of the causes and affects of tuberculation
- D2-D5 Knowledge of pipe cleaning procedures
- D3-D5 Ability to recognize tuberculation
- D3-D5 Ability to choose the proper cleaning technique

Excavation, Installation, and Repair

- D1-D5 Knowledge of bedding techniques
- D1-D5 Knowledge of proper backfill procedures
- D1-D5 Knowledge of notification requirements
- D1-D5 Knowledge of excavating techniques
- D1-D5 Knowledge of compaction tools and methods
- D1-D5 Knowledge of Cal-OSHA trenching and shoring requirements
- D1-D5 Ability to operate a dewatering pump
- D1-D5 Ability to connect water pipe
- D1-D5 Ability to calculate the volume of a trench
- D2-D5 Knowledge of dewatering techniques
- D2-D5 Ability to identify different soil types

Joints and Fittings

- D1-D5 Knowledge of proper joints and fitting applications
- D1-D5 Knowledge of pipe fitting and joining methods
- D2-D5 Knowledge of proper thrust block uses
- D2-D5 Ability to choose the correct type of joint
- D2-D5 Ability to calculate thrust block size

Leak Detection and Repair

- D1-D5 Knowledge of pipe locating methods
- D2-D5 Knowledge of leak detection methods
- D2-D5 Knowledge of factors affecting leak detection

Pipe Selection

- D1-D5 Knowledge of pipe material and applications
- D1-D5 Knowledge of pipe material compatibility
- D2-D5 Knowledge of advantages / disadvantages of pipe material
- D2-D5 Knowledge of "C-Factor"
- D2-D5 Ability to calculate the velocity of water
- D2-D5 Ability to calculate pipe capacity
- D3-D5 Knowledge of flow demand requirements

Service Line Installation

- D1-D5 Knowledge of material compatibility
- D1-D5 Ability to flush a service line
- D1-D5 Ability to differentiate pipe tap size
- D1-D5 Ability to differentiate meter size
- D1-D5 Ability to calculate pipe volumes
- D2-D5 Knowledge of tapping tools / equipment
- D2-D5 Knowledge of tapping methods

Water Quality / Water Sources

Coliform Group

- D1-D5 Knowledge of the definition of pathogenic organisms
- D1-D5 Knowledge of coliform bacteria types
- D1-D5 Knowledge of coliform analysis methods
- D1-D5 Ability to interpret coliform test results
- D2-D5 Knowledge of the use of coliform as a surrogate

Determination of Corrosivity

- D2-D5 Ability to recognize corrosive conditions in the distribution systems
- D2-D5 Knowledge of the effect of corrosion in a distribution system
- D2-D5 Knowledge of the causes of corrosion in a water distribution system
- D3-D5 Knowledge of the relationship between corrosion and lead/copper concentrations
- D3-D5 Knowledge of the Langelier index
- D3-D5 Knowledge of corrosion control techniques
- D4-D5 Ability to interpret a Langelier Index

Heterotrophic Bacteria

- D2-D5 Knowledge of the effects of heterotrophic bacteria in a distribution system
- D2-D5 Knowledge of heterotrophic bacteria

Organic and Inorganic Contaminants

- D1-D5 Knowledge of the impacts of high nitrate concentrations in the distribution system
- D2-D5 Knowledge of nitrate formation in the distribution system
- D3-D5 Knowledge of sources of organic contaminants in a distribution system
- D3-D5 Knowledge of sources of inorganic contaminants in a distribution system
- D3-D5 Knowledge of common organic contaminant compounds
- D3-D5 Knowledge common inorganic contaminant compounds

pH, Conductivity, Hardness, and Turbidity

- D1-D5 Knowledge of the meaning of high levels of turbidity in a distribution system
- D1-D5 Knowledge of normal pH range in drinking water
- D1-D5 Ability to recognize abnormal turbidity levels in a distribution system
- D1-D5 Ability to recognize abnormal pH levels of water in a distribution system
- D2-D5 Knowledge of the effects of hardness in a distribution system
- D2-D5 Knowledge of the effect of abnormal pH levels in the distribution system

Unidirectional Flushing

- D1-D5 Knowledge of the impacts of flushing on a water distribution system
- D1-D5 Knowledge of proper flushing velocities
- D1-D5 Knowledge of equipment used for flushing
- D2-D5 Knowledge of flushing techniques
- D2-D5 Ability to recognize when flushing is required
- D2-D5 Ability to calculate a water velocity
- D3-D5 Knowledge of permit requirements for flushing

Waterborne Diseases

- D2-D5 Knowledge of potential waterborne diseases
- D2-D5 Ability to distinguish between presumptive and confirmed results

Groundwater/ Wells

- D1-D5 Knowledge of the hydrologic cycle
- D1-D5 Ability to measure well depth
- D2-D5 Knowledge of zone of influence
- D2-D5 Knowledge of well protection
- D2-D5 Knowledge of well components and terms
- D2-D5 Knowledge of water table fluctuations
- D2-D5 Knowledge of static and pumping water level

| | |
|-------|---|
| D2-D5 | Knowledge of recovery time |
| D2-D5 | Knowledge of cone of depression |
| D2-D5 | Ability to recognize potential sources of contamination |
| D2-D5 | Ability to convert a pressure reading to depth of water |
| D3-D5 | Knowledge of well location requirements |
| D3-D5 | Knowledge of the chemical components of groundwater |
| D4-D5 | Knowledge of the characteristics of aquifers |

Sanitary Survey

| | |
|-------|---|
| D1-D5 | Ability to recognize potential sources of contamination |
| D4-D5 | Knowledge of sanitary survey requirements |

Water Math

| | |
|-------|--|
| D1-D5 | Ability to convert water units |
| D1-D5 | Ability to convert units of volume, area, pressure and time |
| D1-D5 | Ability to convert pressure to feet of head |
| D1-D5 | Ability to calculate a disinfectant dosage |
| D1-D5 | Ability to measure the water depth in a well |
| D1-D5 | Ability to calculate well draw down |
| D1-D5 | Ability to calculate the volume of a cylinder, rectangle and square |
| D1-D5 | Ability to calculate the volume of a well, storage reservoir, pipe, trench |
| D1-D5 | Ability to calculate flow rates |
| D1-D5 | Ability to calculate the area of a pipe cross-section |
| D1-D5 | Ability to calculate the surface area of a valve face |
| D2-D5 | Ability to calculate total force on a valve |
| D2-D5 | Ability to calculate water velocity |
| D2-D5 | Ability to calculate pipe capacity |
| D2-D5 | Ability to calculate the surface area of the interior walls of a storage reservoir |
| D2-D5 | Ability to convert a scale to actual distance |
| D2-D5 | Ability to convert a pressure reading to depth of water |
| D2-D5 | Ability to calculate chlorine/ammonia ratio for chloramination |
| D2-D5 | Ability to calculate thrust block size |
| D3-D5 | Ability to calculate specific yield of a well |
| D3-D5 | Ability to calculate CT |
| D3-D5 | Ability to calculate pump efficiency |
| D3-D5 | Ability to calculate brake-horsepower |
| D3-D5 | Ability to calculate the cost of water production |
| D4-D5 | Ability to calculate the cost of pumping water |
| D4-D5 | Ability to estimate future water needs |
| D4-D5 | Ability to calculate the hydraulic gradient |
| D4-D5 | Ability to calculate water production costs |
| D4-D5 | Ability to calculate a water loss rate |
| D5 | Ability to calculate annual expenditures |