

**Registration form**

**Wastewater Treatment System Operator \$200  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

**Start and Finish Dates:** \_\_\_\_\_  
*You will have 90 days from this date in order to complete this course*

**Name** \_\_\_\_\_ **Signature** \_\_\_\_\_  
*I have read and understood the disclaimer notice on page 2. Digitally sign XXX*

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**Operator ID #** \_\_\_\_\_ **Exp Date** \_\_\_\_\_

*Please circle/check which certification you are applying the course CEU's.*

Collection \_\_\_ Wastewater Treatment \_\_\_ Other \_\_\_\_\_

***Your certificate will be emailed to you in about two weeks unless you pay for the rush service.***

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I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I fully understand that this type of study program deals with dangerous, changing conditions and various laws and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable in any fashion for any errors, omissions, advice, suggestions or neglect contained in this CEU education training course or for any violation or injury, death, neglect, damage or loss of your license or certification caused in any fashion by this CEU education training or course material suggestion or error or my lack of submitting paperwork. It is my responsibility to call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded. It is my responsibility to ensure all information is correct and to abide with all rules and regulations.

**Professional Engineers;** Most states will accept our courses for credit but we do not officially list the States or Agencies. Please check your State for approval.

*You can obtain a printed version of the course manual from TLC for an additional \$69.95 plus shipping charges.*

## **AFFIDAVIT OF EXAM COMPLETION**

I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

## **Grading Information**

In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity. Thank you...

**Do not solely depend on TLC's Approval list for it may be outdated.**

**A second certificate of completion for a second State Agency \$50processing fee.**

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## WWT System Operator Answer Key

Name \_\_\_\_\_

Phone \_\_\_\_\_

You are solely responsible in ensuring that this course is accepted for credit by your State. Did you check with your State agency to ensure this course is accepted for credit? **No refunds.**

*Method of Course acceptance confirmation. Please fill this section*

Website \_\_\_ Telephone Call \_\_\_ Email \_\_\_ Spoke to \_\_\_\_\_

Do not solely depend on TLC's Approval list for it may be outdated.

What is the approval number if Applicable? \_\_\_\_\_

*You are responsible to ensure that TLC receives the Assignment and Registration Key. Please call us to ensure that we received it.*

*You can use Adobe Acrobat DC Program to complete the assignment.*

**Multiple Choice. Pick only one answer per question. Circle, Mark off, underline or Bold the answer.**

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*This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environmental /building regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to not be in non-compliance and do not follow this course for proper compliance.*

**Please fax the answer key to TLC Western Campus Fax (928) 272-0747**

Always call us after faxing the paperwork to ensure that we've received it.

*Please e-mail or fax this survey along with your final exam*

**WASTEWATER SYSTEM OPERATOR CEU COURSE  
CUSTOMER SERVICE RESPONSE CARD**

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E-MAIL \_\_\_\_\_ PHONE \_\_\_\_\_

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2. Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

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## Wastewater Treatment System Operator Training Assignment

*The Assignment (Exam) is also available in Word on the Internet for your Convenience, please visit [www.ABCTLC.com](http://www.ABCTLC.com) and download the assignment and e-mail it back to TLC.*

You will have 90 days from the start of this course to complete in order to receive your Professional Development Hours (**PDHs**) or Continuing Education Unit (**CEU**). A score of 70 % is necessary to pass this course. We prefer if this exam is proctored. No intentional trick questions. If you should need any assistance, please email all concerns and the completed manual to [info@tlch2o.com](mailto:info@tlch2o.com).

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name and address on your Answer Key and make copy for yourself. You can e-mail or fax your Answer Key along with the Registration Form to TLC. **(S) Means answer may be plural or singular**

1. Which of the following terms are the pollutants of concern are not detectable in the effluent from the industrial user?  
A. Detection Limit  
B. Development Document  
C. Dilute Wastestream  
D. Effluent Limitations Guideline  
E. None of the Above
2. Which of the following terms are BOD, TSS, fecal coliform, oil and grease, and pH?  
A. Daily Maximum Limitations  
B. Continuous Discharge  
C. Concentration-based Limit  
D. Control Authority  
E. Conventional Pollutants  
F. None of the Above
3. Which of the following terms is discharge that occurs without interruption during the operating hours of a facility, except for infrequent shutdowns for maintenance, process changes or similar activities?  
A. Daily Maximum Limitations  
B. Continuous Discharge  
C. Concentration-based Limit  
D. Control Authority  
E. Conventional Pollutants  
F. None of the Above

### Clean Water Act (Rule) Summary

#### 33 U.S.C. s/s 1251 et seq. (1977)

4. Which of the following terms has clarified and expanded permit requirements under the Clean Water Act for 19,000 municipal sanitary sewer collection systems in order to reduce sanitary sewer overflows?  
A. Clean Water Act or CWA  
B. Water quality levels  
C. Clean water legislation  
D. EPA still retains oversight responsibilities  
E. Environmental Protection Agency (EPA)  
F. None of the Above

5. The requirements will help communities improve some of water quality standards—by requiring facilities to develop and implement new capacity, management, operation, and maintenance programs and public notification programs.

A. True B. False

6. The Clean Water Act is a 1977 amendment to the \_\_\_\_\_, which set the basic structure for regulating discharges of pollutants to waters of the United States.

- A. Clean Water Act or CWA D. EPA  
B. Federal Water Pollution Control Act of 1972 E. Valuable wetlands  
C. Clean water legislation F. None of the Above

### Organic Matter

7. Which of the following terms, such as proteins, carbohydrates, or fats, can cause pollution of receiving waters.

- A. Long chained compounds D. Wastewater-related sources  
B. Organics E. Oxygen compounds  
C. Inorganic materials F. None of the Above

8. Organisms use dissolved oxygen in the water to break down biodegradable materials. This process is dangerous to aquatic life because the \_\_\_\_\_ in the water is reduced or depleted.

- A. Sediment D. Graywater and blackwater  
B. Supply of oxygen E. Nitrogen  
C. Hydrogen F. None of the Above

9. Which of the following terms of wastewater is the amount of oxygen that organisms need to break down the biodegradable materials in the wastewater?

- A. Biochemical oxygen demand (BOD) D. Wastewater-related sources  
B. Biodegradable materials E. Oxygen  
C. Organic materials F. None of the Above

10. Some organic compounds are more stable than others and cannot be quickly broken down by organisms this is true of -this missing term-developed for agriculture and industry.

- A. Most inorganic substances D. Graywater and blackwater  
B. Organic material(s) E. Many synthetic organic compounds  
C. Organic compound(s) F. None of the Above

11. Certain synthetic organics, such as \_\_\_\_\_, are toxic to humans, fish, and aquatic plants.

- A. BOD D. Pesticides and herbicide(s)  
B. Most inorganic substances E. Turbidity  
C. Nitrogen and phosphorus F. None of the Above

12. Solvents and pesticides contain toxic \_\_\_\_\_ such as benzene and toluene.

- A. Nutrients from wastewater D. Excessive grease  
B. Inorganic materials E. Organic compounds  
C. Inorganic minerals F. None of the Above

### Oil and Grease

13. Fatty organic materials from animals, vegetables, and petroleum are quickly broken down by bacteria and can cause pollution in receiving environments.

A. True B. False

14. Which of the following terms adds to the scum layer in a septic tank, which in turn requires that the tank be pumped more often?

- A. Nutrients from wastewater
- B. Inorganic materials
- C. Inorganic minerals
- D. Excessive grease
- E. Nitrogen and phosphorus
- F. None of the Above

### Inorganics

15. Organisms in wastewater cannot easily break down \_\_\_\_\_, since these substances are relatively stable.

- A. Most organic substances
- B. Most inorganic substances
- C. Nitrogen and phosphorus
- D. Pesticides and herbicides
- E. Petroleum-based waste oils
- F. None of the Above

16. The removal of \_\_\_\_\_ from industrial wastewater sources often requires additional treatment steps.

- A. Nutrients from wastewater
- B. Inorganic materials
- C. Organic materials
- D. BOD
- E. DON
- F. None of the Above

17. According to the text, heavy metals can be discharged with many types of industrial wastewaters are difficult to remove by conventional treatment methods.

A. True b. False

### Nutrients

18. Normally, excessive nutrients in receiving waters cause algae and other plants to grow quickly adding oxygen in the water, because of this additional of oxygen, fish and other aquatic life thrive.

A. True B. False

19. Which of the following terms have also been linked to ocean "red tides" that poison fish and cause illness in humans?

- A. Nutrients from wastewater
- B. Inorganic materials
- C. Inorganic minerals
- D. Excessive grease
- E. Nitrogen and phosphorus
- F. None of the Above

20. Which of the following terms in drinking water may contribute to miscarriages and is the cause of a serious illness in infants called methemoglobinemia or "blue baby syndrome."

- A. BOD
- B. Most inorganic substances
- C. Phosphorus
- D. Pesticides and herbicide(s)
- E. Nitrogen
- F. None of the Above

### Gases

21. Certain gases in wastewater can cause odors, affect treatment, or are potentially dangerous.

A. True B. False

22. Methane gas is a byproduct of this wastewater term and is highly combustible.
- |                        |                                      |
|------------------------|--------------------------------------|
| A. Dissolved oxygen    | D. Biochemical oxygen demand, or BOD |
| B. Oxygen-demanding    | E. Anaerobic biological treatment    |
| C. Magnesium hydroxide | F. None of the Above                 |

**Hydrogen Sulfide and Ammonia**

23. Hydrogen sulfide and \_\_\_\_\_ are gasses that can be toxic and pose asphyxiation hazards.
- |                     |                      |
|---------------------|----------------------|
| A. Ammonia          | D. Oxygen            |
| B. Wastewater odors | E. Less oxygen       |
| C. Air              | F. None of the Above |

24. Ammonia as a dissolved gas in wastewater is not dangerous to fish.
- A. True B. False

25. Cleaner sewers will produce less hydrogen sulfide because they will harbor \_\_\_\_\_.
- |                         |                      |
|-------------------------|----------------------|
| A. Fewer slime bacteria | D. BOD               |
| B. Wastewater odors     | E. Less oxygen       |
| C. Hydrogen sulfide     | F. None of the Above |

26. Hydrogen sulfide can be reduced by using \_\_\_\_\_ to precipitate sulfides, and by killing bacteria that produce hydrogen sulfide using lime treatments.
- |                           |                                      |
|---------------------------|--------------------------------------|
| A. Dissolved oxygen       | D. Biochemical oxygen demand, or BOD |
| B. Salts of zinc and iron | E. Wastewater odors                  |
| C. Magnesium hydroxide    | F. None of the Above                 |

27. The lack of oxygen causes \_\_\_\_\_ conditions to occur in the sewer system.
- |                       |                       |
|-----------------------|-----------------------|
| A. Slime bacteria     | D. The lack of oxygen |
| B. Wastewater odor(s) | E. Less oxygen        |
| C. Hydrogen sulfide   | F. None of the Above  |

28. The mental well-being and \_\_\_\_\_ of residents can be affected by uncontained wastewater odors.
- |                    |                      |
|--------------------|----------------------|
| A. Attitude        | D. Political views   |
| B. Income          | E. Social activities |
| C. Quality of life | F. None of the Above |

**Pollutants, Oxygen-Demanding Substances**

29. Aquatic life needs \_\_\_\_\_ in the water to survive.
- |                        |                                      |
|------------------------|--------------------------------------|
| A. Dissolved oxygen    | D. Biochemical oxygen demand, or BOD |
| B. Oxygen-demand       | E. Wastewater odors                  |
| C. Magnesium hydroxide | F. None of the Above                 |

30. Biochemical oxygen demand, or BOD is used to measure how well a sewage treatment plant is working, it is a demand placed on the unnatural supply of pollutants in wastewater.
- A. True B. False

### **Inorganic and Synthetic Organic Chemicals**

31. Some inorganic and synthetic organic chemicals are \_\_\_\_\_ at very low concentrations.
- A. Highly poisonous
  - B. Ecology
  - C. Nutrient rich
  - D. Safe for aquatic life
  - E. Non-toxic to humans
  - F. None of the Above

### **Thermal**

32. The capacity of water to retain oxygen is reduced by \_\_\_\_\_.
- A. Heat
  - B. Heavy metals
  - C. Nutrient enrichment
  - D. Excessive growth of algae
  - E. Phosphorus and nitrogen
  - F. None of the Above
33. The ecology of a lake or stream can be seriously altered by uncontrolled discharges of \_\_\_\_\_.
- A. Toxics
  - B. Waste heat
  - C. Nutrients
  - D. Oxygen
  - E. Phosphorus and nitrogen
  - F. None of the Above

34. According to the text, even discharges from wastewater treatment plants and storm water retention ponds affected by winter can be released at temperatures below that of the receiving water, and lower the stream temperature.
- A. True
  - B. False

### **Primary Treatment**

35. The initial stage in the treatment of domestic wastewater is known as bar screens.
- A. True
  - B. False
36. The primary treatment stage removes coarse solids from the wastewater. In some treatment plants, the \_\_\_\_\_ are combined into one operation.
- A. Solid(s)
  - B. Finer debris
  - C. Grit and gravel
  - D. Suspended growth process(es)
  - E. Primary and secondary stages
  - F. None of the Above
37. There are two basic stages in the treatment of wastes, RAS and WAS.
- A. True
  - B. False

### **Preliminary Treatment**

38. The Preliminary Treatment is purely a physical stage consisting of Coarse Screening, Raw Influent Pumping, Static Fine Screening, Grit Removal, and Selector Tanks.
- A. True
  - B. False
39. The \_\_\_\_\_ from the collection system enters into the coarse screening process.
- A. Solid material
  - B. Finer debris
  - C. Grit and gravel
  - D. Raw wastewater
  - E. Dissolved organic and inorganic constituents
  - F. None of the Above

### Primary Sedimentation

40. Pollutants that are dissolved in the wastewater are effectively removed by gravity settling.

A. True B. False

41. When the wastewater flow is slowed down in a sedimentation tank, the suspended solids gradually sink to the bottom. The resulting mass of solids is called \_\_\_\_\_.

- A. Very fine solids
- B. Wastewater pollution
- C. Pollutants
- D. Primary sludge
- E. Grit and screenings
- F. None of the Above

42. When the screening completed and the grit removed, wastewater is clear of dissolved organic and inorganic constituents along with suspended solids.

A. True B. False

### Nitrogen Removal

43. Processes that remove 75 to 100 percent of total nitrogen include aerobic biological systems and media filters, especially recirculating filters.

A. True B. False

44. The vast majority of on-site and cluster nitrogen-removal systems employ nitrification and?

- A. Groundwater recharge
- B. Community drainfield(s)
- C. High-aluminum mud(s)
- D. Denitrification biological reactions
- E. Small volumes of wastewater
- F. None of the Above

45. SBRs, and an array of \_\_\_\_\_ combined with an anoxic/anaerobic process to perform denitrification.

- A. Trickling filter(s)
- B. Oxidation Ditches
- C. Nitrogen removal system(s)
- D. Aerobic nitrification processes
- E. Recirculating sand filters (RSFs)
- F. None of the Above

### Secondary Clarification Process

46. The SCP provides quiescent conditions that allow the larger aggregates of solids and microorganisms to settle out for collection.

A. True B. False

47. In the SCP, the majority of microorganism-rich underflow (or lower layer) is re-circulated to Tanks as Return Sludge to help sustain the microorganism population in the?

- A. Trickling filter(s)
- B. Oxidation Ditches
- C. Nitrogen removal system(s)
- D. Aerobic nitrification processes
- E. Recirculating sand filters (RSFs)
- F. None of the Above

### Other Important Wastewater Characteristics

48. Wastewater characteristics can affect public health, the environment, and the design, cost, and \_\_\_\_\_.

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. The environment
- E. Effectiveness of treatment
- F. None of the Above

### Temperature

49. Temperatures ranging from 77 to 95 degrees Fahrenheit are probably best for wastewater treatment.  
A. True B. False

### pH

50. Treatment processes and the environment are both affected by the acidity or alkalinity of the wastewater.  
A. True B. False
51. Low pH indicates increasing acidity while a high pH indicates increasing alkalinity.  
A. True B. False

52. In order to protect organisms in the biological process, the \_\_\_\_\_ of the wastewater needs to remain between 6 and 9.  
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness  
B. TDS E. Wastewater temperature  
C. pH F. None of the Above

53. Industrial or commercial discharges containing acids and other substances can alter the \_\_\_\_\_ of the wastewater and inactivate treatment processes.  
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness  
B. TDS E. Wastewater temperature  
C. pH F. None of the Above

### Total Dissolved Solids

54. Pure water is tasteless, colorless, and odorless and is often called the universal solvent.  
A. True B. False
55. \_\_\_\_\_ is often called the universal solvent because it picks up impurities easily.  
A. Treatment processes D. Wastewater  
B. Total dissolved solids (TDS) E. Water  
C. Quality of the water F. None of the Above

56. Any minerals, salts, metals, cations or anions dissolved in water are referred to as \_\_\_\_\_.  
A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness  
B. TDS E. Dissolved solids  
C. pH F. None of the Above

57. Inorganic salts and some small amounts of organic matter that are dissolved in water are referred to as \_\_\_\_\_.  
A. Treatment processes D. Both treatment and the environment  
B. Total dissolved solids (TDS) E. Universal solvent  
C. Quality of the water F. None of the Above

58. TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process.  
A. True B. False

59. The TDS test provides only a qualitative measure of the amount of dissolved ions. The test does not provide the nature or ion relationships.  
A. True B. False

### Total Solids

60. Which of the following terms refers to suspended or dissolved matter in water and wastewater. This property is related to both specific conductance and turbidity?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

61. Material left in a container after evaporation and drying of a water sample is called \_\_\_\_\_ (also referred to as total residue).

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Total solids
- E. pH
- F. None of the Above

62. \_\_\_\_\_ –includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater
- F. None of the Above

63. Which of the following terms can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Total Suspended solids
- E. Wastewater
- F. None of the Above

### Total Suspended Solids (TSS)

64. Total Suspended Solids (TSS) are solids in water that can be trapped by a filter.

- A. True
- B. False

65. Because the suspended particles absorb heat and light, \_\_\_\_\_ can raise the surface water temperature. Warmer water can hold less dissolved oxygen, which in turn can harm aquatic life.

- A. Oxygen
- B. High TSS
- C. Settling sediments
- D. Hydrogen sulfide
- E. Suspended sediment
- F. None of the Above

66. The eggs of fish and aquatic insects can be smothered when suspended solids settle to the bottom of a water body.

- A. True
- B. False

67. Which of the following terms can damage the aquatic habitat by filling in spaces between rocks that could have been homes to aquatic organisms?

- A. Oxygen
- B. Organic material
- C. Settling sediments
- D. Hydrogen sulfide
- E. Suspended sediments
- F. None of the Above



### Water Quality Criteria

68. According to the Clean Water Act, water quality criteria developed by the EPA must accurately reflect the latest scientific knowledge about the effects of pollutants on aquatic life and human health.

A. True B. False

### Aquatic Life Criteria

69. The aquatic life criteria developed by EPA are numeric limits on the amounts of chemicals that can be present in the water without harming aquatic life.

A. True B. False

70. Aquatic life criteria do not provide protection for saltwater aquatic organisms.

A. True B. False

### Aerobic Processes

71. Activated sludge systems, lagoons, trickling filters and rotating disk contactors are the most common aerobic processes.

A. True B. False

72. In wastewater treatment, carbonaceous BOD is degraded using \_\_\_\_\_.

- A. Carbonaceous BOD                      D. Suspended growth processes  
B. Attached growth processes      E. Food-to-microorganism ratio, F/M  
C. Activated sludge processes      F. None of the Above

73. Pilot plant and laboratory studies are required to design \_\_\_\_\_.

- A. Effluent quality                      D. Nitrogen and phosphorus load  
B. Organic load                          E. Activated sludge plants  
C. Bacteria                                  F. None of the Above

74. An activated sludge process can be designed based on the amount of time the sludge spends in the system. This is referred to as the \_\_\_\_\_.

- A. Carbonaceous BOD                      D. Suspended growth processes  
B. Attached growth processes              E. Food-to-microorganism ratio, F/M  
C. Mean cell residence time (MCRT)      F. None of the Above

### Microorganisms in Lagoons

75. Swimming and \_\_\_\_\_ engulf bacteria or other prey.

- A. Strict aerobes                          D. Heterotrophic bacteria  
B. Predators                                  E. Gliding ciliates  
C. Bacteria                                      F. None of the Above

76. Which of the following bugs or terms attach to the biomass and vortex suspended bacteria into their gullets, while crawlers break bacteria loose from the floc surface?

- A. Treatment organism(s)                  D. Floc-forming bacteria  
B. Aerobic bacteria                          E. Filamentous bacteria  
C. Stalked ciliate(s)                          F. None of the Above

77. The omnivores, such as most of these bugs, eat whatever is readily available, while the these or the missing terms feed on the floc or prey on larger organisms. Microorganisms are directly affected by their treatment environment.

- A. Strict aerobes
- B. Worms
- C. Bacteria
- D. Heterotrophic bacteria
- E. Many bacterial species
- F. None of the Above

78. The following changes in food, dissolved oxygen, temperature, pH, total dissolved solids, sludge age, presence of toxins, and other factors create a dynamic environment for the?

- A. Treatment organism(s)
- B. Aerobic bacteria
- C. Stalked ciliate(s)
- D. Floc-forming bacteria
- E. Filamentous bacteria
- F. None of the Above

79. Food (organic loading) regulates?

- A. Strict aerobes
- B. Predators
- C. Microorganism numbers
- D. Heterotrophic bacteria
- E. Many bacterial species
- F. None of the Above

### **Microorganisms in Lagoons and Activated Sludge - Aerobic Bacteria**

80. Three functional groups of aerobic bacteria found in the activated sludge process are: freely dispersed, single bacteria; floc-forming bacteria; and filamentous bacteria.

- A. True
- B. False

81. Which of the following bugs or terms that occur are similar to those found in other treatment processes such as activated sludge?

- A. Treatment organism(s)
- B. Aerobic bacteria
- C. Stalked ciliate(s)
- D. Floc-forming bacteria
- E. Filamentous bacteria
- F. None of the Above

82. Which of the following bugs or terms that degrade wastes grow as single bacteria dispersed in the wastewater?

- A. Strict aerobes
- B. Predators
- C. Bacteria
- D. Heterotrophic bacteria
- E. Many bacterial species
- F. None of the Above

83. Which of the following terms grow in a large aggregate (floc)?

- A. Treatment organism(s)
- B. Aerobic bacteria
- C. Stalked ciliate(s)
- D. Floc-forming bacteria
- E. Filamentous bacteria
- F. None of the Above

84. The floc-forming bacteria degrade \_\_\_\_\_ and settle at the end of the process, resulting in a low TSS effluent.

- A. Anaerobic bacteria
- B. Dissolved oxygen
- C. BOD
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

85. \_\_\_\_\_ can be found in lagoons at specific growth locations.

- A. Anaerobic action
- B. Absence of free oxygen
- C. Filamentous bacteria
- D. Anaerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

86. Filamentous bacteria do not cause operational problems in lagoons, but cause filamentous bulking and \_\_\_\_\_ in activated sludge processes.

- A. Strict aerobes
- B. Predators
- C. Bacteria
- D. Poor sludge settling
- E. Many bacterial species
- F. None of the Above

87. Anaerobic BOD removal generally proceeds well from pH 6.5 to 9.0 and at temperatures from 3-4°C to 60-70°C.

- A. True
- B. False

88. BOD removal increases rapidly below 3-4°C and ceases at 1-2°C.

- A. True
- B. False

89. Ammonia can be oxidized to nitrate by \_\_\_\_\_.

- A. Strict aerobes
- B. Predators
- C. Nitrifying bacteria
- D. Heterotrophic bacteria
- E. Many bacterial species
- F. None of the Above

### **Nitrification**

90. Nitrosomonas europaea, which oxidizes ammonia to nitrite, and Nitrobacter winogradskyi, which oxidizes nitrite to nitrate.

- A. True
- B. False

91. Which of the following bugs require a neutral pH and substantial alkalinity?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. Two bacteria
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

92. Nitrification ceases at pH values above pH 9 and declines at pH values below 7.

- A. True
- B. False

93. Nitrification is a major pathway for nitrogen removal in lagoons.

- A. True
- B. False

### **Anaerobic Bacteria**

94. Which of the following bugs or related terms commonly occur in lagoons are involved in methane formation and in sulfate reduction?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. Only two bacteria
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

95. Anaerobic methane formation involves \_\_\_\_\_ bacteria.

- A. Three different groups of anaerobic
- B. Methane fermentation
- C. Methane bacteria
- D. Organic overloading conditions
- E. Acid-forming bacteria
- F. None of the Above

96. Which of the following bugs or related terms many genera of anaerobic bacteria hydrolyze proteins, fats, and polysaccharides present in wastewater to amino acids?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. General anaerobic degraders
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

### Photosynthetic Organisms

97. Which of the following bugs or related terms - this diverse group of bacteria converts products from above under anaerobic conditions to simple alcohols and organic acids?

- A. BOD and sulfate
- B. Methane fermentation
- C. Methane bacteria
- D. Organic overloading and anaerobic conditions
- E. Acid-forming bacteria
- F. None of the Above

98. Which of the following bugs or related terms these bacteria convert formic acid, methanol, methylamine, and acetic acid under anaerobic conditions to methane?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. General anaerobic degraders
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

99. A problem exists at times where the acid formers overproduce organic acids, lowering the pH below where the methane bacteria can function (a pH < 6.5).

- A. True
- B. False

100. Which of the following bugs or related terms are environmentally sensitive and have a narrow pH range of 6.5-7.5 and require temperatures > 14° C.

- A. BOD and sulfate
- B. Methane fermentation
- C. Methane bacteria
- D. Organic overloading and anaerobic conditions
- E. Acid-forming bacteria
- F. None of the Above

### Protozoans and Microinvertebrates

101. Many higher life forms (animals) develop in lagoons. These include protozoans and microinvertebrates such as rotifers, daphnia, annelids, chironomids, and mosquito larvae.

- A. True
- B. False

102. The requirement for a minimum lagoon bank slope and removal of shoreline vegetation by most regulatory agencies is based on the public health need to reduce mosquito vectors.

- A. True
- B. False

### Activated Sludge Methods- Organic Load

103. The organic load (generally coming from primary treatment operations such as settling, screening or flotation) enters the reactor where the active microbial population is present. The reactor must be continuously aerated.

- A. True
- B. False

104. The flocculating characteristics of the cells improve the longer they are retained in the system, since they start to produce extra cellular slime which favors \_\_\_\_\_.

- A. Secondary settling
- B. High degradation rate
- C. Flocculating
- D. Organic load
- E. Settled biomass
- F. None of the Above

### Common Types

105. In the conventional activated sludge process, baffles in the aeration tank cause the wastewater to circulate along the aeration tank in \_\_\_\_\_.

- A. Plug flow mode
- B. Laminar flow mode
- C. 24 to 48 hours
- D. Higher organic load
- E. Settled biomass
- F. None of the Above

**Paramecium sp.**

106. Paramecium is a \_\_\_\_\_ commonly present in activated sludge. It is medium to large size (100-300  $\mu\text{m}$ ).

- A. Shelled amoebas
- B. Euglypha
- C. Vorticella
- D. Stalked ciliate
- E. Swimming ciliate
- F. None of the Above

**Vorticella sp.**

107. Vorticella is a \_\_\_\_\_ found in activated sludge that ranges in length from 30 to 150  $\mu\text{m}$ .

- A. Shelled amoeba(s)
- B. Euglypha
- C. Water bear
- D. Stalked ciliates
- E. Paramecium
- F. None of the Above

108. According to the text, if treatment conditions are bad, for example, low DO or toxicity, \_\_\_\_\_ will leave their stalks.

- A. Shelled amoeba(s)
- B. Euglypha
- C. Vorticella
- D. Stalked ciliate
- E. Ciliate
- F. None of the Above

109. Which of the following bugs are present when the plant effluent quality is high?

- A. Shelled amoeba(s)
- B. Euglypha
- C. Vorticella
- D. Stalked ciliate
- E. Paramecium
- F. None of the Above

**Euglypha sp.**

110. Euglypha are \_\_\_\_\_ with jelly-like bodies and range in size from 70 to 100  $\mu\text{m}$ .

- A. Shelled amoeba(s)
- B. Water bears
- C. Vorticella
- D. Stalked ciliate
- E. Paramecium
- F. None of the Above

111. The shell of this bug is often transparent, allowing the hyaline (watery) body to be seen inside the shell.

- A. Euglypha
- B. Shelled amoeba(s)
- C. Rotifer(s)
- D. Euchlanis
- E. Spirochaetes
- F. None of the Above

**Euchlanis sp.**

112. Euchlanis is a swimmer, using its foot and cilia for locomotion. In common with other rotifers, it has a head rimmed with cilia, a transparent body, and a foot with two strong swimming toes.

- A. True
- B. False

113. Euchlanis is a typical \_\_\_\_\_. It uses cilia rimmed around its head and a foot with two strong swimming toes for locomotion. It also has a transparent body.

- A. Euglypha
- B. Shelled amoeba(s)
- C. Rotifer(s)
- D. Euchlanis
- E. Spirochaetes
- F. None of the Above

### Filamentous Bacteria

114. \_\_\_\_\_ are a type of bacteria that can be found in a wastewater treatment system?

- A. Filamentous Bacteria
- B. Facultative
- C. Application-specific bacteria
- D. Either anaerobic or aerobic conditions
- E. Anaerobic to aerobic state
- F. None of the Above

### Site Specific Bacteria

115. The efficient degradation of organic matter depends on two key operational parameters – aeration and biofilm building.

- A. True
- B. False

116. Which of the following terms become site-specific over time as the biofilm develops and matures?

- A. Anaerobic action
- B. Absence of free oxygen
- C. Facultative bacteria
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

### Facultative Bacteria

117. Facultative bacteria can survive and multiply in either anaerobic or aerobic conditions.

- A. True
- B. False

118. According to the text, usually, facultative bacteria will be \_\_\_\_\_ unless there is some type of mechanical or biochemical process used to add oxygen to the wastewater.

- A. Anaerobic
- B. Absence of free oxygen
- C. Facultative bacteria
- D. Aerobic
- E. Application-specific bacteria
- F. None of the Above

119. According to the text, when bacteria are in the process of being transferred from one environment to another, the metamorphosis from \_\_\_\_\_ (and vice versa) takes place within a couple of hours.

- A. Filamentous Bacteria
- B. Facultative
- C. Application-specific bacteria
- D. Either anaerobic or aerobic conditions
- E. Anaerobic to aerobic state
- F. None of the Above

### Anaerobic Bacteria

120. \_\_\_\_\_ live and reproduce when free oxygen is absent.

- A. Site-specific bacteria
- B. Anaerobic bacteria
- C. Facultative bacteria
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

### Filamentous Bacteria Identification

121. Filamentous Identification should be used as a tool to monitor the health of the biomass when a floating scum mat is suspected.

- A. True
- B. False

122. Filamentous Identification is used to determine the type of filaments present so that a cause can be found and corrections can be made to the system to alleviate future problems.

- A. True
- B. False

123. \_\_\_\_\_ usually have a process control variation associated with the type of filament present that can be implemented to change the environment present?

- A. Filamentous organisms
- B. Floc particles
- C. Organic material
- D. All filamentous bacteria
- E. Biosurfactant trehalose
- F. None of the Above

124. Nostocoida can also be identified by their starburst effect formations using phase contrast microscopy at 400 to 1000x magnification. After chlorination, a few dead cells sticking out identify stress to this species.

- A. True
- B. False

125. \_\_\_\_\_, Nostocoida produces round cells within tight coil formations?

- A. Viscous brown color
- B. Staining gram-positive
- C. Staining gram-negative
- D. Gram-positive, chemoautotrophic, filamentous
- E. Disruptive foaming
- F. None of the Above

126. Thiothrix are considered \_\_\_\_\_, using several small organic carbons and reduced inorganic sulfur sources for growth and energy.

- A. Viscous brown color
- B. Staining gram-positive
- C. Mixotrophic
- D. Gram-positive, chemoautotrophic, filamentous
- E. Disruptive foaming
- F. None of the Above

127. According to the text, Thiothrix II produces rectangular filaments up to 200 microns in length and is easily identified by their \_\_\_\_\_ using phase contrast microscopy at 400 to 1000x magnification.

- A. Stain gram-negative
- B. Not casease
- C. Slower growing filaments
- D. Starburst effect formations
- E. Multicellular rigid filaments
- F. None of the Above

128. Microthrix parvicella is another common cause of?

- A. Viscous brown color
- B. Staining gram-positive
- C. Mixotrophic
- D. Gram-positive, chemoautotrophic, filamentous
- E. Disruptive foaming
- F. None of the Above

129. Sphaeroliticus natans is another filamentous species, and yet it is reputed to increase settleability by branching between flocs, increasing surface area.

- A. True
- B. False

130. Cells are straight to slightly curved, up to 1000 microns in length and?

- A. Stain gram-negative
- B. Not casease
- C. Slower growing filaments
- D. Disruptive foaming
- E. Multicellular rigid filaments
- F. None of the Above

131. A low F/M ratio favors filamentous organisms, because their higher ratio of surface area to volume provides them with a selective advantage for?

- A. Viscous brown color
- B. Staining gram-positive
- C. Mixotrophic
- D. Gram-positive, chemoautotrophic, filamentous
- E. Securing nutrients in nutrient limited environments
- F. None of the Above

132. \_\_\_\_\_ requires high levels of oxygen are necessary?
- A. Stain gram-negative
  - B. A strict aerobe
  - C. Slower growing filaments
  - D. Disruptive foaming
  - E. Multicellular rigid filaments
  - F. None of the Above

### **Filamentous Bacteria**

133. A problem that often frustrates the performance of activated sludge is bulking sludge due to the growth of filamentous bacteria. Sludge bulking can often be solved by careful process modifications.

- A. True
- B. False

134. Different filamentous bacteria such as Microthrix, Sphaerotilus, Nostocoida, Thiothrix or "Type 021N" and others cause?

- A. Bulking for very different reasons
- B. Dissolved oxygen decrease
- C. Sludge bulking
- D. Bacteria and other microbes
- E. Oxygen-demanding pollutants
- F. None of the Above

135. There is a potential for instability with \_\_\_\_\_ is an acute problem when strict demands on treatment performance are in place.

- A. Organic carbon
- B. Activated sludge
- C. Domestic wastewater
- D. High BOD
- E. Growth of filamentous bacteria
- F. None of the Above

### **Activated Sludge Process**

136. When free or dissolved oxygen is present in the aquatic environment, the condition is called aerobic.

- A. True
- B. False

137. Aerobic bacteria require an environment containing oxygen to live and reproduce. .

- A. True
- B. False

138. Aerobes can use chemically combined oxygen, such as in water molecules, for respiration.

- A. True
- B. False

139. When free or dissolved oxygen is not present in the aquatic environment, the condition is called anaerobic.

- A. True
- B. False

140. Anaerobic bacteria need oxygen to thrive.

- A. True
- B. False

141. Saprophytic bacteria break down complex solids to volatile acids.

- A. True
- B. False

142. Methane Fermenters – bacteria that break down the volatile acids to methane, carbon dioxide and water.

- A. True
- B. False



143. Reduction is the addition of oxygen to an element or compound, or removal of hydrogen or an electron from an element or compound in a chemical reaction.

A. True B. False

144. The removal of oxygen, addition of hydrogen, or addition of electrons to/from an element or compound in a chemical reaction is called reduction.

A. True B. False

145. Sulfur compounds or elemental sulfur are reduced to H<sub>2</sub>S or sulfide ions under anaerobic conditions in wastewater.

A. True B. False

### **Basic System Components of Activated Sludge**

146. In the activated sludge process, the wastewater enters an aerated tank where previously developed biological floc particles are brought into contact with the organic matter of the wastewater.

A. True B. False

147. Organic matter in the wastewater mixes with previously developed biological floc particles and oxygen in the aeration tank. The organic matter is a food and energy source for the microorganisms, and is converted into cell tissue. The oxidized end product is mainly carbon dioxide, CO<sub>2</sub>.

A. True B. False

148. The mixture of wastewater and organisms in the aeration tank is referred to as mixed liquor.

A. True B. False

### **POTW's Wastewater Samples**

149. Hand compositing is a series of time proportional grab samples that are collected and composited by hand.

A. True B. False

### **Wastewater Grab Samples**

150. Grab samples are individual samples collected in less than 3 minutes without regard to flow or time of day.

A. True B. False

151. Which of the following sampling terms - are normally taken manually, but can be pumped?

- A. Quantify the pollutants
- B. Grab samples
- C. Hand composites
- D. Time proportional composite sampling methods
- E. Flow proportional composites
- F. None of the Above

### **A grab sample is usually taken when a sample is needed to:**

152. Provide information about -this missing term-of pollutants at a specific time.

- A. Entire batch discharge
- B. The volume of sample
- C. Concentration of pollutants
- D. An individual sample
- E. An instantaneous concentration
- F. None of the Above

153. According to the text, quantify the \_\_\_\_\_ in a non-continuous discharge?

- A. Pollutants
- B. Split samples
- C. Duplicate samples
- D. Taste test
- E. Blanks
- F. None of the Above

154. According to the text, corroborate \_\_\_\_\_ if the waste is not highly variable.

- A. Entire batch discharge
- B. The volume of sample
- C. Composite samples
- D. An individual sample
- E. Proportional composite sampling
- F. None of the Above

155. Which of the following sampling terms - not amenable to compositing such as pH, temperature, dissolved oxygen, chlorine, purgeable organics and sulfides, oil and grease, coliform bacteria, and sulfites?

- A. Quantify the pollutants
- B. Grab samples
- C. Hand composites
- D. Monitor parameters
- E. Flow proportional composites
- F. None of the Above

### **Flow Proportional Composites**

156. Which of the following terms consist of: a series of grab samples whose volumes are equal in size and proportion to the flow at the time of sampling?

- A. The sampling point(s)
- B. Sample preservation
- C. Duplicate samples
- D. Routine QA/QC measures
- E. Flow proportional composite samples
- F. None of the Above

157. Which of the following terms are taken at varying time intervals, or continuous samples taken over a period of time based on the flow?

- A. Entire batch discharge
- B. The volume of sample
- C. Concentration of pollutants
- D. An individual sample
- E. Samples
- F. None of the Above

158. Wherever possible, grab sampling is recommended because it most accurately reflects the nature of the wastestream.

- A. True
- B. False

### **Industrial Users - Permitted/Non-permitted Example**

159. \_\_\_\_\_ within an industry vary with each industry depending on the nature of the process and location of pretreatment facilities?

- A. The sampling point(s)
- B. Sample preservation
- C. Duplicate samples
- D. Routine QA/QC measures
- E. Blanks
- F. None of the Above

160. Exact sampling locations must be identified on a case by case basis. The following general principles apply in all cases: A permanent sampling location(s) must be identified for use by the collection system.

- A. True
- B. False

### Wastewater Sample Preservation

161. One or more unstable pollutants that require immediate analysis or preservation until -this missing term- can be made.
- A. An analysis
  - B. Split samples
  - C. Duplicate samples
  - D. Taste test
  - E. Blanks
  - F. None of the Above

### Quality Assurance/Quality Control Policy Example

162. According the text, Quality Assurance/Quality Control (QA/QC) measures taken by the sampling crew include equipment blanks, trip blanks, split samples and duplicate samples.
- A. True
  - B. False

163. Equipment blanks and \_\_\_\_\_ are routine QA/QC measures.
- A. The sampling point(s)
  - B. Sample preservation
  - C. Duplicate samples
  - D. Routine QA/QC measures
  - E. Trip blanks
  - F. None of the Above

164. \_\_\_\_\_ should be run when requested by a Supervisor or Project Leader?
- A. An analysis
  - B. Split samples
  - C. Duplicate samples
  - D. Taste test
  - E. Blanks
  - F. None of the Above

165. The laboratory needs to prepare -this missing term-used by the sampling crews.
- A. The sampling point(s)
  - B. Sample preservation
  - C. Duplicate samples
  - D. Routine QA/QC measures
  - E. All trip blanks/travel blanks
  - F. None of the Above

166. Any contamination detected in the \_\_\_\_\_ would result from field exposure which could in turn affect collected samples.
- A. An analysis
  - B. Split samples
  - C. Duplicate samples
  - D. Taste test
  - E. Blanks
  - F. None of the Above

### Chain-of-Custody

167. If sampling is performed for the Pretreatment program, any sampling data may be used as evidence in court proceedings in this case \_\_\_\_\_ becomes critical.
- A. Sampling crew
  - B. Duplicate samples
  - C. Pre-preserved bottles
  - D. Documentation
  - E. Noncompliant industrial user
  - F. None of the Above

168. Laboratory personnel sign and date the chain of custody form, and return it to the sampling crew who makes two copies of the form. One copy is for the sampling crew files and the other is for data entry.
- A. True
  - B. False

**Proper Sample Handling**

169. The proper handling of \_\_\_\_\_ also includes wearing gloves.

- A. Other parameters
- B. Pre-preserved bottles
- C. Preservatives
- D. Some samples
- E. Water quality samples
- F. None of the Above

170. When the missing term are received from the laboratory, check to see that none have leaked.

- A. Other parameters
- B. Pre-preserved bottles
- C. Preservatives
- D. Some samples
- E. Containers and preservatives
- F. None of the Above

171. Which of the following wastewater sampling terms – should be labeled with type of preservative used, type of analysis to be done and be accompanied by a Safety Data Sheet?

- A. Sampling crew
- B. Duplicate samples
- C. Pre-preserved bottles
- D. Sampling bottles
- E. Noncompliant industrial user
- F. None of the Above

172. Make sure you can tell if containers are pre-preserved, because you do not to overfill them when collecting samples in the field.

- A. True
- B. False

173. Check with the laboratory about \_\_\_\_\_ when using pre-preserved bottles.

- A. Other parameters
- B. Quality control procedures
- C. Preservatives
- D. Some samples
- E. Organics
- F. None of the Above

174. If necessary, obtain extra coolers and never store coolers and containers near solvents, fuels or other sources of contamination or combustion. In warm weather, keep coolers and samples in the shade.

- A. True
- B. False

**Field Parameters**

175. Be sure to measure and record the field parameters of temperature, electrical conductivity, pH and \_\_\_\_\_ in an undisturbed section of stream flow.

- A. Nitrified effluent
- B. Nitrogen
- C. Total Nitrogen (TN)
- D. Dissolved oxygen
- E. Activated sludge
- F. None of the Above

**Dissolved Oxygen**

176. Aerobic means without air and some bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist.

- A. True
- B. False

177. \_\_\_\_\_ live on the volatile acids produced by these saprophytes?

- A. Wildlife habitat
- B. Methane fermenters
- C. Denitrification
- D. Phosphorus-reduction system(s)
- E. Excessive sludge production
- F. None of the Above

178. \_\_\_\_\_ indicate that dissolved oxygen is present.

- A. Sample(s)
- B. DO analysis
- C. Carbon dioxide
- D. Frequent dissolved oxygen measurement
- E. Aerobic conditions
- F. None of the Above

179. \_\_\_\_\_ in a water sample can be detrimental to metal pipes in high concentrations because oxygen helps accelerate corrosion?

- A. Winkler Method
- B. Dissolved Oxygen
- C. Only molecular oxygen
- D. Anaerobic conditions
- E. The Iodometric (titration) test
- F. None of the Above

180. Oxygen's primary value is to oxidize iron and manganese into forms that will precipitate out of the water; it also removes excess carbon dioxide.

- A. True
- B. False

181. \_\_\_\_\_ – in a water sample will affect the taste of drinking water?

- A. Sample(s)
- B. DO analysis
- C. Carbon dioxide
- D. Dissolved oxygen
- E. Aerobic conditions
- F. None of the Above

### Methods of Determination

182. Temperature, atmospheric pressure, salinity, biological activity and pH all have an effect on the (DO) content.

- A. True
- B. False

183. \_\_\_\_\_ procedure is based on the rate of diffusion of molecular oxygen across a membrane?

- A. Membrane electrode method
- B. Dissolved Oxygen
- C. Only molecular oxygen
- D. Anaerobic conditions
- E. Iodometric (titration) test
- F. None of the Above

184. Many factors determine the -this missing term- in a water sample.

- A. Solubility of oxygen
- B. DO analysis
- C. Carbon dioxide
- D. Frequent dissolved oxygen measurement
- E. Aerobic conditions
- F. None of the Above

### Iodometric Test

185. The Iodometric (titration) test is not a very precise and reliable for (DO) analysis of samples.

- A. True
- B. False

186. \_\_\_\_\_ – passes through the membrane and is measured by the meter?

- A. Carbon dioxide
- B. Dissolved Oxygen
- C. Only molecular oxygen
- D. H<sub>2</sub>S
- E. Carbon
- F. None of the Above

187. According to the text, membrane electrodes provide an excellent method for \_\_\_\_\_ in polluted, highly colored turbid waters and strong waste effluents.

- A. Sample(s)
- B. DO analysis
- C. Carbon dioxide
- D. Frequent dissolved oxygen measurement
- E. Aerobic conditions
- F. None of the Above

188. Proper samples must be taken in \_\_\_\_\_ bottles where agitation or contact with air is at a minimum.

- A. Sample(s)
- B. DO analysis
- C. BOD
- D. Frequent dissolved oxygen measurement
- E. Aerobic conditions
- F. None of the Above

189. \_\_\_\_\_ is the one of the most important analyses in determining the quality of natural waters?

- A. Winkler Method
- B. Dissolved Oxygen
- C. The dissolved oxygen test
- D. Anaerobic conditions
- E. The iodometric (titration) test
- F. None of the Above

190. \_\_\_\_\_ measurement is essential for adequate process control?

- A. Sample(s)
- B. DO analysis
- C. Carbon dioxide
- D. Dissolved oxygen
- E. Aerobic conditions
- F. None of the Above

### Sludge Volume Index (SVI)

191. The higher the (SVI), the better is the settling quality of the aerated mixed liquor, low (SVI) of 50 or less is considered a good settling sludge.

- A. True
- B. False

192. The Sludge Volume Index (SVI) of activated sludge is defined as the volume in milliliters occupied by \_\_\_\_\_ after settling for 30 minutes.

- A. A closed loop
- B. 1g of activated sludge
- C. Optimal DO levels
- D. Trickling filter FFSS
- E. A portion of the denitrified effluent
- F. None of the Above

### Chlorine Section

#### Chlorine's Appearance and Odor (QA/QC)

193. Chlorine is a greenish-yellow gas it will condense to an amber liquid at approximately \_\_\_\_\_ F or at high pressures.

- A. 32 degrees
- B. - 100 degrees
- C. 129 degrees
- D. 29 degrees
- E. -29.2 degrees
- F. None of the Above

194. Prolonged exposures to chlorine gas may result in \_\_\_\_\_. Odor thresholds ranging from 0.08 to part per million (ppm) parts of air have been reported.

- A. Exposure to chlorine
- B. Odor thresholds
- C. A corrosive material
- D. Olfactory fatigue
- E. Moisture, steam, and water
- F. None of the Above

**(S) Means the answer can be plural or singular**

### Reactivity

195. Conditions Contributing to Instability: Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms?

- A. Hydrogen sulfide
- B. Oxomonosilane
- C. Ammonia
- D. A characteristic pungent odor
- E. A corrosive material
- F. None of the Above

196. Incompatibilities: What is formed when chlorine is in contact with combustible substances reducing agents, and finely divided metals?

- A. Exposure to chlorine
- B. Odor thresholds
- C. A corrosive material
- D. Fires and explosions
- E. Moisture, steam, and water
- F. None of the Above

197. Chlorine reacts with hydrogen sulfide and water to form this substance?

- A. Hydrogen sulfide
- B. Oxomonosilane
- C. Sodium Chloride
- D. Chlorinates
- E. Hydrochloric acid
- F. None of the Above

198. According to the text, chlorine is also incompatible with?

- A. Air
- B. Ammonia
- C. Sodium Chloride
- D. Hydrogen sulfide
- E. Moisture, steam, and water
- F. None of the Above

### Flammability

199. Keep unnecessary people away; isolate the hazard area and deny entry. For a massive fire in a cargo area, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn.

- A. True
- B. False

### Chemistry of Chlorination

200. According to the text, pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the \_\_\_\_\_ increases.

- A. Reduction Ratio
- B. CT actual
- C. Free chlorine residual
- D. "CT" disinfection concept
- E. Ratio of hypochlorous acid
- F. None of the Above

201. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.

- A. True
- B. False

202. Temperature plays a small part in the acid ratio. Although the ratio of \_\_\_\_\_ is greater at lower temperatures, pathogenic organisms are actually harder to kill.

- A. Hypochlorous acid
- B. The amount of chlorine
- C. Chlorine Demand
- D. Total chlorine
- E. pH value and temperature
- F. None of the Above

203. If all other things were equal, \_\_\_\_\_ and a lower pH are more conducive to chlorine disinfection.

- A. Lower pH
- B. Hypochlorous acid
- C. Higher water temperatures
- D. Lower water temperature
- E. The hypochlorite ion
- F. None of the Above

204. The disassociation of chlorine gas  
(OCI - ): HOCl H<sup>+</sup> + OCI<sup>-</sup> Also expressed HOCl → H<sup>+</sup> + OCI<sup>-</sup>  
(hypochlorous acid) (hydrogen) (hypochlorite ion)  
A. True B. False

205. All three forms of chlorine produce Sodium hypochlorite when added to water.  
A. True B. False

206. Hypochlorous acid is a strong acid but a weak disinfecting agent. The amount of hypochlorous acid depends on the pH and temperature of the water.  
A. True B. False

### **Pumps and Lift Stations Section**

#### **Visual Inspection**

207. In smaller sewers, the scope of problems does provide information needed to make decisions on?

- A. SSOs
- B. Visual inspection(s)
- C. Rehabilitation
- D. Sewer line cleaning
- E. Fire hazard
- F. None of the Above

#### **Camera Inspection**

208. \_\_\_\_\_ in a large diameter sewer, the inspection crew is essentially taking photographs?

- A. Rodding
- B. Visual inspection(s)
- C. Lamping
- D. Sewer examination
- E. Camera inspection
- F. None of the Above

#### **Closed Circuit Television (CCTV)**

209. \_\_\_\_\_ requires late night inspection and as a result the TV operators are vulnerable to lapses in concentration.

- A. Sanitary sewer overflow(s)
- B. Rehabilitation
- C. CCTV inspection(s)
- D. Check with the local authorities
- E. Sewer examination
- F. None of the Above

#### **Lamping Inspection**

210. \_\_\_\_\_ is only able to inspect the first 10 feet of the pipe?

- A. Bucketing
- B. Rodding
- C. Rehabilitation
- D. Sewer line cleaning
- E. Lamping
- F. None of the Above

211. According to the text, older areas of the sewer system are inspected every four years; whereas, the inspection of relatively new areas may be completed in 1 to 2 years.  
A. True B. False

212. Sewer line cleaning is prioritized based on the age of the pipe and the frequency of the problems within it, many cities use rodding and?

- A. SSOs
- B. Visual inspection(s)
- C. Rehabilitation
- D. Kiting
- E. Pressurized cleaning methods to maintain the pipes
- F. None of the Above

**(S) Means the answer can be plural or singular**



213. \_\_\_\_\_ are rarely used because cleaning by this method tends to be time consuming?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Scooter
- E. Kite or Bag
- F. None of the Above

214. Most cities that use chemicals into the cleaning program may hire an expert crew, adopting a new program, and instituting a detention time to ensure the?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Results
- E. Cost
- F. None of the Above

### **Cleaning Method Limitation**

215. Balling, Jetting, Scooter: In general, these methods are only successful when necessary water pressure or Head is maintained without flooding basements or houses at high elevations.

- A. True
- B. False

216. \_\_\_\_\_ the main limitation of this technique is that cautions need to be used in areas with basement fixtures and in steep-grade hill areas?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Scooter
- E. Kite or Bag
- F. None of the Above

217. Balling - Balling cannot be used effectively in pipes with \_\_\_\_\_ or protruding service connections because the ball can become distorted.

- A. Steep-grade hill areas
- B. Backups into residences
- C. Variety of cleaning methods
- D. Completely plugged
- E. Bad offset joints
- F. None of the Above

218. \_\_\_\_\_ cleaning larger lines, the manholes need to be designed to a larger size in order to receive and retrieve the equipment?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Scooter
- E. Kite or Bag
- F. None of the Above

219. Bucket Machine- This device has been known to damage sewers and the set-up of this equipment is?

- A. Good for steep-grade hill areas
- B. Able to backups into residences
- C. Able for a variety of cleaning methods
- D. Time-consuming
- E. Not effectively remove sand or grit
- F. None of the Above

220. \_\_\_\_\_ is not very effective in removing heavy solids?

- A. Bucket machine(s)
- B. Jetting
- C. Flushing
- D. Scooter
- E. Kite or Bag
- F. None of the Above

221. \_\_\_\_\_ causes backups into residences have been known to occur when this method has been used by inexperienced operators?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Scooter
- E. High Velocity Cleaner
- F. None of the Above

222. \_\_\_\_\_ when using this method, use caution in locations with basement fixtures and steep-grade hill areas?

- A. Bucket machine(s)
- B. Jetting
- C. Chemicals' effectiveness
- D. Scooter
- E. Kite or Bag
- F. None of the Above

223. Rodding does \_\_\_\_\_, but may only loosen the material to be flushed out at a later time.

- A. Steep-grade hill areas
- B. Backups into residences
- C. Variety of cleaning methods
- D. Completely plugged
- E. Not effectively remove sand or grit
- F. None of the Above

### Limitations of Cleaning Methods

224. Most of collection inspections use?

- A. Visual inspection(s)
- B. CCTV system
- C. Chemicals' effectiveness
- D. Flush and vacuum systems
- E. The cleaning and inspection crews
- F. None of the Above

225. \_\_\_\_\_ are also used in the most recently installed lines and manholes?

- A. Visual inspection(s)
- B. CCTV system
- C. Chemicals' effectiveness
- D. Flush and vacuum systems
- E. The cleaning and inspection crews
- F. None of the Above

226. \_\_\_\_\_ will normally utilize a variety of cleaning methods including jetting, high velocity cleaning, rodding, bucket machining, and using stop trucks?

- A. Steep-grade hill areas
- B. Backups into residences
- C. Variety of cleaning methods
- D. Completely plugged
- E. The collection system
- F. None of the Above

227. With the preventive maintenance approach, most collection system operators also have been using combination trucks with both?

- A. Completely plugged
- B. Backups into residences
- C. Chemicals' effectiveness
- D. Flush and vacuum systems
- E. The cleaning and inspection crews
- F. None of the Above

228. To control roots, most collection system operators use?

- A. Steep-grade hill areas
- B. Backups into residences
- C. Variety of cleaning methods
- D. A vapor roter eradication system
- E. The cleaning and inspection crews
- F. None of the Above

229. The cleaning and inspection crews will usually consist of two members to operate each of the?

- A. Visual inspection(s)
- B. CCTV system
- C. Chemicals' effectiveness
- D. Flush and vacuum systems
- E. Combination trucks and TV trucks
- F. None of the Above

### **Pumps and Lift Stations**

230. Lift Station: A facility in a sewer system consisting of a receiving chamber, pumping equipment, and associated drive and control devices that collect and lift wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive trench depths.

A. True B. False

231. There should not be an odor coming from a?

A. Lift Station D. Pumping Station  
B. Gravity driven E. Submersible pump(s)  
C. Wet well F. None of the Above

232. Pumping Station is a relatively large sewage pumping installation designed not only to lift sewage to a higher elevation, but also to convey it through force mains to gravity flow points located relatively long distances from the?

A. Key elements of lift stations D. Backup  
B. Lift Station's area E. Pumping Station  
C. Dry well F. None of the Above

### **Lift Stations**

233. Wastewater flows slowly downhill until it reaches a certain low point, at that point a pump or "lift" stations push the wastewater back uphill to a high point where gravity can once again take over the process.

A. True B. False

234. Which of the following terms are generally designed to operate continuously to keep sewerage from backing up through the system?

A. Key elements of lift stations D. Sanitary sewer system(s)  
B. Lift Station E. Pumping Station  
C. Dry well F. None of the Above

235. Most Wastewater Collection systems will have installed radio telemetry, or SCADA which is used to monitor and control pump stations via computer at the?

A. Lift Station D. WW Collections facility  
B. Gravity driven E. Submersible pump(s)  
C. Wet well F. None of the Above

236. Which of the following terms identifies potential problems instantaneously and take the proper steps to rectify the situation before it becomes a public health risk?

A. Key elements of lift stations D. Telemetry  
B. Lift Station's area E. Pumping Station  
C. Dry well F. None of the Above

### **A Lift Station contains 4 main Components:**

237. A wet well - usually 15+ ft. in depth and 8ft. in diameter - that houses two submersible pumps of varying horsepower, discharging piping and floats that operate the?

A. Lift Station D. Radio telemetry, or SCADA system(s)  
B. Gravity driven E. Pumps and keep a set level in the well  
C. Wet well F. None of the Above

238. \_\_\_\_\_ houses the piping and valves that prevent backflow in the station, and can lock connection used to bypass the submersibles in an emergency situation?

- A. Key elements of lift stations
- B. Lift Station's area
- C. Dry well
- D. Backup electrical supply
- E. Pumping Station
- F. None of the Above

239. An electrical panel houses control for the?

- A. Lift Station
- B. Gravity driven
- C. Wet well
- D. Radio telemetry, or SCADA system(s)
- E. Submersible pump(s)
- F. None of the Above

240. A "Log Book" or "Station Book" which contains the records and maps of the?

- A. Key elements of lift stations
- B. Lift Station's area
- C. Dry well area
- D. Quarter section
- E. Pumping Station location
- F. None of the Above

### **Collection Systems, Lift Stations**

241. Which of the following terms are facilities designed to move wastewater from lower to higher elevation through pipes?

- A. Wastewater lift stations
- B. Gravity driven
- C. Wet well
- D. Sewer station
- E. Sewer well
- F. None of the Above

242. Which of the following terms include a wastewater receiving well, often equipped with a screen or grinding to remove coarse materials?

- A. Key elements of lift stations
- B. Lift Station's area
- C. Key elements of dry well
- D. Dry-pit or dry-well and submersible lift stations
- E. Lift station equipment and systems
- F. None of the Above

243. Which of the following terms are often installed in an enclosed structure?

- A. Key elements of lift stations
- B. Lift Station's area
- C. Key elements of dry well
- D. Dry-pit or dry-well and submersible lift stations
- E. Lift station equipment and systems
- F. None of the Above

244. Centrifugal pumps are commonly used in?

- A. Submersible lift station(s)
- B. Wet-well
- C. Lift station(s)
- D. Operation and maintenance
- E. Pump station control
- F. None of the Above

245. A more sophisticated control operation involves the use of?

- A. Lift station(s)
- B. Submersible pump(s)
- C. Submersible lift station(s)
- D. Dry-pit or dry-well and submersible lift stations
- E. Variable speed drives
- F. None of the Above

246. Which of the following terms are typically provided with equipment for easy pump removal?

- A. Submersible lift station(s)
- B. Wet-well
- C. Lift station(s)
- D. Operation and maintenance
- E. Pump station control
- F. None of the Above

247. \_\_\_\_\_ houses pumps and valves are housed in a pump room (dry pit or dry-well), that are easily accessible?

- A. Sewer station(s)
- B. Dry-well lift stations
- C. Submersible lift station(s)
- D. Submersible lift stations
- E. Trapped air column, or bubbler system
- F. None of the Above

248. Which of the following terms is a separate chamber attached or located adjacent to the dry-well structure?

- A. Submersible lift station(s)
- B. Wet-well
- C. Lift station(s)
- D. Operation and maintenance
- E. Pump station control
- F. None of the Above

249. Which of the following terms do not have a separate pump room; the lift station header piping, associated valves, and flow meters are located in a separate dry vault at grade for easy access?

- A. Lift station(s)
- B. Submersible pump(s)
- C. Submersible lift station(s)
- D. Dry-pit or dry-well and submersible lift stations
- E. Trapped air column, or bubbler system
- F. None of the Above

250. Which of the following terms include sealed pumps that operate submerged in the wet-well?

- A. Submersible lift station(s)
- B. Wet-well
- C. Lift station(s)
- D. Operation and maintenance
- E. Pump station control
- F. None of the Above

251. Which of the following terms allow easy access for routine visual inspection and maintenance?

- A. Lift station(s)
- B. Submersible pump(s)
- C. Submersible lift station(s)
- D. Dry-pit or dry-well and submersible lift stations
- E. Dry-well lift stations
- F. None of the Above

252. Which of the following terms do not usually include large aboveground structures and tend to blend in with their surrounding environment in residential areas?

- A. Submersible lift station(s)
- B. Wet-well
- C. Lift station(s)
- D. Operation and maintenance building
- E. Pump station control
- F. None of the Above

## Hydraulic Principles Section

### Hydraulics

253. Hydraulics is a branch of engineering concerned mainly with moving liquids.

- A. True
- B. False

254. Which of the following terms includes the manner in which liquids act in tanks and pipes, deals with their properties, and explores ways to take advantage of these properties?

- A. Pressure
- B. Hydrostatics
- C. Hydrokinetics
- D. Hydraulics
- E. Flow
- F. None of the Above

255. Which of the following terms includes the consideration of liquids at rest, involves problems of buoyancy and flotation?

- A. Pressure      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

256. \_\_\_\_\_ includes the behavior of all liquids, although it is primarily concerned with the motion of liquids.

- A. Fluids      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

257. \_\_\_\_\_ includes the study of liquids in motion, is concerned with such matters as friction and turbulence generated in pipes by flowing liquids?

- A. Pressure      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

258. Which of the following terms is about the pressures exerted by a fluid at rest?

- A. Pressure      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

259. Which of the following terms is an excellent example of deductive mathematical physics, and in which the predictions agree closely with experiment?

- A. Pressure      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

260. Which of the following terms is usually stated that a fluid is a substance that cannot resist a shearing stress, so that pressures are normal to confining surfaces?

- A. Pressure      D. Hydraulics
- B. Hydrostatics    E. Flow
- C. Hydrokinetics   F. None of the Above

261. According to the text, hydraulics may be the physical property that varies over the largest numerical range, competing with electrical resistivity.

- A. True    B. False

### **Atmospheric Pressure**

262. The atmosphere is the entire mass of air that surrounds the earth.

- A. True    B. False

263. Which of the following terms is the layer called that extends upward for about 500 miles, the section of primary interest is the portion that rests on the earth's surface and extends upward for about 7 1/2 miles?

- A. Column      D. Mass
- B. Troposphere    E. Atmospheric pressure
- C. Sea level      F. None of the Above

264. Atmospheric pressure is defined as the force per unit area exerted against a surface by the \_\_\_\_\_ of the air above that surface.

- A. Barometer
- B. Pressure(s)
- C. Weight
- D. Altitude
- E. Equipment
- F. None of the Above

**Barometric Loop**

265. According to the text, the barometric loop, will provide protection against backsiphonage, is based upon the principle that a water column, at sea level pressure, will not rise above 33.9 feet. In general, barometric loops are locally fabricated, and are 35 feet high.

- A. True
- B. False

266. \_\_\_\_\_ could be measured an absolute scale, pounds per square inch absolute (psia), or gauge scale, (psiag).

- A. Static pressure
- B. Pressure
- C. Gauge pressure
- D. Sea level
- E. Atmospheric pressure
- F. None of the Above

267. Absolute pressure is equal to gauge pressure plus the atmospheric pressure.

- A. True
- B. False

268. The barometric loop consists of a continuous section of supply piping that abruptly rises to a height of approximately 233 feet and then returns back down to the originating level.

- A. True
- B. False

269. The barometric loop is a loop in the piping system that effectively protects against backpressure.

- A. True
- B. False

270. The barometric loop may not be used to protect against backsiphonage.

- A. True
- B. False

271. According to the text, absolute pressure and gauge pressure?

- A. Are the same
- B. Referred to using pressure
- C. Are related
- D. That effectively protects
- E. Permanent forces tangential
- F. None of the Above

272. Which of the following terms at sea level is 14.7 psai?

- A. Static pressure
- B. Pressure
- C. Gauge pressure
- D. Sea level
- E. Atmospheric pressure
- F. None of the Above

273. Which of the following terms is the total pressure?

- A. Static pressure
- B. Absolute pressure
- C. Gauge pressure
- D. Sea level
- E. Atmospheric pressure
- F. None of the Above

274. Gauge pressure is simply the pressure read on the gauge. If there is no pressure on the gauge other than atmospheric, the gauge will read zero.

- A. True
- B. False

275. Which of the following terms would be equal to 14.7 psi, which is the atmospheric pressure?

- A. Static pressure
- B. Absolute pressure
- C. Gauge pressure
- D. Sea level
- E. Atmospheric pressure
- F. None of the Above

**Pressure**

276. Water is incompressible, while air is very compressible.

- A. True
- B. False

277. Both air and water are considered to be?

- A. Absolute pressure
- B. Atmospheric pressure
- C. Fluid(s)
- D. Volume
- E. Shearing force
- F. None of the Above

278. Which of the following terms does water possess and air does not?

- A. Absolute pressure
- B. Atmospheric pressure
- C. Fluid(s)
- D. Volume
- E. Shearing force
- F. None of the Above

279. A fluid is a substance that cannot exert any permanent forces tangential to a boundary and any force that it exerts on a boundary must be normal to the boundary.

- A. True
- B. False

280. According to the text, a force is proportional to the \_\_\_\_\_, and is called a pressure.

- A. Pascal's Principle
- B. Hydrostatics
- C. Acting on the body of the fluid
- D. Permanent forces tangential
- E. Area on which it is exerted
- F. None of the Above

**Pumps**

281. Pumps are excellent examples of?

- A. Hydrostatics
- B. Quasi-static
- C. Oscillating diaphragm
- D. Multi-stage pumps
- E. Complicated part
- F. None of the Above

282. Pumps are of two general types, \_\_\_\_\_ or positive displacement pumps, and pumps depending on dynamic forces, such as centrifugal pumps.

- A. Hydrostatic
- B. Quasi-static
- C. Oscillating diaphragm
- D. Hydrostatic considerations
- E. Complicated part
- F. None of the Above

283. Positive displacement pumps, have a piston (or equivalent) moving in a closely-fitting cylinder and forces are exerted on the fluid by motion of the piston.

- A. True
- B. False

284. The delivery in this case is from the upper part of the \_\_\_\_\_, which the piston does not enter.

- A. Rotor
- B. Force pump
- C. Volume decreases
- D. Air space
- E. Cylinder
- F. None of the Above



285. Diaphragm pumps are force pumps in which the oscillating diaphragm takes the place of the piston.

- A. True B. False

286. Which of the following terms may be moved mechanically, or by the pressure of the fluid on one side of the diaphragm?

- A. Piston D. Cylinder  
B. Diaphragm E. Lift pumps  
C. Discharged fluid F. None of the Above

287. Which of the following terms are typically used for water?

- A. Bellows D. Force and lift pumps  
B. Force pumps E. Delivery pumps  
C. Volume pumps F. None of the Above

288. The force pump has two valves in the cylinder, while the lift pump has one valve in the cylinder and one in the piston.

- A. True B. False

289. Which of the following terms is determined by the atmospheric pressure, and either cylinder must be within this height of the free surface?

- A. Suction D. Discharge  
B. Diaphragm E. Force  
C. Discharged fluid F. None of the Above

290. The force pump can give an arbitrarily large pressure to the \_\_\_\_\_, as in the case of a diesel engine injector.

- A. Rotor D. Air space  
B. Discharged fluid E. Delivery  
C. Volume decreases F. None of the Above

291. Fire fighting force pumps usually have two cylinders feeding one receiver alternately.

- A. True B. False

292. The air space in the receiver helps to make the?

- A. Rotor D. Air space  
B. Water pressure uniform E. Delivery  
C. Volume decreases F. None of the Above

293. The Roots blower has no valves, their place taken by the \_\_\_\_\_ between the rotors and the housing.

- A. Piston D. Cylinder  
B. Diaphragm E. Sliding contact  
C. Discharged fluid F. None of the Above

294. The Roots blower can either exhaust a receiver or provide \_\_\_\_\_ under moderate pressure, in large volumes.

- A. Air D. Discharge tube  
B. Mixed flow E. Roots blower  
C. Dynamic F. None of the Above

295. The Bellows is a very old device, requiring no accurate machining.  
A. True B. False

296. The single valve is in one or both sides of the expandable?  
A. Cylinder D. Cavity  
B. Chamber E. Positive Displacement Pump(s)  
C. Radial flow F. None of the Above

297. \_\_\_\_\_ uses the valve on the valve stem of the tire or inner tube to hold pressure in the tire?  
A. Bellows pump D. Bicycle pump  
B. Chamber pump E. Positive Displacement Pump  
C. Radial flow pump F. None of the Above

298. \_\_\_\_\_, which is attached to the discharge tube, has a flexible seal that seals when the cylinder is moved to compress the air, but allows air to pass when the movement is reversed?  
A. Piston D. Cylinder  
B. Diaphragm E. Sliding contact  
C. Discharged fluid F. None of the Above

299. According to the text, diaphragm and vane pumps act the same way by varying the volume of a chamber, and directing the flow with?  
A. Cylinder D. Cavity  
B. Check valves E. Positive Displacement Pump(s)  
C. Radial flow F. None of the Above

### **Types of Pumps**

300. The family of pumps comprises a large number of types based on application and capabilities. The two major groups of pumps are?  
A. Plunger and bicycle pump D. Discharge and radical displacement  
B. Mixed flow and single E. Dynamic and positive displacement  
C. Dynamic and radical F. None of the Above