

**Registration form**

# PUMPING PRINCIPLES

**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** \_\_\_\_\_

**Class/Grade** \_\_\_\_\_

**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



**Pumping Principles 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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| 343. A B C D | 358. A B     | 373. A B     | 388. A B C D |
| 344. A B C D | 359. A B     | 374. A B     | 389. A B C D |
| 345. A B C D | 360. A B     | 375. A B     | 390. A B C D |
| 346. A B C D | 361. A B     | 376. A B     | 391. A B C D |
| 347. A B C D | 362. A B     | 377. A B     | 392. A B C D |
| 348. A B C D | 363. A B C D | 378. A B     | 393. A B C D |
| 349. A B C D | 364. A B C D | 379. A B     | 394. A B C D |
| 350. A B C D | 365. A B C D | 380. A B     | 395. A B C D |
| 351. A B C D | 366. A B C D | 381. A B     | 396. A B C D |
| 352. A B C D | 367. A B C D | 382. A B C D | 397. A B C D |
| 353. A B C D | 368. A B     | 383. A B C D | 398. A B C D |
| 354. A B     | 369. A B C D | 384. A B C D | 399. A B C D |
| 355. A B     | 370. A B C D | 385. A B C D | 400. A B C D |

**Amount of Time for Course Completion – How many hours you spent on course?**

**Must match State Hour Requirement \_\_\_\_\_ (Hours)**

*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.*

**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*

**PUMPING PRINCIPLES 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, Proctoring report, 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.

## Pumping Principles CEU Training Course Assignment

The Pumping Principles 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 or fax 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.

### Experiments and Early Applications Section

1. Which of the following arises from our failure to accept, at first sight, the conclusion published by Blaise Pascal in 1663?  
A. Hydrostatic paradox      C. Specific gravity  
B. Coriolis Force              D. None of the above
2. Which of the following is an upward force exerted by a fluid that opposes the weight of an immersed object?  
A. Archimedes' principle      C. Buoyancy or upthrust  
B. Coriolis Force              D. None of the above
3. \_\_\_\_\_ 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      C. Isobaric process  
B. Buoyancy                      D. None of the above
4. 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      C. Isobaric process  
B. Archimedes' principle      D. None of the above
5. 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      C. Isobaric process  
B. Coriolis Force              D. None of the above

6. 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

7. 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

8. 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

9. 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**

10. 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

11. 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

12. One characteristic of a liquid is the tendency to keep its free surface level.

- A. True
- B. False

13. Air, which is by no means incompressible. As we rise in the atmosphere and the pressure decreases, the air also expands.

- A. True
- B. False

14. Liquids will flow in the direction that will tend to make the surface level, if the surface is not level.

- A. True
- B. False

15. The mercury column was held up by the pressure by horror vacui as Aristotle had supposed.

- A. True
- B. False

16. 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

17. 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's law
- D. None of the above

18. 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

19. 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

20. 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

21. 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

22. 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

23. 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

24. 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

### Physical Science and Laws Section

25. 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
- B. Physical Laws
- C. Newton's laws of motion
- D. None of the above

26. 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

27. Which of the following t can also be described intuitively as a push or a pull?  
 A. Force      C. Drag  
 B. Pull      D. None of the above
28. 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      C. Inertia  
 B. Mass      D. None of the above
29. Which of the following is any interaction that, when unopposed, will change the motion of an object?  
 A. Force      C. Push  
 B. Drag      D. None of the above
30. 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      C. Inertia  
 B. Mass      D. None of the above
31. 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      C. Law of Thermodynamic  
 B. Physical Law      D. None of the above
32. Which of the following is the tendency of objects to keep moving in a straight line at constant velocity?  
 A. Force      C. Friction  
 B. Inertia      D. None of the above
33. Which of the following can cause an object with mass to change its velocity to accelerate?  
 A. Force      C. Push  
 B. Pull      D. None of the above
34. 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
35. 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
36. 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

37. Which of the following laws describe how these quantities behave under various circumstances, and forbid certain phenomena?

- A. Bernoulli's Principles
- B. Physical Law
- C. Laws of Thermodynamics
- D. None of the above

38. 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
- B. Physical Law
- C. Bernoulli's Principle
- D. None of the above

### Physical Science and Related Laws

39. Physical Law Description Physical laws are:

True, at least within their regime of validity. By definition, there have never been repeatable contradicting?

- A. Time
- B. Space and time
- C. Observations
- D. None of the above

40. Which of the following represents unchanged since first discovered although they may have been shown to be approximations of more accurate laws?

- A. Stable
- B. Absolute
- C. Space and time
- D. None of the above

41. Which of the following represents everything in the universe apparently must comply with them according to observations?

- A. Stable
- B. Universal
- C. Omnipotent
- D. None of the above

42. Which of the following represents that this appears to apply everywhere in the universe?

- A. Stable
- B. Universal
- C. Space and time
- D. None of the above

43. Which of the following terms represents in terms of a single mathematical equation?

- A. Easy
- B. Absolute
- C. Simple
- D. None of the above

44. Which of the following terms represents that nothing in the universe appears to affect them?

- A. Time
- B. Stable
- C. Universe
- D. None of the above

45. Theoretically reversible in \_\_\_\_\_, although time itself is irreversible.

- A. Universe
- B. Force
- C. Time
- D. None of the above

### Newton's Laws

46. Newton's first law states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force. This is normally taken as the definition of force.

- A. True
- B. False

47. Concepts related to force include: thrust, which increases the velocity of an object; drag, which decreases the velocity of an object; and torque, which produces changes in rotational speed of?
- A. An object                      C. Torque  
B. Mass                              D. None of the above
48. Which of the following represents cause no acceleration of that body as the forces balance one another?
- A. Gravity                              C. Internal mechanical stresses  
B. Fundamental interactions      D. None of the above
49. Which of the following represents the distribution of many small forces applied over an area of a body, is a simple type of stress that if unbalanced can cause the body to accelerate?
- A. Pressure                          C. Torque  
B. Mass                                D. None of the above
50. Which of the following represents usually causes deformation of solid materials, or flow in fluids?
- A. Acceleration                      C. Stress  
B. Internal mechanical stresses    D. None of the above
51. Gravity is one of the four forces of nature. The strength of the gravitational force between two objects depends on their?
- A. Masses                              C. Gravity  
B. Mass                                D. None of the above
52. Which of the following represents, applied forces, and atmospheric pressure are static factors that apply equally to fluids at rest or in motion?
- A. Gravity                              C. Internal mechanical stresses  
B. Fundamental interactions      D. None of the above
53. Which of the following also known as fundamental forces, are the interactions in physical systems that do not appear to be reducible to more basic interactions?
- A. Fundamental interactions      C. Gravity  
B. Mass                                D. None of the above
54. Which of the following terms is the resistance of any physical object to any change in its state of motion?
- A. Pressure    C. Torque  
B. Inertia      D. None of the above
55. 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                              C. Mass  
B. Fundamental interactions      D. None of the above
56. There are four conventionally accepted fundamental interactions—gravitational, electromagnetic, strong nuclear, and weak nuclear.
- A. True                      B. False

### **Pascal's Law**

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

- A. True      B. False

58. According to the text, pressure acts at right angles to the containing surfaces.

- A. True      B. False

59. If a pressure gauge, with an exposed face, is placed beneath the surface of a liquid at a specific depth and pointed in different directions, the pressure will read the same.

- A. True      B. False

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

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

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

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

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

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

63. The indicated pressure is doubled, when the?

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

### **Static Pressure**

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

- A. True      B. False

65. 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

66. 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

67. 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

68. When velocity becomes a factor it must have a direction, the force related to the velocity must also have a direction, so that Pascal's law alone does not apply to the dynamic factors of?

- A. Pressure drop
- B. Volume of a liquid
- C. Fluid power
- D. None of the above

69. The dynamic factors of inertia and friction are related to the static factors. Velocity head and \_\_\_\_\_ are obtained at the expense of static head.

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

**Volume and Velocity of Flow**

70. Which of the following is passing a point in a given time is known as its volume of flow or flow rate?

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

71. 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
- B. Volume of a liquid
- C. Volume of flow
- D. None of the above

72. 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
- B. Volume of a liquid
- C. Volume of flow
- D. None of the above

73. 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**

74. 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

75. 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

76. 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
- B. Volume of flow
- C. Velocity of flow
- D. None of the above

77. 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
- B. Volume of flow
- C. Velocity of flow
- D. None of the above

78. 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

79. 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**

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

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

81. Which of the following definitions is the pressure is equal to the height times the density of the liquid?

- A. Head, static
- B. Head
- C. Hydrokinetics
- 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    C. Pressure, Gauge  
 B. Pressure, Static         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         C. Hydraulics  
 B. Head, Static            D. None of the above
89. Which of the following definitions is the pressure exported by the atmosphere at any specific location?  
 A. Pressure, Atmospheric    C. Pressure, Gauge  
 B. Pressure, Static         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        C. Pressure, Gauge  
 B. Pressure                    D. None of the above

**Hydraulics**

91. Hydraulics is a branch of engineering concerned mainly with moving liquids.  
 A. True         B. False
92. Which of the following includes the consideration of liquids at rest, involves problems of buoyancy and flotation?  
 A. Hydrokinetics         C. Hydraulics  
 B. Hydrostatics         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                 C. Mechanical properties of water  
 B. Hydrokinetics        D. None of the above
94. Hydraulics can be divided into two areas, \_\_\_\_\_ and hydrokinetics.  
 A. Hydrokinetics         C. Hydraulics  
 B. Hydrostatics         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         C. Hydraulics  
 B. Hydrostatics         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                C. Hydraulics  
 B. Hydrokinetics         D. None of the above
97. Which of the following terms is about the pressures exerted by a fluid at rest?  
 A. Pressure                C. Hydraulics  
 B. Hydrostatics         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. Fluids are \_\_\_\_\_ in the way that all the successors of Euler and Bernoulli have assumed, for fluids are composed of discrete molecules.
- A. Forces
  - B. Its velocity
  - C. Not strictly continuous media
  - D. None of the above

### Fluid Statics

101. Fluid statics or hydrostatics is the branch of fluid mechanics that studies\_\_\_\_\_. It embraces the study of the conditions under which fluids are at rest in stable equilibrium; and is contrasted with fluid dynamics, the study of fluids in motion.
- A. Forces
  - B. Its velocity
  - C. Fluids at rest
  - D. None of the above

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                      C. Difference between gases and liquids  
B. Volume of a liquid                    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                      C. Settle down into the ordered arrays  
B. Any volume available to them      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                      C. Short-range attractive forces  
B. Volume of a liquid                    D. None of the above

### Solids

111. Water owes its strength is extremely reduced by anything that provides a nucleus at which the process known as cavitation can begin, and a liquid containing suspended \_\_\_\_\_ or dissolved gases is liable to cavitate quite easily.

- A. Surface tension      C. Dust particles  
B. Liquid surface      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                  C. Dissolved gases  
B. Liquid surface                          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      C. Dissolved gases  
B. Surface of a liquid    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      C. Liquid drops  
B. Liquid surface      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
- B. Fluid
- C. Internal
- D. None of the above

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

- A. Dry
- B. Fluid
- C. Lubricated
- 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
- B. Fluid
- C. Lubricated
- 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

### Component Equivalents

121. Electric potential: In general, it is equivalent to kinetic energy.

- A. True
- B. False

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. Normally measured in amperes, current is equivalent to a \_\_\_\_\_; that is, the volumetric quantity of flowing water over time.  
A. Stretched rubber      C. Hydraulic volume flow rate  
B. Flow meter      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
  - B. Feedback control
  - C. A positive displacement pump
  - 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. The barometric loop consists of a continuous section of supply piping that abruptly rises to a height of approximately 233 feet and then returns back down to the originating level.

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

156. Absolute pressure and gauge pressure?

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

157. 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
- B. Pressure
- C. Sea level
- D. None of the above

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

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

159. Which of the following is the total pressure?

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

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

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

### Pressure

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

- A. True
- B. False

162. 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

163. Both air and water are considered to be?

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

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

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

165. A force is proportional to the \_\_\_\_\_, and is called a pressure.

- A. Pascal's Principle
- B. Area on which it is exerted
- C. Permanent forces tangential
- D. None of the above

166. In order for the fluid to be in equilibrium, the pressure must be the same in all directions (or the element would move in the direction of least pressure), and if no other forces are?

- A. Permanent forces tangential
- B. Acting on the body of the fluid
- C. Area on which it is exerted
- D. None of the above

167. Which of the following does water and air have; that is, layers of them slide very easily on one another?

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

168. 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

169. 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

170. 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

171. 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

172. 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

173. 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**

174. 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**

175. 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

176. 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**

177. 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

178. 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

179. 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

180. Backsiphonage results from \_\_\_\_\_ exerted on a liquid, forcing it toward a supply system that is under a vacuum.

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

181. It is impossible to produce a partial vacuum.

- A. True
- B. False

### Water Pressure

182. The weight of a cubic foot of water is 62.4 pounds per square foot. The base can be subdivided into 144-square inches with each subdivision being subjected to a pressure of 0.433 psig.

- A. True
- B. False

183. 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

184. 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

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

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

186. 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

187. 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

188. 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

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

- A. True
- B. False

190. 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

191. 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

192. 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

193. 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

194. 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

## Pumps and Pumping Water Section

### Common Types of Water Pumps

195. 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

196. 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)
- B. Turbine pump(s)
- C. Variable displacement pump(s)
- D. None of the above

197. Which of the following are variable displacement pumps that are by far used the most? The water production well industry almost exclusively uses Turbine pumps, which are a type of centrifugal pump.

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

198. Which of the following utilizes impellers enclosed in single or multiple bowls or stages to lift water by centrifugal force? The impellers may be of either a semi-open or closed type.

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

199. Impellers are rotated by the\_\_\_\_\_, which provides the horsepower needed to overcome the pumping head.

- A. Pump motor
- B. Pumping rate
- C. Shaft rotated by a motor
- D. None of the above

200. 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
201. 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
202. 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
203. 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
204. 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
205. 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
206. 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
207. Most installations use an electric motor that is connected to the drive shaft by a \_\_\_\_\_.
- A. Drift pin                C. Pair of strong cotter pins  
B. Keyway and nut        D. None of the above
208. Where electricity is not readily available, fuel powered engines may be connected to the drive shaft by a \_\_\_\_\_.
- A. Drive shaft              C. Right angle drive gear  
B. Keyway and nut        D. None of the above
209. Both oil and water lubricated systems will have a strainer attached to the intake to prevent \_\_\_\_\_ from entering the pump.
- A. Hydraulic fluid        C. Neither oil nor air  
B. Sediment                D. None of the above

210. 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

211. 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

212. 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

213. 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

214. 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

215. 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

216. 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

217. 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

218. 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

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

- A. True
- B. False

220. 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

221. 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

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

- A. True
- B. False

223. 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**

224. 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:**

225. 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

226. 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

227. 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

228. 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

229. 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

230. 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

231. 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

232. 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

233. 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

234. The lift pump has a supply valve and a valve in the piston that allows the liquid to pass around it when the volume of the cylinder is reduced. The delivery in this case is from the upper part of the cylinder, which the \_\_\_\_\_ does not enter.

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

235. Diaphragm pumps are force pumps in which the oscillating diaphragm takes the place of the piston. The diaphragm may be moved mechanically, or by the pressure of the fluid on \_\_\_\_\_.

- A. One side of the diaphragm
- B. Free surface
- C. Reverse flow
- D. None of the above

236. The force and lift pumps are typically used for \_\_\_\_\_.

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

237. 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

238. 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

239. 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

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

- A. True
- B. False

### Key considerations include:

241. 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

242. The fluid specific gravity is the ratio of the \_\_\_\_\_ to that of water under specified conditions.

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

243. 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

244. 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

245. Proper consideration of the \_\_\_\_\_ will help to minimize the risk of cavitation.  
A. Fluid specific gravity      C. Viscosity of a fluid  
B. Fluid's vapor pressure      D. None of the above

246. Which of the following is a measure of its resistance to motion?  
A. Fluid specific gravity      C. Viscosity of a fluid  
B. Fluid's vapor pressure      D. None of the above

247. Which of the following result in reduced centrifugal pump performance and increased power requirements?  
A. Fluid specific gravity      C. High viscosity fluids  
B. Fluid's vapor pressure      D. None of the above

### **Positive Displacement Pump Sub-Section**

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

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

249. 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      C. An expanding cavity  
B. A closed valve      D. None of the above

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

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

251. A positive displacement pump cannot be operated against a closed valve on the discharge side of the pump, i.e. it does not have \_\_\_\_\_ like a centrifugal pump does.

A. A shut-off head      C. An expanding cavity  
B. A closed valve      D. None of the above

### **Centrifugal Pump Sub-Section**

252. 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

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

A. True      B. False

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

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

255. 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

256. 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

257. 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

258. 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

259. 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

260. 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

261. Which of the following is inserted between the rings of the packing in the stuffing box?

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

262. 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

263. 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

264. 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

265. 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

266. 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

267. 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

268. 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

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

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

270. 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

271. Which of the following indicates the measurement does not take into account the friction caused by water moving through the hose or pipes?

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

### Mechanical Efficiency

272. 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

273. 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

274. 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

275. 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

276. 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

277. 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

278. 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

279. 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

280. 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

### Helical Rotor and a Twin Helix

281. Which of the following consists of a helical rotor and a twin helix, twice the wavelength and double the diameter helical hole in a rubber stator? The rotor seals tightly against the rubber stator as it rotates, forming a set of fixed-size cavities in between.

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

282. The cavities move when the \_\_\_\_\_ is rotated but their shape or volume does not change. The pumped material is moved inside the cavities.

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

283. 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

284. 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

285. 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

286. 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

287. 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**

288. 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**

289. 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                    C. Rapid changes of pressure
- B. Cavitation                        D. None of the above

290. 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

### Non-Inertial Cavitation

291. Since the shock waves formed by cavitation are strong enough to significantly damage moving parts, cavitation is usually \_\_\_\_\_. It is specifically avoided in the design of machines such as turbines or propellers, and eliminating cavitation is a major field in the study of fluid dynamics.
- A. An acoustic field
  - B. An undesirable phenomenon
  - C. A shock wave
  - D. None of the above

292. To understand \_\_\_\_\_, you must first understand vapor pressure. Vapor pressure is the pressure required to boil a liquid at a given temperature.
- A. Cavitation
  - B. Vapor pressure
  - C. Vapor bubbles
  - D. None of the above

293. 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

294. 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

### Pump Operation & Performance Section

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

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

296. 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
- B. Best Efficiency Point
- C. Displacement
- D. None of the above

297. Which of the following is the total volume throughput per unit of time at suction conditions? The term capacity is also used.

- A. Viscosity
- B. Displacement
- C. Rate of Flow
- D. None of the above

298. A measure of a liquid's resistance to flow. i.e.: how thick it is. The viscosity determines the type of pump used, the speed it can run at, and with gear pumps, the internal clearances required.

- A. Viscosity
- B. Displacement
- C. Rate of Flow
- D. None of the above

299. A number represents the function of pump flow, head, efficiency etc. Not used in day to day pump selection, but very useful, as pumps with similar specific speed will have similar shaped curves, similar efficiency / NPSH / solids handling characteristics.

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

300. Which of the following is an index of pump suction operating characteristics? It is determined at the BEP rate of flow with the maximum diameter impeller.

- A. Suction Specific Speed
- B. Vapor Pressure
- C. Friction Loss
- D. None of the above

301. 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
- B. Head, Friction
- C. Head, Friction
- D. None of the above

302. The portion of the pump that includes the impeller chamber and volute diffuser.

- A. Diffuser
- B. Inducer
- C. Casing
- D. None of the above

303. A piece, adjacent to the impeller exit, which has multiple passages of increasing area for converting velocity to pressure.

- A. Diffuser
- B. Inducer
- C. Casing
- D. None of the above

304. Which of the following is related to how much suction lift a pump can achieve by creating a partial vacuum?

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

305. 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
- B. NPSHR
- C. NPSH3
- D. None of the above

306. Which of the following is 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
- B. NPSHR
- C. NPSH3
- D. None of the above

307. 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
  - B. NPSH5
  - C. NPSH3
  - D. None of the above

### Pump Efficiency

308. 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
  - B. Dynamic Suction Head
  - C. Total Dynamic Head
  - D. None of the above

309. Which of the following is the Dynamic Suction Head plus the Dynamic Discharge Head, also referred to as Total Head?
- A. Static Suction Lift
  - B. Dynamic Suction Head
  - C. Total Dynamic Head
  - D. None of the above

310. Which of the following indicates that losses due to friction are factored into the performance?
- A. Dynamic
  - B. Static
  - C. Thermodynamic
  - D. None of the above

311. Which of the following indicates the measurement does not take into account the friction caused by water moving through the hose or pipes?
- A. Dynamic
  - B. Static
  - C. Thermodynamic
  - D. None of the above

### Specific Gravity

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

313. 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

### Suction Limitations

314. 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

315. 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

316. 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

## Motor-Pump Coupling Sub-Section

### Rigid Coupling

317. 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

318. 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

### Alignment of Flexible and Rigid Couplings

319. 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

320. 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

321. 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

322. 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

## Electrical Motors Section

### Understanding Motors

323. The classic division of electric motors has been that of Direct Current (DC) types vs. Alternating Current (AC) types.
- A. True
  - B. False

324. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source -- so they are not purely DC machines in a strict sense.  
A. True      B. False

### Brushed DC Motors

325. Which of the following design generates an oscillating current in a wound rotor with a split ring commutator, and either a wound or permanent magnet stator?  
A. Classic DC motor      C. Classic commutator DC motor  
B. A split ring commutator      D. None of the above
326. Which of the following consists of a coil wound around a rotor which is then powered by any type of battery?  
A. Brushes      C. Rotor  
B. A split ring commutator      D. None of the above
327. Many of the limitations of the \_\_\_\_\_ are due to the need for brushes to press against the commutator. This creates friction.  
A. Classic DC motor      C. Classic commutator DC motor  
B. A split ring commutator      D. None of the above
328. At higher speeds, \_\_\_\_\_ have increasing difficulty in maintaining contact.  
A. Brushes      C. Rotor  
B. A split ring commutator      D. None of the above
329. Brushes may bounce off the irregularities in the \_\_\_\_\_, creating sparks. This limits the maximum speed of the machine.  
A. Commutator surface      C. Rotor  
B. A split ring commutator      D. None of the above
330. Brushes eventually wear out and require replacement, and the \_\_\_\_\_ itself is subject to wear and maintenance.  
A. Brushes      C. Rotor  
B. Commutator      D. None of the above

### Brushless DC Motors

331. Brushless motors are typically \_\_\_\_\_% efficient, whereas DC motors with brush gear are typically 75-80% efficient.  
A. 85-90      C. 95-99  
B. 75-84      D. None of the above
332. Midway between ordinary DC motors and stepper motors lies the realm of the brushless DC motor. Built in a fashion very similar to \_\_\_\_\_, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall Effect sensors to sense the position of the rotor, and the associated drive electronics.  
A. Hall effect sensors      C. Coils  
B. Stepper motors      D. None of the above

333. Which of the following are activated one phase after the other by the drive electronics, as cued by the signals from the Hall effect sensors? In effect, they act as three-phase synchronous motors containing their own variable-frequency drive electronics.

- A. Hall effect sensors
- B. Stepper motors
- C. Coils
- D. None of the above

**Universal Motors**

334. A variant of the wound field DC motor is the universal motor. The name derives from the fact that it may use AC or DC supply current, although in practice they are nearly always used with \_\_\_\_\_ supplies.

- A. AC
- B. DC
- C. AC or DC supply current
- D. None of the above

335. The principle is that in a wound field \_\_\_\_\_ the current in both the field and the armature (and hence the resultant magnetic fields) will alternate (reverse polarity) at the same time, and hence the mechanical force generated is always in the same direction.

- A. AC motor
- B. DC motor
- C. AC or DC motors
- D. None of the above

336. In practice, the motor must be specially designed to cope with the \_\_\_\_\_ current (impedance must be taken into account, as must the pulsating force), and the resultant motor is generally less efficient than an equivalent pure DC motor.

- A. AC
- B. DC
- C. AC or DC supply current
- D. None of the above

337. The advantage of the universal motor is that AC supplies may be used on motors that have the typical characteristics of \_\_\_\_\_ motors, specifically high starting torque and very compact design if high running speeds are used.

- A. AC
- B. DC
- C. AC or DC supply current
- D. None of the above

338. The negative aspect is the maintenance and short life problems caused by the commutator. As a result, such motors are usually used in \_\_\_\_\_ devices such as food mixers and power tools which are used only intermittently.

- A. AC
- B. DC
- C. AC or DC supply current
- D. None of the above

339. Continuous speed control of a universal motor running on \_\_\_\_\_ is very easily accomplished using a thyristor circuit, while stepped speed control can be accomplished using multiple taps on the field coil.

- A. AC
- B. DC
- C. AC or DC supply current
- D. None of the above

**AC Motor Sub-Section**

340. In 1882, Nicola Tesla identified the rotating magnetic field principle, and pioneered the use of a rotary field of force to operate machines. He exploited the principle to design a \_\_\_\_\_ in 1883. In 1885, Galileo Ferraris independently researched the concept.

- A. Rotary field of force
- B. Unique two-phase induction motor
- C. Rotating magnetic field principle
- D. None of the above

## Components

### A typical AC motor consists of two parts:

341. An outside stationary stator having coils supplied with AC current to produce a \_\_\_\_\_.

- A. Rotating magnetic field
- B. Torque to the load
- C. Torque by the rotating field
- D. None of the above

342. An inside rotor attached to the output shaft that is given a \_\_\_\_\_.

- A. Rotating magnetic field
- B. Torque to the load
- C. Torque by the rotating field
- D. None of the above

## Torque motors

343. A torque motor is a specialized form of induction motor that is capable of operating indefinitely at stall (with the rotor blocked from turning) without damage. In this mode, the motor will apply a steady stall \_\_\_\_\_.

- A. Rotating magnetic field
- B. Torque to the load
- C. Torque by the rotating field
- D. None of the above

## Slip Ring

344. The slip ring or wound rotor motor is an induction machine where the rotor comprises a set of coils that are terminated in slip rings to which \_\_\_\_\_ can be connected.

- A. Speed/current and speed/torque
- B. External impedances
- C. Energized and de-energized
- D. None of the above

345. The stator is the same as is used with a standard squirrel cage motor. By changing the impedance connected to the rotor circuit, the \_\_\_\_\_ can be altered.

- A. Slip ring starter
- B. Stepper motors
- C. Speed/current and speed/torque curves
- D. None of the above

346. Which of the following is used primarily to start a high inertia load or a load that requires a very high starting torque across the full speed range?

- A. Slip ring motor
- B. Stepper motor
- C. Standard squirrel cage motor
- D. None of the above

347. By correctly selecting the resistors used in the secondary resistance or \_\_\_\_\_, the motor is able to produce maximum torque at a relatively low current from zero speed to full speed.

- A. Slip ring starter
- B. Stepper
- C. Standard squirrel cage
- D. None of the above

348. A secondary use of the \_\_\_\_\_ is to provide a means of speed control.

- A. Slip ring motor
- B. Stepper motors
- C. Standard squirrel cage motor
- D. None of the above

349. Because the torque curve of the motor is effectively modified by the resistance connected to the rotor circuit, the speed of the motor can be altered. Increasing the value of resistance on the \_\_\_\_\_ will move the speed of maximum torque down.

- A. Rotor circuit
- B. Resistance
- C. Secondary resistors
- D. None of the above

350. If the resistance connected to the rotor is increased beyond the point where the maximum torque occurs at zero speed, the torque will be further reduced. When used with a load that has a torque curve that increases with speed, the motor will operate at the speed where the torque developed by the motor is equal to the \_\_\_\_\_.

- A. Motor torque
- B. Resistance
- C. Load torque
- D. None of the above

### Stepper Motors

351. Closely related in design to three-phase AC synchronous motors are \_\_\_\_\_, where an internal rotor containing permanent magnets or a large iron core with salient poles is controlled by a set of external magnets that are switched electronically.

- A. Slip ring starters
- B. Stepper motors
- C. Standard squirrel cage motor
- D. None of the above

352. Unlike a synchronous motor, in its application, the motor may not rotate continuously; instead, it "steps" from one position to the next as field windings are \_\_\_\_\_ in sequence. Depending on the sequence, the rotor may turn forwards or backwards.

- A. Rotate extremely smoothly
- B. Forwards or backwards
- C. Energized and de-energized
- D. None of the above

353. Simple stepper motor drivers entirely energize or entirely de-energize the field windings, leading the rotor to "cog" to a limited number of positions; more sophisticated drivers can proportionally control the power to the field windings, allowing the rotors to position between the cog points and thereby rotate \_\_\_\_\_.

- A. Extremely smoothly
- B. Forwards or backwards
- C. Energized and de-energized
- D. None of the above

### Electric Motor Maintenance Sub-Section

#### General

354. Make a habit of checking that the motor is securely bolted to its platform. Mounting bolts can vibrate loose. Check to see that rotating parts aren't rubbing on stationary parts of the motor, causing damage to the motor.

- A. True
- B. False

355. Even if windings are protected from moisture, minerals in the pumped water can attach to the windings and cause early failure. Motors that operate at 3600-rpm experience twice as much wear as motors operating at 1800 rpm. Regular maintenance is especially critical for 3600-rpm motors and pumps.

- A. True
- B. False

#### Motor Electrical System

356. Wide temperature fluctuations during the year can cause electrical connections (especially in aluminum wire) to expand and contract, loosening connectors. Loose electrical connections cause heat buildup and arcing at electrical terminals.

- A. True
- B. False

357. The voltage drop across loose connections will cause the motor to operate at less than its rated voltage, increasing internal motor temperature. Increased heat will break down motor winding insulation, resulting in electrical shorts and motor failures. A loose or broken connection can also unbalance the phases of three-phase power and damage the motor windings.

- A. True      B. False

## Electrical Understanding Sub-Section

### Understanding Voltage

358. Voltage, electrical potential difference, electric tension or electric pressure and measured in units of electric potential.

- A. True      B. False

359. Volts, or joules per coulomb is the electric potential difference between two points, or the difference in electric potential energy of a unit charge transported between two points.

- A. True      B. False

360. Voltage is electric potential energy per unit charge, measured in amps per coulomb.

- A. True      B. False

361. Electric potential is mathematically expressed as the line integral of the electric field and the time rate of change of voltage.

- A. True      B. False

362. The electric potential of a material is not even a well-defined quantity, since it varies on the subatomic scale.

- A. True      B. False

363. A voltmeter can be used to measure the \_\_\_\_\_ between two points in a system?

- A. Energy                  C. Voltage  
B. Electric potential    D. None of the above

364. Voltage can be caused by \_\_\_\_\_ or, by electric current through a magnetic field, by time-varying magnetic fields, or some combination of these three.

- A. Static electric fields      C. Electric potential difference  
B. Electromotive force      D. None of the above

365. Which of the following is defined so that negatively charged objects are pulled towards higher voltages?

- A. Voltage                          C. Electric potential difference  
B. Electromotive force      D. None of the above

366. Which of the following must be distinguished from electric potential energy by noting that the "potential" is a "per-unit-charge" quantity?

- A. Pressure                  C. Charge  
B. Electric potential    D. None of the above

367. Which of the following is equal to the work done per unit charge against a static electric field to move the charge between two points?  
A. Energy                      C. Voltage  
B. Electric potential      D. None of the above

### Understanding Three-Phase Power

368. The three-phase system was introduced and patented by George Westinghouse.  
A. True              B. False

369. In a three-phase system, \_\_\_\_\_ carry three alternating currents (which reach their instantaneous peak values at different times).  
A. A balanced load                      C. Instantaneous peak values  
B. Three circuit conductors      D. None of the above

370. Taking one conductor as the reference, the other two currents are delayed in time by one-third and two-thirds of one cycle of the?  
A. Electric current                      C. Lowest phase order  
B. Phase system                      D. None of the above

### Three-phase has properties that make it very desirable in electric power systems:

371. Power transfer into a \_\_\_\_\_ is constant, which helps to reduce generator and motor vibrations.  
A. High-voltage distribution situations                      C. Linear balanced load  
B. Two-phase system                      D. None of the above

### SCADA Section

372. 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

373. 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

374. 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

375. 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

376. 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
377. SCADA systems implement the distributed databases known as Excel databases, containing data elements called rows or columns.  
A. True      B. False
378. 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
379. 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
380. 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
381. 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
382. 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
383. 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
384. 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      C. SCADA system  
B. HMI      D. None of the above
385. Which of the following terms can have multiple servers, disaster recovery sites and distributed software applications in larger SCADA systems?  
A. Master station      C. SCADA system(s)  
B. SCADA implementation(s)      D. None of the above

386. 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

387. 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

388. 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

389. 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

390. 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

391. 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

392. 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

393. 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

394. 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

395. 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

396. 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

397. 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

398. Industrial control vendors propose approaching SCADA security like \_\_\_\_\_ with a defense in depth strategy that leverages common IT practices.

- A. Remote control tasks
- B. Information Security
- C. Remote or distant operation
- D. None of the above

399. 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
- B. HMI
- C. PLCs, RTUs etc.
- D. None of the above

400. The master station displays the \_\_\_\_\_ and also allows the operator to implement remote control tasks.

- A. Acquired data
- B. Common IT practices
- C. Remote or distant operation
- D. None of the above

## When Finished with Your Assignment...

### REQUIRED DOCUMENTS

Please scan the **Registration Page, Answer Key, Proctoring report, 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).