A. Hydrological Cycle

The hydrological cycle is the exchange of water between earth and the atmosphere.

_____: The water that enters the atmosphere from wet ground, lakes, rivers and oceans.

_____ The release of water from plants to atmosphere.

_____: Water vapor cools and condenses; it changes from gas to liquid and falls back to earth in form of rain, sleet, snow or hail.

_____: Water that seeps or infiltrates into the ground.

_____ is the most common means of recharging ground water supplies.

B. Formation of an Aquifer

Aquifers are generally classified as Water Table and Artesian.
Water will _____ down through the earth until an impervious stratum is reached.
Impervious layer of material is usually made of _____ or _____ and will not allow water to pass.

C. Water Table Aquifer (_____)

Formed from a _____ impervious layer.
_____ aquifer is very small, unconfined aquifer that does not contain much water and is only recharged by local precipitation.

D. Artesian Aquifer (_____)

Formed when ground water is trapped between _____
The aquifer becomes pressurized as _____

E. Types Of Ground Water Formations

The type of formation will influence the _____ and _____ of a well.
Most aquifers occur in formations of _____ or gravel, less common limestone, sandstone, shale, clay or even silt.

F. Water Well Location

Most important of these is finding adequate quantities of water that will meet SDWA drinking standards with minimum amount of treatment.
Next is the potential _____ of the water supply.

A. Sanitary Consideration

Wells should be never located in the _____ flood plan.
At least from _____ feet from potential pollution sources.

B. Water Well Construction

Well are classified by type of_____
Construction is based on: depth of the well, geology, and amount water needed.
Small wells are _____ _____ or _____ _____.
Large wells are drilled for larger amount of water.
Two types of drilled wells are _____ method and _____ methods.

C. Cable Tool/Percussion Method

Used in _____ and _____ conditions.
Uses a heavy drill bit that is raised that is allowed to drop and breaks formation of rock into smaller pieces.
Slurry is formed when water is added to the up and down motion drill bit to flush out the waste.
A _____ is used to remove the slurry.
The well casing is installed as the _____
These types of wells are more likely to have _____ problems.

D. Rotary Drilled Wells

A large drill bit is attached _____ stem, which are usually hollow.
As the hole is bored water is pumped in the hole to cool and flush the cuttings out of the hole.
When the hole is _____ the casing is installed.

E. Vertical Casing Alignment

Proper vertical alignment is _____
Slight misalignment can cause stress that leads _____ of the well.
If the well casing is misalign, a _____ will need to be installed to correct the problem.

A. Sanitary Protection Of The Well

First a casing installed to prevent _____ and contamination by undesirable water sources in the aquifer.
Casing should be grouted with concrete at least _____ feet or until impervious layer of clay or rock is encountered.
The depth of grout is determined by _____ on case-by-case basis.
May needed to be grout deeper than this to seal out undesirable _____ from the well.
In most instances, grouting will be requires to extend to _____
Grout is pumped in from the _____ to the _____.

The casing should extend at least _____ inches above well pad.
The _____ should be sloped away from the casing.
A sanitary well seal must be used to connect the wellhead and motor to the casing. Well seals are made from _____
Well casing and discharge column should extend at least _____ above grade .
Outlets should be turned down to prevent _____ from entering and _____ to keep bugs out.

Well housing should never be located in a _____
Abandoned wells should be plugged to a depth of at least _____.

B. Developing A Well

Once construction is complete, the well is developed to remove the _____, shavings, and _____ from the surrounding aquifer.
Two methods of developing the well are surging and back washing.

Surging: Water is forced _____ through the screen as it flushes out the drill mud and fine sand.

Back washing The well is pumped at the highest rate possible. To remove the loosened mud, and to determine the well log data.

The development of this data may require that this pumping rate be maintained for

It may take much longer to clear the well of drilling mud prior to _____

Recovery rate is determined after the test is completed.

A. Gravel Packed Wells

Wells that are located in fine sand formations, where sand pumping presents a problem, are usually gravel packed.
A layer of gravel is placed around to hold back the sand and allows a to be installed.
The gravel packing is usually times the diameter of the well screen or a minimum of inches thick.

The selection of the size of the gravel depends upon the type of _____ that is encountered and the type of ____ that is being installed.
The gravel ____ filter the sand.

It is the increasing velocity, as the water gets closer and closer to the screen, which draws the sand into the well.
The gravel pack holds the sand out away from the screen where the velocities are significantly than they are at point where the water enters the screen.

The gravel-packing pipe is usually _____ in diameter.
The level of the gravel packing should be checked.

Before adding the gravel to the well, the gravel should be _____ and _____ with _____ solution before it is added to the well.
The level should be rechecked as the new gravel is added.
Gravel should _____ to stand in the packing pipe.
The vibration that is created when the pump is running can cause the gravel to _____ and _____ the pipe.

B. Disinfecting Water Wells

The chlorine dosage should be at least _____ mg/l.
If dosages in the range of 200-400 mg/l are added, _____ will be required.
The well should then be agitated periodically by _____, ___.
The contact time at a dosage of 50 mg/l should be _____ hours but at 200 mg/l only about _____ hours are needed.

Bac-T samples should be taken from the well.
These samples must be taken until they are negative on _____ days.

A. Well Pumps

Most common type is _____ centrifugal pump.
The difference vertical turbine and centrifugal pumps is that in vertical turbines impeller discharges water out the _____.
"_____" or stacking several impellers on the shaft is how the high pressures are generated.
Anytime pumps are operated in series where one pump or stage discharges to another the pressure will _____ while flow _____.

B. Vertical Turbine Installations

Submersible pumps

In small wells, it is the _____ expensive pump to install.
The motor is installed _____ the pump.
The pump is suited for wells with vertical casing _____.
Disadvantage is if motor needs to repair, the _____ needs be removed to repair it.

Line Shaft pumps

The motor is located on the _____.
Line shaft pumps cost more than _____ pumps.
A line shaft runs down _____ to the pump.
The shaft is supported by _____ that center and stabilize the shaft in the discharge pipe.
Vertical casing misalignment may make installation _____. The stress placed on the shaft and bearings can lead to chronic problems.

C. Line shaft pumps

The bearings are located in every section of pipe. Pipe sections vary in length; there are _____ bearings per 100 feet of shaft.

A. Line Shaft Bearings

Water lubricated bearings

Can only be used where the water table is very _____.
A _____ system is used. It allows water to drip down length of shaft. It can be set on a timer or continuous drip.

Oil lubricated bearings

Installed where the water table depth exceeds _____ feet.
The shaft spins _____ tube of oil.
The _____ must approve the oil.
The oil can be either vegetable or _____ based.

B. Oil Dripper Systems

The dripper system consists of _____ dripper assemblies that keep the _____ full of oil.
One dripper runs constantly. The other will be activated by a _____ and will drip only when the pump is running.

The solenoid-activated dripper will normally have a cooling jacket help maintain constant oil temperature.
The drippers should be checked and adjusted at least twice a year, in early _____ and early _____.

C. Adjusting Dripper Systems

Constant dripper

Should be adjusted when the well has not been running for _____ hours.
The constant drip rate should be _____ drop/minute.

Automatic dripper

Should be set after the well and the dripper cooling water have been running for _____.
Most wells the automatic drip rate should be set at _____ drips/minute.
Well over _____ feet deep may require drip rates of up to 18 drops/minute.

D. Well screens

Continuous slot screens

The best choice because of the _____
The openings are equal to 40–50% total surface of the screen.

A. Well Hydraulics

Static level The water level in a well when the pump is not operating.

Pumping level The water level in the well when it is _____.

Drawdown The difference in elevation between the static and pumping level.
The drawdown is roughly equal to the _____ encountered in moving the water into the well.
Formation of gravel, limestone, and course sand will usually provide more _____ with less drawdown than formation of _____ or _____.

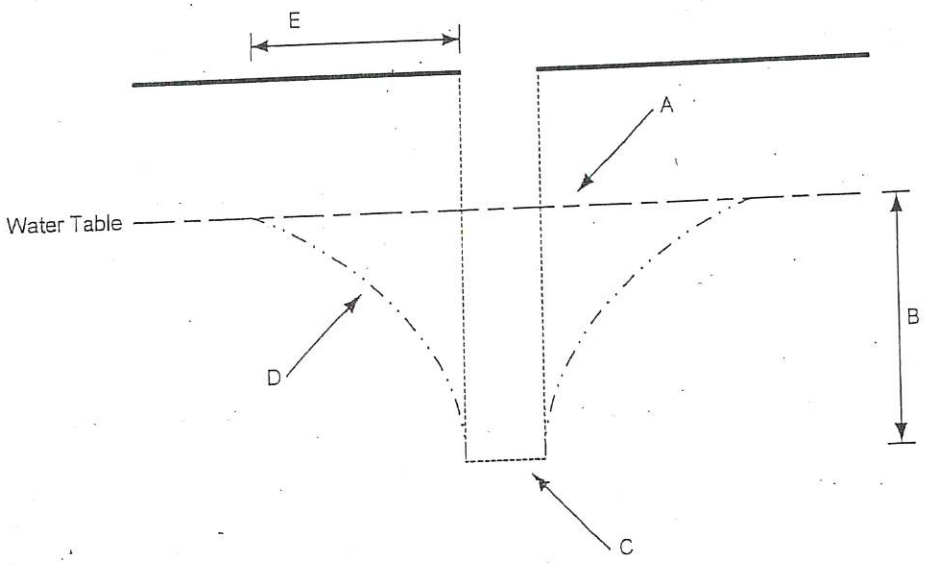
Cone of depression: As the pump draws down the water level, a portion of the aquifer surrounding the well is _____. A cone shape depression is formed in the water table. The shape of the cone varies depending on the _____
Fine sand will create a _____ Coarse sand and gravel the cone will usually be _____

Radius of influence: The _____ distance from the well the cone of depression affects the water table.

Specific capacity: The relationship between the yield of a well and the _____ Expressed as a ratio of yield, in terms of gallons per minute divide by drawn down in feet.
500 gpm/50 feet =10 gpm/feet

Recovery time: The amount of time required for aquifer to stabilize at the _____ once pumping stop.

Well Hydraulic Terms



1. Radius of influence _____
2. Static level _____
3. Drawdown _____
4. Pumping level _____
5. Cone of depression _____

11.10

A. Measuring static and Pumping Levels

Sounding tube/draw down tube: A tube inside the well casing that is used measure water level in the well. A chalk line is used if the approximate level is known. A line with bottom 10 to 15 feet coated with chalk is lowered in the sounding tube. The amount of line that is wet is subtracted from the total amount of the line lowered into the well.

M-scope Method An _____ attached to a cable and connected to _____ supply (battery) is lowered into the sounding tube. When the electrode comes into contact with water completes the circuit and lights an indicator lamp on the power supply.

Air Line Method An airline is installed in the casing and extends to just above the _____ (impeller). As the line is pressurized, the water is slowly forced out. When the pressure stabilized all the _____ has been forced out. Pressure reading is the same height as the distance the line extends _____ the surface of the water. Subtracting this distance from the total length line in the well will give the level of the water in the well.

It might be required convert psi to feet of head using following thumb rule 2.31ft/psi.

For example: *500 feet (air line)-100psi*(2.31feet/psi) =*

B. Well Log

The well log is essential for troubleshooting operational well problems. It represent how well performed during start up and with everything working correctly.
When the well is being develop the following information is recorded:

_____
Length of screen

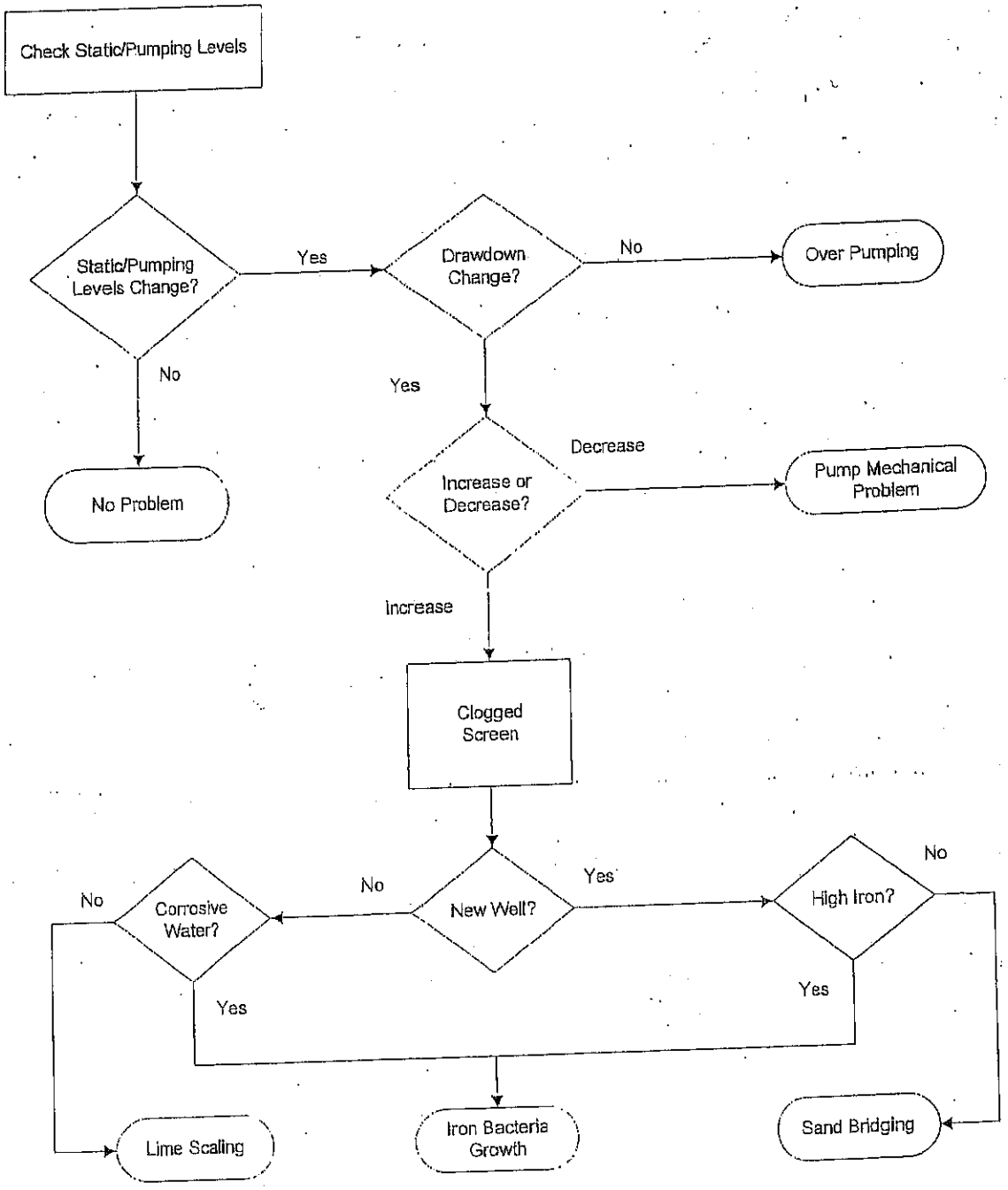
_____
Yield

_____
Pumping level

_____
Specific capacity
Other geological data about the aquifer

Contractors are required to file a copy of the well log with the _____ Office.

Well Troubleshooting Flow Chart



A. Well Related Problems

When the static level has remained the same but the pumping level has **dropped several feet** therefore drawdown _____.

The **Well Trouble Shooting** Flow Chart should be use to pinpoint the problem.

Drawdown is equal to the _____ at the well screen. If there is more headloss (friction loss) either the aquifer change or the screen is becoming clogged.

B. Clogged Well Screens

Sand bridging may develop in newer wells.

It occurs when sand drawn toward the well blocks the screen by forming an arc across the openings.

It is usually the result of improper development of the well or inadequate _____.

It can be corrected by _____. If that does not work, it maybe necessary to remove the pump from the well. Then mechanically clean screen with high-pressure water.

The well should be _____ before replacing the pump.

Iron Bacteria can cause clogged screen in a well that has been in service and the water supply is low in alkalinity and corrosive.

It can be corrected with massive doses of chlorine (_____) followed by _____ or even mechanical cleaning may be the only means of clearing clogged screen opening.

Wells with iron bacteria should be treated with _____ periodically to inhibit the regrowth for as long as possible.

Lime incrustation or _____is the most common cause of clogged well screen.

It occurs when the water contains high amount of alkalinity and hardness.

A. Cleaning Incrusted Well Screens

The four most common are:

Surging

Used to break up _____ that is just beginning to form.
The pump is started and stopped to allow the water in the column pipe to fall into the well. The water surges out the screen.

Percussion

Involves the _____ of some type of explosive with in the well casing. The explosion creates shock waves that shake off the scale. Perhaps the most dangerous of cleaning methods.

Care must be used with explosives, don't want hurt anyone or damage property.

Very small shallow wells a _____ is fired into the casing.
In larger wells a _____ are lowered in well in vicinity of the screen then detonated.

Acid cleaning method

Acid is poured into well casing and allowed to stand for _____ hours. Then the well is then _____ to loosen the remaining scale and flushed.
Caution: Always uses _____ like sulphanic acid.

Mechanical Cleaning

The well will need to be _____ prior to being put back into service.
The pump is removed from the well and the screen by large wire brush or high-pressure jets. Then _____ to remove the debris.

B. Pump Related Problems:

From the well log and current measurements, it is determined that the static level is the same, but the pumping level has _____several feet. Water production from the pump has also decreased. This _____ drawdown and yield from the well indicates with the pump.

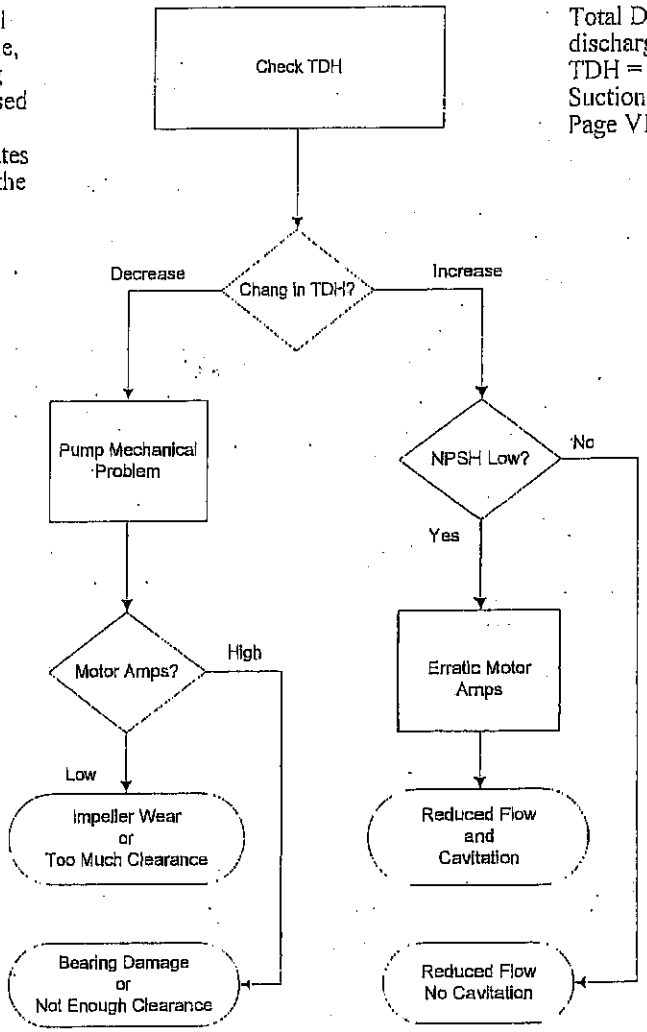
The Troubleshooting Well Pumps Flow Chart should be used.

When drawdown and yield have both decreased, means pump efficiency is reduced.
It could be the clearance between impeller and the pump bowls is _____. Adjusting the impeller clearance is called adjusting the "_____" or "setting the stretch"
If the impeller clearance is properly set, then the cause is a _____ with pump or line shaft. The pump will have to be _____.

Total Dynamic Head: The discharge pressure of the pump.
TDH = Discharge Head +/- Suction Head + Friction loss Chapter 13, Page VII

Troubleshooting Well Pumps

If the static level remains the same, but the pumping level has increased and yield has decreases indicates a problem with the pump.



Total Dynamic Head: The discharge pressure of the pump. TDH = Discharge Head +/- Suction Head + Friction loss
Page VII-13

A. Adjusting Impeller Clearance

As the wear rings wear out the clearance increases and pump efficiency _____. To correct for this, the impeller can be _____ or _____ to bring the clearance with acceptable tolerances.

The line shaft could _____ over time changing the tolerances between the impeller and wear rings.
The factors that cause shaft to stretch:

- The weight of the _____
- The weight of the _____
- The _____ exerted against the impellers.

In larger pumps the shaft can be raised or lowered by adjusting the _____ or adjusting nut located on the top of a hollow core motor.
The _____ in a hollow core motor is hollow allowing the shaft to be moved up or down.
Tightening the nut _____ the shaft and loosening the nut _____ the shaft.

Smaller shallow well may not have hollow core motor. Adjustments are made with a special motor coupling or _____ the motor.
After a lateral adjustment is complete, the _____ can be used to check the adjustment.

End of the Wells Chapter Questions and Answers

Basic Study Questions

1. When water seeps or infiltrates the ground. Page X-1
2. Prevents any surface contamination from entering the water supply. Page X-5
3. Difference in elevations between the static level and pumping level. Page X-14
4. Disinfection is achieved by the addition of a strong solution of chlorine to the well. The chlorine dosage should be at least 50 mg/l. If dosages in the range of 200-400 mg/l are added, less contact time will be required. The well should then be agitated periodically by surging. The contact time at a dosage of 50 mg/l should be 18 to 24 hours but at 200 mg/l only about 2 hours are needed. Page X-8
5. Submersible pump Page X-8

Advanced Study Questions

1. 100 feet and less. Page X-10
2. Used in location with fine sand formations, where sand pumping is a problem. The gravel pack holds the sand out away from the screen where velocities are significantly lower than they are at the point where the water enters the screen. This minimizes the amount of the sand that enters the well. Page X-7
3. The relationship between the yield of a well and the amount of drawdown in the well. Page X-14.
4. Should be at least 200 feet. Page X-4
5. Massive Doses of chlorine (200-300 mg/l) followed by surging or even mechanical cleaning may be the only means of clearing clogged screen opening. Even then it is unlikely that the entire colony has been removed. The remaining bacteria will begin to grow, causing a recurrence of the problem. Wells with iron bacteria should be treated with chlorine periodically to inhibit the regrowth for as long as possible. Page X-18

Basic Sample Test Questions

1. B. The radius of influence Page X-14
2. A. True Page X-21
3. A. Page X-7
4. C. Motor coupling page X-5

Advance Sample Test Question

1. C. 342 feet, 400 feet-25psi (2.31) = 342 ft page X-15
2. A. The drawdown Page X-14/21
3. A. The screen is clogged. Page X-21
4. C. The pump impellers are worn. Page X-21/22

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4. C. The line shaft bearings are failing. Page X-21/22

Quiz Question on

Water Sampling

1. Water Technician Level I certification requires how many hours of train credits?
2. How many training credits are required for Water Technician Level II?
3. Are there experience requirements for WST certification?
4. New Mexico Water Conservation Fee was created when?
5. What is Conservation Fee used for?
6. PWS means?
7. POU means?
8. POE means?
9. Public Water System mean a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of at twenty-five individuals daily at least 60 days out of the year? True or False
10. Non-Community water system means a system that in not a community water system. A non-community water system is either a transient non-community water system (TWS) or non-transient non-community water system (NTNCWS)? True or False
11. (TWS) means the dose not regularly serve at least 25 of the persons over six months per year. A NTNCWS means public water system that in not a community water system and that they regularly servers at least 25 of the same person over 6 months per year? True or False
12. What is the pH range for drinking?
13. Is pH measured in mg/l? True or False
14. What is the MCL for Nitrate?
15. What is the MCL for Nitrite?
16. What is the MCL for Arsenic?
17. Name some water borne Pathogens in all water sources?
18. The SDWA Compliance Cycle for Standardized Monitoring Rule consist of three: (a) years (b) Compliance Period (c) Quarters (D) Months
19. What is the MCL for Chlorine residual allowed by the Disinfectant –Disinfection By-Products Rule?
20. What is optimum dosage for fluoride?
21. MCL for Lead? And for Copper?

25. A sample collected after a water line repair should be identified as _____on the sample request form.
26. Repeat samples required upstream and downstream sampling. This must be done within how many services connection of the original sample?
27. How many milliliters of sample are required for testing?
28. If a positive result occur, what is the minimum number of samples for next month?
29. Microbiological samples must be tested within ___ hours?
30. If a system takes one microbiological sample a month, how many repeat samples must be taken with positive result are reported?

OBJECTIVE TEST

CHAPTER 3. WASTEWATER COLLECTION SYSTEMS

1. Wastewater collection systems usually consist of:
   1. Sewers
   2. Manholes
   3. Grit Chambers
   4. Stoppages
   5. Lift Stations

2. Collection system maintenance problems that should be considered during the design of the collection system include:
   1. Hazards from gases found in sewers
   2. Maintaining vehicles
   3. Cleaning sewers
   4. Clearing stoppages
   5. Clearing work orders with your supervisor

3. Wastewater carried by collection systems may come from
   1. Digester supernatant
   2. Homes
   3. Infiltration
   4. Inflow
   5. Exfiltration

4. Velocity of water flowing in a sewer may be estimated by
   1. Driving between manholes and reading speedometer in pickup truck.
   2. Measuring the time it takes to run between two manholes.
   3. Measuring the time it takes for dye to be carried by the wastewater between two manholes.
   4. Recording the time it takes for a floating object to travel betweer two manholes.
   5. Measuring the Manning's roughness coefficient for the sewer.

GO ON TO NEXT PAGE

5. Sewer pipe materials that can be corroded by acids formed from gases found in sewers include:

   1. Vitrified Clay Pipe
   2. Polyvinychloride Pipe
   3. Asbestos Cement Pipe
   4. Reinforced Concrete Pipe
   5. Reinforced Plastic Mortar Pipe

6. The purpose of a wastewater collection system is to accept, at the point of origin, water and water-carried wastes and to convey them at an acceptable rate to wastewater treatment plants.

   1. True
   2. False

7. Wastewater collection systems are usually gravity flow systems with as few pumps and other moving parts as possible.

   1. True
   2. False

8. Knowing how wastewater flow fluctuates in a sewer is useful in planning when to

   1. Plug a sewer for repairs
   2. Start the canning season
   3. Remove grit and debris from a sewer using a bucket machine
   4. Schedule cleaning operations using high flows
   5. Time the travel of root growths

9. Wastewater collection system workers should have a basic knowledge of how sewers are designed so they can

   1. Replace designers
   2. Communicate with designers
   3. Review plans and specifications
   4. Recommend improvements in design that make operation and maintenance of collection systems more effective
   5. Draw plans for the construction of collection systems

10. A minimum scouring velocity of 2 feet per second is necesssary so

    1. Sewer pipes won't become eroded on the bottom
    2. Solids won't settle out on the bottom of a sewer
    3. Roots won't grow in sewers
    4. Flow velocities can be estimated between manholes
    5. Solids won't build up in a sewer and reduce flow capacity

11. What questions should be asked and answered during a review of plans and specifications and a field investigation of a new intercepting sewer?

    1. Is the route or alignment satisfactory?
    2. Are easements large enough?
    3. Is there sufficient overhead clearance?
    4. How could repairs be made in case of failures?
    5. Can the system be easily and properly operated and maintained?

12. When reviewing the plans and specifications of a new sewer, what items should be considered?

    1. How to clear stoppages
    2. How to handle flows when lift station pumps fail
    3. How to clean the sewer
    4. How to control hydrogen sulfide
    5. How to control odors

CHAPTER 3. WASTEWATER COLLECTION SYSTEMS

EXPLANATION OF OBJECTIVE TEST QUESTIONS

These explanations are those used by the computer to explain missed questions.

1. Wastewater collection systems usually consist of:

    1. Sewers are a vital part of wastewater collection systems.
    2. Manholes provide access for workers and equipment to collection systems.
    3. Grit chambers are found in wastewater treatment plants not in collection systems.
    4. Stoppages are not part of collection systems, but do develop in the system.
    5. Lift stations are an important part of wastewater collection systems.

2. Collection system maintenance problems that should be considered during the design of the collection system include:

    1. Design must consider provisions to minimize hazards from sewer gases.
    2. Maintaining vehicles is important but not a problem considered by designers.
    3. How sewers are to be cleaned must be considered when a system is designed.
    4. How stoppages will be cleared must be considered when a system is designed.
    5. Clearing work orders with supervisor need not be considered during design.

3. Wastewater carried by collection systems may come from

    1. Digester supernatant is found in treatment plants, not collection systems.
    2. Homes contribute wastewater to collection systems.
    3. Infiltration waters may contribute to wastewater in collection systems.
    4. Inflow water may contribute to wastewater in collection systems.
    5. Exfiltration water is wastewater that leaks out of a collection system.

4. Velocity of water flowing in a sewer may be estimated by

    1. Velocity of water may not be estimated by driving a truck between manholes.
    2. Velocity of water may not be estimated by running between manholes.
    3. Velocity can be estimated by measuring the flow time of dye in a sewer.
    4. Velocity can be estimated by measuring the flow time of a float.
    5. The Manning roughness coefficient does not provide the flow velocity.

5. Sewer pipe materials that can be corroded by acids formed from gases found in sewers include:

    1. Vitrified clay pipe is not corroded by acids formed from gases in sewers.
    2. PVC pipe is not corroded by acids formed from gases found in sewers.
    3. Asbestos cement pipe may be corroded by acids formed from gases in sewers.
    4. Reinforced concrete pipe is corroded by acids formed from gases in sewers.
    5. Reinforced plastic mortar pipe is not corroded by acids formed from gases.

6. The purpose of a wastewater collection system is to accept, at the point of origin, water and water-carried wastes and to convey them at an acceptable rate to wastewater treatment plants.

    1. True, collection systems collect and convey water and water-carried wastes.

7. Wastewater collection systems are usually gravity flow systems with as few pumps and other moving parts as possible.

    1. True, collection systems are usually gravity flow systems with minimum pumping.

8. Knowing how wastewater flow fluctuates in a sewer is useful in planning when to

    1. Try to plug a sewer for repairs during periods of minimum flows.
    2. Wrong, the canning season starts when fruits and vegetables are ripe.
    3. Try to remove grit and debris using a bucket machine during minimum flows.
    4. Try to schedule hydraulic cleaning methods (balling) during high flows.
    5. Root growths are not controlled by knowing how flows fluctuate.

9. Wastewater collection system workers should have a basic knowledge of how sewers are designed so they can

    1. Knowing how sewers are designed will not allow you to replace designers.
    2. Knowing how sewers are designed helps you communicate with designers.
    3. Knowing how sewers are designed helps you review plans and specifications.
    4. Knowing how sewers are designed helps you recommend improvements.
    5. Knowing how sewers are designed will not allow you to draw plans.

10. A minimum scouring velocity of 2 feet per second is necessary so

    1. A minimum scouring velocity will not erode the bottom of a sewer pipe.
    2. A minimum scouring velocity is important so solids will not settle out.
    3. A minimum scouring velocity will not prevent root growth in sewers.
    4. No, minimum velocities have nothing to do with estimating flows.
    5. A minimum velocity is important to prevent solid build up in a sewer.

11. What questions should be asked and answered during a review of plans and specifications and a field investigation of a new intercepting sewer?

    1. When reviewing a new sewer, be sure the route or alignment is satisfactory.
    2. When reviewing a new sewer, be sure the easements are large enough.
    3. When reviewing a new sewer, be sure there is enough overhead clearance.
    4. Determine how repairs can be made when reviewing a new sewer.
    5. Be sure the new system can be easily and properly operated and maintained.

12. When reviewing the plans and specifications of a new sewer, what items should be considered?

    1. Determine how stoppages will be cleared when reviewing a new sewer.
    2. Determine how to handle flows if pumps fail when reviewing plans and specifications.
    3. Determine how to clean the sewers when reviewing the plans and specifications.
    4. Determine how to control hydrogen sulfide when reviewing plans and specifications.
    5. Determine how to control odors when reviewing plans and specifications for a sewer.

PRACTICE CERTIFICATION EXAM

Name: **# Correct:**

1. What is the primary origin of coliform bacteria in a water supply?
   - Natural algae growth
   - Industrial solvents
   - Animal or human feces
   - Acid rain

2. Which of the following terms is defined as the killing or inactivation of pathogenic organisms in water?
   - Sterilization
   - Pasteurization
   - Disinfection
   - Deactivation

3. Free chlorine residual values are based on a reaction time of:
   - 1 minute
   - 3 minutes
   - 30 minutes
   - 60 minutes

4. Positive Bacti samples can be caused by:
   - Sampling error
   - Backflow
   - Missing well vent screens
   - All of the above

5. A filter has a surface area of 920 ft^2. What is the filtration rate in gallons per minute per square foot if it receives a flow of 4,875 gpm?
   - 2.4 gpm/ft^2
   - 4.8 gpm/ft^2
   - 5.3 gpm/ft^2
   - 9.2 gpm/ft^2

6. Which of the following parameters is used to indicate the clarity of water?
   - pH
   - Chlorine residual
   - Turbidity
   - Bacteriological

7. pH is the measure of:
   - Conductivity
   - Water's ability to neutralize acid
   - Hydrogen ion concentration
   - Dissolved solids

8. Four-log removal is:
   - 90.00%
   - 99.00%
   - 99.90%
   - 99.99%

9. A full circle clamp is used to:
   - Stop the bleeding of an injured worker
   - Repair a flat tire
   - Connect electrical fittings
   - Repair a broken or leaking water main line

10. The quantity of oxygen that can remain dissolved in water is related to:
   - temperature
   - pH
   - Turbidity
   - Alkalinity

11. Check valves are used to prevent:
   - Excessive pump pressure
   - Priming
   - Water from flowing in two directions
   - Water hammer

12. If two rings of packing are used in the stuffing box the joints should be:
   - Aligned
   - Staggered
   - Large
   - Made of lead

13. Which of the following is the primary function of pump system couplings?
   - Compensate for alignment changes
   - Control motor temperature
   - Reduce shaft wear
   - Lubricate motor

14. What is the correct formula for determining watts?
   - watts = volts/amps
   - watts = (horsepower) (ohms)
   - watts = resistance/volts
   - watts = (amps) (volts)

15. Convert 2,167 ft^3 to gallons.
   - 260 gal
   - 295 gal
   - 16,253 gal
   - 18,070 gal

16. Convert 8.60 MGD into cubic feet per second.
   - 8.6 cfs
   - 13.3 cfs
   - 798.4 cfs
   - 19,162.2 cfs

17. Convert 91°F to degrees Celsius.
   - 33°C
   - 42°C
   - 55°C
   - 74°C

18. If 154 is 72%, what is 100%?
    46
    110
    214
    462

19. Calculate the volume of a pipe 14" in diameter and 2,156 feet long.
    1,975 cu ft
    2,305 cu ft
    3,172 cu ft
    3,694 cu ft

20. A hypochlorinator is used to:
    Measure residual chlorine
    Treat iron and turbidity
    Feed a liquid chlorine solution into the water supply
    Measure an adequate amount of chlorine gas into the supply

21. Water hammer is most likely caused by:
    Dissolved gases in the water
    Closing a valve too fast
    Tuberculation
    Ruptured water line

22. Positive displacement pumps should be started with:
    Suction and discharge line valves closed
    Suction and discharge lines valves open
    Suction line valves closed and the discharge line valves open
    Suction line valves open and the discharge line valves closed

23. What is the most probable cause of a pinging sound coming from a pump?
    Descaling
    Cavitation
    Corrosion
    Hardness

24. What is the main purpose of priming a pump?
    Ensure the pump operates freely
    Compress the air in the cylinder
    Replace air with water inside the pump
    Wet the packing

25. Which of the following valves is the most suitable for controlling flow?
    Pressure sustaining
    Check
    Gate
    Globe

26. Tubercles will most likely form on which of the following type of pipe?
    Ductile iron
    PVC
    Asbestos-cement
    Concrete lined

27. What is the pressure in feet of head on the discharge side of a pump that is pumping against a pressure of 100 psi?
    12.0 ft
    14.6 ft
    43.3 ft
    231 ft

100 psi

28. Pump shaft seals need replacement when leakage occurs from which of the following?
    Pump body
    Around the shaft
    Volute
    Slinger ring

29. Which of the following parts in a centrifugal pump restricts flow from between the impeller discharge and suction areas?
    Wear rings
    Shaft rings
    Packing rings
    Lantern rings

30. Small gaseous chlorine leaks in and around a chlorinator can be detected by the use of:
    Ammonia
    Hypochlorite
    Lime
    Soda ash

31. Packing should be replaced when tightening no longer controls the leakage from the:
    Mechanical seal
    Packing gland
    Stuffing box
    Shaft sleeve

32. During a routine inspection on a centrifugal pump the operator notices that the bearings are excessively hot. Which of the following is the most likely cause?
    Over lubrication
    Speed being to slow
    Worn impeller
    Worn packing

33. The least amount of head loss in a pipe would result from a fully open:
    Angle valve
    Check valve
    Gate valve
    Globe valve

34. Which of the following diseases is capable of being transmitted by water?
    Typhoid
    Measles
    Encephalitis
    Mumps

35. When any piece of electrical equipment is being worked on the circuit breaker should be:
    Painted when repair is complete
    Videotaped for future reference
    De-energized and locked out
    Replaced

36. Which of the following directly impacts the treatment of drinking water?
    Fair Labor Standards Act
    Food Security Act
    Safe Drinking Water Act
    Clean Water Act

37. Corrosive water acting on a customer's plumbing may cause which of the following metals to enter their drinking water?
    Lead
    Silver
    Bismuth
    Carbon

38. A foul, rotten-egg odor is an indication that the water contains:
    Methane
    Carbon Dioxide
    Hydrogen Sulfide
    Manganese

39. Which of the following types of extinguishers should be used on electrical fires?
    Water
    Soda-ash
    Blanket
    Carbon dioxide

40. A room measures 12 feet high, 30 feet long and 17 feet wide. How many cubic feet per minute must a blower in an air exchange unit move to completely change the room air every 10 minutes?
    102 cfm
    612 cfm
    1,020 cfm
    6,120 cfm

41. Which of the following is the most typical or common water quality complaint?
    Stained laundry and plumbing fixtures
    Objectionable appearance of the water
    Objectionable taste/odor
    Illnesses alleged to be caused by the drinking water

42. What US agency establishes drinking water standards?
    AWWA
    USEPA
    NIOSH
    NSF

43. What does the abbreviation DBP stand for?
    Determine by-product
    Determinant by-product
    Disinfection by-product
    Detergent by-product

44. Records of chemical analyses should be kept for minimum of
    5 years
    7 years
    10 years
    20 years

45. Copper sulfate is used in surface water reservoirs to control:
    - Emergent weeds
    - Algae
    - Mosquito larvae
    - Snails

46. Hard water scale is most frequently caused by:
    - Calcium bicarbonate
    - Calcium carbonate
    - Magnesium bicarbonate
    - Magnesium carbonate

47. A tank is conical at the bottom and cylindrical at the top. What is the approximate volume in gallons if the diameter of the cylinder is 16 feet with a depth of 30 feet and the cone depth is 10 feet?
    - 20,000 gal
    - 30,000 gal
    - 40,000 gal
    - 50,000 gal

48. What is the water velocity in feet per second in a 3 inch diameter pipe that delivers 60 gpm? (Hint: Q = A x V)
    a. 2.4 fps
    b. 2.6 fps
    c. 3.3 fps
    d. 3.6 fps

49. Convert a solution that has 80,350 ppm to percent. (Hint: 1% = 10,000 ppm)
    - 8%
    - 80%
    - 800%
    - 8,000%

50. How many pounds per day of chlorine are needed to treat 38.75 MGD if the dosage used is 3.50 mg/L?
    - 42 lbs/day
    - 136 lbs/day
    - 323 lbs/day
    - 1,131 lbs/day

51. An operator mixes 125 lbs of HTH (64.50% available chlorine) with 250 gallons of water. What is the strength of the solution?
    - 4% chlorine
    - 6% chlorine
    - 8% chlorine
    - 10% chlorine

52. Piping containing reclaimed water should be painted what color?
    - Orange
    - Yellow
    - Purple
    - Red

53. Which of the following types of valves is the best to use to maintain the water level in a tank?
    - Altitude
    - Tapping
    - Butterfly
    - Needle

54. What water quality problem is most likely to occur at dead-end water mains?
    Dirty water
    Taste and odor
    Milky water due to air bubbles
    Dirty clothes due to manganese

55. How many hours minimum must water remain undisturbed in a pipe before collecting a sample for lead and copper analysis?
    4 hours
    6 hours
    8 hours
    18 hours

56. If a confined aquifer's recharge area is elevated, the water in the aquifer will be
    Contaminated
    High in iron and manganese
    Under pressure
    Soft

57. Peak hour water use demand for CT calculations is determined by the highest 1-hour period during one
    Day
    Week
    Month
    Year

58. Which of the following best defines the term *drawdown*?
    Water level in a well after a pump has operated over a period of time
    Change in water elevation from the normal level to the pumping level
    Distance between a well that the cone of depression affects the pumping level
    Distance from the ground to the pumping level

59. Which of the following determines the number of samples that must be collected for the utilities that are monitoring for lead and copper for the first time?
    Number of connections
    Type of source water
    Amount of water produced
    Area served

60. Dry barrel hydrants are used in what type of climate?
    Dry
    Wet
    Freezing
    Hot

61. In general, what is the maximum practical lift of a centrifugal pump at sea level?
    5 to 15 ft
    15 to 25 ft
    30 to 40 ft
    45 to 55 ft

62. Which of the following is the best type of valve to dampen a water hammer?
    Pressure relief
    Needle
    Pressure reducing
    Pinch

63. What is the pressure head on a system exerting a static pressure of 62 psi?
    - 27 ft
    - 89 ft
    - 143 ft
    - 175 ft

64. Which of the following devices is used to measure water depths in storage facilities?
    - Transducer
    - Magnetic sensor
    - Venturi meter
    - Thermistor

65. What health risk is associated with nitrate in water?
    - Liver damage
    - "Blue Baby" syndrome
    - Kidney damage
    - Nervous system damage

66. Corrosion control in metal pipes is often achieved by using what method?
    - Cathodic protection
    - Calcium and magnesium
    - Zinc orthophosphates
    - All of the above

67. If the source water for a water system is surface water, the possible presence of organics in the treated water may make chlorine a less desirable method for disinfection due to the potential creation of
    - Trihalomethanes
    - TTHM's
    - Cancer causing substances
    - All of the above

68. A confined space refers to a space that
    - Has limited or restricted means for entry or exit
    - Is not designed for continuous employee occupancy
    - Is large enough and so configured that employees can enter and work
    - All of the above

69. In the water industry what do the initials DO stand for?
    - Dissolved oxygen
    - Decaying oxygen
    - Diseased oxygen
    - Dangerous oxygen (levels)

70. A water with a pH of 6.5 is considered
    - Basic
    - Acidic
    - Neutral
    - Toxic

Practice Problems (Circle the "**best**" answer)

1) A pump supplies 1.45 MGD (million gallons per day). How many gallons/minute is this?

1000 gpm
1100 gpm
1200 gpm
1300 gpm

2) A pump produces 3,265 gallons/minute. How many MGD (million gallons per day) is this?

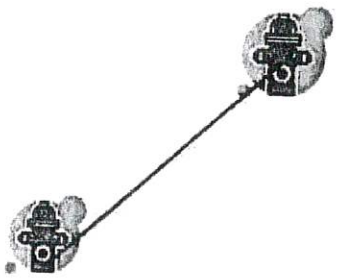
2.8 MGD
3.2 MGD
4.7 MGD
12.8 MGD

3) A well in Rosebud, NM produces 1375 gallons/minute. Convert this Cubic Feet/second (cfs).

1.0 cu-ft/sec
1.2 cu-ft/sec
1.9 cu-ft/sec
3.1 cu-ft/sec

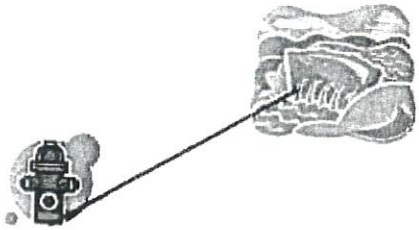
4) Two hydrants are served by the same water system. Hydrant #1 has a pressure reading of 42.5 psi. Hydrant #2 has a reading of 108.6 psi. What is the elevation (head) difference between the two hydrants?

66 ft.
98 ft.
153 ft.
251 ft.



Practice Problems cont'd

5) A reservoir on the Rio Grande has a maximum water level of 3618.2 feet above sea level. A fire hydrant served by this reservoir is situated at an elevation of 3509.6 feet above sea level. What pressure would be measured at the fire hydrant in psi?

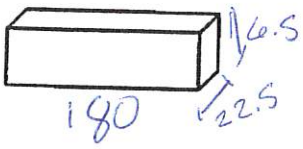


23 psi
47 psi
98 psi
109 psi

6) A settling tank is 180 ft. long by 22.5 ft. wide by 6.5 feet deep?

a) What is the volume in cubic feet?

b) How many gallons of water will it hold?



Volume

5,250 cu-ft.
15,750 cu-ft.
26,325 cu-ft.
44,625 cu-ft.

Gallons

26,300 gal
200,000 gal
280,000 gal
310,000 gal

7) A circular tank measures 80 ft. in diameter and 32 feet in height. It is already ¾ full. How much more water (in gallons) can it hold?

40,000 gal
150,000 gal
275,000 gal
300,000 gal

Practice Problems cont'd

8) A length of pipe 3,650 feet long and 14 inches in inside diameter (16 in. in outside diameter) is to be installed. Find:

a) Internal volume of pipe in cubic feet.

b) How many gallons of water the pipe will hold.

c) If this volume drains at a rate of 65 gallons/minute, how long (in hours) will it take to drain the pipe?

d) If the pipe is placed in a trench that is 5 ft. deep X 5 ft. wide with vertical walls, how much material (in cubic yards) is needed to cover the pipe & fill the trench?

e) How many pounds of HTH (at 55% chlorine) would you need to disinfect one pipe volume with a dosage of 50 mg/l?

Volume:	*Gallons*	*Drain Time*	*Cubic Yards of Fill*	*lbs. of HTH*
1000	6,100	1.5 hrs.	500	2 lbs.
2000	19,000	4.5 hrs.	3,200	4. lbs.
3000	29,000	5.5 hrs.	3,400	16 lbs.
4000	33,200	7.5 hrs.	5,200	22 lbs.

Practice Problems cont'd

9) If fill dirt costs $3.65/ cubic yard, how much will it cost to re-fill the trench in Problem 8? (Be sure to add the 6.875% Sales Tax).

$ 10, 811
$ 11,600
$ 12,250
$ 16,100

10) A runoff basin is 20 feet deep, 700 feet wide, and 2,200 feet long. How many acre-feet of water can it hold?

308 ac-ft.
435 ac-ft.
641ac-ft.
700 ac-ft.

11) A water treatment plant handling 55,600,000 gallons/day wants a Chlorine dosage of 0.75 mg/liter. Chlorine gas (100% available chorine) is to be the chlorine source.

a) How many pounds of chlorine gas must be added?

b) If HTH (58% available chlorine) is used, how many pounds are added?

Pound of Chlorine Gas
26 lbs.
350 lbs.
600 lbs.
834 lbs.

Pounds of HTH
140 lbs.
223 lbs.
366 lbs.
560 lbs.

Practice Problems cont'd

12) A cylindrical reservoir 85 feet in diameter and 24 feet high is a source of water. If a concentration of 0.7 mg/liter of chlorine is desired, calculate the number of pounds of chlorine used to treat one reservoir volume, assuming 85% available chlorine.

1.4 lbs.
3.4 lbs.
5.4 lbs.
7.0 lbs.

13) In Problem 12, if 10 pounds are used, compute the concentration in mg/l.

0.8 mg/l
0.9 mg/l
1.0 mg/l
1.2 mg/l

14) The velocity of water in a pipe is 5.25 feet/second. If the diameter of the pipe is 10 inches, how many gallons/minute are flowing through the pipe?

290 gpm
748 gpm
1,300 gpm
2,200 gpm

Practice Problems cont'd

15) A tank holds 8,650,000 gallons and the flow rate from the tank is 2700 gallons/minute. What is the detention time in hours?

27 hrs.
54 hrs.
612 hrs.
3,203 hrs.

16) A pump rated at 2,250 gallons/minute is pumping against a static head of 225 feet plus a dynamic head of 36 feet. The pump efficiency is 69.1% and the electrical motor efficiency is 83.7%. Power costs 9.277 cents per kilowatt-hour plus 7.89% sales tax. Compute the following:

Water Horsepower (WHP)

Brake Horsepower (BHP)

Motor Horsepower (MHP)

Cost to pump 30 days at 12 hours/day

Water Horsepower	*Brake Horsepower*	*Motor Horsepower*	*Cost*
119	148	197	$6,391
136	181	215	$6,820
148	197	257	$6,930
161	215	292	$6,900

Practice Problems cont'd

17) For the reservoir in Problem 12, compute:

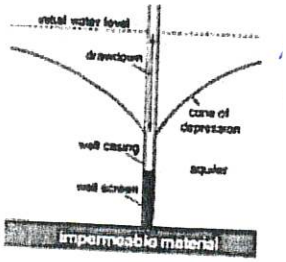
the amount of paint (in gallons) required to coat it on the inside(ceiling & bottom & wall); outside (roof & wall) top if one gallon covers 125 square feet.

175 gal
240 gal
475 gal
600 gal

18. A 20% available alum solution is used to dose 500,000 gpd at 20 mg/l. How many ml/min is the pump feeding?

a. 50 ml/min
b. 83 ml/min
c. 130 ml/min
d. 260 ml/min

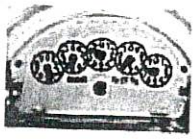
19) A well has a specific capacity of 36.1 gallons/min/foot. The drawdown is 32.8 feet. What is the Well Yield in gallons/minute?



a. 400 gpm
b. 800 gpm
c. 1200 gpm
d. 1600 gpm

Practice Problems cont'd

20) A well flow meter shows on October 1, 2012 a reading of 1,075,220 gallons. The electric meter showed 15,265 kilowatt-hours at the same time. On October 31, 2012, the well meter reads 2,460,192 gallons and the electric meter read 18,889. What is the Well Efficiency in gallons/kilowatt-hour?

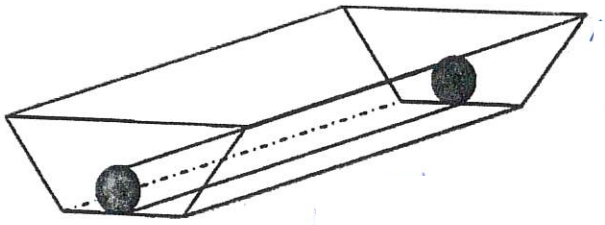


117
382
400
812

21) An open pipe is discharging onto a flat area. The height is 36 inches, the length is 4.5 feet, and the diameter of the pipe is 10 inches. Estimate the flow from this pipe in gallons/minute.

a. 12 gpm
b. 148 gpm
c. 255 gpm
d. 1,528 gpm

22) You have a trench that is 1,260 feet long, 5 feet deep and the sides are sloped at 45 degrees upward from the trench bottom which is 4 feet wide. If you place a 20" water line (22" O.D.), how may cubic yards of material will you need to fill the trench & cover the pipe?



a. 56,700 cu. yds.
b. 53,375 cu. yds.
c. 2,100 cu. yds.
d. 2,000 cu. yds.

Practice Problems cont'd

23) A cone-shaped chemical feed bin has a 12" radius and is 52" deep. What is its volume in cubic feet?

a. 1.13 cu. ft.
b. 2.76 cu. ft.
c. 541 cu. ft.
d. 1,960 cu. ft.

24) The friction loss in a 4" PVC main flowing at 4.25 feet/sec has a head loss of 0.36 psi/100 feet of line. What is the head loss (expressed in feet) for a line 2260 feet long?

a. 58 ft.
b. 19 ft.
c. 84 ft.
d. 8.1 ft.

25) Flow velocity in a pipe must not exceed 4.5 feet/sec. To get a flow volume of 2500 gallons/min (gpm), what size of pipe would you need?

a. 8"
b. 12"
c. 14"
d. 16"

Practice Problems cont'd

26) For the pipe size you selected in Problem 25, determine the actual velocity if the flow is 2500 gallons per minute.

a. 5.55 ft/sec
b. 4.0 ft/sec
c. 3.8 ft/sec
d. 2.5 ft/sec

Circle one answer, the closest or best answer, to the question. Use the scratch paper to show all your work on the math problems.

1. Hydrogen sulfide gives off an odor similar to _____.
   a. Ammonia
   b. Chlorine gas
   c. Rotten eggs
   d. Decayed wood

2. Three diseases potentially carried by wastewater are _____.
   a. Mumps, measles, colds
   b. Scarlet fever, pneumonia, hay fever
   c. Typhoid fever, dysentery, cholera
   d. Tuberculosis, diphtheria, chickenpox

3. Immediate first aid for burns is to _____.
   a. Bandage tightly
   b. Apply warm, moist compress
   c. Immerse in warm water
   d. Flood with cool water

4. Of the following, which is the most likely cause of electric motor failure?
   a. Bearing failure
   b. Dust and dirt
   c. Thermal overload
   d. Moisture

5. Before repairing a pump's electrical circuit, which of the following actions should you take?
   a. Disconnect the circuit breaker, place a red tag stating "do not activate", and lock out
   b. Post a notice in the break room
   c. Tell all the operators not to activate the circuit
   d. Turn the pump switch to standby

6. A valve that allows water to flow in one direction only is a _____ valve.
   a. Check
   b. Gate
   c. Globe
   d. Plug

7. Centrifugal pump parts include a(n) _____.
   a. Diaphragm
   b. Impeller
   c. Piston
   d. Rotor

8. Which of the following forms of plant life is necessary for the proper functioning of a stabilization or oxidation pond?
   a. Algae
   b. Cattails
   c. Water lilies
   d. Weeds

9. Chlorine gas is _____.
   a. Colorless
   b. Heavier than air
   c. Lighter than air
   d. Odorless

10. Raw wastewater contains what percent solids?
   a. 0.01%
   b. 0.1%
   c. 1 %
   d. 10%

11. What is the ideal velocity in a gravity sewer line?
   a. 0.5 foot/second
   b. 1 foot/second
   c. 1.5 feet/second
   d. 2 feet/second

12. What is the ideal velocity for flow through a traditional grit channel?
   a. 0.5 foot/second
   b. 1 foot/second
   c. 1.5 feet/second
   d. 2 feet/second

13. What does BOD stand for?
   a. Biological Oxygen Demand
   b. Biological Oxidation Demand
   c. Biochemical Oxygen Demand
   d. Biochemical Oxidation Demand

14. How long are BOD samples incubated and at what temperature?
    a. 5 days at 20 C
    b. 5 days at 20 C + 1 C
    c. 7 days at 20 C
    d. 7 days at 20 C + 1 C

15. What do we use BOD to indicate?
    a. Hydraulic loading
    b. Organic loading
    c. Chemical loading
    d. Biological loading

16. What is an average detention time in a primary clarifier?
    a. .5 – 1 hour
    b. 1 – 1.5 hours
    c. 1.5 – 2 hours
    d. 2 – 2.5 hours

17. What device or piece of glassware is used to measure settleable solids?
    a. Settleometer
    b. Erlenmeyer Flask
    c. Volumetric Flask
    d. Imhoff Cone

18. What percentage of settleable solids is removed in a primary clarifier?
    a. 60 – 65%
    b. 65 – 75%
    c. 75 – 90 %
    d. 90 – 95 %

19. What is the name used to identify microorganisms that cause disease in humans?
    a. Coliform bacteria
    b. Pathogens
    c. Amoebic dysentery
    d. Wastewater microbes

20. What is the name used to identify bacteria that must utilize dissolved oxygen?
    a. Aerobic
    b. Anaerobic
    c. Facultative
    d. Filamentous

21. What is the minimum safe oxygen level for entry into a manhole/confined space?
    a. **19%**
    b. 21%
    c. 23%
    d. 25%

22. Which of the following is *not* a biological treatment process?
    a. Digesters
    b. **Grit chambers**
    c. Ponds
    d. Trickling filters

23. When checking a pump, you find it not running, and it should be, what is the first item you should check?
    a. Float switch
    b. Impeller
    c. Wet well
    d. **Fuse or circuit breaker**

24. A lift station wet well is 10 ft. by 12 ft. For 5 minutes the influent valve is closed and the well level drops 2.1 ft. What is the pumping rate in gallons?
    a. 37.7 gpm
    b. 188.5 gpm
    c. **377 gpm**
    d. 1885 gpm

Accumulated Volume in 5 min $= (10\text{ ft})(12\text{ ft})(2.1\text{ ft})\left(\frac{7.48\text{ gal}}{1\text{ cu ft.}}\right)$

$= 1885\text{ gal}$

$\text{Accumulation} = \frac{1885\text{ gal}}{5\text{ min}} = \frac{X\text{ gal}}{1\text{ min}}$

$= 377\text{ gpm}$

25. The highest concentration of algae growth in a facultative lagoon is usually observed _____.
    a. **Near the top**
    b. Near mid-depth
    c. Near the bottom
    d. In the sludge layer

26. Which gas is produced in anaerobic digesters and can be used as a fuel?
    a. Propane
    b. Methane
    c. Ethane
    d. Carbon dioxide

27. The media in a trickling filter is usually placed _____.
    a. Directly in the ground
    b. Directly on a concrete slab
    c. On a tile underdrain system
    d. On a rubber tile floor

28. Chlorine is primarily used to _____.
    a. Disinfect
    b. Prevent corrosion
    c. Raise pH
    d. Stabilize organics

29. What is the purpose of heating and mixing a primary anaerobic digester?
    a. To eliminate all oxygen present
    b. To increase the digestion rate
    c. To keep methane gas in suspension
    d. To prevent grit from settling to the bottom of the digester

30. Which of the following devices is used to measure the flow of wastewater?
    a. Comminutor
    b. Comparator
    c. Parshall flume
    d. Sluice gate

31. Exhaust from a chlorinator room should be taken _____.
    a. From anywhere- the location is not important
    b. At floor level
    c. Close to the entrance
    d. Near the ceiling

32. What test is typically never performed on wastewater influent?
    a. BOD
    b. Fecal coliform
    c. Suspended solids
    d. pH

33. What is the name of the slime layer that is found on the media of a trickling filter or RBC?
    a. Sloughings
    b. MLSS
    c. Activated sludge
    d. Zoogleal film

34. What is the temperature range that would cause the fusible plug on a chlorine cylinder to melt?
    a. 70 – 85 F
    b. 120 – 140 F
    c. 158 – 165 F
    d. 180 – 195 F

35. The amount of energy required to pump water is measured in what terms?
    a. Feet of head
    b. Total dynamic head
    c. Horsepower
    d. Pounds per foot

36. The lantern ring in a pump_____.
    a. Is located in the stuffing box
    b. Must be positioned properly to prevent damage to the shaft
    c. Allows seal water to cool and lubricate the packing rings
    d. All of the above

37. The electrical pressure available to cause a flow of current when an electrical circuit is closed or connected is called _____.
    a. Amps
    b. Voltage
    c. Ohms
    d. None of the above

38. A line replacement took two men twenty hours to complete. How long would it take a crew of five men to complete the same job?
    a. 5 hours
    b. 8 hours
    c. 10 hours
    d. The same amount of time

    2 X 20 = 40 Total Man-hours to complete the job
    40 hr. / 5 men = 8 hours to complete the job with 5 men

39. Pretreatment processes may include
    a. Primary and secondary clarifiers
    b. Barscreens, grit channels, comminutors
    c. Aerobic and anaerobic disgesters
    d. Disinfection

40. A stick travels 10 ft. in 20 seconds in a grit channel. Estimate the flow velocity.
    a. 0.075 ft/sec
    b. 0.5 ft/sec
    c. 1 ft/sec
    d. 2 ft/sec

    10 ft./20 sec. = 0.5 ft./sec.

41. Which type of pump can be run with the discharge valve closed without damaging the pump?
    a. Centrifugal
    b. Piston
    c. Diaphragm
    d. Progressive cavity

42. A facultative pond that is operating properly will have:
    a. A low pH, high dissolved oxygen and an emerald green color
    b. A low pH, low dissolved oxygen and a grassy green color
    c. A high pH, high dissolved oxygen and an emerald green color
    d. A high pH, high dissolved oxygen and a grey, tan color

43. A common problem that hurts wastewater pond performance is:
    a. Over aeration
    b. Short circuiting
    c. Too much wind and sunlight
    d. Lightning storms

44. Trenching or shoring systems must be used when an excavation's depth exceeds:
    a. 3.5 feet
    b. 4 feet
    c. 4.5 feet
    d. 5 feet

45. The guy you work with cuts off his finger with a circular saw. What is the first aid you should give him?
    a. Hold his hand in the air to slow bleeding
    b. Call 911, put the finger on ice
    c. Apply a tight tourniquet to his wrist to stop bleeding
    d. Apply direct pressure to the wound with a clean cloth

46. Secondary treatment processes primarily remove:
    a. Dissolved inorganics
    b. Alkalinity
    c. Pathogens
    d. Dissolved organics

47. When having to install an "inside drop" of a service line in a manhole, how should the inside drop be secured to the manhole?
    a. Cement
    b. Double strapped
    c. Epoxy
    d. Glued

48. The pH of typical domestic wastewater is usually between
    a. 1-3
    b. 3-6
    c. 6-9
    d. 9-12

49. Wastewater that contains no dissolved oxygen is said to be
    a. Aerobic
    b. Anaerobic
    c. Facultative
    d. Thermophilic

50. Which of the following will most likely negatively impact a lagoon's BOD removal efficiency?
    a. Short circuiting
    b. Algal blooms
    c. Low influent flows
    d. High influent fecal coliform counts

51. What will happen if the flow velocity in a grit channel is too low?
    a. Not enough grit will be removed
    b. Too much grit will be removed
    c. Organic material will be removed along with the grit
    d. No organic material will be removed along with the grit

52. When compared to secondary sludges, primary sludges are
    a. Lighter than secondary sludges
    b. Denser than secondary sludges
    c. More digested than secondary sludges
    d. Slower settling sludges

53. Which is not a property of hydrogen sulfide gas?
    a. Flammable
    b. Explosive
    c. Poisonous
    d. Pale yellow color

54. Atmospheric testing of a confined space shall continue
    a. Until the hazardous atmospheric conditions are no longer detected
    b. Until the confined space has been completely ventilated
    c. Until the confined space is occupied
    d. As long as the confined space is occupied

55. The typical concentration of total suspended solids in raw domestic sewage is
    a. 20 mg/l
    b. 200 mg/l
    c. 2000 mg/l
    d. 20,000 mg/l

56. An empty screenings hopper 4.2 ft. by 5.6 ft. is filled to an even depth of 26 inches over the course of 96 hours. If the average plant flow was 4.8 MG during this period, how many cubic feet of screenings were removed per million gallons of wastewater received?
    a. 19.2 MG
    b. 49 cu. Ft.
    c. 2.6 cu. Ft
    d. None of the above

$$\frac{4.8\ MG}{1\ day} \times \frac{1\ day}{24\ hr} \times 96\ hrs = 19.2\ MG$$

Convert 26 in to ft: $26\ in = \frac{1\ ft}{12\ in}$

$$\frac{4.2\ ft \times 5.6\ ft \times 2.16 ft}{19.2\ MG} = \frac{49\ cu\ ft}{19.2\ MG} = 2.6\ cu\ ft/MG$$

57. Primary clarifiers are designed to remove
    a. Non-settleable suspended organics
    b. Non-settleable suspended inorganics
    c. Settleable and floatable organics
    d. Settleable and floatable inorganics

58. Grit is a term used to refer to what type of material found in wastewater?
    a. Settleable inorganic solids
    b. Non-settleable organic solids
    c. Abrasive dissolved solids
    d. Dissolved inorganic solids

59. As the operator of a two cell facultative lagoon system being operated in parallel, you notice that one of the cells is emerald green while the other cell is grass green or gray. What is the most likely cause for the difference?
    a. Short-circuiting
    b. Uneven organic loading
    c. Toxic influent
    d. Wrong type of bacteria in one of the cells

60. When cleaning sewer lines with a high velocity cleaner (jet rodder) the preferred method is to
    a. Clean upstream toward the blockage
    b. Clean downstream toward the blockage
    c. Approach the blockage from the nearest manhole
    d. Approach the blockage from an manhole at least 100 feet away

61. An air gap is used to
    a. Provide aeration of wastewater in collection systems
    b. Prevent backsiphonage of wastewater into the drinking water system
    c. Prevent collections workers from infectious diseases
    d. Prevent flooding of dwellings while cleaning sewers on steep grades

62. Why must infiltration be controlled in wastewater collection systems?
    a. It causes corrosion of the sewer pipes
    b. It causes an increase in hydrogen sulfide production
    c. It can hydraulically overload wastewater treatment plants
    d. It can pollute drinking water aquifers

63. Solids removed during the treatment process generally undergo further treatment. These solids handling processes include
    a. Digestion and dewatering
    b. Dilution
    c. Scum removal
    d. Inorganic breakdown and filtration

64. Raw influent BOD is 290 mg/l. If the influent flow rate is 5.70 MGD, at what rate are the pounds of BOD entering the plant?
    a. 13.78 lbs./day
    b. 137.8 lbs./day
    c. 1378.6 lbs./day
    d. 13,786 lbs./day

$$290\ \text{mg/l} \times 5.70\ \text{MGD} \times \frac{8.34\ \text{lb}}{1\ \text{gal}} = \frac{13{,}786\ \text{lb}}{1\ \text{day}}$$

65. You are using sand as a bedding in a sewer line you are installing. You have calculated you will need 40 cu. yards of sand to complete the job. Sand weighs 144 lbs. per cubic ft. How many tons of sand will you need to order to complete the job?
    a. 0.77
    b. 7.7
    c. 77
    d. 777

$$40 \text{ cu yd} \times \frac{27 \text{ cu ft}}{1 \text{ cu yd}} = 1080 \text{ cu ft} \times \frac{144 \text{ lbs}}{1 \text{ cu ft}} = \frac{155{,}520 \text{ lbs}}{2000 \text{ lbs/Ton}} = 77.76 \text{ Tons}$$

66. A supervisor sends you to the warehouse to get 100 pounds of calcium hypochlorite, but the barrels are only marked with chemical symbols. Which one do you bring?
    a. Na(Ocl)
    b. $Ca(Ocl)_2$
    c. NaOH
    d. Ca(och)

67. The hydraulic loading rate to a trickling filter is based on
    a. The total volume of the filter
    b. The total volume of the filter plus the surface area
    c. The surface area
    d. None of the above

68. What is another name for a type of trickling filter?
    a. Biofilter
    b. Biotower
    c. Biomembrane
    d. Biological contactor

69. What percentage of an RBC disk is submerged?
    a. 10%
    b. 20%
    c. 30%
    d. 40%

70. What does RBC stand for?
    a. Revolving Biological Contactor
    b. Revolving Biochemical Contactor
    c. Rotating Biochemical Contactor
    d. Rotating Biological Contactor

71. In what range of rotational speeds are RBCs typically operated?
    a. 1 – 1.5 rpm
    b. 1.5-1.6 rpm
    c. 1.8-2 rpms
    d. 2 – 2.3 rpms

72. Water seen standing on the surface of a trickling filter is known as
    a. Recirculation water
    b. Ponding
    c. Roughing water
    d. Intermittent filter water

73. Which is not a category of lagoon?
    a. Aerobic
    b. Anaerobic
    c. Facultative
    d. Psycrophillic

74. When carbon dioxide is added to water, how is the pH affected?
    a. pH goes up
    b. pH goes down
    c. pH stays the same
    d. Only the DO is affected

75. A wastewater treatment pond as an average length of 705 ft. and with an average width of 450 ft. If the flow rate into the pond is 290,000 gallons each day, and it is operated at at depth of 5.8 ft., what is the hydraulic detention time in the pond in days?
    a. 13.76
    b. 137.60
    c. 4.75
    d. 47.5

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

$$(705 \text{ ft} \times 450 \text{ ft} \times 5.8 \text{ ft}) \times \frac{7.48 \text{ gal}}{1 \text{ cu ft}} = 13{,}760{,}000 \text{ gal}$$

$$\frac{13{,}760{,}000 \text{ gal (Vol)}}{290{,}000 \text{ gpd (Flow)}} = 47.5 \text{ days}$$

76. Residual is the amount of chlorine_____.
    a. Needed to be added for disinfection
    b. Needed to satisfy the demand
    c. That equals the dose
    d. Left in the water after the demand is satisfied

77. Chlorine gas is
    a. **Greenish yellow**
    b. Amber
    c. White
    d. Colorless

78. Disinfection is
    a. **Killing most of the organisms**
    b. Killing all of the organisms
    c. Killing only the coliform bacteria
    d. Sterilization

79. Which is not a source of oxygen for lagoons?
    a. **Sunlight**
    b. Wind
    c. Algae
    d. Surface aerators

80. At sunrise, the operator can expect the following conditions in a stabilization pond:
    a. **Low DO, low pH**
    b. Low DO, high pH
    c. High DO, low pH
    d. High DO, high pH

81. An oxidation pond will be immediately preceded by
    a. Headworks
    b. **Primary treatment unit**
    c. Secondary treatment unit
    d. Pre-filtration unit

82. According to the Sacramento Training Manual, during any permit-required confined space entry,
    a. At least one person with the 40 hour HAZMAT training must be immediately available
    b. At least one person with the 24 hour operations HAZMAT training must be immediately available
    c. At least one person with a current certification in CPR must be immediately available
    d. At least one person with a current certification in First Aid must be immediately available

83. A sample of water collected at a particular time and place that represents the composition of the water only at that time and place is known as
    a. A composite sample
    b. A representative sample
    c. **A grab sample**
    d. All of the above

84. Most anaerobic digesters are operated for medium temperature range bacteria that thrive between 68 and 113 F, which are known as:
    a. Psychrophilic bacteria
    b. Mesophilic bacteria
    c. Thermophilic bacteria
    d. None of the above

85. If odors become a problem at a lagoon system, what is the most likely cause?
    a. Lack of food for the bugs
    b. Overloading and poor housekeeping
    c. Cold weather
    d. None of the above

86. Wear rings are installed on a pump to
    a. Wear instead of the impeller
    b. Plug internal water leakage
    c. Keep impeller in place
    d. Hold shaft in position

87. If a pump shaft or motor spins backwards from wastewater flows backing up into the pump when the pump is turned off, this probably means that:
    a. A check valve has failed
    b. A gate valve has failed
    c. A globe valve has failed
    d. None of the above

88. Valves should be closed slowly to avoid_____.
    a. Excessive head loss
    b. Excessive wear
    c. Injury to the operator
    d. Water hammer

89. A waste treatment pond has an average width of 387 ft. and an average length of 692 ft. The influent flow rate to the pond is 0.14 MGD with a BOD concentration of 162 mg/l. What is the organic loading rate to the pond in pounds per day per acre?
    a. 6.15
    b. 30.8
    c. 189.2
    d. 267,804

0.14 MGD X 162 mg/l BOD X 8.34 lb/gal = 189.2 lb/day

$$692 \text{ ft} \times 387 \text{ ft} \times \frac{1 \text{ acre}}{43{,}560 \text{ sq ft}} = 6.15 \text{ acres}$$

$$\frac{189.2 \text{ lb/day}}{6.15 \text{ acres}} = 30.8 \text{ lb/day/acre}$$

90. Nobody may enter a confined space, as defined by OSHA or the employer, unless the proposed entrant has first undergone which of the following training?
    a. Training in the wearing, use, and maintenance of enhanced level B personal protective equipment (PPE)
    b. **Training in the details of the facility confined space entry procedures**
    c. Training in emergency first aid related to the contaminants expected to be present
    d. Training in the maintenance of the appropriate rescue equipment

91. A possible cause of low output capacity from a plunger pump could be
    a. **An air leak in suction piping**
    b. The pump packing is too tight
    c. The pump stroke is too long
    d. Insufficient or excessive lubrication

92. The main reason electrical distribution networks are grounded is to
    a. Prevent short-circuiting
    b. Provide alternating current (AC) power
    c. Provide direct current (DC) power
    d. **Prevent the development of unsafe conditions**

93. The MOST important parameter to monitor on a chemical feed pump is
    a. Vibration
    b. **Flowrate**
    c. Day tank level
    d. Pump run times

94. What maintenance should be performed on the empty sand drying bed before refilling it?
    a. Flush with effluent
    b. Inspect for cracking
    c. **Rake the sand bed surface**
    d. Till the sand bed surface

95. Misalignment between a motor and a pump could cause _____.
    a. Improved motor efficiency
    b. **A damaged shaft**
    c. Excess capacity
    d. Excessive pump speed

96. What is the primary reason to regularly exercise and lubricate a typically closed plug valve?
    a. To ensure operators know where it is located
    b. To prevent material deposited in the dead end pipe from becoming septic
    c. **To ensure that the valve operates correctly when it is needed**
    d. To provide work for operations staff

97. After performing maintenance on a positive displacement pump, ensure that the following task is performed before starting the pump:
    a. **The valve(s) on the discharge side of the pump is (are) open**
    b. The seal water is turned off to the pump
    c. The pump motor is reading the full load amperage
    d. The pump motor is disconnected

98. A common way to measure flow in a pipe is to
    a. **Use a magnetic flow meter**
    b. Measure the water level through a trapezoidal flume
    c. Use a Parshall flume
    d. Measure the water level over a V-notch weir

99. What is the effect of influent temperature on settling?
    a. There is no effect
    b. Warm influent reduces settling
    c. Cold influent increases settling
    d. **Warm influent increases settling**

100. Ultraviolet disinfection is a form of wastewater disinfection that operates on the principle that radiation
    a. **Alters the DNA of a bacterial cell preventing the reproduction of that cell**
    b. Oxidizes the bacteria
    c. Completely destroys the bacterial cell material
    d. Causes the bacteria to coagulate and the removed by sedimentation