

**Registration form**

**PUMPS AND MOTORS**

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

*Your certificate will be mailed to you in about two weeks.*

**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



# Pumps and Motors 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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***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*

**PUMPS AND MOTORS 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.

## Pumps and Motors CEU Training Course Assignment

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

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

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

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

### Fluid Mechanics and Hydraulic Principles Section

- Which of the following definitions is often used to indicate gauge pressure?  
A. Head, Friction      C. Hydraulics  
B. Head                      D. None of the above
- Which of the following definitions is the pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid?  
A. Pressure                  C. Pascal's Law  
B. Hydraulics                D. None of the above
- Which of the following definitions is the pressure differential above or below ambient atmospheric pressure?  
A. Pressure, Atmospheric    C. Pressure, Gauge  
B. Pressure, Static            D. None of the above
- 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      C. Hydraulics  
B. Head                      D. None of the above
- 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      C. Hydraulics  
B. Head, static          D. None of the above
- Which of the following definitions varies with flow, size, type, and conditions of conductors and fittings, and the fluid characteristics?  
A. Head, Friction      C. Hydraulics  
B. Head, static          D. None of the above

7. 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
8. 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
9. 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
10. 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
11. Sea level pressure is approximately 2.31 pounds per square inch absolute, 1 bar = .433psi.  
 A. True            B. False

**Hydraulics**

12. 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
13. 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
14. Hydraulics can be divided into two areas, \_\_\_\_\_ and hydrokinetics.  
 A. Hydrokinetics                C. Hydraulics  
 B. Hydrostatics                 D. None of the above
15. 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
16. 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
17. 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

18. 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?**

19. 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**

20. 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

**Isotropic Fluid or Newtonian Fluid**

21. If the fluid is also \_\_\_\_\_, the viscosity tensor reduces to two real coefficients, describing the fluid's resistance to continuous shear deformation and continuous compression or expansion, respectively.

- A. Isotropic
- B. Azeotropic
- C. Composed of discrete molecules
- D. None of the above

**Fluid Statics**

22. 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**

23. 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

24. 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

25. 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

26. 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

27. 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

28. 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

29. 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

30. 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

31. 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

32. 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

33. 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

34. 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

35. Which type of friction is a case of fluid friction where a lubricant fluid separates two solid surfaces?  
A. Dry      C. Lubricated  
B. Fluid     D. None of the above

36. Which type of friction is the force resisting motion between the elements making up a solid material while it undergoes deformation?  
A. Dry      C. Internal  
B. Fluid     D. None of the above

37. Which type of friction resists relative lateral motion of two solid surfaces in contact?  
A. Dry      C. Lubricated  
B. Fluid     D. None of the above

38. Which type of friction describes the friction between layers of a viscous fluid that are moving relative to each other?  
A. Dry      C. Lubricated  
B. Fluid     D. None of the above

### Water and Electrical Principles are Very Similar

39. The electronic-hydraulic analogy is the most widely used analogy for "Hydraulic fluid" in a metal conductor.  
A. True      B. False

40. 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

41. Electric potential: In general, it is equivalent to kinetic energy.  
A. True      B. False

42. 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

43. 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

44. Memristor is a needle valve operated by a flow meter.  
A. True      B. False

45. A capacitor cannot "filter out" constant pressure differences frequency pressure differences.  
A. True      B. False

46. 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

47. Voltage is the difference in pressure between two points, usually measured in volts.  
A. True      B. False
48. A diode is equivalent to a two-way check valve with a tight valve seal.  
A. True      B. False
49. 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
50. 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
51. Which of the following does the inductor and its blades are analogous to inductance, and friction between its axle and the axle bearings corresponds to?  
A. Resistance to current      C. The mass and surface area of the wheel  
B. Water level      D. None of the above
52. 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
53. 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
54. 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
55. Voltage is also called voltage drop or?  
A. Valve assembly      C. A positive displacement pump  
B. Potential difference      D. None of the above
56. 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
57. As with a diode, a small pressure difference is needed before the valve opens. In addition, like a diode, too much reverse bias can damage or destroy the?  
A. Valve assembly      C. A positive displacement pump  
B. Feedback control      D. None of the above

## Fluid/Hydraulic Forces & Pressures Section

### Atmospheric Pressure

58. 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

59. 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

60. 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

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

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

62. The atmospheric pressure does not vary uniformly with?

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

63. 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

### Barometric Loop

64. 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

65. 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

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

- A. True
- B. False

67. 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

68. The barometric loop is a loop in the piping system that effectively protects against backpressure.  
A. True      B. False
69. The barometric loop may not be used to protect against backsiphonage.  
A. True      B. False
70. Absolute pressure and gauge pressure?  
A. Are the same      C. That effectively protects  
B. Are related      D. None of the above
71. Which of the following terms could be measured on an absolute scale, pounds per square inch absolute (psia), or gauge scale, (psig).  
A. Static pressure      C. Sea level  
B. Pressure      D. None of the above
72. Which of the following at sea level is 14.7 psia?  
A. Pressure      C. Atmospheric pressure  
B. Gauge pressure      D. None of the above
73. Which of the following is the total pressure?  
A. Absolute pressure      C. Atmospheric pressure  
B. Gauge pressure      D. None of the above

**Pressure**

74. Water is incompressible, while air is very compressible.  
A. True      B. False
75. 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
76. Both air and water are considered to be?  
A. Gases      C. Volume  
B. Fluid(s)      D. None of the above
77. Which of the following terms does water possess and air does not?  
A. Gases      C. Volume  
B. Fluid(s)      D. None of the above
78. A force is proportional to the \_\_\_\_\_, and is called a pressure.  
A. Pascal's Principle      C. Permanent forces tangential  
B. Area on which it is exerted      D. None of the above
79. 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      C. Area on which it is exerted  
B. Acting on the body of the fluid      D. None of the above

80. 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

81. 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

82. 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

83. 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**

84. 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**

85. 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

86. 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**

87. 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

88. 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

89. 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

90. 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

**Water Pressure**

91. 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

92. 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

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

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

94. 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

95. 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**

96. 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

97. 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

98. 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

99. Which of the following means the amount of push or pull applied to each unit area of the surface?  
A. Absolute pressure                      C. Volume  
B. Pressure                                      D. None of the above
100. Which of the following maybe exerted in one direction, in several directions, or in all directions?  
A. Absolute pressure                      C. Volume  
B. Pressure                                      D. None of the above

## Experiments and Early Applications Section

101. 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
102. 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
103. \_\_\_\_\_ 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
104. 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
105. 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
106. 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                      C. Specific gravity  
B. Coriolis Force                              D. None of the above
107. 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                      C. Specific gravity  
B. Coriolis Force                              D. None of the above

108. Which of the following is of great importance in meteorology, since it determines the winds?  
A. Stratosphere      C. Atmospheric pressure  
B. Atmosphere      D. None of the above

109. Certain typical weather patterns are associated with relatively high and relatively low \_\_\_\_\_, and how they vary with time.  
A. Forces      C. Pressures  
B. Physics      D. None of the above

### **Experiments and Early Applications Key Terms**

110. 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      C. Aristotle' law  
B. Archimedes' law      D. None of the above

111. 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

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

A. True      B. False

113. 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

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

A. True      B. False

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

A. True      B. False

116. 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

117. 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      C. Aristotle' law  
B. Blaise Pascal      D. None of the above

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

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

### Measurement of Specific Gravity

119. 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

120. 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

121. 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

122. 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

123. 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

124. 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

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

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

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

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

### Physical Science and Laws Section

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

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

128. 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

129. Which of the following is the tendency of objects to keep moving in a straight line at constant velocity?

- A. Force
- B. Inertia
- C. Friction
- D. None of the above

130. Which of the following can cause an object with mass to change its velocity to accelerate?

- A. Force
- B. Pull
- C. Push
- D. None of the above

131. Which of the following determines the strength of its mutual gravitational attraction to other bodies?

- A. Force
- B. Mass
- C. Weight
- D. None of the above

132. 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

133. 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

134. 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

135. 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

136. 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

137. 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

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

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

139. 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

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

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

### Newton's Laws

141. 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
- B. Mass
- C. Torque
- D. None of the above

142. Which of the following represents cause no acceleration of that body as the forces balance one another?

- A. Gravity
- B. Fundamental interactions
- C. Internal mechanical stresses
- D. None of the above

143. 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
- B. Mass
- C. Torque
- D. None of the above

144. Which of the following represents usually causes deformation of solid materials, or flow in fluids?

- A. Acceleration
- B. Internal mechanical stresses
- C. Stress
- D. None of the above

145. Gravity is one of the four forces of nature. The strength of the gravitational force between two objects depends on their?

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

146. 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
- B. Fundamental interactions
- C. Internal mechanical stresses
- D. None of the above

147. 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
- B. Mass
- C. Gravity
- D. None of the above

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

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

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

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

### **Pascal's Law**

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

- A. True
- B. False

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

- A. True
- B. False

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

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

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

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

154. The indicated pressure is doubled, when the?

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

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

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

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

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

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

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

### Static Pressure

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

- A. True      B. False

159. 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

160. 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

### Volume and Velocity of Flow

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

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

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

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

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

164. 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

165. 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

166. 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

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

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

168. 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

169. 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

170. 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

## Pumps and Pumping Water Section

### Common Types of Water Pumps

171. 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

172. 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

173. 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

174. 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

175. 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

176. 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)
- B. Pumping rate
- C. Pumping head
- D. None of the above

177. Which of the following pumps are commonly used in groundwater wells but also in many other applications?

- A. Dynamic
- B. Vertical turbine
- C. Variable displacement
- D. None of the above

178. 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)
- B. Pumping rate
- C. Shaft rotated by a motor
- D. None of the above

179. The rotating shaft in a \_\_\_\_\_ is actually housed within the column pipe that delivers the water to the surface.

- A. Line shaft turbine
- B. Shaft pump(s)
- C. Variable displacement pump(s)
- D. None of the above

180. The size of the column, impeller, and bowls are selected based on which desired requirements?

- A. Pumping head
- B. Pumping rate
- C. Pumping rate and lift
- D. None of the above

181. Column pipe sections can be threaded or coupled together while the drive shaft is coupled and suspended within the column by \_\_\_\_\_.

- A. Oil bearings
- B. Spider bearings
- C. Column bearings
- D. None of the above

182. 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
- B. Strainer
- C. Column pipe joints
- D. None of the above

183. Most installations use an electric motor that is connected to the drive shaft by a \_\_\_\_\_.

- A. Drift pin
- B. Keyway and nut
- C. Pair of strong cotter pins
- D. None of the above

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

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

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

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

186. 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

187. 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

188. 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

189. 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

190. 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

191. 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

192. 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

193. 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

194. 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

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

- A. True
- B. False

196. 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**

197. 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:**

198. 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

199. 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

200. 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**

201. 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

202. 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

203. 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

204. 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

205. 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

206. 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

207. 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

208. 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

209. The force and lift pumps are typically used for \_\_\_\_\_.
- A. Solids
  - B. Pressure
  - C. Water
  - D. None of the above

210. 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

211. 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

212. 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

#### Key considerations include:

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

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

214. Specific gravity affects the \_\_\_\_\_ required to lift and move the fluid, and must be considered when determining pump power requirements.

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

215. Pump materials and expansion, mechanical seal components, and packing materials need to be considered with pumped fluids that are hotter than \_\_\_\_\_ °F.

- A. 100
- B. 200
- C. 212
- D. None of the above

216. 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

217. 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

218. 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

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

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

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

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

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

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

**Positive Displacement Pump Sub-Section**

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

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

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

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

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

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

225. 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
- B. A closed valve
- C. An expanding cavity
- D. None of the above

226. If a positive displacement pump is allowed to operate against a closed discharge valve, it will continue to produce flow that will increase the pressure in the discharge line until either \_\_\_\_\_ or the pump is severely damaged or both.

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

**Centrifugal Pump Sub-Section**

227. 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

228. Centrifugal pumps may be classified in several ways. For example, they may be either Multi-Stage or Single Stage.

- A. True
- B. False

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

- A. True
- B. False

230. The impellers used on centrifugal pumps may be classified as single suction or double suction.  
 A. True      B. False
231. 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
232. A pump does not create pressure; it only provides flow. Pressure is just an indication of the amount of \_\_\_\_\_.  
 A. Centrifugal force      C. Resistance to flow  
 B. Pressure      D. None of the above
233. A single-stage pump has only one impeller. A multi-stage pump has two or more impellers housed together in \_\_\_\_\_.  
 A. Stage      C. The eye  
 B. One casing      D. None of the above
234. As a standard, each impeller acts separately, discharging to the suction of the next stage impeller. This arrangement is called \_\_\_\_\_.  
 A. Centrifugal force      C. Series staging  
 B. The amount of resistance to flow      D. None of the above
235. Centrifugal pumps are also classified as Horizontal or Vertical, depending upon the position of the \_\_\_\_\_.  
 A. Pump shaft      C. Eye  
 B. Casing      D. None of the above
236. 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      C. The eye  
 B. One casing      D. None of the above
237. 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      C. The vane tips  
 B. One casing      D. None of the above
238. Open impellers do not have these side walls. Some small pumps with single-suction impellers have only a casing wearing ring and no impeller ring. In this type of pump, the casing wearing ring is fitted into \_\_\_\_\_.  
 A. Pump shaft      C. The eye  
 B. The end plate      D. None of the above
239. Recirculation lines are installed on some centrifugal pumps to prevent the pumps from overheating and becoming vapor bound, in case \_\_\_\_\_ or the flow of fluid is stopped for extended periods.  
 A. Centrifugal force      C. The discharge is entirely shut off  
 B. The amount of resistance to flow      D. None of the above

240. Which of the following is installed to cool the shaft and the packing, to lubricate the packing, and to seal the rotating joint between the shaft and the packing against air leakage?

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

241. 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

242. Which of the following leads the liquid from the discharge side of the pump to the annular space formed by the lantern ring? The web of the ring is perforated so that the water can flow in either direction along the shaft (between the shaft and the packing).

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

243. 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**

244. 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

245. 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

246. 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**

247. 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

248. 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

249. Positive Displacement pumps generally gives more \_\_\_\_\_ than centrifugal pumps.  
 A. Centrifugal force            C. Pressure  
 B. Centrifugal acceleration    D. None of the above
250. 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                      C. Suction  
 B. Static                         D. None of the above
251. Which of the following indicates the vertical distance from the water line to the centerline of the impeller?  
 A. Dynamic                      C. Static Suction Lift  
 B. Static Discharge Head    D. None of the above
252. Depending on how the measurement is taken \_\_\_\_\_ and head may also be referred to as static or dynamic.  
 A. Dynamic                      C. Suction Lift  
 B. Static Discharge Head    D. None of the above
253. 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                      C. Suction  
 B. Static                         D. None of the above
254. Which of the following indicates the vertical distance from the discharge outlet to the point of discharge or liquid level when discharging into the bottom of a water tank?  
 A. Dynamic                      C. Static Suction Lift  
 B. Static Discharge Head    D. None of the above

**Mechanical Efficiency**

255. 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    C. Positive displacement pump  
 B. Vertical turbine    D. None of the above
256. Changing the system pressure or head has a dramatic effect on the flow rate in the \_\_\_\_\_.  
 A. Centrifugal pump    C. Positive displacement pump  
 B. Vertical turbine    D. None of the above

**Net Positive Suction Head - NPSH**

257. 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

258. 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

259. 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

260. 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

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

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

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

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

### Helical Rotor and a Twin Helix

263. 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

264. 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

265. 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

266. 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

267. 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

268. 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

269. 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

270. 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    C. The formation of cavities
- B. Cavitation    D. None of the above

271. Which of the following is usually divided into two classes of behavior: inertial (or transient) cavitation and non-inertial cavitation?

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

272. To understand \_\_\_\_\_, you must first understand vapor pressure. Vapor pressure is the pressure required to boil a liquid at a given temperature.

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

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

274. 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    C. Vapor bubbles  
B. Vapor pressure    D. None of the above

### **Maintenance of a Vertical Turbine Pump**

275. A periodic inspection is recommended as the best means of preventing breakdown and keeping maintenance costs to a minimum.
- A. True            B. False
276. A periodic monthly inspection is suggested for all units. During this inspection the pump and driver should be checked for performance, change in noise or vibration level, loose bolts or piping, dirt and corrosion. Clean and re-paint all areas that are rusted or corroded.
- A. True            B. False
277. Maintenance personnel should look over the whole installation with a critical eye each time the pump is inspected -- a change in noise level, amplitude of vibration, or performance can be an indication of impending trouble.
- A. True            B. False

278. Maintenance of the stuffing box will consist of greasing the box when required, tightening the packing gland occasionally as the leakage becomes excessive, and installing new packing rings or sets as required.
- A. True            B. False
279. Remove gland and all old packing. If the box contains a lantern ring remove this and all packing below it using two long threaded machine screws. Inspect shaft or sleeve for score marks or rough spots. Be sure by-pass holes (if supplied) are not plugged.
- A. True            B. False

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

280. The rate of flow and total head at which the pump efficiency is maximum at a given speed and impeller diameter.
- A. Specific Speed            C. Displacement  
B. Best Efficiency Point    D. None of the above
281. For a positive displacement pump, it is the theoretical volume per revolution of the pump shaft. Calculation methods and terminology may differ between different types of positive displacement pumps.
- A. Specific Speed            C. Displacement  
B. Best Efficiency Point    D. None of the above
282. 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            C. Rate of Flow  
B. Displacement        D. None of the above

283. 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

284. 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

285. Which of the following is an indicator of the net positive suction head required [NPSH<sub>3</sub>] for given values of capacity and also provides an assessment of a pump's susceptibility to internal recirculation?

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

286. If the vapor pressure of a liquid is greater than the surrounding air pressure, the liquid will boil.

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

287. The amount of pressure / head required to 'force' liquid through pipe and fittings.

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

288. Which of the following is the expression of the energy content of a liquid in reference to an arbitrary datum? It is expressed in units of energy per unit weight of liquid. The measuring unit for head is meters (feet) of liquid.

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

289. The head required to overcome the friction at the interior surface of a conductor and between fluid particles in motion. It varies with flow, size, type, and conditions of conductors and fittings, and the fluid characteristics.

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

290. The height of a column or body of fluid above a given point.

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

291. 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, Suction
- C. Head, Friction
- D. None of the above

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

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

293. The pump casing for a centrifugal type of pump, typically spiral or circular in shape.  
 A. Impeller C. Casing  
 B. Volute D. None of the above
294. Which of the following is related to how much suction lift a pump can achieve by creating a partial vacuum?  
 A. NPSH C. NPSH3  
 B. NPSHR D. None of the above
295. Which of the following is determined by the conditions of the installation and is the total suction head of liquid absolute, determined at the first-stage impeller datum minus the absolute vapor pressure in meters (feet) of the liquid at a specific rate of flow expressed in meters (feet) of liquid?  
 A. NPSHA C. NPSH3  
 B. NPSHR D. None of the above
296. 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 C. NPSH3  
 B. NPSHR D. None of the above
297. For rotodynamic pumps \_\_\_\_\_ is defined as the value of NPSHR at which the first-stage total head drops by 3% due to cavitation.  
 A. NPSH7 C. NPSH3  
 B. NPSH5 D. None of the above

**Pump Efficiency**

298. Which of the following is the Static Discharge Head plus the friction in the discharge line, also referred to as Total Discharge Head?  
 A. Dynamic Discharge Head C. Total Dynamic Head  
 B. Dynamic Suction Head D. None of the above
299. Which of the following is the Dynamic Suction Head plus the Dynamic Discharge Head, also referred to as Total Head?  
 A. Static Suction Lift C. Total Dynamic Head  
 B. Dynamic Suction Head D. None of the above
300. Which of the following indicates that losses due to friction are factored into the performance?  
 A. Dynamic C. Thermodynamic  
 B. Static D. None of the above
301. Which of the following is the vertical distance from the water line to the centerline of the impeller?  
 A. Static Suction Lift C. Total Dynamic Head  
 B. Dynamic Suction Head D. None of the above
302. Which of the following is the vertical distance from the discharge outlet to the point of discharge or liquid level when discharging into the bottom of a water tank?  
 A. Static Suction Lift C. Total Dynamic Head  
 B. Static Discharge Head D. None of the above

303. Which of the following is the Static Suction Lift plus the friction in the suction line, also referred to as a Total Suction Head?

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

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

**Specific Gravity**

308. 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

309. 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

310. Specific gravity is important when sizing a centrifugal pump because it is indicative of the weight of the fluid and its weight will have a direct effect on the amount of \_\_\_\_\_ performed by the pump.

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

311. One of the beauties of the centrifugal pump is that the head (in feet) and flow it produces has nothing to do with the weight of the liquid. It is all about the velocity that is added by the impeller. The simplest way to prove the validity of this statement is to use the \_\_\_\_\_.

- A. Falling body equation
- B. Law of Pascal
- C. Pump curve
- D. None of the above

### Understanding Pump Viscosity

312. When to use a centrifugal or a Positive Displacement pump ("PD Pump") is always a clear choice. To make a good choice between these pump types it is important to understand that these two types of pumps behave very summarily.

- A. True      B. False

### Understanding Suction Lift

313. Suction lift deals with the maximum distance to the intake of a pump. Fire pumps and others may lift about \_\_\_\_\_ of suction.

- A. 33.9      C. 3 -5  
B. 5' to 10'      D. None of the above

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

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

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

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

## Motor-Pump Coupling Sub-Section

### Rigid Coupling

316. 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      C. Motor shaft and the pump shaft  
B. Rigid coupling      D. None of the above

### Flexible Coupling

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

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

### Alignment of Flexible and Rigid Couplings

318. 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      C. Misalignment  
B. Coupling      D. None of the above

### **V-Belt Drive Couplings**

319. 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**

320. 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**

321. 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

## **Groundwater Treatment/Production System Section**

### **Groundwater and Wells**

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

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

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

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

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

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

325. The area above the water table lies the?

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

326. The water in the saturated zone is called?

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

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

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

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

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

### **Cone of Depression**

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

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

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

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

## **Electrical Motors Section**

### **Understanding Motors**

331. The classic division of electric motors has been that of Direct Current (DC) types vs. Alternating Current (AC) types.

- A. True
- B. False

332. Many classic DC motors run happily on AC power.

- A. True
- B. False

333. The ongoing trend toward electronic control further muddles the distinction; as modern drivers have moved the commutator out of the motor shell. For this new breed of motor, driver circuits are relied upon to generate sinusoidal AC drive currents, or some approximation of.

- A. True
- B. False

334. The two best motor examples are: the brushless DC motor and the stepping motor, both being polyphase AC motors requiring external electronic control.

- A. True
- B. False

### **Brushed DC Motors**

335. 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
- B. A split ring commutator
- C. Classic commutator DC motor
- D. None of the above

336. Which of the following consists of a coil wound around a rotor which is then powered by any type of battery?

- A. Brushes
- B. A split ring commutator
- C. Rotor
- D. None of the above

337. 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
- B. A split ring commutator
- C. Classic commutator DC motor
- D. None of the above



347. Tesla had suggested that the commutators from a machine could be removed and the device could operate on \_\_\_\_\_.
- A. A rotary field of force
  - B. A stationary magnetic field
  - C. A rotating magnetic field principle
  - D. None of the above

### Components

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

348. 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

349. 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

350. 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

351. 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

### Stepper Motors

352. 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

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

### **Motor Bearings**

358. Lubricate the motor according to the manufacturer's instructions. Intervals between lubrication will vary with motor speed, power draw, load, ambient temperatures, exposure to moisture, and seasonal or continuous operation.

A. True      B. False

359. Electric motors should not be greased daily. Bearings can be ruined by either over- or under-greasing.

A. True      B. False

360. Even a current of 15 milliamps (one milliamp is one one-thousandth of an amp) can cause serious injury or death. Always play it safe!

A. True      B. False

## **Electrical Understanding Sub-Section**

### **Understanding Voltage**

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

A. True      B. False

362. 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

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

A. True      B. False

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

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

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

368. Which of the following along with the dynamic electromagnetic field must be included in determining the voltage between two points?

- A. Electric current
- B. Electromotive force
- C. A static (unchanging) electric field
- D. None of the above

369. Which of the following is now obsolete but tension is still used?

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

370. Which of the following may represent either a source of energy or lost, used, or stored energy?

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

371. Which of the following can flow from lower voltage to higher voltage, but only when a source of energy is present to "push" it?

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

372. Which of the following is not the only issue determining charge flow?

- A. Electric field
- B. Electromotive force
- C. Resistance
- D. None of the above

### **Understanding Three-Phase Power**

373. The three-phase system was introduced and patented by George Westinghouse.

- A. True
- B. False

374. Which of the following terms has the effect of giving constant power transfer over each cycle of the current and makes it possible to produce a rotating magnetic field in an electric motor?

- A. This delay between phases
- B. The lowest phase order
- C. Linear balanced load
- D. None of the above

375. Three-phase systems may have a?

- A. Neutral wire
- B. One phase system
- C. Non-linear balanced load
- D. None of the above

376. In a three-phase system, \_\_\_\_\_ carry three alternating currents (which reach their instantaneous peak values at different times).

- A. A balanced load
- B. Three circuit conductors
- C. Instantaneous peak values
- D. None of the above

377. 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
- B. Phase system
- C. Lowest phase order
- D. None of the above

378. Which of the following is common not to have a neutral wire as the loads can simply be connected between phases?

- A. High-voltage distribution situations
- B. Two-phase system
- C. Linear balanced load
- D. None of the above

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

379. Power transfer into a \_\_\_\_\_ is constant, which helps to reduce generator and motor vibrations.

- A. High-voltage distribution situations
- B. Two-phase system
- C. Linear balanced load
- D. None of the above

**SCADA Section**

380. 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

381. 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

382. 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

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

- A. True
- B. False

384. 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
385. 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
386. 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
387. 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
388. Which of the following 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
389. 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
390. 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
391. Which of the following 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
392. 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      C. Multiple stations  
B. Independent systems      D. None of the above



## **When Finished with Your Assignment...**

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