

Registration form

PUMPS 202

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

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.

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 202 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? No refunds.

Method of Course acceptance confirmation. Please fill this section

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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| 16. A B C D | 34. A B C D | 52. A B C D | 70. A B C D |
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339. A B C D	355. A B C D	371. A B C D	387. A B C D
340. A B C D	356. A B C D	372. A B C D	388. A B C D
341. A B C D	357. A B	373. A B	389. A B C D
342. A B C D	358. A B	374. A B C D	390. A B C D
343. A B C D	359. A B	375. A B C D	391. A B C D
344. A B C D	360. A B	376. A B	392. A B C D
345. A B C D	361. A B	377. A B	393. A B C D
346. A B C D	362. A B	378. A B	394. A B C D
347. A B C D	363. A B	379. A B	395. A B C D
348. A B C D	364. A B	380. A B	396. A B C D
349. A B C D	365. A B	381. A B	397. A B C D
350. A B C D	366. A B C D	382. A B C D	398. A B C D
351. A B C D	367. A B C D	383. A B C D	399. A B C D
352. A B C D	368. A B C D	384. A B C D	400. A B C D

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

Must match State Hour Requirement _____ (Hours)

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

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

Signature

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

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

**PUMPS 202 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?

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.

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.

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.

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 202 CEU Training Course Assignment

The Pumps 202 CEU course assignment is available in Word on the Internet for your convenience, please visit 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.

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

(Give or take 60 questions)

1. 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
2. Which of the following definitions is the application of continuous force by one body upon another that it is touching; compression?
A. Pressure C. Pascal's Law
B. Hydraulics D. None of the above
3. 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
4. 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
5. 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
6. 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

Hydraulics

11. Which of the following includes the behavior of all liquids, although it is primarily concerned with the motion of liquids?
 A. Fluids C. Hydraulics
 B. Hydrostatics D. None of the above
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
- B. Hydrostatics
- C. Hydraulics
- 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. There are a few liquids, known as liquid crystals, in which the molecules are packed together in such a way as to make the properties of the medium locally anisotropic, but the vast majority of fluids - including air and water- are _____.

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

21. In fluid mechanics, the state of an isotropic fluid may be explained by defining its mean mass per unit volume, or density, its temperature, and its velocity at every point in space, and just what the connection is between these macroscopic properties and the positions and velocities of individual molecules is of no direct relevance.

- A. True
- B. False

22. 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

23. 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 Dynamics

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

Basic Ideas

41. Flow and pressure variables can be calculated in fluid flow network with the use of the?
A. Electron fluids C. Hydraulic ohm analogy
B. Pressures D. None of the above

Component Equivalents

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. Normally measured in amperes, current is equivalent to a _____; that is, the volumetric quantity of flowing water over time.
A. Stretched rubber C. Hydraulic volume flow rate
B. Flow meter D. None of the above
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
 - B. Feedback control
 - C. A positive displacement pump
 - 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. Which of the following if you could be below, in excavations and depressions, atmospheric pressure increases?

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

60. 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

61. 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

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

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

63. The atmospheric pressure does not vary uniformly with?

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

64. 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

65. 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

66. 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
67. The barometric loop is a loop in the piping system that effectively protects against backpressure.
 A. True B. False
68. Absolute pressure and gauge pressure?
 A. Are the same C. That effectively protects
 B. Are related D. None of the above
69. 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

Pressure

70. Both air and water are considered to be?
 A. Gases C. Volume
 B. Fluid(s) D. None of the above
71. Which of the following terms does water possess and air does not?
 A. Gases C. Volume
 B. Fluid(s) D. None of the above
72. 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
73. Which of the following deals with permanent, time-independent states of fluids, so viscosity does not appear?
 A. Pascal's Principle C. Permanent forces tangential
 B. Hydrostatics D. None of the above
74. 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 C. Permanent forces tangential
 B. Acting on the body of the fluid D. None of the above
75. 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 C. Displaced fluid
 B. Pressure D. None of the above
76. Which of the following is an example of a body force that disturbs the equality of pressure in a fluid?
 A. Gravitational body force C. Gravitation
 B. Pressure D. None of the above

77. 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

78. 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

79. 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

80. 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

81. 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

82. 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

83. 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

84. 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

85. 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

86. Water flowing in a pipe is subject to head loss because of?
 A. Friction C. Siphon
 B. Pressure(s) D. None of the above
87. When a siphon goes below the free water levels, it is called an?
 A. Water bearer C. Inverted siphon
 B. Siphon D. None of the above
88. 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 C. Inverted siphon
 B. Siphon D. None of the above

Pressure and Force

89. Which of the following is the force that pushes water through pipes?
 A. Pressure C. Shearing force
 B. Fluid(s) D. None of the above
90. Water pressure determines the flow of water from the tap.
 A. True B. False
91. Which of the following and force are used extensively in the study of fluid power?
 A. Pressure C. Shearing force
 B. Fluid(s) D. None of the above
92. 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 C. Volume
 B. Force D. None of the above
93. 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
94. 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

95. 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
96. Which of the following is a law of physics fundamental to fluid mechanics?
 A. Archimedes' principle C. Downthrust
 B. Coriolis Force D. None of the above

97. Which of the following is an effect whereby a mass moving in a rotating system experiences a force acting perpendicular to the direction of motion and to the axis of rotation.
- A. Hydrostatic paradox C. Isobaric process
 B. Coriolis Force D. None of the above
98. 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
99. 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
100. 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

Experiments and Early Applications Key Terms

101. 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
102. One characteristic of a liquid is the tendency to keep its free surface level.
- A. True B. False
103. 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
104. Liquids will flow in the direction that will tend to make the surface level, if the surface is not level.
- A. True B. False
105. The mercury column was held up by the pressure by horror vacui as Aristotle had supposed.
- A. True B. False
106. 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
107. 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

108. 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

109. 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 C. Specific gravity of a material
B. Density D. None of the above

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

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

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

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

Variations in Specific Gravity

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

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

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

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

Hydrometer

114. 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 C. Measurement of specific gravity
B. Specific gravities D. None of the above

115. _____ 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 C. Measurement of specific gravity
B. Specific gravities D. None of the above

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

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

Physical Science and Laws Section

117. 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

118. 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

119. Which of the following states that every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it?

- A. First law
- B. Physical Law
- C. Law of Thermodynamics
- D. None of the above

120. Which of the following can also be described intuitively as a push or a pull?

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

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

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

Three Laws of Motion

122. First rule: An object will remain at rest or in a uniform state of motion unless that state is changed by?

- A. An internal force
- B. An external force
- C. Inertia
- D. None of the above

123. Which of the following is any interaction that, when unopposed, will change the motion of an object?

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

124. Which of the following is the force that attracts a body toward the center of the earth, or toward any other physical body having mass?

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

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

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

126. Which of the following represents an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy?

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

127. Which of the following is a theoretical statement inferred from particular facts, applicable to a defined group or class of phenomena, and expressible by the statement that a particular phenomenon always occurs if certain conditions be present?

- A. Newton's Laws
- B. Physical Law
- C. Law of Thermodynamic
- D. None of the above

128. 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

129. 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

130. 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

131. Which of the following define fundamental physical quantities that characterize thermodynamic systems?

- A. Newton's Laws
- B. Physical Laws
- C. Laws of Thermodynamics
- 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

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

- A. True
- B. False

151. Pressure in a _____ of direction.

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

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

Bernoulli's Principle

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

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

165. 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

166. 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

167. 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

168. 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

169. 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

170. 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

171. 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

172. 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

173. 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

174. 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

175. 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

176. 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

177. 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

178. 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

179. 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

180. Some vertical turbines are lubricated by hydraulic fluid rather than water, these pumps are essentially the same as non-lubricated units; only the drive shaft is enclosed within the transmission.

- A. True
- B. False

181. 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

182. 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

183. 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

184. 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

185. 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

186. 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

187. 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

188. 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

189. 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

190. 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

191. 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

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

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

Complicated Pumps - Introduction

203. 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

204. 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

205. 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

206. The force and lift pumps are typically used for _____.

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

207. 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

208. 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

209. 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

210. The properties of the fluids being pumped can significantly affect the choice of pump.
- A. True
 - B. False

Key considerations include:

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

- A. True
- B. False

212. The properties of the fluids being pumped can significantly affect the choice of pump.
- A. True
 - B. False

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. 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

216. 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

217. 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

218. 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

219. 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

220. 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

221. 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

Centrifugal Pump Sub-Section

222. 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

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

- A. True
- B. False

224. In the operation of a centrifugal pump, the pump “slings” liquid out of the impeller via _____.

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

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

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

226. A single-stage pump has only one impeller. A multi-stage pump has two or more impellers housed together in _____.

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

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

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

228. Centrifugal pumps are also classified as Horizontal or Vertical, depending upon the position of the _____.

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

229. The single-suction impeller allows liquid to enter the eye from one side only. The double-suction impeller allows liquid to enter _____ from two directions.

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

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

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

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

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

232. 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
- B. The amount of resistance to flow
- C. The discharge is entirely shut off
- D. None of the above

233. 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

Generation of Centrifugal Force

234. 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

235. 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

236. 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

237. 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

238. 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

239. Positive Displacement pumps generally gives more _____ than centrifugal pumps.

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

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

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

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

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

242. Depending on how the measurement is taken _____ and head may also be referred to as static or dynamic.

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

Mechanical Efficiency

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

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

244. Changing the system pressure or head has a dramatic effect on the flow rate in the _____.

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

Net Positive Suction Head - NPSH

245. 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
- B. Vertical turbine
- C. Positive displacement pump
- D. None of the above

Understanding Progressing Cavity Pump Theory

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

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

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

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

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

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

249. 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

250. 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

251. 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

Helical Rotor and a Twin Helix

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

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

253. 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

254. 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

255. 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

256. 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

257. 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

258. 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

259. 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

260. 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

261. 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

Inertial Cavitation

262. Inertial cavitation is the process where a void or bubble in a liquid rapidly collapses, producing _____.

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

Non-Inertial Cavitation

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

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

264. Since the shock waves formed by cavitation are strong enough to significantly damage moving parts, cavitation is usually _____. It is specifically avoided in the design of machines such as turbines or propellers, and eliminating cavitation is a major field in the study of fluid dynamics.

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

Maintenance of a Vertical Turbine Pump

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

- A. True
- B. False

266. 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

267. 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

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

- A. True
- B. False

269. 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

270. 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

271. Which of the following is the total volume throughput per unit of time at suction conditions? The term capacity is also used.
- A. Viscosity
 - B. Displacement
 - C. Rate of Flow
 - D. None of the above
272. A measure of a liquid's resistance to flow. i.e.: how thick it is. The viscosity determines the type of pump used, the speed it can run at, and with gear pumps, the internal clearances required.
- A. Viscosity
 - B. Displacement
 - C. Rate of Flow
 - D. None of the above
273. 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
274. 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
275. Which of the following is an indicator of the net positive suction head required [NPSH₃] 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
276. 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
277. 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
278. 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, Suction
 - C. Head, Friction
 - D. None of the above
279. 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, Loss
 - C. Head, Friction
 - D. None of the above

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

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

281. 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

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

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

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

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

284. A single-stage axial flow helix installed in the suction eye of an impeller to lower the NPSHR.

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

285. Which of the following is determined by the conditions of the installation and is the total suction head of liquid absolute, determined at the first-stage impeller datum minus the absolute vapor pressure in meters (feet) of the liquid at a specific rate of flow expressed in meters (feet) of liquid?

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

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

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

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

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

Pump Efficiency

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

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

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

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

290. 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
291. 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
292. 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
293. 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 C. Total Dynamic Head
 B. Dynamic Suction Head D. None of the above
294. Subject on how the measurement is taken suction lift and head may also be referred to as static or dynamic.
 A. True B. False
295. 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
296. 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
297. 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

298. The term specific gravity compares the density of some substance to the _____.
 A. Density of water C. Systems of measure
 B. Pressure D. None of the above
299. 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

300. 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

301. 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

302. 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

303. The density of a substance is defined as its force per unit mass, but here on the earth's surface, we can substitute weight for volume.

- A. True
- B. False

Understanding Suction Lift

304. 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
- B. 5' to 10'
- C. 3 -5
- D. None of the above

305. Pumps operating at a negative minimum inlet pressure are capable of creating a suction lift (non-self-priming). The suction capacity is approximately equal to the level of the negative minimum inlet pressure minus a _____ foot safety factor.

- A. 5
- B. 2
- C. 3
- D. None of the above

306. Centrifugal pumps are particularly vulnerable especially when pumping heated solution near the vapor pressure, whereas positive displacement pumps are less affected by cavitation, as they are better able to pump two-phase flow (the mixture of gas and liquid), however, the resultant flow rate of the pump will be diminished because of the gas volumetrically displacing a disproportion of liquid.

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

309. Careful design is required to pump high temperature liquids with a centrifugal pump when the liquid is near its _____.
- A. Damage point
 - B. Boiling point
 - C. Vapor pressure at a given temperature
 - D. None of the above

Suction Limitations

310. Regardless of the extent of the vacuum, water can only be “lifted” a set distance or height due to its' _____.
- A. Atmospheric pressure
 - B. Vaporization pressure
 - C. Suction lift
 - D. None of the above

311. It must be remembered that _____ of the impeller increases as the suction lift increases, and therefore, the pump, where possible, should be located so that the suction line is submerged at all times.
- A. Atmospheric pressure
 - B. Cavitation
 - C. Suction lift
 - D. None of the above

312. Pumps lift water with the help of atmospheric pressure, then pressurize and discharge the water from the casing. The practical suction lift, at sea level is _____ feet.
- A. 25
 - B. 32
 - C. 18
 - D. None of the above

313. As the pressure above the water is reduced, the water will tend to rise as a result of the atmospheric pressure, which is tending to push the water into the pump suction piping. The theoretical maximum suction lift for water is _____ feet.
- A. 31.9
 - B. 33.9
 - C. 18
 - D. None of the above

314. From a practical standpoint, in consideration of the friction loss of the piping, the altitude of the station, etc., the normal maximum lift for any pump is approximately _____ ft.
- A. 18
 - B. 32
 - C. 33.9
 - D. None of the above

315. Which of the following is the maximum distance from the water level, to the centerline of the impeller? The main type of pump used for suction lift is a vertical shaft turbine pump.
- A. Static Suction Lift
 - B. Dynamic Suction Lift
 - C. Total Dynamic Suction Lift
 - D. None of the above

316. Which of the following exists when a liquid is taken from an open tank to an atmospheric tank where the liquid level is below the centerline of the pump suction.
- A. Suction Lift
 - B. Dynamic Suction Lift
 - C. Total Dynamic Suction Lift
 - D. None of the above

Motor-Pump Coupling Sub-Section

Rigid Coupling

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

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

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
- B. Coupling
- C. Misalignment
- 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

322. You do not need to replace a mechanical seal whenever the seal is removed from the shaft for any reason, or whenever leakage causes undesirable effects on equipment or surrounding spaces.

- A. True
- B. False

323. It is okay to touch a new seal on the sealing face.

- A. True
- B. False

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

- A. True
- B. False

Electrical Motors Section

Understanding Motors

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

- A. True B. False

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

- A. True B. False

327. 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

328. 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

329. Which of the following design generates an oscillating current in a wound rotor with a split ring commutator, and either a wound or permanent magnet stator?

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

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

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

331. Many of the limitations of the _____ are due to the need for brushes to press against the commutator. This creates friction.

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

Brushless DC Motors

332. Some of the problems of the brushed DC motor are eliminated in the _____ design.

- A. Rotor's position C. Brushless
B. Hall Effect D. None of the above

333. In the brushless motor, the mechanical "rotating switch" or commutator/brush gear assembly is replaced by an external electronic switch synchronized to the _____.

- A. Rotor's position C. Motors
B. Hall Effect sensors D. None of the above

334. Brushless motors are typically _____% efficient, whereas DC motors with brush gear are typically 75-80% efficient.

- A. 85-90 C. 95-99
B. 75-84 D. None of the above

Universal Motors

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

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

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

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

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

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

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

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

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

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

AC Motor Sub-Section

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

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

Components

A typical AC motor consists of two parts:

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

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

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

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

Torque motors

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

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

Slip Ring

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

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

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

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

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

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

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

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

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

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

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

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

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

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

351. Reducing the load will cause the motor to speed up, and increasing the load will cause the motor to slow down until the _____ and motor torque are equal.

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

352. Operated in this manner, the slip losses are dissipated in the secondary resistors and can be very significant. The _____ is also very poor.

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

Stepper Motors

353. 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

354. Which of the following may also be thought of as a cross between a DC electric motor and a solenoid? As each coil is energized in turn, the rotor aligns itself with the magnetic field produced by the energized field winding.

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

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

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

356. 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

357. 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

358. 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

359. 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

360. 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

361. 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

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

- A. True B. False

Electrical Understanding Sub-Section

Understanding Voltage

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

- A. True B. False

364. 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

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

- A. True B. False

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

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

367. Which of the following is equal to the work done per unit charge against a static electric field to move the charge between two points?

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

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

- A. Electric current C. A static (unchanging) electric field
B. Electromotive force 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

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

374. 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

375. Which of the following can produce a magnetic field that rotates in a specified direction, which simplifies the design of electric motors?

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

SCADA Section

376. 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

377. 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

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

- A. True
- B. False

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

- A. True B. False

380. 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

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

- A. True B. False

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

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

383. 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

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

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

385. The monitoring function or remote management of the _____ is referred to as telemetry.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

393. The interaction between the system and the master station is done through the WAN protocols like the _____.

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

394. Since the standard protocols used and the _____ can be accessed through the internet, the vulnerability of the system is enlarged.

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

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

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

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

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

397. In many cases, SCADA users have assumed that having a VPN offered sufficient protection, unaware that security can be _____ to SCADA-associated network jacks and switches.

- A. Different risks and priorities
- C. Trivially bypassed with physical access
- B. Significantly less isolation
- D. None of the above

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

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

399. A SCADA (or supervisory control and data acquisition) system means a system consisting of a number of remote terminal units (or RTUs) collecting field data connected back to a master station via a _____.

- A. Communications system
- C. PLCs, RTUs etc.
- B. HMI
- D. None of the above

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

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

When Finished with Your Assignment...

REQUIRED DOCUMENTS

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