

The study guide is for water distribution operator practices involving advanced skill and knowledge levels. The outlined topics are the general subjects which are the basis for the examination questions. The operator should be knowledgeable in the subject matter outlined and contained in the reference material list.

- PUBLIC HEALTH ASPECTS
 - Define potable water
 - Define contamination and list possible sources
 - Define microbiological characteristics of water
 - Define pathogenic bacteria
 - Define coliform bacteria
 - Define sterilization
 - Define disinfection
 - Physical and chemical properties of chlorine
 - Recommended free chlorine concentration in water distribution system (1.0 mg/l)
 - Chlorinator operation and maintenance
 - Define physical characteristics of water
 - Turbidity
 - Odor and taste – rotten egg smell (H₂S)
 - Temperature
 - Color
- Define chemical characteristics of water
 - Milligrams per liter (mg/l) or parts per million (ppm)
 - Milligrams = weight
 - Liter = volume
 - pH – acid range and base range
 - Inorganic contaminants (many are metals)
 - Organic contaminants (pesticides, herbicides)
 - Fluoride – proper concentration (1.2 mg/l)
 - Iron and manganese – problem concentrations
- Define radiological characteristics of water
- Basic disinfection practices of water mains (minimum concentration 50 mg/l)

- DISTRIBUTION SYSTEM
 - Basic cross-connection control
 - Air gap
 - Vacuum breakers
 - Reduced pressure zone backflow preventor
 - Minimum separation of water and sewer lines (10 feet horizontal)
 - Minimum depth of cover on waterlines (7.5 feet)
 - Minimum pressure – 20 (units of measure – p.s.i.)
 - Necessity of minimum waterline size (6 inches) for fire protection
 - Friction factor or c value (factors influencing)
 - Carrying capacity reduced by tuberculations (rust deposits)
 - Water quantity (flow rate) in pipe = cubic feet/second
 - Water velocity in pipe = feet/second
 - Scaling deposits of lime – factors influencing
 - Types of pipes – plastic, cast iron, steel, concrete, and asbestos-cement
 - Composition
 - Strength rating
 - Jointing materials and methods
 - Proper installation, backfill, and tamping
 - Corrosion control (use of dissimilar metals increases corrosion)
 - Looping of water distribution lines
 - Basic valve operation and maintenance
 - Types of valves and functions – diaphragm, globe, rotary, slide, check, relief, altitude, pressure reducing
 - Proper repair
 - Proper opening and closing of valves
 - Fire hydrants
 - Dry barrel type
 - Wet barrel type
 - Proper installation
 - Proper technique to reduce flow
 - Customer service lines
 - Proper installation
 - Tapping techniques
 - Water main chlorination and flushing

- PUMPING STATIONS, PUMPS, AND APPURTENANCES
 - Types and classification of pumps
 - Centrifugal pumps
 - Mechanical parts and function
 - Proper packing techniques
 - Pump priming
 - Shutoff head
 - Conditions causing overheating of motors
 - Conditions causing loss of suction
 - Positive displacement
 - Mechanical parts and function
 - Operation and maintenance
 - Booster pumping
 - Function
 - Control systems
 - Reservoirs
 - Protection from vandalism
 - Manhole for entry-overlapping and locked
 - Vents and overflows screened
- METERS
 - Various types
 - Displacement meters – mechanical parts
 - Venturi meter – pressure differential
 - Compound meter – low and high flows
 - Proper meter installation
 - Meter testing and maintenance
 - Meter reading
- SAFETY
 - Housekeeping techniques
 - Handling hazardous materials
 - Construction safety
 - Trench construction and shoring
 - Ventilation of all underground areas – pits, vaults, manholes
 - No smoking in manholes, vaults, pits
 - First aid

- STATE AND FEDERAL SAFE DRINKING WATER ACT REGULATIONS
 - Responsibility (lawsuits and fines)
 - Sampling responsibility lies with provider
 - Requirements for submission of plans and specifications (required for new facilities, but also for changes in existing systems)
 - Sampling frequencies – physical, chemical, microbiological, radiological
 - Microbiological – number of monthly samples from distribution system based on population
 - Proper sampling technique for microbiological sample
 - Radiological sampling – 4 samples collected during the year and combined to form one composite sample
 - Proper written reports
 - Public notification responsibilities

REFERENCES

1. “Water Distribution Operator Training Handbook,” American Water Works Association Manual No. 3P-7M-5/78-20103
2. “Environmental Data Sheets for Municipal Utilities,” North Dakota Water and Pollution Control Conference
3. “Cross-Connection Control Manual, EPA Manual 430/9-73-002
4. North Dakota Administrative Code Title 33 – Department of Health Chapter 33-17, Public Water Supply Systems (Safe Drinking Water Regulations)

TYPICAL EXAMINATION QUESTIONS
Class II and III Water Distribution

1. The minimum distance a municipal well may be located from a cesspool, septic tank, or clay sewer is:
 - a. 25 feet
 - b. 50 feet
 - c. 75 feet
 - d. 100 feet
 - e. 300 feet

2. The type of valve that is designed to permit flow in only one direction is a:
 - a. Diaphragm valve
 - b. Globe valve
 - c. Rotary valve
 - d. Ball valve
 - e. Check valve

3. Which statement about displacement meters is not correct:
 - a. The most common type of water service meter is the displacement type
 - b. Displacement meters are accurate at low flows
 - c. Excess sediment can cause the meter to stop registering
 - d. Displacement meters have little head loss due to friction
 - e. Displacement meters operated at a rate in excess of its stated capacity can result in excessive wear.

4. The main purpose for the chlorination of drinking water is:
 - a. To control odors
 - b. To ensure bacterial safety
 - c. To control phenols
 - d. To remove hydrogen sulfide
 - e. To insure iron precipitation

ANSWERS: 1. d 2. e 3. d 4. b

PROBLEMS:

1. A water system bills quarterly at a rate of 25¢/1000 gallons for the first 10,000 gallons, 30¢/1000 gallons for the next 10,000 gallons, 35¢/1000 gallons for all over 20,000 gallons. If a customer uses 35,000 gallons per quarter, what is the water bill?
 - a. \$ 9.50
 - b. \$10.75
 - c. \$12.25
 - d. \$12.50
 - e. \$13.25

2. A ground level storage tank is 25 feet long, 20 feet wide, and 10 feet deep. When the storage tank is completely empty, calculate how many minutes it will take to fill the tank with a pump that has a capacity of 300 gallons per minute.
 - a. 60 minutes
 - b. 100 minutes
 - c. 125 minutes
 - d. 150 minutes
 - e. 200 minutes

ANSWERS:

1. b. \$10.75 i) Find cost of first 10,000 gallons
$$\frac{\$.25}{1000 \text{ gal.}} \times 10,000 \text{ gallons} = \$ 2.50$$

ii) Find cost of second 10,000 gallons
$$\frac{\$.30}{1000 \text{ gal.}} \times 10,000 \text{ gallons} = \$ 3.00$$

iii) Find cost of all gallons over 20,000
$$\frac{\$.35}{1000 \text{ gal.}} \times 15,000 \text{ gallons} = \$ 5.25$$

Water bill for quarter	\$ 10.75
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2. c. 125 minutes i) Find volume of storage tank in cubic feet using the formula: $V = lwh$

$$V = lwh$$

$$V = (25 \text{ ft.}) (20 \text{ ft.}) (10 \text{ ft.})$$

$$V = 5000 \text{ cu. ft.}$$

- ii) Find the number of gallons in 5000 cu. ft.

$$5000 \text{ cu. ft.} \times \frac{7.5 \text{ gallons}}{1 \text{ cu. ft.}} = 37,500 \text{ gallons}$$

- iii) Divide the total gallons of the storage tank by the pumping rate of the pump

$$\frac{37,500 \text{ gallons}}{300 \text{ gallons/minute}} = 125 \text{ minutes}$$