

**Registration form**

**FLUID MECHANICS \$300.00**  
**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*

**Address** \_\_\_\_\_

**City** \_\_\_\_\_ **State** \_\_\_\_\_ **Zip** \_\_\_\_\_

**Email** \_\_\_\_\_ **Fax (\_\_\_\_\_)** \_\_\_\_\_

**Phone:**  
**Home (\_\_\_\_\_)** \_\_\_\_\_ **Work (\_\_\_\_\_)** \_\_\_\_\_

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

**Please circle/check which certification you are applying the course CEU's.**  
Water Treatment \_\_\_ Water Distribution \_\_\_ Other \_\_\_\_\_  
Collections \_\_\_ Wastewater Treatment \_\_\_ Onsite Installer \_\_\_\_\_

**Technical Learning College TLC PO Box 3060, Chino Valley, AZ 86323**  
**Toll Free (866) 557-1746 Fax (928) 272-0747 [info@tlch2o.com](mailto:info@tlch2o.com)**

**If you've paid on the Internet, please write your Customer#** \_\_\_\_\_

**Please invoice me, my PO#** \_\_\_\_\_

***We'll stop mailing the certificate of completion we need your e-mail address. We will e-mail the certificate to you, if no e-mail address; we will mail it to you.***

## **DISCLAIMER NOTICE**

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.

**State Approval Listing Link**, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. If the course is not accepted for CEU credit, we will give you the course free if you ask your State to accept it for credit.

**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.

## **State Approval Listing URL...**

<http://www.ABCTLC.com/downloads/PDF/CEU%20State%20Approvals.pdf>

*You can obtain a printed version of the course manual from TLC for an additional \$169.95 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.

**No refunds.**

## CERTIFICATION OF COURSE PROCTOR

Technical Learning College requires that our students who takes a correspondence or home study program course must pass a proctored course reading, quiz and final examination. The proctor must complete and provide to the school a certification form approved by the commission for each examination administered by the proctor.

**Instructions.** When a student completes the course work, fill out the blanks in this section and provide the form to the proctor with the examination.

Name of Course: \_\_\_\_\_

Name of Licensee: \_\_\_\_\_

**Instructions to Proctor.** After an examination is administered, complete and return this certification and examination to the school in a sealed exam packet or in pdf format.

I certify that:

1. I am a disinterested third party in the administration of this examination. I am not related by blood, marriage or any other relationship to the licensee which would influence me from properly administering the examination.
2. The licensee showed me positive photo identification prior to completing the examination.
3. The enclosed examination was administered under my supervision on \_\_\_\_\_. The licensee received no assistance and had no access to books, notes or reference material.
4. I have not permitted the examination to be compromised, copied, or recorded in any way or by any method.
5. Provide an estimate of the amount of time the student took to complete the assignment.

Time to complete the entire course and final exam. \_\_\_\_\_

Notation of any problem or concerns:

Name and Telephone of Proctor (please print):

\_\_\_\_\_

\_\_\_\_\_

Signature of Proctor



# Fluid Mechanics Answer Key

Name \_\_\_\_\_

Phone \_\_\_\_\_

**You are solely responsible to ensure this course is accepted for credit by your State. Did you check with your State agency to ensure this course is accepted for credit?**

**Method of Course acceptance confirmation. Please fill this section  
No refunds**

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

Did you receive the approval number, if applicable? \_\_\_\_\_

What is the course 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.**

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473. A B	481. A B C D	489. A B C D	497. A B C D
474. A B	482. A B C D	490. A B C D	498. A B C D
475. A B	483. A B C D	491. A B C D	499. A B C D
476. A B	484. A B C D	492. A B C D	500. A B C D

*I understand that I am 100 percent responsible to ensure that TLC receives the Assignment and Registration Key and that it is accepted for credit by my State or Providence. I understand that TLC has a zero tolerance towards not following their rules, cheating or hostility towards staff or instructors. I need to complete the entire assignment for credit. There is no credit for partial assignment completion. My exam was proctored. I will contact TLC if I do not hear back from them within 2 days of assignment submission. I will forfeit my purchase costs and will not receive credit or a refund if I do not abide with TLC's rules. I will not hold TLC liable for any errors, injury, death or non-compliance with rules. I will abide with all federal and state rules and rules found on page 2.*

**Please Sign that you understand and will abide with TLC's Rules.**

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**Signature**

***Please write down any questions you were not able to find the answers or that have errors.***



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

**FLUID MECHANICS CEU COURSE  
CUSTOMER SERVICE RESPONSE CARD**

NAME: \_\_\_\_\_

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

**PLEASE COMPLETE THIS FORM BY CIRCLING THE NUMBER OF THE APPROPRIATE ANSWER IN THE AREA BELOW.**

1. Please rate the difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.

Very Similar 0 1 2 3 4 5 Very Different

4. How did you hear about this Course? \_\_\_\_\_

5. What would you do to improve the Course?

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How about the price of the course?

Poor\_\_\_\_ Fair \_\_\_\_ Average \_\_\_\_ Good\_\_\_\_ Great\_\_\_\_

How was your customer service?

Poor\_\_ Fair \_\_\_\_ Average \_\_\_\_ Good \_\_\_\_ Great\_\_\_\_

Any other concerns or comments.

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## **When Finished with Your Assignment**

### **REQUIRED DOCUMENTS**

Please scan the **Registration Page, Answer Key, Survey and Driver's License** and email these documents to [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **IPhone Scanning Instructions**

If you are unable to scan, take a photo of these documents with your **iPhone** and send these photos to TLC, [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **FAX**

If you are unable to scan and email, please fax these documents to TLC, if you fax, call to confirm that we received your paperwork. **(928) 468-0675**

### **Rush Grading Service**

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of \$50.00.

## Fluid Mechanics CEU Training Course Assignment

The Fluid Mechanics CEU course assignment is available in Word on the Internet for your convenience, please visit [www.ABCTLTC.com](http://www.ABCTLTC.com) and download the assignment and e-mail it back to TLC.

You will have 90 days from receipt of this manual to complete it in order to receive your Professional Development Hours (PDHs) or Continuing Education Unit (CEU). A score of 70 % or better is necessary to pass this course. If you should need any assistance, please email all concerns and the completed ANSWER KEY to [info@tlch2o.com](mailto:info@tlch2o.com).

Select one answer per question. Please utilize the answer key. If you see (s) in the answer, this means the answer could be singular or plural.

If you find any error or problem with the question or the answer, please write that concern down and notify us of this issue.

### Section 1 - Water Key Words

Identify the proper term.

- Which of the following terms has to do with the charge while organic vs. inorganic has to do with the presence or absence of carbon?  
A. Supercritical Fluid                      C. Water Chemistry Analysis  
B. Polar Inorganic Compound              D. None of the above
- Which of the following terms is the ability of a liquid to flow in narrow spaces without the assistance of, or even in opposition to, external forces like gravity?  
A. Capillary action                          C. Supercritical Fluid  
B. Polar Inorganic Compound              D. None of the above
- Which of the following terms is a compound that is not considered "organic"?  
A. Inorganic Compound                    C. Organic Material  
B. Molecule                                  D. None of the above
- Which of the following terms allows various insects, usually denser than water, to float and stride on a water surface?  
A. Polar Inorganic Compound              C. Supercritical Fluid  
B. Surface Tension                          D. None of the above
- Which of the following terms can occur in three different forms - gaseous, liquid, and solid?  
A. Capillary action                          C. Supercritical Fluid  
B. Properties of Water                      D. None of the above
- Which of the following terms is the elastic tendency of a fluid surface that makes it acquire the least surface area possible?  
A. Capillary action                          C. Supercritical Fluid  
B. Surface Tension                          D. None of the above



17. A phase diagram is a chart used in physical chemistry, engineering, mineralogy, and materials science to show conditions at which thermodynamically distinct phases occur and coexist at equilibrium.

A. True      B. False

18. The solidus is the pressure in which the substance is stable in the solid state.

A. True      B. False

19. Supercritical phase occurs in nature, in most normal conditions.

A. True      B. False

### **Water as a Solvent**

20. Water is a super solvent, due to its polarity.

A. True      B. False

21. The capability of a substance to dissolve in water is governed by whether or not the substance can match or better the strong attractive forces that water molecules generate between other water molecules.

A. True      B. False

22. If a substance has properties that do not allow it to overcome these strong intermolecular forces, the molecules are "pushed out" from the water, and will easily dissolve.

A. True      B. False

23. Contrary to the common misunderstanding, water and hydrophobic substances do not "repel", and the hydration of a hydrophobic surface is energetically, but not entropically, favorable.

A. True      B. False

24. Generally speaking, ionic and polar substances such as acids, alcohols, and salts are relatively non-soluble in water, as polar substances such as fats and oils.

A. True      B. False

25. Polar molecules stay together in water because it is energetically more favorable for the water molecules to hydrogen bond to each other than to engage in van der Waals interactions with polar molecules.

A. True      B. False

### **Physical Science and Laws Section**

26. Which of the following is the assumption that a fluid is composed of a continuous material so that properties such as density, pressure, temperature, and velocity are well-defined?

A. Force                      C. Continuum Assumption  
B. Inertia                     D. None of the above

27. Which of the following are three physical laws that directly relate the forces acting on a body to the motion of the body?

A. Laws of Thermodynamics                      C. Newton's laws of motion  
B. Physical Laws                                     D. None of the above

28. Which of the following states that every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it?
- A. First law
  - B. Physical Law
  - C. Law of Thermodynamics
  - D. None of the above
29. Which of the following can also be described intuitively as a push or a pull?
- A. Force
  - B. Pull
  - C. Drag
  - D. None of the above
30. Which of the following is both a property of a physical body and a measure of its resistance to acceleration when a net force is applied?
- A. Gravity
  - B. Mass
  - C. Inertia
  - D. None of the above
31. Which of the following is any interaction that, when unopposed, will change the motion of an object?
- A. Force
  - B. Drag
  - C. Push
  - D. None of the above
32. Which of the following is the force that attracts a body toward the center of the earth, or toward any other physical body having mass?
- A. Gravity
  - B. Mass
  - C. Inertia
  - D. None of the above
33. Which of the following is the resistance of any physical object to any change in its state of motion?
- A. Gravity
  - B. Mass
  - C. Inertia
  - D. None of the above
34. Which of the following represents an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy?
- A. Pascal's Law
  - B. Physical Law
  - C. Bernoulli's Principle
  - D. None of the above
35. Which of the following is a theoretical statement inferred from particular facts, applicable to a defined group or class of phenomena, and expressible by the statement that a particular phenomenon always occurs if certain conditions be present?
- A. Newton's Laws
  - B. Physical Law
  - C. Law of Thermodynamic
  - D. None of the above
36. Which of the following is the tendency of objects to keep moving in a straight line at constant velocity?
- A. Force
  - B. Inertia
  - C. Friction
  - D. None of the above
37. Which of the following can cause an object with mass to change its velocity to accelerate?
- A. Force
  - B. Pull
  - C. Push
  - D. None of the above

38. Which of the following determines the strength of its mutual gravitational attraction to other bodies?  
 A. Force      C. Weight  
 B. Mass      D. None of the above
39. Which of the following are three physical laws that, together, laid the foundation for classical mechanics?  
 A. Newton's Laws of motion    C. Laws of Thermodynamics  
 B. Physical Laws                  D. None of the above
40. Which of the following describe the relationship between a body and the forces acting upon it, and its motion in response to those forces.  
 A. Newton's Laws of motion    C. Laws of Thermodynamics  
 B. Bernoulli's Principle        D. None of the above
41. Which of the following define fundamental physical quantities that characterize thermodynamic systems?  
 A. Newton's Laws      C. Laws of Thermodynamics  
 B. Physical Laws      D. None of the above
42. Which of the following laws describe how these quantities behave under various circumstances, and forbid certain phenomena?  
 A. Bernoulli's Principles      C. Laws of Thermodynamics  
 B. Physical Law                  D. None of the above
43. Which of the following represent the principle of transmission of fluid-pressure is a principle in fluid mechanics that states that pressure exerted anywhere in a confined incompressible fluid is transmitted equally in all directions throughout the fluid such that the pressure variations remain the same?  
 A. Pascal's Law      C. Bernoulli's Principle  
 B. Physical Law      D. None of the above
- Physical Law Description Physical laws are:
44. True, at least within their regime of validity. By definition, there have never been repeatable contradicting?  
 A. Time                  C. Observations  
 B. Space and time    D. None of the above
45. Which of the following represents unchanged since first discovered although they may have been shown to be approximations of more accurate laws?  
 A. Stable      C. Space and time  
 B. Absolute    D. None of the above
46. Which of the following represents everything in the universe apparently must comply with them according to observations?  
 A. Stable                  C. Omnipotent  
 B. Universal              D. None of the above
47. Which of the following represents that this appears to apply everywhere in the universe?  
 A. Stable                  C. Space and time  
 B. Universal              D. None of the above



58. Which of the following terms is the resistance of any physical object to any change in its state of motion?

- A. Pressure
- B. Inertia
- C. Torque
- D. None of the above

59. Which of the following is both a property of a physical body and a measure of its resistance to acceleration when a net force is applied?

- A. Gravity
- B. Fundamental interactions
- C. Mass
- D. None of the above

### **Pascal's Law**

60. Pascal discovered that pressure in a fluid acts equally in some directions.

- A. True
- B. False

61. Pressure in a \_\_\_\_\_ of direction.

- A. Liquid at a specific depth
- B. Liquid is independent
- C. Height of a liquid
- D. None of the above

62. Pressure due to the \_\_\_\_\_, at any level, depends on the depth of the fluid from the surface.

- A. Weight of a liquid
- B. Liquid at a specific depth
- C. Height of a liquid
- D. None of the above

63. If the exposed face of the pressure gauges are moved closer to the surface of the liquid, the indicated?

- A. Pressure will be less
- B. Pressure of a liquid
- C. Is equal
- D. None of the above

64. The indicated pressure is doubled, when the?

- A. Depth is doubled
- B. Pressure of a liquid
- C. Column is tripled
- D. None of the above

65. The pressure at any depth in that the \_\_\_\_\_ of the column of liquid at that depth divided by the cross-sectional area of the column at that depth.

- A. Depth is doubled
- B. Pressure of a liquid
- C. Liquid is equal to the weight
- D. None of the above

66. Which of the following produces the pressure is referred to as the fluid head of the liquid?

- A. Depth is doubled
- B. Pressure of a liquid
- C. Volume of a liquid
- D. None of the above

67. Which of the following is due to its fluid head is also dependent on the density of the liquid?

- A. Pressure will be less
- B. Pressure of a liquid
- C. Is equal
- D. None of the above

### **Static Pressure**

68. Static pressure exists in addition to Gravity that may also be present at the same time.

- A. True
- B. False

69. Pascal's law states that a pressure set up in a fluid acts equally in all directions and at right angles to the containing surfaces.

- A. True      B. False

70. Which of the following flow terms is an important consideration in sizing the hydraulic lines?

- A. Velocity of flow      C. Volume of flow  
B. Volume of a liquid      D. None of the above

71. Pascal's law covers the situation only for fluids at rest or practically at rest. It is true only for the factors making up \_\_\_\_\_.

- A. Velocity of flow      C. Static head  
B. Volume of a liquid      D. None of the above

### **Volume and Velocity of Flow**

72. Which of the following is usually expressed in gallons per minute (gpm) and is associated with relative pressures of the liquid, such as 5 gpm at 40 psi?

- A. Velocity of flow      C. Volume of flow  
B. Volume of a liquid      D. None of the above

73. Which of the following flow terms is defined as the average speed at which the fluid moves past a given point. It is usually expressed in feet per second (fps) or feet per minute (fpm).

- A. Velocity of flow      C. Volume of flow  
B. Volume of a liquid      D. None of the above

74. Volume and friction head are often considered together, that is, with volume of input unchanged—the velocity of flow increases as the cross section or size of the pipe decreases.

- A. True      B. False

### **Bernoulli's Principle**

75. Bernoulli's principle thus says that a rise (or fall) in pressure in a flowing fluid must always be accompanied by a decrease (or increase) in the speed, and conversely, if an increase (decrease) in, the speed of the fluid results in a decrease (or increase) in the pressure.

- A. True      B. False

76. Bernoulli's principle is responsible for the fact that a shower curtain gets "sucked inwards" when the water is first turned on. What happens is that the increased water/air velocity inside the curtain causes a pressure drop.

- A. True      B. False

77. Which of the following s explains the difference between the outside and inside causes a net force on the shower curtain which sucks it inward?

- A. Pressure      C. Velocity of flow  
B. Volume of flow      D. None of the above

78. Squeezing the bulb over the fluid creates a low \_\_\_\_\_ area due to the higher speed of the air, which subsequently draws the fluid up.

- A. Pressure      C. Velocity of flow  
B. Volume of flow      D. None of the above

79. Which of the following explains why windows tend to explode, rather than implode in hurricanes: the very high speed of the air just outside the window causes the pressure just outside to be much less than the pressure inside, where the air is still.

- A. Venturi effect
- B. Bernoulli's principle
- C. Conservation of energy
- D. None of the above

80. Another example of \_\_\_\_\_ at work is in the lift of aircraft wings and the motion of "curve balls" in baseball. In both cases the design is such as to create a speed differential of the flowing air past the object on the top and the bottom.

- A. Venturi
- B. Bernoulli's principle
- C. Conservation of energy
- D. None of the Above

### **Fluid Mechanics and Hydraulic Principles Section**

81. Which of the following definitions is often used to indicate gauge pressure?

- A. Head, Friction
- B. Head
- C. Hydraulics
- D. None of the above

82. Which of the following definitions is the force per unit area, usually expressed in pounds per square inch?

- A. Pressure
- B. Hydraulics
- C. Pascal's Law
- D. None of the above

83. Which of the following definitions is the pressure differential above or below ambient atmospheric pressure?

- A. Pressure, Atmospheric
- B. Pressure, Static
- C. Pressure, Gauge
- D. None of the above

84. Which of the following definitions is height of a column or body of fluid above a given point expressed in linear units?

- A. Head, Friction
- B. Head
- C. Hydraulics
- D. None of the above

85. Which of the following definitions is required to overcome the friction at the interior surface of a conductor and between fluid particles in motion?

- A. Head, Friction
- B. Head, static
- C. Hydraulics
- D. None of the above

86. Which of the following definitions varies with flow, size, type, and conditions of conductors and fittings, and the fluid characteristics?

- A. Head, Friction
- B. Head, static
- C. Hydraulics
- D. None of the above

87. Which of the following definitions is the pressure in a fluid at rest?

- A. Pressure, Atmospheric
- B. Pressure, Static
- C. Pressure, Gauge
- D. None of the above

88. Which of the following definitions is the height of a column or body of fluid above a given point?

- A. Head, Friction
- B. Head, static
- C. Hydraulics
- D. None of the above

89. Which of the following definitions is the pressure exerted by the atmosphere at any specific location?

- A. Pressure, Atmospheric
- B. Pressure, Static
- C. Pressure, Gauge
- D. None of the above

90. Which of the following definitions is pressure above zero absolute, i.e. the sum of atmospheric and gauge pressure?

- A. Pressure, Absolute
- B. Pressure
- C. Pressure, Gauge
- D. None of the above

### Hydraulics

91. Which of the following includes the behavior of all liquids, although it is primarily concerned with the motion of liquids?

- A. Fluids
- B. Hydrostatics
- C. Hydraulics
- D. None of the above

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

- A. Hydrokinetics
- B. Hydrostatics
- C. Hydraulics
- D. None of the above

93. Hydraulics is applied commonly to the study of the \_\_\_\_\_, other liquids, and even gases when the effects of compressibility are small.

- A. Fluids
- B. Hydrokinetics
- C. Mechanical properties of water
- D. None of the above

94. Hydraulics can be divided into two areas, \_\_\_\_\_ and hydrokinetics.

- A. Hydrokinetics
- B. Hydrostatics
- C. Hydraulics
- D. None of the above

95. Which of the following 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. Hydrokinetics
- B. Hydrostatics
- C. Hydraulics
- D. None of the above

96. Which of the following terms includes the study of liquids in motion, is concerned with such matters as friction and turbulence generated in pipes by flowing liquids?

- A. Pressure
- B. Hydrokinetics
- C. Hydraulics
- D. None of the above

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

- A. Pressure
- B. Hydrostatics
- C. Hydraulics
- D. None of the above

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

- A. Pressure
- B. Hydrokinetics
- C. Hydrostatics
- D. None of the above

### What is Fluid Mechanics?

99. Fluid mechanics is a science concerned with the response of fluids to \_\_\_\_\_.
- A. Forces
  - B. Its velocity
  - C. Forces exerted upon them
  - D. None of the above

### Properties of Fluids

100. There are a few liquids, known as liquid crystals, in which the molecules are packed together in such a way as to make the properties of the medium locally anisotropic, but the vast majority of fluids - including air and water- are \_\_\_\_\_.
- A. Isotropic
  - B. Anisotropic
  - C. Composed of discrete molecules
  - D. None of the above

### Isotropic Fluid or Newtonian Fluid

101. If the fluid is also \_\_\_\_\_, the viscosity tensor reduces to two real coefficients, describing the fluid's resistance to continuous shear deformation and continuous compression or expansion, respectively.
- A. Isotropic
  - B. Azeotropic
  - C. Composed of discrete molecules
  - D. None of the above

### Fluid Statics

102. Hydrostatics is fundamental to hydraulics, the engineering of equipment for storing, transporting and using fluids. It is also relevant to some aspect of geophysics and astrophysics (i.e., in understanding plate tectonics and \_\_\_\_\_), to meteorology, to medicine (with the context of blood pressure), and many other fields.
- A. Forces
  - B. Its velocity
  - C. Anomalies in the Earth's gravitational field
  - D. None of the above

### Fluid Dynamics

103. The solution to a fluid dynamics problem typically involves calculating various properties of the fluid, such as velocity, pressure, density, and temperature, as functions of space and time.
- A. True
  - B. False
104. Fluid dynamics has several sub-disciplines itself, including aerodynamics (the study of air and other gases in motion) and hydrodynamics (the study of liquids in motion).
- A. True
  - B. False
105. Fluid dynamics offers a systematic structure—which underlies these practical disciplines—that embraces empirical and semi-empirical laws derived from flow measurement and used to solve practical problems.
- A. True
  - B. False
106. Fluid dynamics has a wide range of applications, including calculating forces and moments on aircraft, determining the mass flow rate of petroleum through pipelines, predicting evolving weather patterns, even understanding nebulae in interstellar space and modeling explosions.
- A. True
  - B. False
107. Fluid dynamics is a sub-discipline of fluid mechanics that deals with fluid flow—the science of liquids and gases in motion.
- A. True
  - B. False

### Gases and Liquids

108. A word is needed about the \_\_\_\_\_, though the difference is easier to perceive than to describe.

- A. Volume available
- B. Volume of a liquid
- C. Difference between gases and liquids
- D. None of the above

109. In gases, the molecules are sufficiently far apart to move almost independently of one another, and gases tend to expand to fill \_\_\_\_\_.

- A. Volume available
- B. Any volume available to them
- C. Settle down into the ordered arrays
- D. None of the above

110. In liquids, the molecules are more or less in contact, and the \_\_\_\_\_ between them make them cohere; the molecules are moving too fast to settle down into the ordered arrays that are characteristic of solids, but not so fast that they can fly apart.

- A. Volume available
- B. Volume of a liquid
- C. Short-range attractive forces
- D. None of the above

111. Samples of liquid can exist as drops or as jets with free surfaces, or they can sit in beakers constrained only by \_\_\_\_\_, in a way that samples of gas cannot.

- A. Volume
- B. Gravity
- C. Ordered arrays
- D. None of the above

### Surface Tension

112. Work also must be done if a free liquid drop of spherical shape is to be drawn out into a long thin cylinder or deformed in any other way that increases its surface area. Here again work is needed to break \_\_\_\_\_.

- A. Intermolecular links
- B. Liquid surface
- C. Dissolved gases
- D. None of the above

113. The \_\_\_\_\_ behaves as if it were an elastic membrane under tension, except that the tension exerted by an elastic membrane increases when the membrane is stretched in a way that the tension exerted by a liquid surface does not.

- A. Surface tension
- B. Surface of a liquid
- C. Dissolved gases
- D. None of the above

114. Surface tension is what causes liquids to rise up capillary tubes, what supports hanging \_\_\_\_\_, what limits the formation of ripples on the surface of liquids, and so on.

- A. Surface tension
- B. Liquid surface
- C. Liquid drops
- D. None of the above

### Several Types of Friction

115. Which type of friction is a case of fluid friction where a lubricant fluid separates two solid surfaces?

- A. Dry
- B. Fluid
- C. Lubricated
- D. None of the above

116. Which type of friction is the force resisting motion between the elements making up a solid material while it undergoes deformation?

- A. Dry      C. Internal
- B. Fluid     D. None of the above

117. Which type of friction resists relative lateral motion of two solid surfaces in contact?

- A. Dry      C. Lubricated
- B. Fluid     D. None of the above

118. Which type of friction describes the friction between layers of a viscous fluid that are moving relative to each other?

- A. Dry      C. Lubricated
- B. Fluid     D. None of the above

### **Water and Electrical Principles are Very Similar**

119. The electronic–hydraulic analogy is the most widely used analogy for "Hydraulic fluid" in a metal conductor.

- A. True      B. False

120. Electricity was understood to be a kind of energy, and the names of certain electric quantities are derived from heating equivalents.

- A. True      B. False

### **Basic Ideas**

121. Flow and pressure variables can be calculated in fluid flow network with the use of the?

- A. Electron fluids      C. Hydraulic ohm analogy
- B. Pressures             D. None of the above

### **Component Equivalents**

122. Connecting one end of a wire to a circuit is equivalent to forcibly un-capping one end of the pipe and attaching it to another pipe.

- A. True      B. False

123. When comparing to a piece of wire, a water pipe should be thought of as having semi-permanent caps on the ends.

- A. True      B. False

124. Memristor is a needle valve operated by a flow meter.

- A. True      B. False

125. A capacitor cannot "filter out" constant pressure differences frequency pressure differences.

- A. True      B. False

126. A resistor is considered a constriction in the bore of the pipe that requires less pressure to pass the same amount of water.

- A. True      B. False

127. Voltage is the difference in pressure between two points, usually measured in volts.

- A. True      B. False

128. A diode is equivalent to a two-way check valve with a tight valve seal.  
A. True      B. False
129. A wire with only one end attached to a circuit will do nothing; the pipe remains capped on the free end, and?  
A. Voltage in a capacitor      C. Thus adds nothing to the circuit  
B. Force of gravity      D. None of the above
130. If water is flowing horizontally, so that the force of gravity can be overlooked, and then electric potential is equivalent to?  
A. Nothing to the circuit      C. Pressure  
B. Force of gravity      D. None of the above
131. An Inductor is a heavy paddle wheel placed in?  
A. Potential difference      C. The current  
B. Feedback control      D. None of the above
132. The perfect voltage source, or ideal battery is a dynamic pump with?  
A. Potential difference      C. Water flow  
B. Feedback control      D. None of the above
133. Another analogy is \_\_\_\_\_, if one terminal is kept fixed at ground, sufficiently large that the drawn water does not affect the water level.  
A. Quantity of water      C. A large body of water at a high elevation  
B. Water level      D. None of the above
134. All pipes have \_\_\_\_\_, just as all wires have some resistance to current.  
A. Quantity of water      C. Some resistance to flow  
B. Water level      D. None of the above
135. Voltage is also called voltage drop or?  
A. Valve assembly      C. A positive displacement pump  
B. Potential difference      D. None of the above
136. According to the text, electric charge is equivalent to?  
A. Resistance to current      C. The mass and surface area of the wheel  
B. Quantity of water      D. None of the above
137. As with a diode, a small pressure difference is needed before the valve opens. In addition, like a diode, too much reverse bias can damage or destroy the?  
A. Valve assembly      C. A positive displacement pump  
B. Feedback control      D. None of the above

## Fluid/Hydraulic Forces & Pressures Section

### Atmospheric Pressure

138. The atmosphere is the entire mass of air that surrounds the earth.  
A. True      B. False

139. Which of the following 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. Troposphere
- B. Sea level
- C. Atmospheric pressure
- D. None of the above

140. If a column of air 1-inch square extending all the way to the "atmosphere", this column of air would weigh approximately 2.31 pounds at sea level.

- A. True
- B. False

141. Which of the following at sea level is approximately 14.7 psi?

- A. Pressure
- B. Gauge pressure
- C. Atmospheric pressure
- D. None of the above

142. Which of the following if you could be below, in excavations and depressions, atmospheric pressure increases?

- A. Static pressure
- B. Pressure
- C. Sea level
- D. None of the above

143. Pressures under water differ from those under air only because the weight of the water must be added to the?

- A. Pressure(s) of the air
- B. Height
- C. Seal Level
- D. None of the above

144. Which of the following can be measured by any of several methods, one method is the mercury column barometer?

- A. Pressure
- B. Gauge pressure
- C. Atmospheric pressure
- D. None of the above

145. Which of the following could be measured with the aneroid Barometer?

- A. Pressure
- B. Gauge pressure
- C. Atmospheric pressure
- D. None of the above

146. The atmospheric pressure does not vary uniformly with?

- A. Barometric pressure
- B. Weight
- C. Altitude
- D. None of the above

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

- A. Barometric pressure
- B. Weight
- C. Altitude
- D. None of the above

148. If you were to ascend, the atmospheric pressure increases by approximately 1.0 psi for every 2,343 feet.

- A. True
- B. False

149. At sea level and at a temperature of 0° Celsius (C), the height of the mercury column is approximately 30 inches, or 76 centimeters. This represents a pressure of approximately 14.7 psi.

- A. True
- B. False

### Barometric Loop

150. 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

151. 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

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

- A. True      B. False

153. Absolute pressure and gauge pressure?

- A. Are the same      C. That effectively protects  
B. Are related      D. None of the above

154. Which of the following terms could be measured on an absolute scale, pounds per square inch absolute (psia), or gauge scale, (psiag).

- A. Static pressure      C. Sea level  
B. Pressure      D. None of the above

155. Which of the following at sea level is 14.7 psia?

- A. Pressure      C. Atmospheric pressure  
B. Gauge pressure      D. None of the above

156. Which of the following is the total pressure?

- A. Absolute pressure      C. Atmospheric pressure  
B. Gauge pressure      D. None of the above

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

- A. Absolute pressure      C. Atmospheric pressure  
B. Gauge pressure      D. None of the above

### Pressure

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

- A. True      B. False

159. 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

160. Both air and water are considered to be?

- A. Gases      C. Volume  
B. Fluid(s)      D. None of the above

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

- A. Gases      C. Volume  
B. Fluid(s)      D. None of the above

162. The coefficient of viscosity is the ratio of \_\_\_\_\_ to the velocity gradient.

- A. Absolute pressure
- B. Shearing force
- C. Volume
- D. None of the above

163. Which of the following deals with permanent, time-independent states of fluids, so viscosity does not appear?

- A. Pascal's Principle
- B. Hydrostatics
- C. Permanent forces tangential
- D. None of the above

164. In permanent, time-independent states of fluids, the pressure will be the same throughout the fluid, and the same in any direction at a point?

- A. Pascal's Principle
- B. Acting on the body of the fluid
- C. Permanent forces tangential
- D. None of the above

165. Which of the following that if a certain volume of fluid were somehow made solid, the equilibrium of forces would not be disturbed?

- A. Axiom
- B. Pressure
- C. Displaced fluid
- D. None of the above

166. Which of the following is an example of a body force that disturbs the equality of pressure in a fluid?

- A. Gravitational body force
- B. Pressure
- C. Gravitation
- D. None of the above

167. We call this relation the barometric equation, for when this equation is integrated, we find the variation of pressure with?

- A. Height or depth
- B. Gravitation
- C. Displaced fluid
- D. None of the above

### **Free Surface Perpendicular to Gravity**

168. Archimedes' Principle says that the buoyant force is equal to the weight of the displaced fluid, and passes through the center of mass of?

- A. Gravitation
- B. Pressure
- C. Displaced fluid
- D. None of the above

### **Standard Atmospheric Pressure**

169. Which of the following is a practice that is convenient to measure pressure differences by measuring the height of liquid columns?

- A. Barometer measurement
- B. Manometer
- C. Partial vacuum measurement
- D. None of the above

170. Which of the following uses a partially evacuated chamber of thin metal that expands and contracts according to the external pressure?

- A. Aneroid barometer
- B. Capillarity tube
- C. Partial vacuum
- D. None of the above

### **Vacuum**

171. The term vacuum indicates that the absolute pressure is less than the atmospheric pressure and that the \_\_\_\_\_ is negative.

- A. Pressure
- B. Gauge pressure
- C. Atmospheric pressure
- D. None of the above

172. Which of the following would mean a pressure of 0 psia or  $-14.7$  psig?

- A. Static pressure
- B. Gauge pressure
- C. Total vacuum
- D. None of the above

173. Which of the following the pressure would range from slightly less than  $14.7$  psia to slightly greater than 0 psia?

- A. Pressure
- B. Gauge pressure
- C. Partial vacuum
- D. None of the above

### **Water Pressure**

174. Which of the following are very frequently stated in terms of the height of a fluid.

- A. Weight
- B. Pressure(s)
- C. Depth
- D. None of the above

175. Water with a pressure head of 10 ft can provide the same \_\_\_\_\_ as an equal amount of water raised by 10 ft.

- A. Weight
- B. Pressure(s)
- C. Energy
- D. None of the above

176. Water flowing in a pipe is subject to head loss because of?

- A. Friction
- B. Pressure(s)
- C. Siphon
- D. None of the above

177. When a siphon goes below the free water levels, it is called an?

- A. Water bearer
- B. Siphon
- C. Inverted siphon
- D. None of the above

178. Which of the following can be made by filling the tube, closing the ends, and then putting the ends under the surface on both sides?

- A. Water bearer
- B. Siphon
- C. Inverted siphon
- D. None of the above

### **Pressure and Force**

179. Which of the following is the force that pushes water through pipes?

- A. Pressure
- B. Fluid(s)
- C. Shearing force
- D. None of the above

180. Water pressure determines the flow of water from the tap.

- A. True
- B. False

181. Which of the following and force are used extensively in the study of fluid power?

- A. Pressure
- B. Fluid(s)
- C. Shearing force
- D. None of the above

182. Which of the following terms means a total push or pull. It is the push or pull exerted against the total area of a particular surface?

- A. Absolute pressure
- B. Force
- C. Volume
- D. None of the above

183. Which of the following means the amount of push or pull applied to each unit area of the surface?

- A. Absolute pressure
- B. Pressure
- C. Volume
- D. None of the above

184. Which of the following maybe exerted in one direction, in several directions, or in all directions?

- A. Absolute pressure
- B. Pressure
- C. Volume
- D. None of the above

### Computing Force, Pressure, and Area

185. A formula is used in computing force, volume, and area in fluid power systems. In this formula, P refers to pressure, F indicates volume, and A represents area.

- A. True
- B. False

## Experiments and Early Applications Section

186. Which of the following arises from our failure to accept, at first sight, the conclusion published by Blaise Pascal in 1663?

- A. Hydrostatic paradox
- B. Coriolis Force
- C. Specific gravity
- D. None of the above

187. Which of the following is a law of physics fundamental to fluid mechanics?

- A. Archimedes' principle
- B. Coriolis Force
- C. Downthrust
- D. None of the above

188. Which of the following is an effect whereby a mass moving in a rotating system experiences a force acting perpendicular to the direction of motion and to the axis of rotation?

- A. Hydrostatic paradox
- B. Coriolis Force
- C. Isobaric process
- D. None of the above

189. Which of the following is an upward force exerted by a fluid that opposes the weight of an immersed object?

- A. Archimedes' principle
- B. Coriolis Force
- C. Buoyancy or upthrust
- D. None of the above

190. \_\_\_\_\_ in a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. Thus the pressure at the bottom of a column of fluid is greater than at the top of the column.

- A. Hydrostatic paradox
- B. Buoyancy
- C. Isobaric process
- D. None of the above

191. Which of the following indicates that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid.

- A. Hydrostatic paradox
- B. Archimedes' principle
- C. Isobaric process
- D. None of the above

192. Which of the following is the pressure at a certain level in a fluid is proportional to the vertical distance to the surface of the liquid?

- A. Hydrostatic paradox
- B. Coriolis Force
- C. Isobaric process
- D. None of the above

193. Which of the following is the ratio of the density of a substance to the density of a reference substance; equivalently, it is the ratio of the mass of a substance to the mass of a reference substance for the same given volume?

- A. Hydrostatic paradox
- B. Coriolis Force
- C. Specific gravity
- D. None of the above

194. Which of the following is the ratio of the weight of a volume of the substance to the weight of an equal volume of the reference substance?

- A. Hydrostatic paradox
- B. Coriolis Force
- C. Specific gravity
- D. None of the above

195. Which of the following is of great importance in meteorology, since it determines the winds?

- A. Stratosphere
- B. Atmosphere
- C. Atmospheric pressure
- D. None of the above

196. Certain typical weather patterns are associated with relatively high and relatively low \_\_\_\_\_, and how they vary with time.

- A. Forces
- B. Physics
- C. Pressures
- D. None of the above

### Experiments and Early Applications Key Terms

197. Which of the following to be made effective for practical applications, it was necessary to have a piston that "fit exactly?"

- A. Pascal's law
- B. Archimedes' law
- C. Aristotle' law
- D. None of the above

198. Valves, pumps, actuating cylinders, and motors have been developed and refined to make hydraulics one of the leading methods of transmitting power.

- A. True
- B. False

199. Daniel Bernoulli conducted experiments to study the elements of force in the discharge of water through small openings in the sides of tanks and through short pipes.

- A. True
- B. False

200. Which of the following states that increase in pressure on the surface of a confined fluid is transmitted undiminished throughout the confining vessel or system?

- A. Pascal's law
- B. Blaise Pascal
- C. Aristotle' law
- D. None of the above

201. Which of the following is by no means isothermal close to the ground?

- A. Stratosphere
- B. Atmosphere
- C. Atmospheric pressure
- D. None of the above

### Measurement of Specific Gravity

202. Which of the following is the ratio of the mass (or weight) of a certain sample of it to the mass or weight of an equal volume of water, the conventional reference material?

- A. Water
- B. Density
- C. Specific gravity of a material
- D. None of the above

203. In the metric system, the \_\_\_\_\_ of water is 1 g/cc, which makes the specific gravity numerically equal to the density.

- A. Water
- B. Density
- C. Specific gravity of a material
- D. None of the above

204. Which of the following has the dimensions' g/cc, while specific gravity is a dimensionless ratio?

- A. Water
- B. Density
- C. Specific gravity of a material
- D. None of the above

### Variations in Specific Gravity

205. Which of the following of the density may have to be taken into consideration in accurate work?

- A. Water
- B. Temperature dependence
- C. Specific gravity of a material
- D. None of the above

206. Which of the following has a density 13.5955 at 0°C, and 13.5461 at 20°C?

- A. Water
- B. Air
- C. Mercury
- D. None of the above

### Hydrometer

207. An instrument for the \_\_\_\_\_ is the hydrometer, which consists of a weighted float and a calibrated stem that protrudes from the liquid when the float is entirely immersed.

- A. Higher specific gravity
- B. Specific gravities
- C. Measurement of specific gravity
- D. None of the above

208. \_\_\_\_\_ will result in a greater length of the stem above the surface, while a lower specific gravity will cause the hydrometer to float lower.

- A. Higher specific gravity
- B. Specific gravities
- C. Measurement of specific gravity
- D. None of the above

209. In most cases, the graduations or "degrees" are arbitrary and reference is made to a table to determine the \_\_\_\_\_.

- A. Higher specific gravity
- B. Specific gravities
- C. Measurement of specific gravity
- D. None of the above

## Pumps and Pumping Water Section

### Common Types of Water Pumps

210. The most common type of water pumps used for municipal and domestic water supplies are variable displacement pumps another term for \_\_\_\_\_.

- A. Dynamic pump(s)
- B. Turbine pump(s)
- C. Variable displacement pump(s)
- D. None of the above

211. Which of the following will produce at different rates relative to the amount of pressure or lift the pump is working against?
- A. Dynamic pump(s)                      C. Variable displacement pump(s)  
 B. Turbine pump(s)                      D. None of the above
212. Impellers are rotated by the \_\_\_\_\_, which provides the horsepower needed to overcome the pumping head.
- A. Pump motor                      C. Shaft rotated by a motor  
 B. Pumping rate                      D. None of the above
213. The size and number of stages, horsepower of the motor and \_\_\_\_\_ are the key components relating to the pump's lifting capacity.
- A. Impeller(s)                      C. Pumping head  
 B. Pumping rate                      D. None of the above
214. Which of the following pumps are commonly used in groundwater wells but also in many other applications?
- A. Dynamic                      C. Variable displacement  
 B. Vertical turbine                      D. None of the above
215. Vertical turbine pumps are driven by a shaft rotated by a motor that is usually found on the surface. The shaft turns the \_\_\_\_\_ within the pump housing while the water moves up the column.
- A. Impeller(s)                      C. Shaft rotated by a motor  
 B. Pumping rate                      D. None of the above
216. The rotating shaft in a \_\_\_\_\_ is actually housed within the column pipe that delivers the water to the surface.
- A. Line shaft turbine                      C. Variable displacement pump(s)  
 B. Shaft pump(s)                      D. None of the above
217. The size of the column, impeller, and bowls are selected based on which desired requirements?
- A. Pumping head                      C. Pumping rate and lift  
 B. Pumping rate                      D. None of the above
218. Column pipe sections can be threaded or coupled together while the drive shaft is coupled and suspended within the column by \_\_\_\_\_.
- A. Oil bearings                      C. Column bearings  
 B. Spider bearings                      D. None of the above
219. The spider bearings provide both a seal at the \_\_\_\_\_ and keep the shaft aligned within the column. The water passing through the column pipe serves as the lubricant for the bearings.
- A. Check valve                      C. Column pipe joints  
 B. Strainer                      D. None of the above
220. Some vertical turbines are lubricated by hydraulic fluid rather than water, these pumps are essentially the same as non-lubricated units; only the drive shaft is enclosed within the transmission.
- A. True                      B. False

221. Where electricity is not readily available, fuel powered engines may be connected to the drive shaft by a \_\_\_\_\_.

- A. Drive shaft
- B. Keyway and nut
- C. Right angle drive gear
- D. None of the above

222. Both oil and water lubricated systems will have a strainer attached to the intake to prevent \_\_\_\_\_ from entering the pump.

- A. Hydraulic fluid
- B. Sediment
- C. Neither oil nor air
- D. None of the above

223. When the line shaft turbine is turned off, \_\_\_\_\_ will flow back down the column, turning the impellers in a reverse direction. A pump and shaft can easily be broken if the motor were to turn on during this process.

- A. Hydraulic fluid
- B. Sediment
- C. Water
- D. None of the above

### Three Main Types of Diaphragm Pumps

224. In the first type, the diaphragm is sealed with one side in the fluid to be pumped, and the other in \_\_\_\_\_.

- A. Hydraulic fluid
- B. Sediment
- C. Air or hydraulic fluid
- D. None of the above

225. The diaphragm is flexed, causing the volume of the pump chamber to increase and decrease. A pair of non-return check valves prevents reverse flow of the \_\_\_\_\_.

- A. Fluid
- B. Sediment
- C. Air
- D. None of the above

226. The second type of diaphragm pump works with volumetric positive displacement, but differs in that the prime mover of the diaphragm is \_\_\_\_\_; but is electro-mechanical, working through a crank or geared motor drive. This method flexes the diaphragm through simple mechanical action, and one side of the diaphragm is open to air.

- A. Hydraulic fluid
- B. Sediment
- C. Neither oil nor air
- D. None of the above

227. When the volume of a chamber of either type of pump is increased (the diaphragm moving up), the pressure decreases, and fluid is drawn into the chamber. When the chamber pressure later increases from decreased volume (the diaphragm moving down), the \_\_\_\_\_ previously drawn in is forced out.

- A. Fluid
- B. Volume
- C. Vapor pressure
- D. None of the above

228. Finally, the diaphragm moving up once again draws \_\_\_\_\_ into the chamber, completing the cycle. This action is similar to that of the cylinder in an internal combustion engine.

- A. Fluid
- B. Volume
- C. Vapor pressure
- D. None of the above

### **Cavitation**

229. Cavitation is defined as the phenomenon of formation of \_\_\_\_\_ of a flowing liquid in a region where the pressure of the liquid falls below its vapor pressure.

- A. Fluid
- B. Vapor bubbles
- C. Vapor pressure
- D. None of the above

230. Non-inertial cavitation is the process in which a bubble in a fluid is forced to oscillate in size or shape due to some form of energy input, such as \_\_\_\_\_.

- A. An acoustic field
- B. Volume
- C. Vapor pressure
- D. None of the above

231. When the cavitation bubbles collapse, they force \_\_\_\_\_ into very small volumes, thereby creating spots of high temperature and emitting shock waves, the latter of which are the source of rattling noise.

- A. Liquid energy
- B. Volume
- C. Vapor pressure
- D. None of the above

232. Cavitation is, in many cases, an acceptable occurrence.

- A. True
- B. False

233. In devices such as propellers and pumps, cavitation causes a great deal of noise, damage to components, vibrations, and a loss of efficiency.

- A. True
- B. False

234. Although the collapse of a cavity is a relatively low-energy event, highly localized collapses can erode metals, such as steel, over time. The pitting caused by the collapse of cavities produces great wear on components and can dramatically shorten a propeller's or pump's lifetime.

- A. True
- B. False

235. Cavitation is usually divided into three classes of behavior: collisional, transcendental and non-transcendental.

- A. True
- B. False

236. Non-inertial cavitation is the process where a void or bubble in a liquid rapidly collapses, producing a shock wave.

- A. True
- B. False

### **Complicated Pump Section - Types of Pumps**

237. The family of pumps comprises a large number of types based on application and capabilities. The two major groups of pumps are dynamic and positive displacement.

- A. True
- B. False

### **Dynamic Pumps (Centrifugal Pump)**

**Centrifugal pumps are classified into three general categories:**

238. Which of the following is a centrifugal pump in which the pressure is developed partly by centrifugal force and partly by the lift of the vanes of the impeller on the liquid?

- A. Mixed flow
- B. Axial flow
- C. Radial flow
- D. None of the above

239. Which of the following is a centrifugal pump in which the pressure is developed by the propelling or lifting action of the vanes of the impeller on the liquid?

- A. Mixed flow
- B. Axial flow
- C. Radial flow
- D. None of the above

240. Which of the following is a centrifugal pump in which the pressure is developed wholly by centrifugal force?

- A. Mixed flow
- B. Axial flow
- C. Radial flow
- D. None of the above

### Plunger Pump

241. The plunger pump is a positive displacement pump that uses a plunger or piston to force \_\_\_\_\_ from the suction side to the discharge side of the pump. It is used for heavy sludge.

- A. Solids
- B. Pressure
- C. Liquid
- D. None of the above

242. The movement of the plunger or piston inside the plunger pump creates \_\_\_\_\_ inside the pump, so you have to be careful that this kind of pump is never operated against any closed discharge valve.

- A. Work
- B. Pressure
- C. Drag
- D. None of the above

243. All discharge valves must be open before the plunger pump is started, to prevent any fast build-up of \_\_\_\_\_ that could damage the pump.

- A. Metal
- B. Pressure
- C. Liquid
- D. None of the above

### Diaphragm Pumps

244. In this type of pump, a diaphragm provides the mechanical action used to force \_\_\_\_\_ from the suction to the discharge side of the pump. The advantage the diaphragm has over the plunger is that the diaphragm pump does not come in contact with moving metal. This can be important when pumping abrasive or corrosive materials.

- A. Metal
- B. Pressure
- C. Liquid
- D. None of the above

### Complicated Pumps - Introduction

245. More complicated pumps have valves allowing them to work repetitively. These are usually check valves that open to allow passage in one direction, and close automatically to prevent \_\_\_\_\_ flow.

- A. Decreased
- B. Increased
- C. Reverse
- D. None of the above

246. The force pump has two check valves in the cylinder, one for supply and the other for delivery. The supply valve opens when the cylinder volume \_\_\_\_\_, the delivery valve when the cylinder volume decreases.

- A. Enters
- B. Increases
- C. Reverses flow
- D. None of the above

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

- A. Cylinder
- B. Tank
- C. Discharged fluid
- D. None of the above

248. The maximum lift, or "suction," is determined by the \_\_\_\_\_, and either cylinder must be within this height of the free surface.

- A. Atmospheric pressure
- B. Pressure
- C. Discharged fluid
- D. None of the above

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

- A. Solids
- B. Pressure
- C. Discharged fluid
- D. None of the above

### Fluid Properties

250. The properties of the fluids being pumped can significantly affect the choice of pump.

- A. True
- B. False

### Key considerations include:

251. When pumping abrasive liquids such as industrial slurries, selecting a pump that will not clog or fail prematurely depends on particle size, hardness, and the volumetric percentage of solids.

The properties of the fluids being pumped can significantly affect the choice of pump.

- A. True
- B. False

252. It is particularly important to consider pump suction-side line losses when pumping \_\_\_\_\_.

- A. Fluid specific gravity
- B. Fluid's vapor pressure
- C. Viscous fluids
- D. None of the above

253. Which of the following normally varies directly with temperature, the pumping system designer must know the viscosity of the fluid at the lowest anticipated pumping temperature?

- A. Fluid specific gravity
- B. Kinematic viscosity
- C. High viscosity fluids
- D. None of the above

254. Which of the following is the force per unit area that a fluid exerts in an effort to change phase from a liquid to a vapor, and depends on the fluid's chemical and physical properties?

- A. Fluid specific gravity
- B. Fluid's vapor pressure
- C. Viscosity of a fluid
- D. None of the above

255. Proper consideration of the \_\_\_\_\_ will help to minimize the risk of cavitation.

- A. Fluid specific gravity
- B. Fluid's vapor pressure
- C. Viscosity of a fluid
- D. None of the above

256. Which of the following is a measure of its resistance to motion?

- A. Fluid specific gravity
- B. Fluid's vapor pressure
- C. Viscosity of a fluid
- D. None of the above

257. Which of the following result in reduced centrifugal pump performance and increased power requirements?

- A. Fluid specific gravity
- B. Fluid's vapor pressure
- C. High viscosity fluids
- D. None of the above

**Positive Displacement Pump Sub-Section**

258. A positive displacement pump has an expanding cavity on \_\_\_\_\_ and a decreasing cavity on the discharge side.

- A. The discharge line
- B. A closed valve
- C. The suction side of the pump
- D. None of the above

259. Liquid is allowed to flow into the pump as the cavity on the suction side expands and the liquid is forced out of the discharge as \_\_\_\_\_. This principle applies to all types of positive displacement pumps whether the pump is a rotary lobe, gear within a gear, piston, diaphragm, screw, progressing cavity, etc.

- A. The cavity collapses
- B. A closed valve
- C. An expanding cavity
- D. None of the above

260. A positive displacement pump, unlike a centrifugal pump, will produce the same flow at a given RPM no matter what \_\_\_\_\_.

- A. The discharge line
- B. The discharge pressure is
- C. An expanding cavity
- D. None of the above

**Centrifugal Pump Sub-Section**

261. By definition, a centrifugal pump is a machine. Specifically, a pump is a machine that imparts energy to a fluid. This energy infusion can cause a liquid to flow, rise to a higher level, or both.

- A. True
- B. False

262. The centrifugal pump is an extremely simple machine. It is a member of a family known as rotary machines and consists of two basic parts: 1) the stationary element or casing (volute) and 2) the rotary element or impeller.

- A. True
- B. False

263. The impellers used on centrifugal pumps may be classified as single suction or double suction.

- A. True
- B. False

264. In the operation of a centrifugal pump, the pump "slings" liquid out of the impeller via \_\_\_\_\_.

- A. Centrifugal force
- B. The amount of resistance to flow
- C. Resistance to flow
- D. None of the above

265. A pump does not create pressure; it only provides flow. Pressure is just an indication of the amount of \_\_\_\_\_.

- A. Centrifugal force
- B. Pressure
- C. Resistance to flow
- D. None of the above

266. A single-stage pump has only one impeller. A multi-stage pump has two or more impellers housed together in \_\_\_\_\_.

- A. Stage
- B. One casing
- C. The eye
- D. None of the above

267. As a standard, each impeller acts separately, discharging to the suction of the next stage impeller. This arrangement is called \_\_\_\_\_.

- A. Centrifugal force
- B. The amount of resistance to flow
- C. Series staging
- D. None of the above

268. Centrifugal pumps are also classified as Horizontal or Vertical, depending upon the position of the \_\_\_\_\_.

- A. Pump shaft
- B. Casing
- C. Eye
- D. None of the above

269. The single-suction impeller allows liquid to enter the eye from one side only. The double-suction impeller allows liquid to enter \_\_\_\_\_ from two directions.

- A. Pump shaft
- B. One casing
- C. The eye
- D. None of the above

270. Impellers are also classified as opened or closed. Closed impellers have side walls that extend from the eye to the outer edge of \_\_\_\_\_.

- A. Pump shaft
- B. One casing
- C. The vane tips
- D. None of the above

271. Open impellers do not have these side walls. Some small pumps with single-suction impellers have only a casing wearing ring and no impeller ring. In this type of pump, the casing wearing ring is fitted into \_\_\_\_\_.

- A. Pump shaft
- B. The end plate
- C. The eye
- D. None of the above

272. Which of the following may be fitted on the shaft between the packing gland and the pump bearing housing.

- A. Water flinger rings
- B. Seal piping
- C. A lantern ring spacer
- D. None of the above

273. Which of the following prevent water in the stuffing box from flowing along the shaft and entering the bearing housing?

- A. Water flinger rings
- B. Seal piping
- C. A lantern ring spacer
- D. None of the above

### Generation of Centrifugal Force

274. When the impeller rotates, it spins the liquid sitting in the cavities between the vanes outward and provides \_\_\_\_\_.

- A. Centrifugal force
- B. Centrifugal acceleration
- C. System pressure or head
- D. None of the above

275. As liquid leaves the eye of the impeller a \_\_\_\_\_ area is created causing more liquid to flow toward the inlet.

- A. Centrifugal force
- B. Low-pressure
- C. System pressure or head
- D. None of the above

276. Because the impeller blades are curved, the fluid is pushed in a \_\_\_\_\_ direction by the centrifugal force. This force acting inside the pump is the same one that keeps water inside a bucket that is rotating at the end of a string.

- A. Centrifugal force
- B. Centrifugal acceleration
- C. Tangential and radial
- D. None of the above

**Flow Rate and Pressure Head**

277. The two types of pumps behave very differently regarding pressure head and flow rate: The centrifugal pump has varying flow depending on the \_\_\_\_\_.

- A. Centrifugal force
- B. Centrifugal acceleration
- C. System pressure or head
- D. None of the above

278. The positive displacement pump has \_\_\_\_\_ regardless of the system pressure or head.

- A. Centrifugal force
- B. Centrifugal acceleration
- C. More or less a constant flow
- D. None of the above

279. Positive Displacement pumps generally gives more \_\_\_\_\_ than centrifugal pumps.

- A. Centrifugal force
- B. Centrifugal acceleration
- C. Pressure
- D. None of the above

280. Which of the following indicates the losses due to friction are factored into the performance. The following terms are usually used when referring to lift or head?

- A. Dynamic
- B. Static
- C. Suction
- D. None of the above

281. Which of the following indicates the vertical distance from the water line to the centerline of the impeller?

- A. Dynamic
- B. Static Discharge Head
- C. Static Suction Lift
- D. None of the above

**Mechanical Efficiency**

282. The pumps behaves different considering mechanical efficiency as well. Changing the system pressure or head has little or no effect on the flow rate in the \_\_\_\_\_.

- A. Centrifugal pump
- B. Vertical turbine
- C. Positive displacement pump
- D. None of the above

283. Changing the system pressure or head has a dramatic effect on the flow rate in the \_\_\_\_\_.

- A. Centrifugal pump
- B. Vertical turbine
- C. Positive displacement pump
- D. None of the above

### Net Positive Suction Head - NPSH

284. In a \_\_\_\_\_, NPSH varies as a function of flow determined by speed. Reducing the speed of the positive displacement pump reduces the NPSH.

- A. Centrifugal pump
- C. Positive displacement pump
- B. Vertical turbine
- D. None of the above

### Understanding Progressing Cavity Pump Theory

285. Progressing cavity pumps (PCPs) are a special type of rotary \_\_\_\_\_ where the produced fluid is displaced axially at a constant rate.

- A. Centrifugal pump
- C. Positive displacement pump
- B. Vertical turbine
- D. None of the above

286. Progressing cavity pumps are comprised of two helicoidal gears (rotor and stator), where the rotor is positioned inside the \_\_\_\_\_. The combination of rotational movement and geometry of the rotor inside the stator results in the formation of cavities that move axially from pump suction to pump discharge.

- A. Rotor(s)
- C. Elastomer
- B. Stator(s)
- D. None of the above

287. Which of the following are typically machined from high-strength steel and then coated with a wear resistant material to resist abrasion and reduce stator/rotor friction?

- A. Rotor(s)
- C. Elastomer
- B. Stator(s)
- D. None of the above

288. Which of the following consist of steel tubular with an elastomer core bonded to the steel?

- A. Rotor(s)
- C. Elastomer
- B. Stator(s)
- D. None of the above

289. Which of the following is molded into the shape of an internal helix to match the rotor?

- A. Rotor(s)
- C. Elastomer
- B. Stator(s)
- D. None of the above

290. Which of the following are fundamentally fixed flow rate pumps, like piston pumps and peristaltic pumps, and this type of pump needs a fundamentally different understanding to the types of pumps to which people are more commonly first introduced, namely ones that can be thought of as generating pressure?

- A. Fixed flow rate pump(s)
- C. Positive displacement pump(s)
- B. Progressive cavity pump(s)
- D. None of the above

291. Which of the following are often fitted with cut-off pressure switches, burst disks (deliberately weak and easily replaced), or a bypass pipe that allows a variable amount a fluid to return to the inlet? With a bypass fitted, a fixed flow rate pump is effectively converted to a fixed pressure one.

- A. Fixed flow rate pump(s)
- C. Positive displacement pump(s)
- B. Progressive cavity pump(s)
- D. None of the above

292. At the points where the rotor touches the stator, the surfaces are generally traveling transversely, so small areas of sliding contact occur. These areas need to be lubricated by the fluid being pumped (Hydrodynamic lubrication). This can mean that more torque is required for starting, and if allowed to operate without fluid, called 'run dry', rapid deterioration of the \_\_\_\_\_ can result.

- A. Rotor(s)    C. Elastomer
- B. Stator(s)    D. None of the above

**Helical Rotor and a Twin Helix**

293. The principle of this pumping technique is due to the \_\_\_\_\_, like a piston pump, and so has similar operational characteristics, such as being able to pump at extremely low rates, even to high pressure, revealing the effect to be purely positive displacement.

- A. Rotor(s)    C. Sealed cavities
- B. Stator(s)    D. None of the above

294. Which of the following is rotated, it rolls around the inside surface of the hole. The motion of the rotor is the same as the smaller gears of a planetary gears system?

- A. Rotor(s)    C. Hypocycloid
- B. Stator(s)    D. None of the above

295. As the rotor simultaneously rotates and moves around, the combined motion of the eccentrically mounted drive shaft is in the form of a \_\_\_\_\_.

- A. Rotor(s)    C. Hypocycloid
- B. Stator(s)    D. None of the above

296. In the typical case of single-helix rotor and double-helix stator, the hypocycloid is just a straight line. The \_\_\_\_\_ must be driven through a set of universal joints or other mechanisms to allow for the movement.

- A. Rotor(s)    C. Hypocycloid
- B. Stator(s)    D. None of the above

297. The elastomer core of the stator forms the \_\_\_\_\_. The rotor is held against the inside surface of the stator by angled link arms, bearings (immersed in the fluid) allowing it to roll around the inner surface (un-driven).

- A. Required complex cavities            C. Elastomer
- B. Stator(s)                                    D. None of the above

**Elastomer**

298. Elastomer is used for the stator to simplify the creation of the \_\_\_\_\_, created by means of casting, which also improves the quality and longevity of the seals by progressively swelling due to absorption of water and/or other common constituents of pumped fluids.

- A. Complex internal shape    C. Elastomer
- B. Stator(s)                        D. None of the above

### Vapor Pressure and Cavitation Sub-Section

299. Cavitation is the formation and then immediate implosion of cavities in a liquid – i.e. small liquid-free zones ("bubbles") – that are the consequence of forces acting upon the liquid. It usually occurs when a liquid is subjected to \_\_\_\_\_ that cause the formation of cavities where the pressure is relatively low.

- A. Cyclic stress
- B. Cavitation
- C. Rapid changes of pressure
- D. None of the above

300. Cavitation is a significant cause of wear in some engineering contexts. When entering high pressure areas, cavitation bubbles that implode on a metal surface cause \_\_\_\_\_. These results in surface fatigue of the metal causing a type of wear also called "cavitation".

- A. Cyclic stress
- B. Cavitation
- C. The formation of cavities
- D. None of the above

### Inertial Cavitation

301. Inertial cavitation is the process where a void or bubble in a liquid rapidly collapses, producing \_\_\_\_\_.

- A. An acoustic field
- B. An undesirable phenomenon
- C. A shock wave
- D. None of the above

### Non-Inertial Cavitation

302. Non-inertial cavitation is the process in which a bubble in a fluid is forced to oscillate in size or shape due to some form of energy input, such as \_\_\_\_\_.

- A. An acoustic field
- B. An undesirable phenomenon
- C. A shock wave
- D. None of the above

303. Temperature affects \_\_\_\_\_ as well, raises the water's temperature to 212°F and the vapors are released because at that increased temperature the vapor pressure is greater than the atmospheric pressure.

- A. Pump cavitation
- B. Vapor pressure
- C. Vapor bubbles
- D. None of the above

304. Pump cavitation occurs when the pressure in the pump inlet drops below the vapor pressure of the liquid. \_\_\_\_\_ form at the inlet of the pump and are moved to the discharge of the pump where they collapse, often taking small pieces of the pump with them.

- A. Pump cavitation
- B. Vapor pressure
- C. Vapor bubbles
- D. None of the above

### Maintenance of a Vertical Turbine Pump

305. A periodic inspection is recommended as the best means of preventing breakdown and keeping maintenance costs to a minimum.

- A. True
- B. False

306. A periodic monthly inspection is suggested for all units. During this inspection the pump and driver should be checked for performance, change in noise or vibration level, loose bolts or piping, dirt and corrosion. Clean and re-paint all areas that are rusted or corroded.

- A. True
- B. False

307. Maintenance personnel should look over the whole installation with a critical eye each time the pump is inspected -- a change in noise level, amplitude of vibration, or performance can be an indication of impending trouble.

- A. True      B. False

308. Any deviation in performance or operation from what is expected can be traced to some specific cause. Determination of the cause of any mis-performance or improper operation is essential to the correction of the trouble -- whether the correction is done by the user, the dealer or reported back to the factory.

- A. True      B. False

309. Ordinarily impellers will not require readjustment if properly set at initial installation. Almost no change in performance can be obtained by minor adjustment of enclosed impellers. All adjustments of the impellers will change the mechanical seal setting. It is recommended that the seal be loosened from the shaft until the adjustment is complete and then reset.

- A. True      B. False

310. Other than the stuffing box lubrication, mechanical seal, and/or lineshaft lubrication, the pump will not require further periodic lubrication.

- A. True      B. False

311. On water pumps and sumps, the suction bearing on the bowl assembly should be repacked when repairs are made, however, no attempt should be made to repack until repairs to the bowl assembly are necessary. Pumps that pump hydrocarbons or have carbon or rubber bearings do not have the suction bearing packed.

- A. True      B. False

312. Maintenance of the stuffing box will consist of greasing the box when required, tightening the packing gland occasionally as the leakage becomes excessive, and installing new packing rings or sets as required.

- A. True      B. False

313. Remove gland and all old packing. If the box contains a lantern ring remove this and all packing below it using two long threaded machine screws. Inspect shaft or sleeve for score marks or rough spots. Be sure by-pass holes (if supplied) are not plugged.

- A. True      B. False

### **Pump Operation & Performance Section**

314. The rate of flow and total head at which the pump efficiency is maximum at a given speed and impeller diameter.

- A. Specific Speed      C. Displacement  
B. Best Efficiency Point      D. None of the above

315. For a positive displacement pump, it is the theoretical volume per revolution of the pump shaft. Calculation methods and terminology may differ between different types of positive displacement pumps.

- A. Specific Speed      C. Displacement  
B. Best Efficiency Point      D. None of the above

316. Which of the following is an indicator of the net positive suction head required [NPSH<sub>3</sub>] for given values of capacity and also provides an assessment of a pump's susceptibility to internal recirculation?
- A. Suction Specific Speed    C. Friction Loss  
 B. Vapor Pressure            D. None of the above
317. The amount of pressure / head required to 'force' liquid through pipe and fittings.
- A. Suction Specific Speed    C. Friction Loss  
 B. Vapor Pressure            D. None of the above
318. Which of the following is the expression of the energy content of a liquid in reference to an arbitrary datum? It is expressed in units of energy per unit weight of liquid. The measuring unit for head is meters (feet) of liquid.
- A. Head                        C. Head, Loss  
 B. Head, Friction          D. None of the above
319. The head required to overcome the friction at the interior surface of a conductor and between fluid particles in motion. It varies with flow, size, type, and conditions of conductors and fittings, and the fluid characteristics.
- A. Head                        C. Head, Friction  
 B. Head, Suction          D. None of the above
320. The height of a column or body of fluid above a given point.
- A. Head, Static            C. Head, Suction  
 B. Head, Friction          D. None of the above
321. This is the measure of energy increase, per unit weight of liquid, imparted to the liquid by the pump, and is the difference between total discharge head and total suction head.
- A. Head, Total            C. Head, Volume  
 B. Head, Friction          D. None of the above
322. The bladed member of a rotating assembly of the pump which imparts the principal force to the liquid pumped.
- A. Impeller    C. Casing  
 B. Inducer    D. None of the above
323. The pump casing for a centrifugal type of pump, typically spiral or circular in shape.
- A. Impeller    C. Casing  
 B. Volute      D. None of the above
324. Which of the following is related to how much suction lift a pump can achieve by creating a partial vacuum?
- A. NPSH    C. NPSH<sub>3</sub>  
 B. NPSHR    D. None of the above
325. Which of the following is determined by the conditions of the installation and is the total suction head of liquid absolute, determined at the first-stage impeller datum minus the absolute vapor pressure in meters (feet) of the liquid at a specific rate of flow expressed in meters (feet) of liquid?
- A. NPSHA    C. NPSH<sub>3</sub>  
 B. NPSHR    D. None of the above

326. Which is the following the minimum NPSH given by the manufacturer/supplier for a pump achieving a specified performance at the specified capacity, speed, and pumped liquid?

- A. NPSH      C. NPSH3
- B. NPSHR    D. None of the above

327. For rotodynamic pumps \_\_\_\_\_ is defined as the value of NPSHR at which the first-stage total head drops by 3% due to cavitation.

- A. NPSH7      C. NPSH3
- B. NPSH5      D. None of the above

### **Pump Efficiency**

328. Which of the following is the Static Discharge Head plus the friction in the discharge line, also referred to as Total Discharge Head?

- A. Dynamic Discharge Head      C. Total Dynamic Head
- B. Dynamic Suction Head        D. None of the above

329. Which of the following is the Dynamic Suction Head plus the Dynamic Discharge Head, also referred to as Total Head?

- A. Static Suction Lift            C. Total Dynamic Head
- B. Dynamic Suction Head        D. None of the above

330. Which of the following indicates that losses due to friction are factored into the performance?

- A. Dynamic    C. Thermodynamic
- B. Static       D. None of the above

331. Which of the following is the vertical distance from the water line to the centerline of the impeller?

- A. Static Suction Lift            C. Total Dynamic Head
- B. Dynamic Suction Head        D. None of the above

332. Which of the following is the vertical distance from the discharge outlet to the point of discharge or liquid level when discharging into the bottom of a water tank?

- A. Static Suction Lift            C. Total Dynamic Head
- B. Static Discharge Head        D. None of the above

333. Pump efficiency is an important characteristic and pumps should be regularly tested.

Thermodynamic pump testing is one method.

- A. True        B. False

334. Subject on how the measurement is taken suction lift and head may also be referred to as static or dynamic.

- A. True        B. False

335. When a system design includes a centrifugal pump, a critical issue in its design is matching the head loss-flow characteristic with the pump so that it operates at or close to the point of its maximum efficiency.

- A. True        B. False

336. Pump efficiency is defined as the ratio of the power imparted on the fluid by the pump in relation to the power supplied to drive the pump. Its value is not fixed for a given pump; efficiency is a function of the discharge and therefore also operating head.  
A. True      B. False

337. For centrifugal pumps, the efficiency tends to improve with flow rate up to a point midway through the operating range (peak efficiency) and then declines as flow rates rise further.  
A. True      B. False

### Specific Gravity

338. The term specific gravity compares the density of some substance to the \_\_\_\_\_.  
A. Density of water    C. Systems of measure  
B. Pressure            D. None of the above

339. Since specific gravity is the ratio of those densities, the units of measure cancel themselves, and we end up with a whole number that is the same for all systems of measure. Therefore, the specific gravity of water is .5— regardless of the measurement system.  
A. True      B. False

340. Specific gravity is important when sizing a centrifugal pump because it is indicative of the weight of the fluid and its weight will have a direct effect on the amount of \_\_\_\_\_ performed by the pump.  
A. Work      C. Force  
B. Pressure    D. None of the above

341. One of the beauties of the centrifugal pump is that the head (in feet) and flow it produces has nothing to do with the weight of the liquid. It is all about the velocity that is added by the impeller. The simplest way to prove the validity of this statement is to use the \_\_\_\_\_.  
A. Falling body equation            C. Pump curve  
B. Law of Pascal                      D. None of the above

### Understanding Pump Viscosity

342. When to use a centrifugal or a Positive Displacement pump (“PD Pump”) is always a clear choice. To make a good choice between these pump types it is important to understand that these two types of pumps behave very summarily.  
A. True      B. False

### Understanding Suction Lift

343. Suction lift deals with the maximum distance to the intake of a pump. Fire pumps and others may lift about \_\_\_\_\_ of suction.  
A. 33.9                      C. 3 -5  
B. 5' to 10'                D. None of the above

344. Pumps operating at a negative minimum inlet pressure are capable of creating a suction lift (non-self-priming). The suction capacity is approximately equal to the level of the negative minimum inlet pressure minus a \_\_\_\_\_ foot safety factor.  
A. 5                      C. 3  
B. 2                      D. None of the above

345. In any cross-section of a generic hydraulic circuit, the NPSH parameter shows the difference between the actual pressure of a \_\_\_\_\_ and the liquid's vapor pressure at a given temperature.

- A. Liquid in a pipeline
- B. Boiling point
- C. Temperature
- D. None of the above

346. NPSH is an important parameter to take into account when designing a circuit: whenever the liquid pressure drops below the vapor pressure, liquid boiling occurs, and the final effect will be cavitation: \_\_\_\_\_ may reduce or stop the liquid flow, as well as damage the system.

- A. Vapor bubbles
- B. Boiling point
- C. Vapor pressure at a given temperature
- D. None of the above

347. The violent collapse of the cavitation bubble creates a shock wave that can literally carve material from internal pump components (usually the leading edge of the impeller) and creates noise often described as "pumping gravel".

- A. True
- B. False

348. The inevitable decrease in vibration can cause other mechanical faults in the pump and associated equipment.

- A. True
- B. False

349. Careful design is required to pump high temperature liquids with a centrifugal pump when the liquid is near its \_\_\_\_\_.

- A. Damage point
- B. Boiling point
- C. Vapor pressure at a given temperature
- D. None of the above

### Suction Limitations

350. Regardless of the extent of the vacuum, water can only be "lifted" a set distance or height due to its' \_\_\_\_\_.

- A. Atmospheric pressure
- B. Vaporization pressure
- C. Suction lift
- D. None of the above

351. It must be remembered that \_\_\_\_\_ of the impeller increases as the suction lift increases, and therefore, the pump, where possible, should be located so that the suction line is submerged at all times.

- A. Atmospheric pressure
- B. Cavitation
- C. Suction lift
- D. None of the above

352. Pumps lift water with the help of atmospheric pressure, then pressurize and discharge the water from the casing. The practical suction lift, at sea level is \_\_\_\_\_ feet.

- A. 25
- B. 32
- C. 18
- D. None of the above

353. As the pressure above the water is reduced, the water will tend to rise as a result of the atmospheric pressure, which is tending to push the water into the pump suction piping. The theoretical maximum suction lift for water is \_\_\_\_\_ feet.

- A. 31.9
- B. 33.9
- C. 18
- D. None of the above

354. From a practical standpoint, in consideration of the friction loss of the piping, the altitude of the station, etc., the normal maximum lift for any pump is approximately \_\_\_\_\_ ft.

- A. 18
- B. 32
- C. 33.9
- D. None of the above

355. Which of the following is the maximum distance from the water level, to the centerline of the impeller? The main type of pump used for suction lift is a vertical shaft turbine pump.

- A. Static Suction Lift
- B. Dynamic Suction Lift
- C. Total Dynamic Suction Lift
- D. None of the above

356. Which of the following exists when a liquid is taken from an open tank to an atmospheric tank where the liquid level is below the centerline of the pump suction.

- A. Suction Lift
- B. Dynamic Suction Lift
- C. Total Dynamic Suction Lift
- D. None of the above

## Motor-Pump Coupling Sub-Section

### Rigid Coupling

357. Rigid couplings are most commonly used on vertically mounted pumps. The rigid coupling is usually specially keyed or constructed for joining the coupling to the \_\_\_\_\_. There are two types of rigid couplings: the flanged coupling, and the split coupling.

- A. Pulley
- B. Rigid coupling
- C. Motor shaft and the pump shaft
- D. None of the above

### Flexible Coupling

358. The \_\_\_\_\_ provides the ability to compensate for small shaft misalignments.

- A. Flexible coupling
- B. Rigid coupling
- C. Motor shaft and the pump shaft
- D. None of the above

359. Shafts should be aligned as close as possible, regardless. The greater the misalignment, the shorter the life of the \_\_\_\_\_. Bearing wear and life are also affected by misalignment.

- A. Rotation
- B. Coupling
- C. Small shaft misalignments
- D. None of the above

### Alignment of Flexible and Rigid Couplings

360. Both flexible and rigid couplings must be carefully aligned before they are connected. Misalignment will cause excessive heat and vibration, as well as bearing wear. Usually, the noise from the \_\_\_\_\_ will warn you of shaft misalignment problems.

- A. Rotation
- B. Coupling
- C. Misalignment
- D. None of the above

### V-Belt Drive Couplings

361. V-belt drives connect the pump to the motor. A pulley is mounted on the \_\_\_\_\_. One or more belts are used to connect the two pulleys.

- A. Pump and motor shaft
- B. Rigid coupling
- C. Coupling
- D. None of the above

### Shaft Bearings

362. Proper lubrication means using the correct type and the correct amount of lubrication. Similar to motor bearings, \_\_\_\_\_ can be lubricated either by oil or by grease.

- A. Shaft bearings
- B. Mechanical seals
- C. Packing
- D. None of the above

### Mechanical Seals- Detailed

363. Mechanical seals are rapidly replacing \_\_\_\_\_ as the means of controlling leakage on rotary and positive-displacement pumps.

- A. Bearings
- B. Mechanical seals
- C. Conventional packing
- D. None of the above

364. Mechanical shaft seals serve to ensure that position liquid pressure is supplied to the seal faces under all conditions of operation. They also ensure adequate circulation of the liquid at the seal faces to minimize the deposit of foreign matter on the seal parts.

- A. True
- B. False

## Groundwater Treatment/Production System Section

### Groundwater and Wells

365. When toxic substances are spilled or dumped near a well, these can leach into \_\_\_\_\_ and contaminate the groundwater drawn from that well.

- A. Karst
- B. Aquifer
- C. Soil moisture
- D. None of the above

366. Which of the following flows slowly through water-bearing formations at different rates?

- A. Groundwater
- B. Drinking water
- C. Soil moisture
- D. None of the above

367. The level below which all the spaces in the ground are filled with water is called the?

- A. Unconfined aquifer(s)
- B. Water table
- C. Well(s)
- D. None of the above

368. The water in the saturated zone is called?

- A. Unconfined aquifer(s)
- B. Groundwater
- C. Water table
- D. None of the above

369. Which of the following terms are cracks, joints, or fractures in solid rock, through which groundwater moves?

- A. Fractured aquifer(s)
- B. Karst
- C. Soil moisture
- D. None of the above

370. Limestone is often located in which of the following?

- A. Unconfined aquifer(s)
- B. Soil moisture
- C. Fractured aquifer(s)
- D. None of the above

371. Which of the following may move in different directions below the ground than the water flowing on the surface?

- A. Water table
- B. Groundwater
- C. Soil moisture
- D. None of the above

372. Which of the following is the level to which the water in an artesian aquifer will rise?

- A. Aquifer
- B. Piezometric surface
- C. Water table
- D. None of the above

373. Sandstone may become so highly cemented or recrystallized that all of the original space is filled, in this case, the rock is no longer a porous medium and is known as?

- A. Unconfined aquifer(s)
- B. Porous media
- C. Fractured aquifer(s)
- D. None of the above

374. Which of the following usually flows downhill along the slope of the water table?

- A. Groundwater
- B. Water table
- C. Soil moisture
- D. None of the above

### **Cone of Depression**

375. During pumping, the water level in the well falls below the water table in the?

- A. Water table
- B. Surrounding aquifer
- C. Unconfined aquifer
- D. None of the above

376. The movement of water from \_\_\_\_\_ into a well results in the formation of a cone of depression.

- A. Confined aquifer
- B. An aquifer
- C. Water table
- D. None of the above

377. Which of the following describes a three-dimensional inverted cone surrounding the well that represents the volume of water removed as a result of pumping?

- A. Water table
- B. Groundwater
- C. Cone of depression
- D. None of the above

378. Which of the following is the vertical drop in the height between the water level in the well prior to pumping and the water level in the well during pumping?

- A. Drawdown
- B. Groundwater
- C. Cone of depression
- D. None of the above

379. When a water well is installed in \_\_\_\_\_, water moves from the aquifer into the well through small holes or slits in the well casing or, in some types of wells, through the open bottom of the well?

- A. Confined aquifer
- B. An unconfined aquifer
- C. Water table
- D. None of the above

### **Where Is Ground Water Stored?**

380. Areas where ground water exists in sufficient quantities to supply wells or springs are called aquifers, that literally means?

- A. Water table
- B. Water bearer
- C. Cone of depression
- D. None of the above

381. Which of the following is regulated largely by its porosity, or the relative amount of open space present to hold water?

- A. Water table
- B. Groundwater
- C. An aquifer's storage capacity
- D. None of the above

382. If the aquifer is sandwiched between layers of comparatively impermeable materials, it is called?

- A. Confined aquifer
- B. Unconfined aquifer
- C. Water table
- D. None of the above

383. Which of the following are frequently found at greater depths than unconfined aquifers?

- A. Confined aquifer(s)
- B. Unconfined aquifer(s)
- C. Water table
- D. None of the above

### Does Groundwater Move?

384. Groundwater can move sideways as well as up or down. This movement is in response to gravity, differences in elevation, and?

- A. Permeable zones
- B. Differences in pressure
- C. Saturated zone
- D. None of the above

385. Groundwater can move even more quickly in karst aquifers, which are areas in \_\_\_\_\_ and similar rocks where fractures or cracks have been widened by the action of the ground water to form sinkholes, tunnels, or even caves?

- A. Karst aquifer(s)
- B. Saturated zone
- C. Water soluble limestone
- D. None of the above

### Groundwater Quality

386. The layers of soil and particles of sand, gravel, crushed rocks, and larger rocks were thought to act as filters, trapping contaminants before they could reach the ground water.

- A. True
- B. False

387. It is known that some contaminants can pass through all of these filtering layers into \_\_\_\_\_ to contaminate ground water.

- A. Permeable zones
- B. Unsaturated zone
- C. Saturated zone
- D. None of the above

### How Does Ground Water Become Contaminated?

388. Groundwater contamination can begin on the surface of the ground, in the ground above the water table, or in the ground below the?

- A. Water table
- B. Ground water
- C. Permeable zones
- D. None of the above

389. If the contaminant is introduced straight into the area below \_\_\_\_\_, the primary process that can affect the impact of the contaminant is dilution by the surrounding ground water.

- A. Water table
- B. Saturated zone
- C. Unsaturated zone
- D. None of the above

### What Kinds of Substances Can Contaminate Groundwater, and Where Do They Come from?

390. Substances that can pollute \_\_\_\_\_ can be divided into two basic categories: substances that occur naturally and substances produced or introduced by man's activities.

- A. Synthetic organic chemical(s)
- B. Groundwater
- C. Permeable zones
- D. None of the above

391. A substantial number of today's groundwater contamination problems stem from man's activities and can be introduced into ground water from?

- A. Contaminant(s)
- B. Saturated zone
- C. A variety of sources
- D. None of the above

### Water Well Reports and Hydrogeology

#### Hydrogeologic Data

392. For hydrogeologists to make reliable assessments about the current and future status of ground water, they need to know where ground water occurs in the subsurface, what the properties are of the various geologic units below the surface, and how fast and in what direction ground water is moving.

- A. True
- B. False

#### Nature of the Aquifer

393. An unconfined aquifer has the \_\_\_\_\_ as its upper surface; there are no significant low-permeability layers between the water table and the surface.

- A. Hydraulic head
- B. Water table
- C. Permeability area
- D. None of the above

394. According to the text, the top of the aquifer, can rise or fall depending on water use and amount of recharge to the aquifer and is called?

- A. Hydraulic head
- B. Water table
- C. Permeability zone
- D. None of the above

395. Which of the following terms has a low-permeability geologic formation as its upper boundary?

- A. Hydraulic head
- B. Water table
- C. A confined aquifer
- D. None of the above

#### Hydraulic Head (h)

396. The hydraulic head is a measure of the water at a certain depth possesses because of its elevation and the pressure exerted through the weight of the water above it.

- A. True
- B. False

397. Which of the following has units of feet, and generally parallels to the elevation of water in the well?

- A. Hydraulic head
- B. Water table
- C. Permeability zone
- D. None of the above

#### Permeability of the Aquifer (K)

398. Which of the following \_\_\_\_\_ or the permeability of the aquifer is a measure of how fast ground water can move through the aquifer?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

399. Which of the following terms has units of distance/time, e.g., feet/day, although it does not represent an actual speed?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

**In What Direction Is Groundwater Flowing?**

400. The direction of groundwater flow is from higher to lower?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

401. Which of the following can be measured by lowering a probe through the observation port of a number of wells, all within the same relative time period?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

**What Is the Drawdown Associated with Pumping of a Well?**

402. There is a relationship between the pumping rate of the well, the transmissivity of the aquifer, the distance between wells, \_\_\_\_\_, and the duration of the pumping event.

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

**Depth to First Water-Bearing Zone**

403. Some report the depth at which water is first encountered in?

- A. The drill hole
- B. Static water level (SWL)
- C. Recharge and discharge zone(s)
- D. None of the above

**Static Water Level**

404. The driving force for ground water movement is the hydraulic head, and the \_\_\_\_\_ is a measure of that force.

- A. Hydrogeologic investigation(s)
- B. Static water level (SWL)
- C. Recharge and discharge zone(s)
- D. None of the above

405. Which of the following is a better gauge that a different aquifer has been encountered than the lithologic description?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

406. Which of the following have important effects in groundwater protection and identifying the relation between area groundwater and local streams?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

**Water-Bearing Zones**

407. Arriving at accurate approximations of aquifer parameters or calculating ground water velocity requires us to know the thickness of the?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

### Basic Rotary Drilling Methods

408. Rotary drilling uses two methods that include: direct and reverse mud rotary, direct air rotary, and?
- A. Advanced methods
  - B. Typical drilling fluid(s)
  - C. Drill through casing driver methods
  - D. None of the above

### Cross-Connection Section

#### What is Backflow?

409. Backflow is the undesirable reversal of flow of nonpotable water or other substances through a \_\_\_\_\_ and into the piping of a public water system or consumer's potable water system.
- A. Backflow
  - B. Indirect connection
  - C. Cross-connection
  - D. None of the above
410. Which of the following can occur when there is a stoppage of water supply due to nearby firefighting, a break in a water main?
- A. Backsiphonage
  - B. Backpressure
  - C. Cross-connection
  - D. None of the above
411. Which of the following is a type of backflow caused by a downstream pressure that is greater than the upstream or supply pressure in a public water system or consumer's potable water system?
- A. Backflow
  - B. Backpressure
  - C. Indirect connection
  - D. None of the above
412. Which of the following can result from an increase in downstream pressure, a reduction in the potable water supply pressure, or a combination of both?
- A. Backflow
  - B. Backpressure
  - C. Backsiphonage
  - D. None of the above
413. Which of the following can have two forms-backpressure and backsiphonage?
- A. Backflow
  - B. Backpressure
  - C. Cross-connection
  - D. None of the above
414. The basic mechanism for preventing backflow is a mechanical \_\_\_\_\_, which provides a physical barrier to backflow.
- A. Air gap
  - B. Backflow preventer
  - C. Backflow
  - D. None of the above
415. The principal types of mechanical backflow preventer are the reduced-pressure principle assembly, the \_\_\_\_\_, and the double check valve assembly.
- A. Vacuum breaker
  - B. Air gaper
  - C. Backflow check
  - D. None of the above
416. Which of the following is a means or mechanism to prevent backflow?
- A. Check device or method
  - B. Backflow preventer
  - C. Backflow check valve
  - D. None of the above

417. According to the text, basic means of preventing backflow is a(n) \_\_\_\_\_, which either eliminates a cross-connection or provides a barrier to backflow.

- A. Vacuum breaker
- B. Air gap
- C. Backflow check
- D. None of the above

418. Which of the following is any temporary or permanent connection between a public water system or consumer's potable water system and any source or system containing nonpotable water or other substances?

- A. Indirect connection
- B. Jumper
- C. Cross-connection
- D. None of the above

419. Which of the following is a type of backflow caused by a negative pressure (i.e., a vacuum or partial vacuum) in a public water system or consumer's potable water system?

- A. Backsiphonage
- B. Backpressure
- C. Cross-connection
- D. None of the above

420. Which of the following can occur whenever the amount of water being used exceeds the amount of water being supplied, such as during water line flushing, firefighting, or breaks in water mains?

- A. Backsiphonage
- B. Backpressure
- C. Cross-connection
- D. None of the above

#### **Types of Backflow Prevention Methods and Assemblies**

421. Which of the following must either be physically disconnected or have an approved backflow prevention device installed to protect the public water system?

- A. Indirect connection
- B. Jumper
- C. Cross-connection
- D. None of the above

422. When the \_\_\_\_\_ is restricted, such as the case of an air gap located near a wall, the air gap separation must be increased.

- A. Air break
- B. Barrier to backflow
- C. Airflow
- D. None of the above

423. An air gap is a physical disconnection between the free flowing discharge end of a potable water pipeline and the top of a(n)?

- A. Open receiving vessel
- B. Air break
- C. Barrier to backflow
- D. None of the above

424. Which of the following must be at least two times the diameter of the supply pipe and not less than one inch?

- A. Open receiving vessel
- B. Air break
- C. Air gap
- D. None of the above

425. Air gap separations must be vertically orientated a distance of at least twice the inside diameter of the supply, but never less than?

- A. 1 inch
- B. 2 inches
- C. 12 inches
- D. None of the above

426. An obstruction around or near an \_\_\_\_\_ may restrict the flow of air into the outlet pipe and nullify the effectiveness of the air gap to prevent backsiphonage.

- A. Open receiving vessel
- B. Air break
- C. Air gap
- D. None of the above

427. An air gap is acceptable for \_\_\_\_\_ and is theoretically the most effective protection.

- A. High hazard installations
- B. High polluttional concerns
- C. Low polluttional hazards
- D. None of the above

428. The type of device selected for a particular backflow installation depends on several factors.

- A. True
- B. False

429. An air break is a physical separation between the free flowing discharge end of a potable water supply pipeline, and the overflow rim of an open or non-pressure receiving vessel.

- A. True
- B. False

### **Vacuum Breakers**

430. The Atmospheric vacuum breaker allows air to enter the water line when the line pressure is reduced to a gauge pressure of zero or below.

- A. True
- B. False

431. Both vacuum breakers devices primary purpose is to protect the water system from cross connections due to submerged inlets, such as irrigation systems and tank applications.

- A. True
- B. False

432. Both vacuum breakers devices open the pipeline to atmosphere in the event of backsiphonage only.

- A. True
- B. False

433. Both vacuum breakers devices are approved for backpressure conditions.

- A. True
- B. False

434. To prevent the air inlet from sticking open, the device must not be installed on the pressure side of a shutoff valve, or wherever it may be under constant pressure more than 2 hours during a 12-hour period.

- A. True
- B. False

435. Atmospheric vacuum breakers Uses: Irrigation systems, commercial dishwasher and laundry equipment, chemical tanks and laboratory sinks.

- A. True
- B. False

436. Pressure Vacuum Breaker Assembly (PVB) consists of a weighted check valve, an independently operating relief valve, two resilient seated shutoff valves, and two properly located resilient seated test cocks.

- A. True
- B. False

437. The PVB needs to be installed 12 inches above the service or supply line to work correctly.

- A. True
- B. False

438. Which of the following devices can have two primary types: atmospheric and pressure.
- A. Vacuum breaker(s)
  - B. Atmospheric vacuum breakers
  - C. Hazard application(s)
  - D. None of the above
439. Both vacuum breakers devices are only suitable for?
- A. High hazard installations
  - B. High pollutional concerns
  - C. Low hazard conditions
  - D. None of the above
440. Which of the following may not be installed downstream of atmospheric vacuum breakers but are allowed on pressure vacuum breakers?
- A. Valve assembly
  - B. Shut offs
  - C. Air inlet valve
  - D. None of the above
441. The devices must be installed above the highest?
- A. Downstream piping
  - B. Vacuum breakers
  - C. Hazard applications
  - D. None of the above
442. Which of the following contains a float check, a check seat, and an air inlet port?
- A. Double check
  - B. Atmospheric vacuum breaker
  - C. RP
  - D. None of the above
443. The double check valve should be installed in an \_\_\_\_\_ and protected from freezing.
- A. Confined space
  - B. Accessible location
  - C. Above the ground
  - D. None of the above
444. Double Check Valve Assembly (DC) consists of two internally loaded check valves, either spring loaded or internally weighted, two resilient seated full ported shutoff valves, and four properly located resilient seated test cocks
- A. True
  - B. False
445. The double check valve assembly is designed to prevent backflow caused by backpressure and backsiphonage from high health hazards.
- A. True
  - B. False
446. Reduced Pressure Backflow Assembly (RP) consists of two independently acting spring loaded check valves separated by a Spring loaded differential pressure relief valve, two resilient seated full ported shutoff valves, and four properly located resilient seated test cocks.
- A. True
  - B. False
447. During normal operation of the RP, the pressure between the two check valves, referred to as the air inlet zone, is maintained at a higher pressure than the supply pressure.
- A. True
  - B. False
448. If either reduced pressure backflow assembly check valve leaks, the differential pressure relief valve maintains a differential pressure of at least one psi between the supply pressure and the zone between the four check valves by discharging water to atmosphere.
- A. True
  - B. False

449. The reduced pressure backflow assembly or RP is designed to prevent backflow caused by backpressure and backsiphonage from low to high health hazards.  
A. True      B. False
450. The RP needs to be installed 24 inches above the ground for testing purposes but could function inside a vault.  
A. True      B. False
451. The reduced pressure backflow assembly can be used for high hazard situations under backpressure only. Under normal conditions, the second check valve should never close.  
A. True      B. False
452. If the second check valve fails or becomes fouled and backflow into the reduced pressure zone occurs, the relief port vents the backflow to atmosphere.  
A. True      B. False
453. The reduced pressure zone port opens anytime pressure in the zone comes within 10 psi of the supply pressure.  
A. True      B. False

### **Fire System Classifications**

454. Industrial fire protection systems will usually consist of sprinklers, hose connections, and hydrants.  
A. True      B. False
455. Sprinkler system may be dry or wet, open or closed.  
A. True      B. False
456. Systems of fixed-spray nozzles may be used indoors or outdoors for protection of flammable-liquid and other hazardous processes. It is standard practice, especially in cities, to equip automatic sprinkler systems with fire department pumper connections.  
A. True      B. False
457. Class 1--direct connections from public water mains only; no pumps, tanks, or reservoirs; no physical connection from \_\_\_\_\_; no antifreeze or other additives of any kind; all sprinkler drains discharging to atmosphere, dry wells, or other safe outlets.  
A. Public water only      C. Other water supplies  
B. Non-potable      D. None of the above
458. Class 5--directly supplied from public mains, and interconnected with auxiliary supplies, such as: pumps taking suction from reservoirs exposed to contamination, or rivers and ponds; driven wells; mills or \_\_\_\_\_; or where antifreeze or other additives are used.  
A. Public water only      C. Other industrial water systems  
B. An auxiliary water supply      D. None of the above
459. Class 6--combined industrial and fire protection systems supplied from the \_\_\_\_\_, with or without gravity storage or pump suction tanks.  
A. Public water mains only      C. Antifreeze or other additives  
B. With or without gravity storage      D. None of the above

460. Class 3--direct connection from \_\_\_\_\_ plus one or more of the following: elevated storage tanks; fire pumps taking suction from above-ground covered reservoirs or tanks; and pressure tanks.

- A. An auxiliary water supply
- B. Public water supply main
- C. Antifreeze or other additives
- D. None of the above

461. All storage facilities are filled or connected to public water only, the water in the tanks to be maintained in potable conditions. Otherwise, \_\_\_\_\_ systems are the same as Class 1.

- A. Class 3
- B. Class 4
- C. Class 2
- D. None of the above

462. Class 4--directly supplied from public mains similar to Classes 1 and 2, and with an auxiliary water supply on or available to the premises; or \_\_\_\_\_ may be located within 1,700 ft. of the pumper connection.

- A. An auxiliary water supply
- B. Gravity storage
- C. Antifreeze or other additives
- D. None of the above

463. Class 2--same as class 1, except that booster pumps may be installed in the connections from \_\_\_\_\_.

- A. Public water only
- B. The street mains
- C. Other water supplies
- D. None of the above

464. Booster pumps do not affect the potability of the system; it is necessary, however, to avoid drafting so much water that pressure in the water main is reduced below \_\_\_\_\_ psi.

- A. 10
- B. 20
- C. 100
- D. None of the above

### **Thermal Expansion Tank (Closed Loop System)**

465. Prior to the installation of the backflow device, the volume of water in customer's pipes, which can expand when heated, could easily flow back into the public water system. With the installation of the backflow preventer, the water pressure in the customer's pipes may build up, particularly when the hot water system is activated.

- A. True
- B. False

466. To prevent thermal expansion, the Administrative Authority or Water Provider will suggest having a thermal expansion tank installed.

- A. True
- B. False

### **SCADA Section**

467. Industrial organizations and companies in the public and private sectors to maintain and control efficiency, distribute data for smarter decisions, and communicate system issues to help mitigate downtime utilize SCADA systems.

- A. True
- B. False

468. SCADA systems are critical for industrial organizations (like water and wastewater facilities) since they help to maintain efficiency, process data for smarter decisions, and communicate system issues to help mitigate downtime.

- A. True
- B. False

469. The SCADA software will process, distribute, and display important data, helping operators and other employees understand the data and make important decisions.

A. True      B. False

470. The acronym SCADA refers to the centralized computer systems that control and monitor the entire sites, or they are the complex systems spread out over large areas. Nearly all the control actions are automatically performed by the remote terminal units (RTUs) or by the programmable logic controllers (PLCs).

A. True      B. False

471. Data acquisition starts at the HMI level, which includes the equipment status reports, and meter readings. Data is then formatted in such way that the operator of the control room can make the supervisory decisions to override or adjust normal HMI controls, by using the PLC.

A. True      B. False

472. SCADA systems implement the distributed databases known as Excel databases, containing data elements called rows or columns.

A. True      B. False

473. The key attribute of a SCADA system is its capability to perform a supervisory operation over a variety of other proprietary devices.

A. True      B. False

474. The internet is linked to the SCADA system's databases, to provide the diagnostic data, management information and trending information such as logistic information, detailed schematics for a certain machine or sensor, maintenance procedures and troubleshooting guides.

A. True      B. False

475. The HMI, or Human Machine Interface, is a device apparatus that gives the processed data to the human operator. A human operator uses HMI to control processes.

A. True      B. False

476. The information provided by the HMI to the operating personnel is graphical, in the form of mimic diagrams. This means the schematic representation of the plant that is being controlled is obtainable to the operator.

A. True      B. False

477. Which of the following terms can convert electrical signals coming from the equipment into digital values like the status- open/closed – from a valve or switch, or the measurements like flow, pressure, current or voltage?

A. RTU      C. PLC  
B. HMI      D. None of the above

478. By converting and sending the electrical signals to the equipment, \_\_\_\_\_ may control the equipment, like closing or opening a valve or a switch, or setting the speed of the pump.

A. RTU      C. SCADA system  
B. HMI      D. None of the above

479. A 'supervisory Station' refers to the software and servers responsible for communication with the field equipment (PLCs, RTUs etc.), and after that, to \_\_\_\_\_ software running on the workstations in the control room, or somewhere else.

- A. RTU
- B. HMI
- C. SCADA system
- D. None of the above

480. Which of the following terms can have multiple servers, disaster recovery sites and distributed software applications in larger SCADA systems?

- A. Master station
- B. SCADA implementation(s)
- C. SCADA system(s)
- D. None of the above

481. For increasing the system integrity, \_\_\_\_\_ are occasionally configured in hot standby or dual-redundant formation, providing monitoring and continuous control during server failures.

- A. Multiple servers
- B. Independent systems
- C. Multiple stations
- D. None of the above

482. Which of the following originally used modem connections or combinations of direct and radio serial to meet communication requirements, even though IP and Ethernet over SONET/SDH can also be used at larger sites like power stations and railways?

- A. SCADA systems
- B. SCADA implementation(s)
- C. SCADA
- D. None of the above

483. The monitoring function or remote management of the \_\_\_\_\_ is referred to as telemetry.

- A. SCADA operator
- B. SCADA implementation(s)
- C. SCADA system(s)
- D. None of the above

484. An important part of most SCADA implementations is \_\_\_\_\_. The system monitors whether certain alarm conditions are satisfied, to determine when an alarm event has occurred.

- A. Policies and procedures
- B. The cyber security team
- C. Alarm handling
- D. None of the above

485. Once an alarm event has been detected, one or more actions are taken (such as the activation of one or more alarm indicators, and perhaps the generation of email or text messages so that management or \_\_\_\_\_ are informed).

- A. SCADA operator
- B. SCADA implementation(s)
- C. Remote SCADA operators
- D. None of the above

486. In many cases, a \_\_\_\_\_ may have to recognize the alarm event; this may deactivate some alarm indicators, whereas other indicators remain active until the alarm conditions are cleared.

- A. SCADA operator
- B. SCADA implementation(s)
- C. SCADA
- D. None of the above

487. Which of the following terms might automatically monitor whether the value in an analogue point lies outside high and low- limit values associated with that point?

- A. SCADA operator
- B. SCADA implementation(s)
- C. SCADA system(s)
- D. None of the above

488. Which of the following terms translates the electrical signals from the equipment to digital values such as the open/closed status from a switch or a valve, or measurements such as pressure, flow, voltage or current? By translating and sending these electrical signals out to equipment the RTU can control equipment, such as opening or closing a switch or a valve, or setting the speed of a pump.

- A. RTU
- B. HMI
- C. PLCs
- D. None of the above

489. In the first production, mainframe systems were used for computing. At the time SCADA was established, networks did not exist. Therefore, the \_\_\_\_\_ did not have any connectivity to other systems, meaning they were independent systems.

- A. SCADA systems
- B. Independent systems
- C. Multiple stations
- D. None of the above

490. The information between multiple stations was shared in real time through \_\_\_\_\_ and the processing was distributed between various multiple stations. The cost and size of the stations were reduced in comparison to the ones used in the first generation.

- A. RTU
- B. HMI
- C. LAN
- D. None of the above

491. The interaction between the system and the master station is done through the WAN protocols like the \_\_\_\_\_.

- A. Internet Protocols (IP)
- B. Common IT practices
- C. Remote or distant operation
- D. None of the above

492. Since the standard protocols used and the \_\_\_\_\_ can be accessed through the internet, the vulnerability of the system is enlarged.

- A. Networked SCADA systems
- B. SCADA implementation(s)
- C. SCADA system(s)
- D. None of the above

493. SCADA systems are now in line with the standard networking technologies. The old proprietary standards are being replaced by the \_\_\_\_\_. However, due to certain characteristics of frame-based network communication technology, Ethernet networks have been recognized by the majority of markets for HMI SCADA.

- A. ICS network
- B. LAN to a WAN
- C. TCP/IP and Ethernet protocols
- D. None of the above

494. There are many threat vectors to a modern SCADA system. One is the threat of unauthorized access to the control software, whether it is human access or changes induced intentionally or accidentally by \_\_\_\_\_ residing on the control host machine.

- A. Policies and procedures
- B. DoS attacks and malware
- C. Virus infections and other software threats
- D. None of the above

495. In many cases, SCADA users have assumed that having a VPN offered sufficient protection, unaware that security can be \_\_\_\_\_ to SCADA-associated network jacks and switches.  
 A. Different risks and priorities      C. Trivially bypassed with physical access  
 B. Significantly less isolation      D. None of the above
496. Industrial control vendors propose approaching SCADA security like \_\_\_\_\_ with a defense in depth strategy that leverages common IT practices.  
 A. Remote control tasks      C. Remote or distant operation  
 B. Information Security      D. None of the above
497. A SCADA (or supervisory control and data acquisition) system means a system consisting of a number of remote terminal units (or RTUs) collecting field data connected back to a master station via a \_\_\_\_\_.  
 A. Communications system      C. PLCs, RTUs etc.  
 B. HMI      D. None of the above
498. The master station displays the \_\_\_\_\_ and also allows the operator to implement remote control tasks.  
 A. Acquired data      C. Remote or distant operation  
 B. Common IT practices      D. None of the above
499. The accurate and timely data (normally real-time) allows for optimization of the operation of the plant and process. A further benefit is more efficient, reliable and most importantly, safer operations. This all results in a lower cost of operation compared to earlier \_\_\_\_\_.  
 A. Remote control tasks      C. Remote or distant operation  
 B. Non-automated systems      D. None of the above
500. There is a fair degree of misunderstanding between the definition of SCADA systems and process control system. SCADA has the \_\_\_\_\_.  
 A. Remote control tasks      C. Connotation of remote or distant operation  
 B. Non-automated systems      D. None of the above

## When Finished with Your Assignment

### REQUIRED DOCUMENTS

Please scan the **Registration Page, Answer Key, Survey and Driver's License** and email these documents to [info@TLCH2O.com](mailto:info@TLCH2O.com).

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