

Registration Form

**PUMPING PRINCIPLES CEU COURSE \$150.00**

**48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

**Start and Finish Dates:** \_\_\_\_\_

*You will have 90 days from this date in order to complete this course*

**Name** \_\_\_\_\_ **Signature** \_\_\_\_\_

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

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

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

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

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

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

*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 \_\_\_ WWT \_\_\_ Well Operator \_\_\_ Pump Installer \_\_\_

**Technical Learning College PO Box 420, Payson AZ 85547-0420**

**Primary Fax (928) 272-0747 Backup Fax (928) 468-0675**

**Telephone (928) 468-0665 Toll Free (866) 557-1746**

[info@tlch2o.com](mailto:info@tlch2o.com)

**Discover card** \_\_\_\_\_ **CCV code** \_\_\_\_\_

**American Express**

**Visa or MasterCard #** \_\_\_\_\_ **Exp. Date** \_\_\_\_\_

**If you've paid on the Internet, Please write your customer#** \_\_\_\_\_

**Purchase Order #, Please invoice me** \_\_\_\_\_

**We will e-mail you the certificate of completion. Please provide an e-mail address.**

## **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 also understand that this type of study program deals with dangerous conditions and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material. I will 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.

**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.tlch2o.com/PDF/CEU%20State%20Approvals.pdf>

*You can obtain a printed version of the course manual from TLC for an additional \$79.95 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.

# Pumping Principles Answer Sheet

Name \_\_\_\_\_

Telephone \_\_\_\_\_

**Please circle only one answer per question or X, underline, bold or circle it**

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| 1. A B C D E  | 45. A B C D E | 89. A B C D E  |
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| 290. | A B C D E | 295. | A B C D E | 300. | A B C D E |

Please fax or e-mail the answer key to TLC  
Western Campus Fax (928) 272-0747.

### **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. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line.

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

Thank you...

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

**Pumping Principles CEU Course  
CUSTOMER SERVICE RESPONSE CARD**

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

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

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

1. Please rate the difficulty of your course.  
Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.  
Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.  
Very Similar 0 1 2 3 4 5 Very Different

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

5. What would you do to improve the Course?

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How about the price of the course?

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

How was your customer service?

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

Any other concerns or comments.

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## Pumping Principles CEU Training Course Assignment

You will have 90 days to complete this assignment and submit it to TLC. Please include the Registration Page, Answer Key and Customer Survey. You can find help utilizing the search function in Adobe Acrobat.

### Multiple Choice Exam

***Please utilize the Answer key in the front of this section. Select the answer that comes from the text only. One answer per question.***

1. \_\_\_\_\_ is a branch of engineering concerned mainly with moving liquids.  
A. Hydrokinetics  
B. Hydrostatics  
C. Hydraulics  
D. Engineering  
E. None of the Above
  
2. Hydraulics is applied commonly to the study of the mechanical properties of water, other \_\_\_\_\_, and even gases when the effects of compressibility are small.  
A. Hydrokinetics  
B. Hydrostatics  
C. Hydraulics  
D. Liquids  
E. None of the Above
  
3. Hydraulics can be divided into two areas, \_\_\_\_\_ and hydrokinetics.  
A. Hydrokinetics  
B. Hydrostatics  
C. Hydraulics  
D. Engineering  
E. None of the Above
  
4. The word \_\_\_\_\_ is based on the Greek word for water, and originally covered the study of the physical behavior of water at rest and in motion.  
A. Hydrokinetics  
B. Hydrostatics  
C. Hydraulics  
D. Engineering  
E. None of the Above
  
5. Hydraulics includes the manner in which \_\_\_\_\_ act in tanks and pipes, deals with their properties, and explores ways to take advantage of these properties.  
A. Hydrokinetics  
B. Hydrostatics  
C. Hydraulics  
D. Liquids  
E. None of the Above

6. \_\_\_\_\_, the consideration of liquids at rest, involves problems of buoyancy and flotation, pressure on dams and submerged devices, and hydraulic presses.
- A. Hydrokinetics
  - B. Hydrostatics
  - C. Hydraulics
  - D. Engineering
  - E. None of the Above
7. The relative incompressibility of \_\_\_\_\_ is one of its basic principles.
- A. Hydrokinetics
  - B. Fluids
  - C. Hydraulics
  - D. Liquids
  - E. None of the Above
8. \_\_\_\_\_, the study of liquids in motion, is concerned with such matters as friction and turbulence generated in pipes by flowing liquids, the flow of water over weirs and through nozzles, and the use of hydraulic pressure in machinery.
- A. Hydrokinetics
  - B. Hydrodynamics
  - C. Hydraulics
  - D. Engineering
  - E. None of the Above
9. \_\_\_\_\_ is about the pressures exerted by a fluid at rest. Any fluid is meant, not just water.
- A. Hydrokinetics
  - B. Hydrostatics
  - C. Hydraulics
  - D. Engineering
  - E. None of the Above
10. Hydrostatics is an excellent example of \_\_\_\_\_, one that can be understood easily and completely from a very few fundamentals, and in which the predictions agree closely with.
- A. Experiment
  - B. Atmosphere
  - C. Geology
  - D. Column
  - E. None of the Above
11. The definition of a fluid deserves careful consideration. Although time is not a factor in hydrostatics, it enters in the approach to hydrostatic equilibrium. It is usually stated that a fluid is a substance that cannot resist a \_\_\_\_\_, so that pressures are normal to confining surfaces.
- A. Experiment
  - B. Atmosphere
  - C. Geology
  - D. Shearing stress
  - E. None of the Above

**Please use the Answer Key in front, utilize the search function to help you if necessary.**

12. The atmosphere is the entire mass of air that surrounds the earth. While it 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. This layer is called the \_\_\_\_\_.

- A. Experiment
- B. Atmosphere
- C. Geology
- D. Column
- E. None of the Above

13. If a \_\_\_\_\_ of air 1-inch square extending all the way to the "top" of the atmosphere could be weighed, this column of air would weigh approximately 14.7 pounds at sea level.

- A. Experiment
- B. Atmosphere
- C. Geology
- D. Column
- E. None of the Above

14. \_\_\_\_\_ pressure at sea level is approximately 14.7 psi.

- A. Experiment
- B. Atmospheric
- C. Geology
- D. Column
- E. None of the Above

15. As one \_\_\_\_\_, the atmospheric pressure decreases by approximately 1.0 psi for every 2,343 feet.

- A. Experiment
- B. Atmosphere
- C. Geology
- D. Column
- E. None of the Above

16. Below sea level, in excavations and depressions, atmospheric pressure \_\_\_\_\_.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

17. \_\_\_\_\_ under water differ from those under air only because the weight of the water must be added to the pressure of the air.

- A. Pressures
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

18. Atmospheric pressure can be measured by any of several methods. The common laboratory method uses the mercury column barometer. The height of the \_\_\_\_\_ column serves as an indicator of atmospheric pressure.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

19. At sea level and at a temperature of 0° Celsius (**C**), the height of the mercury column is approximately 30 inches, or 76 centimeters. This represents a pressure of approximately 14.7 psi. The 30-inch column is used as a \_\_\_\_\_.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

20. Another device used to measure atmospheric \_\_\_\_\_ is the aneroid barometer.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

21. The aneroid barometer uses the change in shape of an evacuated metal cell to measure variations in atmospheric \_\_\_\_\_.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

22. The atmospheric pressure does \_\_\_\_\_ with altitude. It changes very rapid.

- A. Pressure
- B. Weight
- C. Increases
- D. Mercury
- E. None of the Above

23. The barometric loop consists of a continuous section of supply piping that abruptly rises to a height of approximately 35 feet and then returns back down to the originating level. It is a loop in the piping system that effectively protects against \_\_\_\_\_.

- A. Absolute scale
- B. Barometric loops
- C. Back-pressure
- D. Backsiphonage
- E. None of the Above

24. The barometric loop may not be used to protect against \_\_\_\_\_.

- A. Absolute scale
- B. Barometric loops
- C. Back-pressure
- D. Backsiphonage
- E. None of the Above

25. Its operation, in the protection against backsiphonage, is based upon the \_\_\_\_\_ that a water column, at sea level pressure, will not rise above 33.9 feet.

- A. Absolute scale
- B. Barometric loops
- C. Back-pressure
- D. Backsiphonage
- E. None of the Above

26. In general, \_\_\_\_\_ are locally fabricated, and are 35 feet high.
- A. Absolute scale
  - B. Barometric loops
  - C. Back-pressure
  - D. Backsiphonage
  - E. None of the Above
27. Pressure may be referred to using an \_\_\_\_\_, pounds per square inch absolute (**psia**), or gauge scale, (**psiag**).
- A. Absolute scale
  - B. Barometric loops
  - C. Back-pressure
  - D. Backsiphonage
  - E. None of the Above
28. Absolute pressure and gage pressure are related. \_\_\_\_\_ pressure is equal to gauge pressure plus the atmospheric pressure.
- A. Absolute
  - B. Barometric loops
  - C. Back-pressure
  - D. Backsiphonage
  - E. None of the Above
29. \_\_\_\_\_ is a condition in which the pressure in the distribution system is less than atmospheric pressure. In other words, something is “sucked” into the system because the main is under a vacuum.
- A. Backsiphonage
  - B. Backpressure
  - C. None of the Above
30. Absolute pressure is the \_\_\_\_\_.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
31. The volume of a liquid passing a point in a given time is known as its \_\_\_\_\_ or flow rate.
- A. Volume of flow
  - B. Velocity of flow
  - C. Volume and velocity
  - D. Feet per minute (fpm)
  - E. None of the Above
32. The \_\_\_\_\_ 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. Volume of flow
  - B. Velocity of flow
  - C. Volume and velocity
  - D. Feet per minute (fpm)
  - E. None of the Above

33. The \_\_\_\_\_ or velocity of the fluid is defined as the average speed at which the fluid moves past a given point.
- A. Volume of flow
  - B. Velocity of flow
  - C. Volume and velocity
  - D. Feet per minute (fpm)
  - E. None of the Above
34. 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. Then the \_\_\_\_\_ pressure would be equal to 14.7 psi, which is the atmospheric pressure.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
35. Water is \_\_\_\_\_, while air is very compressible, but both are fluids.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
36. Water has a definite \_\_\_\_\_; air does not.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
37. Water and air have low \_\_\_\_\_; that is, layers of them slide very easily on one another, and they quickly assume their permanent shapes when disturbed by rapid flows.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
38. A fluid, therefore, is a substance that cannot exert any \_\_\_\_\_ tangential to a boundary.
- A. Absolute
  - B. Gauge
  - C. Volume
  - D. Incompressible
  - E. None of the Above
39. Any force that it exerts on a boundary must be normal to the boundary. Such a force is proportional to the area on which it is exerted, and is called a \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Pressure
  - E. None of the Above

40. On earth, fluids are also subject to the force of \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
41. The density of water is about 1 g/cm<sup>3</sup>, or its \_\_\_\_\_ is 62.4 pcf.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
42. 33.9 ft of water is the maximum height to which water can be raised by a suction pump, or, more correctly, can be supported by \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
43. When \_\_\_\_\_ acts, the liquid assumes a free surface perpendicular to gravity, which can be proved by Thomson's method.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
44. This definition of the standard \_\_\_\_\_ was established by Regnault in the mid-19th century. In Britain, 30 in Hg (inches of mercury) had been used previously.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
45. As a practical matter, it is convenient to measure pressure differences by measuring the height of liquid columns, a practice known as \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
46. The barometer is a familiar example of this, and atmospheric pressures are traditionally given in terms of the length of a \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above

47. To make a barometer, the barometric tube, closed at one end, is filled with mercury and then \_\_\_\_\_ and placed in a mercury reservoir.
- A. Barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
48. An \_\_\_\_\_ uses a partially evacuated chamber of thin metal that expands and contracts according to the external pressure. This movement is communicated to a needle that revolves in a dial.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
49. The materials and construction in an aneroid barometer are arranged to give a low temperature \_\_\_\_\_.
- A. Aneroid barometer
  - B. Specific weight
  - C. Gravity
  - D. Atmospheric pressure
  - E. None of the Above
50. The aneroid barometer instrument must be calibrated before use, and is usually arranged to read directly in \_\_\_\_\_.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
51. An aneroid barometer is much easier to use in field observations, such as in \_\_\_\_\_ surveys.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
52. An absolute pressure is referred to a \_\_\_\_\_, while a gauge pressure is referred to the atmospheric pressure at the moment.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
53. Negative gauge pressure is a (\_\_\_\_\_) vacuum.
- A. Gauge
  - B. Zero
  - C. Pressure
  - D. Partial
  - E. None of the Above

54. When a \_\_\_\_\_ is stated to be so many inches, this means the pressure below the atmospheric pressure of about 30 in.
- A. Gauge
  - B. Vacuum
  - C. Pressure device
  - D. Partial
  - E. None of the Above
55. A vacuum of 25 inches is the same thing as an \_\_\_\_\_ pressure of 5 inches (of mercury).
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
56. The term **vacuum** indicates that the absolute \_\_\_\_\_ is less than the atmospheric pressure and that the gauge pressure is negative.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
57. A complete or total vacuum would mean a \_\_\_\_\_ of 0 psia or -14.7 psig.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Partial
  - E. None of the Above
58. Since it is impossible to produce a total vacuum, the term \_\_\_\_\_, will mean all degrees of partial vacuum.
- A. Gauge
  - B. Vacuum
  - C. Pressure
  - D. Zero
  - E. None of the Above
59. In a \_\_\_\_\_ vacuum, the pressure would range from slightly less than 14.7 psia (0 psig) to slightly greater than 0 psia (-14.7 psig).
- A. Gauge
  - B. Complete
  - C. Pressure
  - D. Partial
  - E. None of the Above
60. Backsiphonage results from atmospheric pressure exerted on a liquid forcing it toward a supply system that is under a \_\_\_\_\_.
- A. Suction
  - B. Vacuum
  - C. Pressure break
  - D. Condition
  - E. None of the Above

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

- A. Is related to gauge pressure
- B. Is related to vacuum
- C. Is related to pressure
- D. Feet
- E. None of the Above

62. Pressures are very frequently stated in terms of the height of a fluid. If it is the same fluid whose pressure is being given, it is usually called "head," and the factor connecting the head and the pressure is the weight density  $\rho_g$ . In the English \_\_\_\_\_ system, weight density is in pounds per cubic inch or cubic foot.

- A. Gauge
- B. Vacuum
- C. Pressure
- D. Engineer's
- E. None of the Above

**A little math.**

63. What would the static pressure be on a pressure gauge at the bottom of a 60 foot wide water tower that contained 180 feet of water?

- A. 415
- B. 78
- C. 1501.2
- D. 25.98
- E. None of the Above

64. What would the static pressure be on a pressure gauge at the bottom of a 30 foot wide water tower that contained 180 feet of water?

- A. 415
- B. 78
- C. 1501.2
- D. 25.98
- E. None of the Above

65. What would the static pressure be on a pressure gauge at the bottom of a 300 foot wide water tower that contained 10 feet of water?

- A. 2.31
- B. 23.10
- C. 43
- D. 4.33
- E. None of the above

66. A fire hydrant has a static pressure of 86 PSI, how much Head is stores in the storage tank?

- A. Not enough information.
- B. 37.22
- C. 198.66
- D. 643.28
- E. None of the Above

67. There is 35 feet of water in a storage tank. The tank was recently pressure cleaned and is located at the top of a hill. What should the natural pressure be on the bottom of this cleaned tank?

- A. Not enough information.
- B. Too much information but the answer is 15 PSI
- C. Too much information but the answer is 283 PSI
- D. None of the Above

68. In studying fluids \_\_\_\_\_, we are concerned with the transmission of force and the factors which affect the forces in liquids. Additionally, pressure in and on liquids and factors affecting pressure are of great importance.

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

69. Pressure is the force that pushes water through pipes. Water pressure determines the flow of water from the tap. If \_\_\_\_\_ is not sufficient then the flow can reduce to a trickle and it will take a long time to fill a kettle or a cistern.

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

70. The terms **force** and \_\_\_\_\_ are used extensively in the study of fluid power. It is essential that we distinguish between the terms.

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

71. Force means a total push or \_\_\_\_\_. It is the push or pull exerted against the total area of a particular surface and is expressed in pounds or grams.

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

72. Pressure means the amount of \_\_\_\_\_ or pull (force) applied to each unit area of the surface and is expressed in pounds per square inch (lb/in<sup>2</sup>) or grams per square centimeter (gm/cm<sup>2</sup>).

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

73. Pressure maybe \_\_\_\_\_ in one direction, in several directions, or in all directions.

- A. Force
- B. Pressure
- C. Pull
- D. None of the Above

74. A formula is used in computing force, pressure, and area in fluid power systems. In this formula, P refers to pressure, F indicates force, and A represents area. \_\_\_\_\_ equals pressure times area.

- A. Force
- B. Pressure
- C. Pull
- D. Push
- E. None of the Above

#### **Some History**

75. Although the modern development of hydraulics is comparatively recent, the ancients were familiar with many \_\_\_\_\_ and their applications.

- A. Submerged bodies
- B. Fundamental law
- C. Hydraulic principles
- D. Domestic purposes
- E. None of the Above

76. The Egyptians and the ancient people of Persia, India, and China conveyed water along channels for irrigation and \_\_\_\_\_, using dams and sluice gates to control the flow.

- A. Submerged bodies
- B. Fundamental law
- C. Hydraulic principles
- D. Domestic purposes
- E. None of the Above

77. The ancient Cretans had an elaborate plumbing system. Archimedes studied the laws of floating and \_\_\_\_\_. The Romans constructed aqueducts to carry water to their cities.

- A. Submerged bodies
- B. Fundamental law
- C. Hydraulic principles
- D. Domestic purposes
- E. None of the Above

78. Beginning near the end of the seventeenth century, Italian physicist, Evangelista Torricelle, French physicist, Edme Mariotte, and later, Daniel Bernoulli conducted experiments to study the elements of force in the \_\_\_\_\_ through small openings in the sides of tanks and through short pipes.

- A. Submerged bodies
- B. Fundamental law
- C. Hydraulic principles
- D. Discharge of water
- E. None of the Above

79. Blaise Pascal, a French scientist, discovered the \_\_\_\_\_ for the science of hydraulics.

- A. Submerged bodies
- B. Fundamental law
- C. Hydraulic principles
- D. Domestic purposes
- E. None of the Above

80. \_\_\_\_\_ states that increase in pressure on the surface of a confined fluid is transmitted undiminished throughout the confining vessel or system.

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

81. For \_\_\_\_\_ to be made effective for practical applications, it was necessary to have a piston that "**fit exactly**." It was not until the latter part of the eighteenth century that methods were found to make these snugly fitted parts required in hydraulic systems.

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

82. \_\_\_\_\_ was accomplished by the invention of machines that were used to cut and shape the necessary closely fitted parts and, particularly, by the development of gaskets and packings.

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

83. Since that time, \_\_\_\_\_ such as valves, pumps, actuating cylinders, and motors have been developed and refined to make hydraulics one of the leading methods of transmitting power.

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

84. Evangelista Torricelli (1608-1647), \_\_\_\_\_'s student and secretary,

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

85. \_\_\_\_\_ a member of the Florentine Academy of Experiments, invented the mercury barometer in 1643, and brought the weight of the atmosphere to light.

- A. Pascal's law
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

86. The mercury column was held up by the pressure of the atmosphere, not by horror vacui as \_\_\_\_\_ had supposed.

- A. Aristotle
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

87. Torricelli's early death was a blow to science, but his ideas were furthered by \_\_\_\_\_ (1623-1662).

- A. Pascal
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

88. \_\_\_\_\_ had a barometer carried up the 1465 m high Puy de Dôme, an extinct volcano in the Auvergne just west of his home of Clermont-Ferrand in 1648 by Périer, his brother-in-law. Pascal's experimentum crucis is one of the triumphs of early modern science.

- A. Pascal
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

89. The Puy de Dôme is not the highest peak in the Massif Central--the Puy de Sancy, at 1866 m is, but it was the closest. \_\_\_\_\_ is now the centre of the French pneumatics industry.

- A. Pascal
- B. Evangelista Torricelli
- C. Galileo
- D. Experimentum cruces
- E. None of the Above

90. The remarkable \_\_\_\_\_ (1602-1686), Burgomeister of Magdeburg, Saxony, took up the cause, making the first vacuum pump, which he used in vivid demonstrations of the pressure of the atmosphere to the Imperial Diet at Regensburg in 1654.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

91. Famously, he evacuated a sphere consisting of two well-fitting hemispheres about a foot in diameter, and showed that 16 horses, 8 on each side, could not pull them apart. An original vacuum pump and hemispheres from 1663.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

92. He also showed that air had weight, and how much force it did require to separate evacuated hemispheres.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

93. In England, Robert Hooke (1635-1703) made a vacuum pump for \_\_\_\_\_ (1627-1691). Christian Huygens (1629-1695) became interested in a visit to London in 1661 and had a vacuum pump built for him.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

94. By this time, \_\_\_\_\_ doctrine had triumphed over the Church's support for horror vacui. This was one of the first victories for rational physics over the illusions of experience, and is well worth consideration.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

95. \_\_\_\_\_ demonstrated that the siphon worked by atmospheric pressure, not by horror vacui.

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above Famous Scientists

96. The mm of mercury is sometimes called a torr after Torricelli, and \_\_\_\_\_ also has been honored by a unit of pressure, a newton per square meter or 10 dyne/cm<sup>2</sup>

- A. Pascal
- B. Otto von Guericke
- C. Robert Boyle
- D. Torricelli's
- E. None of the Above

**These questions will come from the Glossary**

97. \_\_\_\_\_ The Law of Conservation of Mass states that mass can be neither created nor destroyed. Using the Mass Conservation Law on a steady flow process - flow where the flow rate don't change over time - through a control volume where the stored mass in the control volume don't change - implements that inflow equals outflow.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. Equation of Continuity
- E. None of the Above

98. \_\_\_\_\_ is a statement of the first law of thermodynamics. The energy equation involves energy, heat transfer and work.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. Equation of Continuity
- E. None of the Above

99. With certain limitations the mechanical energy equation can be compared to the Bernoulli Equation and transferred to the Mechanical Energy Equation in Terms of Energy per Unit Mass.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. Equation of Continuity
- E. None of the Above

100. The \_\_\_\_\_ describes the behavior of gravitational, electric, and fluid potentials.

- A. Conservation laws
- B. Euler Equations
- C. Darcy-Weisbach Equation
- D. Laplace Equations
- E. None of the Above

101. The \_\_\_\_\_ - For a perfect or ideal gas the change in density is directly related to the change in temperature and pressure as expressed in the Ideal Gas Law.

- A. Mechanical Energy Equation
- B. Pressure
- C. Navier-Stokes Equations
- D. Ideal Gas Law
- E. None of the Above

102. The motion of a non-turbulent, Newtonian fluid is governed by the \_\_\_\_\_. The equation can be used to model turbulent flow, where the fluid parameters are interpreted as time-averaged values.

- A. Mechanical Energy Equation
- B. Pressure
- C. Navier-Stokes Equations
- D. Euler Equations
- E. None of the Above

103. \_\_\_\_\_ - A statement of the conservation of energy in a form useful for solving problems involving fluids. For a non-viscous, incompressible fluid in steady flow, the sum of pressure, potential and kinetic energies per unit volume is constant at any point.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. The Bernoulli Equation
- E. None of the Above

104. The \_\_\_\_\_ states that particular measurable properties of an isolated physical system does not change as the system evolves.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. Equation of Continuity
- E. None of the Above

105. \_\_\_\_\_ Pressure Loss and Head Loss due to Friction in Ducts and Tubes - Major loss - head loss or pressure loss - due to friction in pipes and ducts.

- A. Conservation laws
- B. Euler Equations
- C. Darcy-Weisbach Equation
- D. None of the Above

106. In fluid dynamics, the \_\_\_\_\_ govern the motion of a compressible, inviscid fluid. They correspond to the Navier-Stokes equations with zero viscosity, although they are usually written in the form shown here because this emphasizes the fact that they directly represent conservation of mass, momentum, and energy.

- A. Conservation laws
- B. Euler Equations
- C. Equation of Mechanical Energy
- D. Equation of Continuity
- E. None of the Above

107. The \_\_\_\_\_ - The mechanical energy equation in Terms of Energy per Unit Mass, in Terms of Energy per Unit Volume and in Terms of Energy per Unit Weight involves Heads.

- A. Mechanical Energy Equation
- B. Pressure
- C. Navier-Stokes Equations
- D. Euler Equations
- E. None of the Above

108. Static Pressure and Pressure Head in a Fluid - \_\_\_\_\_ and \_\_\_\_\_ head in a static fluid.

- A. Mechanical Energy Equation
- B. Pressure
- C. Navier-Stokes Equations
- D. Euler Equations
- E. None of the Above

109. In fluid dynamics, the \_\_\_\_\_ govern the motion of a compressible, inviscid fluid. They correspond to the Navier-Stokes equations with zero viscosity, although they are usually written in the form shown here because this emphasizes the fact that they directly represent conservation of mass, momentum, and energy.

- A. Mechanical Energy Equation
- B. Pressure
- C. Navier-Stokes Equations
- D. Euler Equations
- E. None of the Above

110. \_\_\_\_\_: If the compression or expansion takes place under constant temperature conditions - the process is called **isothermal**.

- A. Contaminant
- B. Compression and Expansion of Gases
- C. Conservation Laws
- D. Contamination
- E. None of the Above

111. The \_\_\_\_\_ states that particular measurable properties of an isolated physical system does not change as the system evolves: Conservation of energy (including mass). Fluid Mechanics and Conservation of Mass - The law of conservation of mass states that mass can neither be created or destroyed.

- A. Contaminant
- B. Compression and Expansion of Gases
- C. Conservation Laws
- D. Contamination
- E. None of the Above

112. \_\_\_\_\_ Any natural or man-made physical, chemical, biological, or radiological substance or matter in water, which is at a level that may have an adverse effect on public health, and which is known or anticipated to occur in public water systems.

- A. Contaminant
- B. Compression and Expansion of Gases
- C. Conservation Laws
- D. Contamination
- E. None of the Above

113. \_\_\_\_\_ To make something bad. To pollute or infect something. To reduce the quality of the potable (drinking) water and create an actual hazard to the water supply by poisoning or through spread of diseases.

- A. Contaminant
- B. Compression and Expansion of Gases
- C. Conservation Laws
- D. Contamination
- E. None of the Above

114. The Bernoulli's Equation describes the behavior of \_\_\_\_\_ along a streamline.

- A. Energy principle
- B. Counterintuitive
- C. Moving fluids
- D. Qualitative behavior
- E. None of the Above

115. The Bernoulli Equation can be considered to be a statement of the conservation of \_\_\_\_\_ appropriate for flowing fluids.

- A. Energy principle
- B. Counterintuitive
- C. Moving fluids
- D. Qualitative behavior
- E. None of the Above

116. The \_\_\_\_\_ that is usually labeled with the term "**Bernoulli effect**" is the lowering of fluid pressure in regions where the flow velocity is increased.

- A. Energy principle
- B. Counterintuitive
- C. Moving fluids
- D. Qualitative behavior
- E. None of the Above

117. This lowering of pressure in a constriction of a flow path may seem \_\_\_\_\_, but seems less so when you consider pressure to be energy density. In the high velocity flow through the constriction, kinetic energy must increase at the expense of pressure energy.

- A. Energy principle
- B. Counterintuitive
- C. Moving fluids
- D. Qualitative behavior
- E. None of the Above

118. Bingham Plastic Fluids have a yield value which must be exceeded before it will start to flow like a fluid. From that point the \_\_\_\_\_ with increase of agitation. Toothpaste, mayonnaise and tomato catsup are examples of such products.

- A. Energy principle
- B. Counterintuitive
- C. Moving fluids
- D. Viscosity will decrease
- E. None of the Above

119. The boundary layer is the layer of fluid in the immediate vicinity of a \_\_\_\_\_.

- A. Velocity
- B. Bounding surface
- C. Significant factor
- D. Capillary action
- E. None of the Above

120. **Bulk Modulus and Fluid Elasticity:** An introduction to and a definition of the Bulk Modulus Elasticity commonly used to characterize the \_\_\_\_\_

- A. Velocity
- B. Convex surface
- C. Significant factor
- D. Compressibility of fluids
- E. None of the Above

121. **Capillarity:** Capillarity or \_\_\_\_\_ is the ability of a narrow tube to draw a liquid upwards against the force of gravity.

- A. Velocity
- B. Convex surface
- C. Significant factor
- D. Capillary action
- E. None of the Above

122. **Cauchy Number:** The Cauchy Number is a dimensionless value useful for analyzing fluid flow dynamics problems where compressibility is a \_\_\_\_\_.

- A. Velocity
- B. Convex surface
- C. Significant factor
- D. Capillary action
- E. None of the Above

123. **Chezy Formula:** Conduits flow and mean \_\_\_\_\_.

- A. Velocity
- B. Convex surface
- C. Significant factor
- D. Capillary action
- E. None of the Above

124. The Coanda Effect is the tendency of a stream of fluid to stay attached to a \_\_\_\_\_, rather than follow a straight line in its original direction.

- A. Velocity
- B. Convex surface
- C. Significant factor
- D. Capillary action
- E. None of the Above

125. Under the wrong condition, \_\_\_\_\_ will reduce the components life time dramatically.

- A. Suction
- B. Cavities
- C. Collapse
- D. Cavitation
- E. None of the Above

126. \_\_\_\_\_ may occur when the local static pressure in a fluid reach a level below the vapor pressure of the liquid at the actual temperature.

- A. Suction
- B. Cavities
- C. Collapse
- D. Cavitation
- E. None of the Above

127. According to the Bernoulli Equation this may happen when the \_\_\_\_\_ in a control valve or around a pump impeller.

- A. Suction
- B. Cavities
- C. Collapse
- D. Fluid accelerates
- E. None of the Above

128. The vaporization itself does not cause the damage - the damage happens when the vapor almost immediately \_\_\_\_\_ after evaporation when the velocity is decreased and pressure increased.

- A. Suction
- B. Cavities
- C. Collapse
- D. Fluid accelerates
- E. None of the Above

129. Cavitation means that \_\_\_\_\_ are forming in the liquid that we are pumping.

- A. Suction
- B. Cavities
- C. Collapse
- D. Fluid accelerates
- E. None of the Above

130. When these cavities form at the suction of the pump several things happen all at once: We experience a loss in capacity. We can no longer build the same head (pressure). The efficiency drops. The cavities or bubbles will \_\_\_\_\_ when they pass into the higher regions of pressure causing noise, vibration, and damage to many of the components.

- A. Suction
- B. Cavities
- C. Collapse
- D. Fluid accelerates
- E. None of the Above

131. The \_\_\_\_\_ form for five basic reasons and it is common practice to lump all of them into the general classification of cavitation.

- A. Suction
- B. Cavities
- C. Collapse
- D. Fluid accelerates
- E. None of the Above

132. **Colebrook Equation:** The \_\_\_\_\_ used to calculate pressure loss (or major loss) in ducts, tubes and pipes can be calculated with the Colebrook equation.

- A. Physical separation
- B. Undergo significant
- C. Friction coefficients
- D. Usually expressed
- E. None of Above

133. **Compressible Flow:** We know that fluids are classified as Incompressible and Compressible fluids. Incompressible fluids do not undergo significant changes in density as they flow. In general, liquids are incompressible; water being an excellent example. In contrast compressible fluids do undergo \_\_\_\_\_.

- A. Physical separation
- B. Undergo significant
- C. Friction coefficients
- D. Usually expressed
- E. None of Above

134. **Air Break:** An air break is a \_\_\_\_\_ which may be a low inlet into the indirect waste receptor from the fixture, or device that is indirectly connected. You will most likely find an air break on waste fixtures or on non-potable lines. You should never allow an air break on an ice machine.

- A. Physical separation
- B. Space
- C. Potential
- D. None of the Above

135. **Air Gap Separation:** A \_\_\_\_\_ space that is present between the discharge vessel and the receiving vessel, for an example, a kitchen faucet.

- A. Physical separation
- B. Undergo significant
- C. Friction coefficients
- D. Usually expressed
- E. None of Above

136. **Absolute Pressure:** The pressure above zone absolute, i.e. the sum of atmospheric and gage pressure. In vacuum related work it is \_\_\_\_\_ in millimeters of mercury. (mmHg).

- A. Physical separation
- B. Undergo significant
- C. Friction coefficients
- D. Usually expressed
- E. None of Above

137. **Aerodynamics:** Aerodynamics is the study of the flow of gases. The Ideal Gas Law - For a perfect or ideal gas the \_\_\_\_\_ is directly related to the change in temperature and pressure as expressed in the Ideal Gas Law.

- A. Physical separation
- B. Undergo significant
- C. Friction coefficients
- D. Usually expressed
- E. None of Above

138. **Atmospheric Pressure:** Pressure exerted by the atmosphere at any \_\_\_\_\_. (Sea level pressure is approximately 14.7 pounds per square inch absolute, 1 bar = 14.5psi.)

- A. Undesirable effect
- B. Specific location
- C. Stop or prevent
- D. Destructive manner
- E. None of Above

139. **Backflow Prevention:** To \_\_\_\_\_ the occurrence of, the unnatural act of reversing the normal direction of the flow of liquid, gases, or solid substances back in to the public potable (drinking) water supply. See Cross-connection control.

- A. Undesirable effect
- B. Specific location
- C. Stop or prevent
- D. Destructive manner
- E. None of the Above

140. **Backflow:** To reverse the natural and normal directional flow of a liquid, gases, or solid substances back in to the public potable (drinking) water supply. This is normally an \_\_\_\_\_.

- A. Undesirable effect
- B. Specific location
- C. Stop or prevent
- D. Destructive manner
- E. None of Above

141. **Backsiphonage:** A liquid substance that is carried over a higher point. It is the method by which the \_\_\_\_\_ may be forced by excess pressure over or into a higher point.

- A. Undesirable effect
- B. Specific location
- C. Stop or prevent
- D. Destructive manner
- E. None of Above

142. **Cross-Contamination:** The \_\_\_\_\_ of two unlike qualities of water. For example the mixing of good water with a polluting substance like a chemical substance.

- A. Undesirable effect
- B. Specific location
- C. Stop or prevent
- D. Destructive manner
- E. None of Above

143. **Density:** Is a \_\_\_\_\_ of matter, as each element and compound has a unique density associated with it.

- A. Inhibit growth
- B. Physical property
- C. With agitation
- D. Treatment
- E. None of the Above

144. Density defined in a \_\_\_\_\_ as the measure of the relative "heaviness" of objects with a constant volume.

- A. Inhibit growth
- B. Physical property
- C. Qualitative manner
- D. None of the Above

145. **Dilatant Fluids:** Shear Thickening Fluids or Dilatant Fluids increase their viscosity with agitation. Some of these liquids can become almost solid within a pump or pipe line.

\_\_\_\_\_, cream becomes butter and Candy compounds, clay slurries and similar heavily filled liquids do the same thing.

- A. Inhibit growth
- B. Physical property
- C. With agitation
- D. Treatment
- E. None of the Above

146. **Disinfect:** To kill and \_\_\_\_\_ of harmful bacterial and viruses in drinking water.

- A. Inhibit growth
- B. Physical property
- C. With agitation
- D. Treatment
- E. None of the Above

147. **Disinfection:** The \_\_\_\_\_ of water to inactivate, destroy, and/or remove pathogenic bacteria, viruses, protozoa, and other parasites.

- A. Inhibit growth
- B. Physical property
- C. With agitation
- D. Treatment
- E. None of the Above

148. **Drag Coefficient:** The drag coefficient is used to express the drag of an object in moving fluid. Any \_\_\_\_\_ through a fluid will experience a drag - the net force in direction of flow due to the pressure and shear stress forces on the surface of the object.

- A. Inhibit growth
- B. Physical property
- C. With agitation
- D. Object moving
- E. None of the Above

149. **Dynamic, Absolute and Kinematic Viscosity:** The viscosity of a fluid is an important property in the analysis of liquid behavior and fluid motion near solid boundaries. The viscosity is the fluid resistance to shear or flow and is a measure of the \_\_\_\_\_ or frictional fluid property. The resistance is caused by intermolecular friction exerted when layers of fluids attempts to slide by an other.

- A. Fluids kinetic energy
- B. Adhesive/cohesive
- C. Horizontal plane
- D. Resistance to shear
- E. None of the Above

150. **Dynamic (absolute) Viscosity:** is the tangential force per unit area required to move one \_\_\_\_\_ with respect to the other at unit velocity when maintained a unit distance apart by the fluid.

- A. Fluids kinetic energy
- B. Adhesive/cohesive
- C. Horizontal plane
- D. Resistance to shear
- E. None of the Above

151. **Dynamic or Absolute Viscosity:** The viscosity of a fluid is an important property in the analysis of liquid behavior and fluid motion near solid boundaries. The viscosity of a fluid is its resistance to shear or flow and is a measure of the \_\_\_\_\_ or frictional properties of a fluid. The resistance is caused by intermolecular friction exerted when layers of fluids attempts to slide by an other.

- A. Fluids kinetic energy
- B. Adhesive/cohesive
- C. Horizontal plane
- D. Resistance to shear
- E. None of the Above

152. **Dynamic Pressure:** Dynamic pressure is the component of fluid pressure that represents a \_\_\_\_\_.

- A. Fluids kinetic energy
- B. Adhesive/cohesive
- C. Horizontal plane
- D. Resistance to shear
- E. None of the Above

153. **Elevation Head:** The \_\_\_\_\_ per unit weight of a fluid because of its elevation. 1 foot of water will produce .433 pounds of pressure head.

- A. Ability to do work
- B. Hydraulic grade
- C. Velocity profile
- D. Energy possessed
- E. None of the Above

154. **Energy:** The \_\_\_\_\_. Energy can exist in one of several forms, such as heat, light, mechanical, electrical, or chemical. Energy can be transferred to different forms. It also can exist in one of two states, either potential or kinetic.

- A. Ability to do work
- B. Hydraulic grade
- C. Velocity profile
- D. None of the Above

155. **Energy and Hydraulic Grade Line:** The \_\_\_\_\_ and the energy line are graphical forms of the Bernoulli equation. For steady, in viscid, incompressible flow the total energy remains constant along a stream line as expressed through the Bernoulli

- A. Ability to do work
- B. Hydraulic grade
- C. Velocity profile
- D. Energy possessed
- E. None of the Above

156. **Entrance Length and Developed Flow:** Fluid need some length to \_\_\_\_\_ profile after entering the pipe or after passing through components as bend, valves, pumps, turbines or similar.

- A. Ability to do work
- B. Hydraulic grade
- C. Velocity profile
- D. Energy possessed
- E. None of the Above

157. A fluid is defined as a substance that continually deforms (flows) under an applied shear \_\_\_\_\_ regardless of the magnitude of the applied stress.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

158. It is a subset of the phases of matter and includes \_\_\_\_\_, gases, plasmas and, to some extent, plastic solids.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

159. Fluids are also divided into liquids and gases. Liquids form a free surface (that is, a surface not created by their container) while \_\_\_\_\_ do not.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

160. The distinction between solids and fluids is not so obvious. The distinction is made by evaluating the \_\_\_\_\_ of the matter: for example silly putty can be considered either a solid or a fluid, depending on the time period over which it is observed.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. None of the Above

161. \_\_\_\_\_ share the properties of not resisting deformation and the ability to flow (also described as their ability to take on the shape of their containers).

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

162. These properties are typically a function of their inability to support a shear \_\_\_\_\_ in static equilibrium.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

163. While in a solid, \_\_\_\_\_ is a function of strain, in a fluid, stress is a function of rate of strain.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

164. A consequence of this behavior is Pascal's law which entails the important role of pressure in characterizing a fluid's state. Based on how the \_\_\_\_\_ depends on the rate of strain and its derivatives, fluids can be characterized as: Newtonian fluids are where stress is directly proportional to rate of strain.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

165. Non-Newtonian fluids are where \_\_\_\_\_ is proportional to rate of strain, its higher powers and derivatives (basically everything other than Newtonian fluid).

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

166. The behavior of fluids can be described by a set of partial differential equations, which are based on the \_\_\_\_\_ of mass, linear and angular momentum (Navier-Stokes equations) and energy. The study of fluids is fluid mechanics, which is subdivided into fluid dynamics and fluid statics depending on whether the fluid is in motion or not.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. None of the Above

167. A gas is one of the four major phases of matter (after solid and liquid, and followed by plasma that subsequently appear as a solid material is subjected to increasingly higher \_\_\_\_\_).

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

168. As energy in the form of heat is added, a solid (e.g., ice) will first melt to become a liquid (e.g., water), which will then boil or evaporate to become a gas (e.g., water vapor). In some circumstances, a solid (e.g., "dry ice") can directly turn into a gas: this is called \_\_\_\_\_.

- A. Stress
- B. Pressure
- C. Static equilibrium
- D. Temperatures
- E. None of the Above

169. **Gauge Pressure:** Pressure differential above or below ambient \_\_\_\_\_ pressure.

- A. Atmosphere
- B. Atmospheric
- C. Head
- D. Pressure
- E. None of the Above

170. **Hazardous Atmosphere:** An \_\_\_\_\_ which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

- A. Atmosphere
- B. Atmospheric
- C. Head
- D. Pressure
- E. None of the Above

171. **Hazen-Williams Factor:** Hazen-Williams factor for some common piping materials. Hazen-Williams coefficients are used in the \_\_\_\_\_ for friction loss calculation in ducts and pipes.

- A. Atmosphere
- B. Atmospheric
- C. Head
- D. Pressure
- E. None of the Above

172. **Head:** The height of a column or body of fluid above a given point expressed in linear units. \_\_\_\_\_ if often used to indicate gauge pressure.

- A. Atmosphere
- B. Atmospheric
- C. Head
- D. Pressure
- E. None of the Above

173. \_\_\_\_\_ is equal to the height times the density of the liquid. The measure of the pressure of water expressed in feet of height of water. 1 psi = 2.31 feet of water. There are various types of heads of water depending upon what is being measured. Static (water at rest) and Residual (water at flow conditions).

- A. Atmosphere
- B. Atmospheric
- C. Head
- D. Pressure
- E. None of the Above

174. \_\_\_\_\_ is a branch of science and engineering concerned with the use of liquids to perform mechanical tasks.

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Kinematic Viscosity
- E. None of the Above

175. \_\_\_\_\_ is the fluid dynamics applied to liquids, such as water, alcohol, and oil.

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Hydrodynamics
- E. None of the Above

176. \_\_\_\_\_: Is the ratio of absolute or dynamic viscosity to density.

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Kinematic Viscosity
- E. None of the Above

177. \_\_\_\_\_ The ability of an object to do work by virtue of its motion. The energy terms that are used to describe the operation of a pump are pressure and head.

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Kinematic Viscosity
- E. None of the Above

178. \_\_\_\_\_ Used by modelers who wish to non dimensionless speed

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Kinematic Viscosity
- E. None of the Above

179. \_\_\_\_\_ : The resistance to flow in a liquid can be characterized in terms of the viscosity of the fluid if the flow is smooth. In the case of a moving plate in a liquid, it is found that there is a layer or lamina which moves with the plate and a layer which is essentially stationary if it is next to a stationary plate.

- A. Knudsen Number
- B. Hydraulics
- C. Laminar Flow
- D. Kinematic Viscosity
- E. None of the Above

180. Pascal's Law: A pressure applied to a confined fluid at rest is transmitted with \_\_\_\_\_ throughout the fluid.

- A. Gradually fills
- B. Incompressible and viscosity
- C. Equal intensity
- D. Turbulent flow
- E. None of the Above

181. **Navier-Stokes Equations:** The motion of a non-turbulent, Newtonian fluid is governed by the Navier-Stokes equation. The equation can be used to model \_\_\_\_\_, where the fluid parameters are interpreted as time-averaged values.

- A. Gradually fills
- B. Incompressible and viscosity
- C. Equal intensity
- D. Turbulent flow
- E. None of the Above

182. **Newtonian Fluid:** Newtonian fluid (named for Isaac Newton) is a fluid that flows like water—its \_\_\_\_\_ is linearly proportional to the velocity gradient in the direction perpendicular to the plane of shear.

- A. Gradually fills
- B. Incompressible and viscosity
- C. Equal intensity
- D. Shear stress
- E. None of the Above

183. The constant of proportionality is known as the viscosity. \_\_\_\_\_, because it continues to exemplify fluid properties no matter how fast it is stirred or mixed.

- A. Water is Newtonian
- B. Incompressible and viscosity
- C. Equal intensity
- D. Turbulent flow
- E. None of the Above

184. Contrast this with a non-Newtonian fluid, in which stirring can leave a "hole" behind (that \_\_\_\_\_ up over time - this behavior is seen in materials such as pudding, or to a less rigorous extent, sand), or cause the fluid to become thinner, the drop in viscosity causing it to flow more (this is seen in non-drip paints).

- A. Gradually fills
- B. Incompressible and viscosity
- C. Equal intensity
- D. None of the Above

185. For a Newtonian fluid, the viscosity, by definition, depends only on temperature and pressure (and also the chemical composition of the fluid if the fluid is not a pure substance), not on the forces acting upon it. If the fluid is \_\_\_\_\_ is constant across the fluid, the equation governing the shear stress.

- A. Gradually fills
- B. Incompressible and viscosity
- C. Equal intensity
- D. Turbulent flow
- E. None of the Above

186. \_\_\_\_\_ describes the forces acting on objects interacting with each other.

- A. Isentropic
- B. Ideal Gas Law
- C. Non-Newtonian fluid
- D. Newton's Third Law
- E. None of the Above

187. \_\_\_\_\_ can be expressed as "If one object exerts a force  $\mathbf{F}$  on an other object, then the second object exerts an equal but opposite force  $\mathbf{F}$  on the first object"

- A. Isentropic
- B. Ideal Gas Law
- C. Non-Newtonian fluid
- D. Newton's Third Law
- E. None of the Above

188. Force is a convenient abstraction to represent mentally the pushing and pulling interaction between objects.

- A. Isentropic
- B. Ideal Gas Law
- C. Non-Newtonian fluid
- D. Newton's Third Law
- E. None of the Above

189. It is common to express forces as vectors with magnitude, direction and point of application. The net effect of two or more forces acting on the same point is the vector sum of the forces.

- A. Isentropic
- B. Ideal Gas Law
- C. Newton's Third Law
- D. None of the Above

190. \_\_\_\_\_ viscosity changes with the applied shear force.
- A. Isentropic
  - B. Ideal Gas Law
  - C. Non-Newtonian fluid
  - D. Newton's Third Law
  - E. None of the Above
191. \_\_\_\_\_ For a perfect or ideal gas the change in density is directly related to the change in temperature and pressure as expressed in the Ideal Gas Law.
- A. Isentropic
  - B. Ideal Gas Law
  - C. Non-Newtonian fluid
  - D. Newton's Third Law
  - E. None of the Above
192. \_\_\_\_\_ Describes the behavior of gravitational, electric, and fluid potentials.
- A. Isentropic
  - B. Laplace's Equation
  - C. Non-Newtonian fluid
  - D. Newton's Third Law
  - E. None of the Above
193. \_\_\_\_\_ consists of the sum of all the aerodynamic forces normal to the direction of the external airflow.
- A. Isentropic
  - B. Ideal Gas Law
  - C. Non-Newtonian fluid
  - D. Lift
  - E. None of the Above
194. Liquids are an in-between state of \_\_\_\_\_.
- A. Compress
  - B. Matter
  - C. Gas
  - D. Liquids
  - E. None of the Above
195. Liquids can be found in between the solid and \_\_\_\_\_ states.
- A. Compress
  - B. Matter
  - C. Gas
  - D. Liquids
  - E. None of the Above
196. \_\_\_\_\_ don't have to be made up of the same compounds. If you have a variety of materials in a liquid, it is called a solution.
- A. Compress
  - B. Matter
  - C. Gas
  - D. Liquids
  - E. None of the Above

197. Another trait of \_\_\_\_\_ is that they are difficult to compress.
- A. Compress
  - B. Matter
  - C. Gas
  - D. Liquids
  - E. None of the Above
198. When you compress something, you take a certain amount and force it into a smaller space. \_\_\_\_\_ are very difficult to compress and gases are very easy.
- A. Compress
  - B. Matter
  - C. Gas
  - D. Solids
  - E. None of the Above
199. Liquids are in the middle but tend to be difficult. When you compress something, you force the atoms closer together. When \_\_\_\_\_ go up, substances are compressed.
- A. Bounce
  - B. Molecules
  - C. Evaporation
  - D. Shock absorbers
  - E. None of the Above
200. Liquids already have their atoms close together, so they are hard to compress. Many \_\_\_\_\_ in cars compress liquids in tubes.
- A. Bounce
  - B. Molecules
  - C. Evaporation
  - D. Shock absorbers
  - E. None of the Above
201. A special force keeps \_\_\_\_\_. Solids are stuck together and you have to force them apart.
- A. Bounce
  - B. Molecules
  - C. Evaporation
  - D. Shock absorbers
  - E. None of the Above
202. Gases \_\_\_\_\_ everywhere and they try to spread themselves out.
- A. Bounce
  - B. Molecules
  - C. Evaporation
  - D. Shock absorbers
  - E. None of the Above
203. Liquids actually want to stick together. There will always be the occasional evaporation where extra energy gets a \_\_\_\_\_ excited and the molecule leaves the system.
- A. Bounce
  - B. Molecule
  - C. Evaporation
  - D. Shock absorbers
  - E. None of the Above

204. Overall, liquids have cohesive (sticky) forces at work that hold the \_\_\_\_\_ together.

- A. Bounce
- B. Molecules
- C. Evaporation
- D. Shock absorbers
- E. None of the Above

205. **Isentropic Compression/Expansion Process:** If the compression or expansion takes place under constant volume conditions - the process is called \_\_\_\_\_.

- A. Isentropic
- B. Ideal Gas Law
- C. Non-Newtonian fluid
- D. Newton's Third Law
- E. None of the Above

206. **Manning Formula for Gravity Flow:** Manning's equation can be used to calculate cross-sectional \_\_\_\_\_ in open channels.

- A. Average velocity flow
- B. State enabling
- C. Virtue of its position
- D. Control leakage
- E. None of the Above

207. **Mechanical Seal:** A mechanical device used to \_\_\_\_\_ from the stuffing box of a pump. Usually made of two flat surfaces, one of which rotates on the shaft. The two flat surfaces are of such tolerances as to prevent the passage of water between them.

- A. Average velocity flow
- B. State enabling
- C. Virtue of its position
- D. Control leakage
- E. None of the Above

208. **Potential Energy:** The energy that a body has by virtue of its position or \_\_\_\_\_ it to do work.

- A. Average velocity flow
- B. State enabling
- C. Virtue of its position
- D. Control leakage
- E. None of the Above

209. **Static Head:** The height of a column or body of \_\_\_\_\_ above a given point

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

210. **Static Pressure:** The \_\_\_\_\_ in a fluid at rest.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

211. **Static Pressure and Pressure Head in Fluids:** The pressure indicates the normal force per unit area at a given point acting on a given plane. Since there is no shearing stresses present in a fluid at rest - the \_\_\_\_\_ in a fluid is independent of direction.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

212. For fluids - liquids or gases - at rest the pressure gradient in the vertical direction depends only on the \_\_\_\_\_ of the fluid.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Specific weight
- E. None of the Above

213. The atmospheric pressure is the pressure in the surrounding air. It varies with \_\_\_\_\_ and altitude above sea level.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

214. **Pressure Head:** The height to which \_\_\_\_\_ can be raised by a given pressure.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

215. **Pressure Units:** Since 1 Pa is a small \_\_\_\_\_ unit, the unit hectopascal (hPa) is widely used, especially in meteorology. The unit kilopascal (kPa) is commonly used designing technical applications like HVAC systems, piping systems and similar.

- A. Temperature
- B. Liquid
- C. Pressure
- D. Fluid
- E. None of the Above

216. **Reynolds Number:** The Reynolds number is used for determine whether a flow is laminar or turbulent. The Reynolds Number is a \_\_\_\_\_ defined by the ratio of dynamic pressure ( $\rho u^2$ ) and shearing stress ( $\mu u / L$ ).

- A. Kinetic energy
- B. Weight
- C. Temperature
- D. Nondimensional parameter
- E. None of the Above

217. **Richardson Number:** A dimensionless number that expresses the ratio of potential to \_\_\_\_\_.

- A. Kinetic energy
- B. Weight
- C. Temperature
- D. None of the Above

218. **Specific Gravity:** The Specific Gravity - SG - is a dimensionless unit defined as the ratio of density of the material to the density of water at a specified \_\_\_\_\_.

- A. Kinetic energy
- B. Weight
- C. Temperature
- D. Nondimensional parameter
- E. None of the Above

219. **Specific Weight:** Specific Weight is defined as weight per unit volume. \_\_\_\_\_ is a force.

- A. Kinetic energy
- B. Weight
- C. Temperature
- D. Nondimensional parameter
- E. None of the Above

220. **Strouhal Number:** The Strouhal number is a quantity describing oscillating flow mechanisms. The Strouhal Number is a dimensionless value useful for analyzing oscillating, unsteady \_\_\_\_\_ problems.

- A. Kinetic energy
- B. Weight
- C. Temperature
- D. Fluid flow dynamics
- E. None of the Above

221. **Stuffing Box:** That portion of the pump which houses the packing or \_\_\_\_\_.

- A. Mechanical seal
- B. Volute
- C. Ball
- D. Supersonic
- E. None of the Above

222. **Valve:** A device that opens and closes to regulate the flow of liquids. Faucets, hose bibs, and \_\_\_\_\_ are examples of valves.

- A. Mechanical seal
- B. Volute
- C. Ball
- D. Supersonic
- E. None of the Above

223. **Vane:** That portion of an impeller which throws the water toward the \_\_\_\_\_.

- A. Mechanical seal
- B. Volute
- C. Ball
- D. Supersonic
- E. None of the Above

224. **Supersonic Flow:** Flow with speed above the speed of sound, 1,225 km/h at sea level, is said to be \_\_\_\_\_.

- A. Mechanical seal
- B. Volute
- C. Ball
- D. Supersonic
- E. None of the Above

225. Surface tension is a force within the surface layer of a liquid that causes the layer to behave as an \_\_\_\_\_.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. All of the Above
- E. None of the Above

226. The cohesive forces between liquid molecules are responsible for the phenomenon known as \_\_\_\_\_.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. All of the Above
- E. None of the Above

227. The molecules at the surface do not have other like molecules on all sides of them and consequently they cohere more strongly to those directly associated with them on the \_\_\_\_\_.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. None of the Above

228. This forms a surface "film" which makes it more difficult to move an object through the \_\_\_\_\_ than to move it when it is completely submersed.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. None of the Above

229. Surface tension is typically measured in dynes/cm, the force in dynes required to break a film of length 1 cm. Equivalently, it can be stated as surface energy in \_\_\_\_\_ per square centimeter.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. All of the Above
- E. None of the Above

230. Water at 20°C has a \_\_\_\_\_ of 72.8 dynes/cm compared to 22.3 for ethyl alcohol and 465 for mercury.

- A. Surface tension
- B. Elastic sheet
- C. Surface
- D. All of the Above

231. **Transonic:** Flow with \_\_\_\_\_ just below and above the speed of sound is said to be transonic.

- A. Viscosity as agitation
- B. Used to measure
- C. Speed at velocities
- D. Measure of the cloudiness
- E. None of the Above

232. **Turbidity:** A \_\_\_\_\_ of water caused by suspended particles.
- Viscosity as agitation
  - Used to measure
  - Speed at velocities
  - Measure of the cloudiness
  - None of the Above
233. **U-Tube Manometer:** Pressure measuring devices \_\_\_\_\_ in vertical or inclined tubes are called manometers.
- Viscosity as agitation
  - Used to measure
  - Speed at velocities
  - Using liquid columns
  - None of the Above
234. One of the most common is the water filled u-tube manometer \_\_\_\_\_ pressure difference in pitot or orifices located in the airflow in air handling or ventilation system.
- Viscosity as agitation
  - Used to measure
  - Speed at velocities
  - Measure of the cloudiness
  - None of the Above
235. Vorticity is defined as the \_\_\_\_\_ per unit area at a point in the flow field.
- Viscosity
  - Velocity Head
  - Vorticity
  - Vapor Pressure
  - None of the Above
236. \_\_\_\_\_ For a particular substance at any given temperature there is a pressure at which the vapor of that substance is in equilibrium with its liquid or solid forms.
- Viscosity
  - Velocity Head
  - Vorticity
  - Vapor Pressure
  - None of the Above
237. \_\_\_\_\_ The vertical distance a liquid must fall to acquire the velocity with which it flows through the piping system.
- Viscosity
  - Velocity Head
  - Vorticity
  - Vapor Pressure
  - None of the Above
238. \_\_\_\_\_ For a given quantity of flow, the velocity head will vary indirectly as the pipe diameter varies.
- Viscosity
  - Velocity Head
  - Vorticity
  - Vapor Pressure
  - None of the Above

239. Informally, \_\_\_\_\_ is the quantity that describes a fluid's resistance to flow.
- A. Viscosity
  - B. Velocity Head
  - C. Vorticity
  - D. Vapor Pressure
  - E. None of the Above
240. Fluids resist the relative motion of immersed objects through them as well as to the motion of layers with differing \_\_\_\_\_ within them.
- A. Viscosity
  - B. Velocity Head
  - C. Vorticity
  - D. Velocities
  - E. None of the Above
241. Hydraulics is applied commonly to the study of the mechanical properties of water, other liquids, and even gases when the effects of \_\_\_\_\_ are small.
- A. Hydrokinetics
  - B. Hydrostatics
  - C. Hydraulics
  - D. Compressibility
  - E. None of the Above

### **Pump Section**

Here are the important points to consider about suction piping when the liquid being pumped is below the level of the pump:

242. First, suction lift is when the level of water to be pumped is below the centerline of the pump. Sometimes suction lift is also referred to as '\_\_\_\_\_'.
- A. Partial vacuum
  - B. Hydrostatic or positive
  - C. Quasi-static
  - D. Negative suction head
  - E. None of the Above
243. The ability of the pump to lift water is the result of a \_\_\_\_\_ created at the center of the pump.
- A. Partial vacuum
  - B. Hydrostatic or positive
  - C. Quasi-static
  - D. Negative suction head
  - E. None of the Above
244. The foot valve is located at the end of the suction pipe of a pump. It opens to allow water to enter the \_\_\_\_\_ side, but closes to prevent water from passing back out of the bottom end.
- A. Partial vacuum
  - B. Suction
  - C. Quasi-static
  - D. Negative suction head
  - E. None of the Above

245. The \_\_\_\_\_ side of pipe should be one diameter larger than the pump inlet. The required eccentric reducer should be turned so that the top is flat and the bottom tapered.

- A. Partial vacuum
- B. Hydrostatic or positive
- C. Suction
- D. Negative suction head
- E. None of the Above

Points to Note are:

246. If an elbow and bell are used, they should be at least one pipe diameter from the tank bottom and side. This type of suction piping must have a gate valve which can be used to prevent the reverse flow when the pump has to be removed. The \_\_\_\_\_ is the difference between the two liquid levels.

- A. Partial vacuum
- B. Hydrostatic or positive
- C. Total head
- D. Negative suction head
- E. None of the Above

Pumps

247. Pumps are used to move or raise fluids. They are not only very useful, but are excellent examples of \_\_\_\_\_.

- A. Partial vacuum
- B. Hydrostatics
- C. Quasi-static
- D. Negative suction head
- E. None of the Above

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

- A. Dynamic forces
- B. Hydrostatic or positive
- C. Total head
- D. Negative suction head
- E. None of the Above

249. Positive displacement pumps, which can be understood purely by \_\_\_\_\_ considerations. They have a piston (or equivalent) moving in a closely-fitting cylinder and forces are exerted on the fluid by motion of the piston.

- A. Partial vacuum
- B. Hydrostatic
- C. Total head
- D. Negative suction head
- E. None of the Above

250. We have already seen an important example of this in the hydraulic lever or hydraulic press, which we have called \_\_\_\_\_. The simplest pump is the syringe, filled by withdrawing the piston and emptied by pressing it back in, as its port is immersed in the fluid or removed from it.

- A. Quasi-static
- B. Hydrostatic or positive
- C. Total head
- D. Negative suction head
- E. None of the Above

251. 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 \_\_\_\_\_.

- A. Partial vacuum
- B. Trouble-prone
- C. Reverse flow
- D. None of the Above

252. There are many kinds of valves, and they are usually the most \_\_\_\_\_ and complicated part of a pump.

- A. Partial vacuum
- B. Trouble-prone
- C. Reverse flow
- D. Negative suction head
- E. None of the Above

253. The quasi-static pump has two check valves in the cylinder, one for supply and the other for delivery.

- A. Partial vacuum
- B. Trouble-prone
- C. Force
- D. Negative suction head
- E. None of the Above

254. The supply valve opens when the cylinder volume \_\_\_\_\_, the delivery valve when the cylinder volume decreases.

- A. Partial vacuum
- B. Hydrostatic
- C. Increases
- D. Negative suction head
- E. None of the Above

255. \_\_\_\_\_ 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 piston does not enter.

- A. Partial vacuum
- B. Reduced
- C. The lift pump
- D. Negative suction head
- E. None of the Above

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

- A. The discharged fluid
- B. The diaphragm
- C. The Roots blower
- D. The Bicycle pump
- E. None of the Above

257. Some positive displacement pumps are shown below. The force and lift pumps are typically used for water. \_\_\_\_\_ has two valves in the cylinder, while the lift pump has one valve in the cylinder and one in the piston.

- A. The discharged fluid
- B. The force pump
- C. The Roots blower
- D. The Bicycle pump
- E. None of the Above

258. \_\_\_\_\_, or "suction," is determined by the atmospheric pressure, and either cylinder must be within this height of the free surface.

- A. The discharged fluid
- B. The maximum lift
- C. The Roots blower
- D. The Bicycle pump
- E. None of the Above

259. \_\_\_\_\_, can give an arbitrarily large pressure to the discharged fluid, as in the case of a diesel engine injector. A nozzle can be used to convert the pressure to velocity, to produce a jet, as for firefighting.

- A. The discharged fluid
- B. The maximum lift
- C. The Roots blower
- D. The Force pump
- E. None of the Above

260. Fire fighting force pumps usually have two cylinders feeding one receiver alternately. \_\_\_\_\_ in the receiver helps to make the water pressure uniform.

- A. The discharged fluid
- B. The maximum lift
- C. The Roots blower
- D. The air space
- E. None of the Above

261. \_\_\_\_\_ has no valves, their place taken by the sliding contact between the rotors and the housing. The Roots blower can either exhaust a receiver or provide air under moderate pressure, in large volumes.

- A. The discharged fluid
- B. The maximum lift
- C. The Roots blower
- D. The Bicycle pump
- E. None of the Above

262. \_\_\_\_\_ is a very old device, requiring no accurate machining. The single valve is in one or both sides of the expandable chamber. Another valve can be placed at the nozzle if required. The valve can be a piece of soft leather held close to holes in the chamber.

- A. The discharged fluid
- B. The maximum lift
- C. The Bellows
- D. The Bicycle pump
- E. None of the Above

263. \_\_\_\_\_ uses the valve on the valve stem of the tire or inner tube to hold pressure in the tire. The piston, which is attached to the discharge tube, has a flexible seal that seals when the cylinder is moved to compress the air, but allows air to pass when the movement is reversed.
- A. The discharged fluid
  - B. The maximum lift
  - C. The Roots blower
  - D. The Bicycle pump
  - E. None of the Above

**Types of Pumps** 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.

Centrifugal pumps are classified into three general categories:

264. \_\_\_\_\_—a centrifugal pump in which the pressure is developed wholly by centrifugal force.

- A. Axial flow
- B. Progressing cavity
- C. Radial flow
- D. Forced out of the discharge
- E. None of the Above

265. \_\_\_\_\_—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. Axial flow
- B. Progressing cavity
- C. Mixed flow
- D. Forced out of the discharge
- E. None of the Above

266. \_\_\_\_\_—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. Axial flow
- B. Progressing cavity
- C. Radial flow
- D. Forced out of the discharge
- E. None of the Above

**Positive Displacement Pumps**

267. A Positive Displacement Pump has an expanding cavity on the suction side of the pump and a \_\_\_\_\_ on the discharge side.

- A. Axial flow
- B. Progressing cavity
- C. Decreasing cavity
- D. Forced out of the discharge
- E. None of the Above

268. 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 the \_\_\_\_\_.

- A. Axial flow
- B. Cavity collapses
- C. Radial flow
- D. Forced out of the discharge
- E. None of the Above

269. This principle applies to all types of Positive Displacement Pumps whether the pump is a rotary lobe, gear within a gear, piston, diaphragm, screw, \_\_\_\_\_, etc.

- A. Axial flow
- B. Progressing cavity
- C. Radial flow
- D. None of the Above

270. A \_\_\_\_\_, unlike a Centrifugal Pump, will produce the same flow at a given RPM no matter what the discharge pressure is.

- A. Axial flow
- B. Progressing cavity
- C. Radial flow
- D. Positive Displacement Pump
- E. None of the Above

271. A \_\_\_\_\_ cannot be operated against a closed valve on the discharge side of the pump, i.e. it does not have a shut-off head like a Centrifugal Pump does.

- A. Axial flow
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

272. If a \_\_\_\_\_ is allowed to operate against a closed discharge valve it will continue to produce flow which will increase the pressure in the discharge line until either the line bursts or the pump is severely damaged or both.

- A. Axial flow
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

273. The vane(s) may be blades, buckets, rollers, or slippers that cooperate with a dam to draw fluid into and out of the \_\_\_\_\_.

- A. Pump chamber
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

274. Fluid is drawn in and out of the \_\_\_\_\_ by a piston(s) reciprocating within a cylinder(s) and operating port valves.

- A. Axial flow
- B. Progressing cavity
- C. Pump chamber
- D. Positive Displacement Pump
- E. None of the Above

275. \_\_\_\_\_ and sealing depends on the elasticity of a flexible member(s) that may be a tube, vane, or a liner.

- A. Pumping
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

276. Fluid is carried between rotor screw threads as they mesh with internal threads on the \_\_\_\_\_.

- A. Axial flow
- B. Progressing cavity
- C. Plunger pump
- D. Stator
- E. None of the Above

277. Fluid is carried between gear teeth and is expelled by the meshing of the gears that cooperate to provide continuous sealing between the \_\_\_\_\_.

- A. Pump inlet and outlet
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

278. The \_\_\_\_\_ and the screw are two other types of mechanical action that can be used to provide movement of the liquid through the pump.

- A. Axial flow
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

#### Plunger Pump

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

- A. Axial flow
- B. Progressing cavity
- C. The suction side
- D. Positive Displacement Pump
- E. None of the Above

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

- A. Axial flow
- B. Progressing cavity
- C. Plunger pump
- D. Pump creates pressure
- E. None of the Above

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

- A. Axial flow
- B. Progressing cavity
- C. Pump
- D. Positive Displacement Pump
- E. None of the Above

### Diaphragm Pumps

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

- A. Diaphragm pump
- B. Progressing cavity
- C. Plunger pump
- D. Positive Displacement Pump
- E. None of the Above

### Pump Categories

283. Let's cover the essentials first. The key to the whole operation is, of course, the pump. And regardless of what type it is (\_\_\_\_\_, centrifugal, turbine or jet-ejector, for either shallow or deep well applications), its purpose is to move water and generate the delivery force we call pressure.

- A. Cylindrical pump housing
- B. Reciprocating piston
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

284. Sometimes — with \_\_\_\_\_ in particular — pressure is not referred to in pounds per square inch but rather as the equivalent in elevation, called head. No matter; head in feet divided by 2.31 equals pressure, so it's simple enough to establish a common figure.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

285. Pumps may be classified on the basis of the application they serve. All pumps may be divided into two major categories: (1) dynamic, in which energy is continuously added to increase the fluid velocities within the machine, and (2) \_\_\_\_\_, in which the energy is periodically added by application of force.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

### Basic Water Pump

286. The water pump commonly found in our systems is centrifugal pumps. These pumps work by spinning water around in a circle inside a \_\_\_\_\_. The pump makes the water spin by pushing it with an impeller.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

287. The blades of this impeller project outward from an axle like the arms of a turnstile and, as the impeller spins, the water spins with it. As the water spins, the pressure near the outer edge of the pump housing becomes much higher than near the\_\_\_\_\_.

- A. Cylindrical pump housing
- B. Center of the impeller
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

288. You can view the water as an incompressible fluid, one that obeys \_\_\_\_\_ in the appropriate contexts. As water drifts outward between the impeller blades of the pump, it must move faster and faster because its circular path is getting larger and larger. The impeller blades cause the water to move faster and faster.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

289. By the time the water has reached the outer edge of the impeller, it is moving quite fast. However, when the water leaves the impeller and arrives at the outer edge of the \_\_\_\_\_, it slows down.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

290. Here is where \_\_\_\_\_ figures in. As the water slows down and its kinetic energy decreases, that water's pressure potential energy increases (to conserve energy). Thus, the slowing is accompanied by a pressure rise.

- A. Cylindrical pump housing
- B. Bernoulli's equation
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

291. That is why the water pressure at the outer edge of the pump housing is higher than the water pressure near the center of the impeller. When water is actively flowing through the pump, arriving through a hole near the \_\_\_\_\_ and leaving through a hole near the outer edge of the pump housing, the pressure rise between center and edge of the pump is not as large.

- A. Cylindrical pump housing
- B. Center of the impeller
- C. Centrifugal pump(s)
- D. Displacement
- E. None of the Above

Self-priming pump:

292. A pump that does not require priming or initial filling with liquid. The pump casing carries a reserve of water that helps create a vacuum that will lift\_\_\_\_\_.

- A. The pressure is high and velocity is low
- B. Stuffing box with gland packing
- C. The fluid from a low source
- D. The velocity changes
- E. None of the Above

Stuffing box:

293. The joint that seals the fluid in the pump stopping it from coming out between\_\_\_\_\_. The following image shows a typical stuffing box with gland packing. The function of packing is to control leakage and not to eliminate it completely.

- A. The pressure is high and velocity is low
- B. The casing and the pump shaft
- C. Low pressure occurs
- D. The velocity changes
- E. None of the Above

294. \_\_\_\_\_, and a flow from 40 to 60 drops per minute out of the stuffing box must be maintained for proper lubrication. This makes this type of seal unfit for situations where leakage is unacceptable but they are very common in large primary sector industries such a mining and pulp and paper.

- A. The pressure is high and velocity is low
- B. Stuffing box with gland packing
- C. The packing must be lubricated
- D. The velocity changes
- E. None of the Above

295. It is not easy to understand why \_\_\_\_\_ in the small diameter area of the venturi.

- A. The pressure is high and velocity is low
- B. Stuffing box with gland packing
- C. Low pressure occurs
- D. The velocity changes
- E. None of the Above

296. It is clear that all the flow must pass from the larger section to the smaller section. Or in other words, the flow rate will remain the same in\_\_\_\_\_. The flow rate is the same, but the velocity changes.

- A. The pressure is high and velocity is low
- B. Stuffing box with gland packing
- C. The large and small portions of the tube
- D. The velocity changes
- E. None of the Above

297. The velocity is greater in the small portion of the tube. There is a relationship between the pressure energy and the velocity energy; if velocity increases\_\_\_\_\_.

- A. The pressure is high and velocity is low
- B. The pressure energy must decrease
- C. Low pressure occurs
- D. The velocity changes
- E. None of the Above

298. This is the principle of conservation of energy at work which is also Bernoulli's law. In the large part of the pipe the pressure is high and velocity is low, in\_\_\_\_\_.

- A. The pressure is high and velocity is low
- B. Stuffing box with gland packing
- C. The small part, pressure is low and velocity high
- D. The velocity changes
- E. None of the Above

Venturi (Bernoulli's law):

299. A venturi is a \_\_\_\_\_ that has a gradual restriction that opens up into a gradual enlargement. The area of the restriction will have a lower pressure than the enlarged area ahead of it. If the difference in diameters is large you can even produce a very high vacuum (-28 feet of water).

- A. High speed
- B. Pump and shaft
- C. Pipe
- D. Shaft
- E. None of the Above

Types of Water Pumps

300. The most common type of water pumps used for municipal and domestic water supplies are variable \_\_\_\_\_.

- A. High speed
- B. Pump and shaft
- C. Column pipe
- D. Displacement pumps
- E. None of the Above

Please fax or e-mail the answer key to TLC  
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## ***Special Notice to Help the Less Fortunate***



**Kavi and the believers in his church prayed fervently and lifted up praise to God before digging the well. We here in the U.S. have it very good. Here is a story of and drilling a well just to have drinking water in India.**

Kavi Viresh was accustomed to rejection. A Gospel for Asia missionary, Kavi knew he was laboring in hard soil in his village in Andhra Pradesh, India and the spiritual drought experienced by its people was worse than the physical drought they suffered in the summers. The people of this village lived hard lives focused on daily survival, and most did not have faith in any god.

By God's grace, Kavi has seen a church planted there—and believers who are eager to help him with outreach. Still, the hearts of many in the village have remained hard. Kavi has suffered beatings several times for sharing the Good News of Jesus. One time, a group of 30 people came to his house to attack him. The Gospel tracts he handed out were torn into pieces on many occasions.

***"People told me, 'Your God is a great God.'"***

But Kavi knew the people weren't really rejecting *him*—they were rejecting *Jesus* who sent him. And he knew there just had to be some way to get through to these people whom Jesus loved so much. That way turned out to be a Jesus Well. Before the Jesus Well was dug in this village, the people's only source of water was one government-built water tank that was not nearly enough to meet their basic needs. Kavi knew the Jesus Well would be a tangible way to show the villagers that Jesus loved them.

Sudhir Rao, a new Christian in the village, gladly provided his services as a mason to

help with construction. The digging of the Jesus Well was in itself a miracle. Others had attempted to dig a well in the village but not seen water even at depths of 300 feet. So when Kavi saw water at around 100 feet, villagers were amazed.

"People told me, 'Your God is a great God,'" Kavi recalls. Even the village leader expressed heartfelt appreciation to Kavi for providing his people with water—and that he desired to see another well dug in a nearby area. Although the well was just dug in recent months, Kavi has already seen God wash away barriers in the villagers' hearts through its refreshing waters. Hearts have been brought that much closer to being able to receive the message of hope in Christ. And he has a vision of faith for how God will continue to work. "Through this Jesus Well, surely those who have beaten me and are against me will come to know the Lord Jesus," Kavi shared.

**For more information, we welcome you to visit...**

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