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Water Treatment Primer 4 CEU Training Course $100.00
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Start and Finish Dates: ____
You will have 90 days from this date in order to complete this course

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

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List hours worked on assignment must match State Requirement. _________

Please circle/check which certification you are applying the course CEU's/PDH's.

Water Treatment ______ Distribution______ Well Driller _____________________

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

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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.

Thank you…

Water Treatment Primer 4 Answer Key

Name________________________ Phone____________________________

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Please Circle, Bold, Underline or X, one answer per question. A felt tipped pen workbest.

Please circle, underline, bold or X only one correct answer

1. A B C D E F	12. A B C D E F	23. A B C D E F
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5. A B C D E F	16. A B C D E F	27. A B C D E F
6. A B C D E F	17. A B C D E F	28. A B C D E F
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100. A B C D E F	117. A B C D E F	134. A B C D E F
101. A B C D E F	118. A B C D E F	135. A B C D E F
102. A B C D E F	119. A B C D E F	136. A B C D E F
103. A B C D E F	120. A B C D E F	137. A B C D E F
104. A B C D E F	121. A B C D E F	138. A B C D E F
105. A B C D E F	122. A B C D E F	139. A B C D E F
106. A B C D E F	123. A B C D E F	140. A B C D E F
107. A B C D E F	124. A B C D E F	141. A B C D E F
108. A B C D E F	125. A B C D E F	142. A B C D E F
109. A B C D E F	126. A B C D E F	143. A B C D E F
110. A B C D E F	127. A B C D E F	144. A B C D E F
111. A B C D E F	128. A B C D E F	145. A B C D E F
112. A B C D E F	129. A B C D E F	146. A B C D E F
113. A B C D E F	130. A B C D E F	147. A B C D E F
114. A B C D E F	131. A B C D E F	148. A B C D E F
115. A B C D E F	132. A B C D E F	149. A B C D E F
116. A B C D E F	133. A B C D E F	150. A B C D E F

Please write down any question you may had problems with here.

Please fax the answer key to TLC Western Campus Fax (928) 272-0747.
Always call us after faxing the paperwork to ensure that we've received it.

Rush Grading Service
If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of $50.00. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line.

Grading Information
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WATER TREATMENT PRIMER 4 CEU TRAINING COURSE

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Water Treatment Primer 4 CEU Training Course Assignment

You will have 90 days from the start of this assignment to have successfully completed and submit this assignment back to TLC.

If you need course assistance please call us at (928) 468-0665. You can find online assistance for this course on the in the Search function on Adobe Acrobat PDF to help find the answers. There are no intentional trick questions.

Pascal's Law

1. The foundation of ____________________was established when Pascal discovered that pressure in a fluid acts equally in all directions.

A. P = F/A D. Two different heights
B. Fluids at rest E. Modern hydraulics
C. Inertia and friction F. None of the Above

2. This pressure acts at right angles to the containing surfaces. If some type of pressure gauge, with an exposed face, is placed beneath the surface of _______________and pointed in different directions, the pressure will read the same. Thus, we can say that pressure in a liquid is independent of direction.

A. Velocity head D. Dynamic factors of fluid power
B. A liquid at a specific depth E. Is directly proportional to the depth
C. A liquid F. None of the Above

3. ___________________, at any level, depends on the depth of the fluid from the surface. If the exposed face of the pressure gauges are moved closer to the surface of the liquid, the indicated pressure will be less. When the depth is doubled, the indicated pressure is doubled.

A. P = F/A D. Two different heights
B. Fluids at rest E. Pressure due to the weight of a liquid
C. Inertia and friction F. None of the Above

4. Using this information and equation, ______________, we can calculate the pressure on the bottom of the container.

A. P = F/A D. Two different heights
B. Fluids at rest E. The indicated pressure is doubled
C. Inertia and friction F. None of the Above

Gravity

5. Gravity is one of the four forces of nature. The strength of the _________________between two objects depends on their masses. The more massive the objects are, the stronger the gravitational attraction.

A. Velocity head D. Dynamic factors of fluid power
B. Gravity E. Odor
C. Gravitational force F. None of the Above

6. When you pour water out of a container, the earth's gravity pulls the water towards the ground. The same thing happens when you put two buckets of water, with a tube between them, at two different heights. You must work to start the flow of water from one bucket to the other, but then _______________takes over and the process will continue on its own.

A. Gravity D. Two different heights
B. Fluids at rest E. The indicated pressure is doubled
C. Inertia and friction F. None of the Above

7. Gravity, applied forces, and atmospheric pressure are _______________that apply equally to fluids at rest or in motion, while inertia and friction are dynamic factors that apply only to fluids in motion. The mathematical sum of gravity, applied force, and atmospheric pressure is the static pressure obtained at any one point in a fluid at any given time.
A. Velocity head
B. Gravity
C. Static factors
D. Dynamic factors
E. Are directly proportional
F. None of the Above

Static Pressure
8. Static pressure exists in addition to ______________that may also be present at the same time. 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. This covers the situation only for fluids at rest or practically at rest. It is true only for the factors making up static head.
A. P = F/A
B. Any dynamic factors
C. Inertia and friction
D. Two different heights
E. The indicated pressure is doubled
F. None of the Above

9. Obviously, when velocity becomes a factor it must have____________, and as previously explained, the force related to the velocity must also have a direction, so that Pascal's law alone does not apply to the dynamic factors of fluid power.
A. Velocity head
B. Gravity
C. A liquid
D. Dynamic factors of fluid power
E. A direction
F. None of the Above

10. The dynamic factors of inertia and friction are related to___________.
A. Velocity head
B. Gravity
C. A liquid
D. Dynamic factors of fluid power
E. The static factors
F. None of the Above

11. Velocity head and _________________are obtained at the expense of static head. However, a portion of the velocity head can always be reconverted to static head.
A. Friction head
B. Fluids at rest
C. Inertia
D. Two different heights
E. The indicated pressure
F. None of the Above

12. Force, which can be produced by pressure or head when dealing with fluids, is necessary to start a body moving if it is at rest, and is present in some form when the motion of the body is arrested; therefore, whenever a fluid is given velocity, some part of its __________________is used to impart this velocity, which then exists as velocity head.
A. Velocity head
B. Gravity
C. Original static head
D. Dynamic factor
E. Direction
F. None of the Above

Common Hydraulic Terms, <u>Identify the term for each statement</u>.
13. A pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid.
A. Hydraulics
B. Pressure, Absolute
C. Pascal's Law
D. Pressure, Gauge
E. Head, Friction
F. None of the Above

14. The pressure above zone absolute, i.e. the sum of atmospheric and gauge pressure. In vacuum related work it is usually expressed in millimeters of mercury. (mmHg).
A. Hydraulics
B. Pressure, Absolute
C. Pascal's Law
D. Pressure, Gauge
E. Head, Friction
F. None of the Above

15. Engineering science pertaining to liquid pressure and flow.
A. Hydraulics
B. Pressure, Absolute
C. Pascal's Law
D. Pressure, Gauge
E. Head, Friction
F. None of the Above

16. Head is often used to indicate gauge pressure. Pressure is equal to the height times the density of the liquid.
A. Head
B. Head, static
C. Hydrokinetics
D. Pressure, Atmospheric
E. Pressure, Static
F. None of the Above

17. 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, static
C. Head, Friction
D. Pressure, Atmospheric
E. Pressure, Static
F. None of the Above

18. The height of a column or body of fluid above a given point.
A. Pressure
B. Head, static
C. Hydrokinetics
D. Pressure, Atmospheric
E. Pressure, Static
F. None of the Above

19. Engineering science pertaining to the energy of liquid flow and pressure.
A. Pressure
B. Head, static
C. Hydrokinetics
D. Pressure, Atmospheric
E. Hydraulics
F. None of the Above

20. Pressure exported by the atmosphere at any specific location. (Sea level pressure is approximately 14.7 pounds per square inch absolute, 1 bar = 14.5psi.)
A. Pressure
B. Head, static
C. Hydrokinetics
D. Pressure, Atmospheric
E. Pressure, Static
F. None of the Above

Hydraulic Principles Section **Identify the missing term as in the text.**
21. Definition: **Hydraulics** is a branch of engineering concerned mainly with ________________. The term is applied commonly to the study of the mechanical properties of water, other liquids, and even gases when the effects of compressibility are small.
A. Pressure
B. Head, static
C. Hydrokinetics
D. Hydrostatics
E. Hydraulics
F. None of the Above

Hydraulics: The Engineering science pertaining to liquid pressure and flow.
22. The word ______________ is based on the Greek word for water, and originally covered the study of the physical behavior of water at rest and in motion. Use has broadened its meaning to include the behavior of all liquids, although it is primarily concerned with the motion of liquids.
A. Pressure
B. Hydrodynamics
C. Hydrokinetics
D. Hydrostatics
E. Hydraulics
F. None of the Above

23. _______________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. Pressure
B. Hydrodynamics
C. Hydrokinetics
D. Hydrostatics
E. Hydraulics
F. None of the Above

24. _________________, the consideration of liquids at rest, involves problems of buoyancy and flotation, pressure on dams and submerged devices, and hydraulic presses. The relative incompressibility of liquids is one of its basic principles.

A. Pressure D. Hydrostatics
B. Hydrodynamics E. Hydraulics
C. Hydrokinetics F. None of the Above

25. _____________________, the study of liquids in motion, is concerned with such matters as friction and turbulence generated in pipes by flowing liquids, the flow of water over weirs and through nozzles, and the use of hydraulic pressure in machinery.

A. Pressure D. Hydrostatics
B. Hydrodynamics E. Hydraulics
C. Hydrokinetics F. None of the Above

Hydrostatics

26. Hydrostatics is about the _____________ exerted by a fluid at rest.

A. Pressures D. Hydrostatics
B. Hydrodynamics E. Hydraulics
C. Hydrokinetics F. None of the Above

Atmospheric Pressure… Now we will step it up with harder questions.

27. The atmosphere is the entire mass of air that surrounds the earth. While it extends upward for about 500 miles, the section of primary interest is the portion that rests on the earth's surface and extends upward for about 7 1/2 miles. This layer is called_________________.

A. The atmosphere D. Gauge pressure
B. The mercury column E. Absolute pressure
C. The troposphere F. None of the Above

28. Atmospheric pressure can be measured by any of several methods. The common laboratory method uses the mercury column barometer. ________________serves as an indicator of atmospheric pressure.

A. The originating level D. The total pressure
B. Back pressure E. The height of the mercury column
C. Absolute pressure F. None of the Above

29. __________________and at a temperature of 0° Celsius (**C**), the height of the mercury column is approximately 30 inches, or 76 centimeters.

A. The atmosphere D. Gauge pressure
B. The mercury column E. Absolute pressure
C. At sea level F. None of the Above

Hydrostatic Paradox

30. If a volume of fluid is_________________, the acceleration can be added to the acceleration of gravity. A free surface now becomes perpendicular to the total acceleration, and the pressure is proportional to the distance from this surface.

A. The originating level D. The total acceleration
B. Accelerated uniformly E. A rotating fluid
C. Absolute pressure F. None of the Above

31. The same can be done for a rotating fluid, where the _________________is the important quantity. The earth's atmosphere is an example.

A. The atmosphere D. Gauge pressure
B. The mercury column E. Absolute pressure
C. Centrifugal acceleration F. None of the Above

32. When air moves relative to the rotating system, _______________must also be taken into account. However, these are dynamic effects and are not strictly a part of hydrostatics.
A. The originating level D. The total acceleration
B. Backsiphonage E. The Coriolis force
C. Absolute pressure F. None of the Above

Motor Section
33. The power source of the pump is usually an electric motor. The motor is connected by a coupling to the pump shaft. The purpose of the _________________ is to hold the shaft firmly in place, yet allow it to rotate.
A. Brush(es) D. Bearing house
B. Pump assembly E. Bearing(s) (s) Means Plural or Singular
C. Stator F. None of the Above

34. The ____________ supports the bearings and provides a reservoir for the lubricant. An impeller is connected to the shaft.
A. Brush(es) D. Bearing house
B. Pump assembly E. Bearing(s) (s) Means Plural or Singular
C. Stator F. None of the Above

35. The ______________ can be a vertical or horizontal set-up; the components for both are basically the same.
A. Brush(es) D. Bearing house
B. Pump assembly E. Bearing(s) (s) Means Plural or Singular
C. Stator F. None of the Above

A-C Motors
36. There are a number of different types of alternating current motors, such as Synchronous, Induction, wound rotor, and___________ . The synchronous type of A-C motor requires complex control equipment, since they use a combination of A-C and D-C.
A. DC electric motor D. Three-phase AC synchronous motors
B. AC electric motor E. Computer controlled stepper motors
C. Squirrel cage F. None of the Above

37. This also means that the ____________is used in large horsepower sizes, usually above 250 HP. The induction type motor uses only alternating current.
A. DC electric motor D. Three-phase AC synchronous motor
B. AC electric motor E. Synchronous type of A-C motor
C. Squirrel cage F. None of the Above

38. The ____________ motor provides a relatively constant speed. The wound rotor type could be used as a variable speed motor.
A. DC electric D. Three-phase AC synchronous
B. AC electric E. Computer controlled stepper
C. Squirrel cage F. None of the Above

Motor Starters
39. All electric motors, except very small ones such as chemical feed pumps, are equipped with starters, either full voltage or reduced voltage. This is because motors draw a much higher current when they are starting and gaining speed. The purpose of the _____________is to prevent the load from coming on until the amperage is low enough.
A. Brush(es) D. Reduced voltage starter
B. Pump assembly E. Bearing(s) (s) Means Plural or Singular
C. Stator F. None of the Above

Motor Enclosures

40. Depending on the application, motors may need special protection. Some motors are referred to as open motors. They allow air to pass through to remove heat generated when current passes through the windings. Other motors use ______________ for special environments or safety protection.

A. Brush(es)
B. Specific enclosures
C. Stator
D. Reduced voltage starter
E. Bearing(s)
F. None of the Above

(s) Means Plural or Singular

Motor Controls

41. All pump motors are provided with some method of control, typically a combination of manual and automatic. _____________can be located at the central control panel at the pump or at the suction or discharge points of the liquid being pumped.

A. Circuit
B. Motor control(s)
C. Bearing house
D. Bubble regulator
E. Manual pump control(s)
F. None of the Above

(s) Means Plural or Singular

42. Two typical level sensors are the ___________and the bubble regulator.

A. Circuit
B. Motor control(s)
C. Bearing house
D. Float sensor (s)
E. A-C motor(s)
F. None of the Above

Means Plural or Singular

43. The _____________ is pear-shaped and hangs in the wet well.

A. Brush(es)
B. Specific enclosures
C. Stator
D. Reduced voltage starter
E. Bearing(s)
F. None of the Above

(s) Means Plural or Singular

44. As the height increases, the float tilts, and the mercury in the glass tube flows toward the end of the tube that has two wires attached to it. When the mercury covers the_________, it closes the circuit.

A. Circuit
B. Motor control(s)
C. Wires
D. Bubble regulator
E. A-C motor(s)
F. None of the Above

45. A low pressure air supply is allowed to escape from a bubbler pipe in the wet well. The back-pressure on the air supply will vary with the liquid level over the pipe. ______________will detect this change and use this information to control pump operation.

A. Open motor(s)
B. Sensitive air pressure switches
C. Float sensor
D. Pump assembly
E. Reduced voltage starter
F. None of the Above

(s) Means Plural or Singular

Motor Maintenance

46. Motors should be kept clean, free of moisture, and lubricated properly. Dirt, dust, and grime will plug the ventilating spaces and can actually form an insulating layer over the metal surface of the_______.

A. Brush(es)
B. Pump assembly
C. Stator
D. Reduced voltage starter
E. Bearing(s)
F. None of the Above

(s) Means Plural or Singular

Moisture

47. Moisture harms the insulation on the ____________to the point where they may no longer provide the required insulation for the voltage applied to the motor. In addition, moisture on windings tend to absorb acid and alkali fumes, causing damage to both insulation and metals.

A. Circuit
B. Motor control(s)
C. Wires
D. Windings
E. Motor enclosure
F. None of the Above

48. To reduce problems caused by moisture, the most suitable _____________ for the existing environment will normally be used. It is recommended to run stand by motors to dry up any condensation which accumulates in the motor.
A. Circuit
B. Motor control(s)
C. Wires
D. Windings
E. Motor enclosure
F. None of the Above

Motor Lubrication

49. Friction will cause wear in all moving parts, and lubrication is needed to reduce this friction. It is very important that all your manufacturer's recommended lubrication procedures are strictly followed. You have to be careful not to add too much grease or oil, as this could cause more friction and____________.
A. Vacuum
B. Friction loss
C. Vibration
D. Generate heat
E. Vapor bubbles
F. None of the Above

More Detailed Information on Motors

50. The classic division of electric motors has been that of Direct Current (**DC**) types vs. Alternating Current (**AC**) types. This is more a de facto convention, rather than a rigid distinction. For example, many classic ______________ run happily on AC power.
A. Motor(s)
B. AC power
C. DC motor(s)
D. Direct Current (DC)
E. An asynchronous motor
F. None of the Above

51. 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____________, or some approximation of.
A. Sinusoidal AC drive currents
B. AC power
C. DC motor(s)
D. Direct Current (DC)
E. Asynchronous sinusoidal AC drive currents
F. None of the Above

52. The two best examples are: the ________________and the stepping motor, both being polyphase AC motors requiring external electronic control.
A. Brushless DC motor
B. AC power
C. DC motor(s)
D. Direct Current (DC)
E. An asynchronous motor
F. None of the Above

53. There is a clearer distinction between a _____________and asynchronous types. In the synchronous types, the rotor rotates in synchrony with the oscillating field or current (e.g. permanent magnet motors).
A. Sinusoidal AC drive currents
B. AC power
C. DC motor(s)
D. Synchronous motor
E. Asynchronous sinusoidal AC drive currents
F. None of the Above

54. In contrast, an asynchronous motor is designed to slip; the most ubiquitous example being the common _______________ which must slip in order to generate torque.
A. Sinusoidal AC drive currents
B. AC induction motor
C. DC motor(s)
D. Synchronous motor
E. Asynchronous sinusoidal AC drive currents
F. None of the Above

55. A _____________ is designed to run on DC electric power.
A. Synchronous motor
B. AC power
C. DC motor(s)
D. Direct Current (DC)
E. An asynchronous motor
F. None of the Above

56. Two examples of pure DC designs are Michael Faraday's _______________(which is uncommon), and the ball bearing motor, which is (so far) a novelty.
A. Sinusoidal AC drive currents
B. AC induction motor
C. DC motor(s)
D. Synchronous motor
E. Homopolar motor
F. None of the Above

57. By far the most common _____________ types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source -- so they are not purely DC machines in a strict sense.
A. Motor(s) D. Direct Current (DC)
B. AC power E. An asynchronous motor
C. DC motor(s) F. None of the Above

Brushed DC motors
58. The classic DC motor design generates an oscillating current in a __________________with a split ring commutator, and either a wound or permanent magnet stator.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. Wound rotor
C. Stator F. None of the Above

59. A ______________consists of a coil wound around a rotor which is then powered by any type of battery.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. Rotor
C. Stator F. None of the Above

60. Many of the limitations of the classic commutator DC motor are due to the need for _____________to press against the commutator. This creates friction.
A. Brushes D. Windings
B. Motor control(s) E. Motor enclosure
C. Wires F. None of the Above

61. At higher speeds, brushes have increasing difficulty in maintaining contact. ___________ may bounce off the irregularities in the commutator surface, creating sparks. This limits the maximum speed of the machine.
A. Brushes D. Windings
B. Motor control(s) E. Motor enclosure
C. Wires F. None of the Above

62. The current density per unit area of the __________ limits the output of the motor. The imperfect electric contact also causes electrical noise.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. DC motor(s)
C. Stator F. None of the Above

63. _______________ eventually wear out and require replacement, and the commutator itself is subject to wear and maintenance. The commutator assembly on a large machine is a costly element, requiring precision assembly of many parts.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. DC motor(s)
C. Stator F. None of the Above

Brushless DC Motors
64. Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical "rotating switch" or commutator/brush gear assembly is replaced by _______________ synchronized to the rotor's position.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. An external electronic switch
C. Stator F. None of the Above

65. ______________ motors are typically 85-90% efficient, whereas DC motors with brush gear are typically 75-80% efficient.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. Brushless
C. Stator F. None of the Above

66. Midway between ordinary DC motors and _____________lies the realm of the brushless DC motor. Built in a fashion very similar to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall Effect sensors to sense the position of the rotor, and the associated drive electronics.
A. Stepper motors D. Direct Current (DC)
B. AC power E. An asynchronous motor
C. DC motor(s) F. None of the Above

67. The coils are activated one phase after the other by the drive electronics, as cued by the signals from the____________ . In effect, they act as three-phase synchronous motors containing their own variable-frequency drive electronics.
A. Brush(es) D. Permanent magnet stator
B. Rotating switch E. Hall effect sensors
C. Stator F. None of the Above

68. _________________are commonly used where precise speed control is necessary, as in computer disk drives or in video cassette recorders, the spindles within CD, CD-ROM (etc.) drives, and mechanisms within office products such as fans, laser printers, and photocopiers.
A. Stepper motors D. Direct Current (DC)
B. AC power E. Brushless DC motors
C. DC motor(s) F. None of the Above

Components
A typical AC motor consists of two parts:
69. _________________ having coils supplied with AC current to produce a rotating magnetic field.
A. Torque motor(s) D. Slip ring or wound rotor motor
B. An inside rotor E. An outside stationary stator
C. Standard squirrel cage motor F. None of the Above

70. _____________ attached to the output shaft that is given a torque by the rotating field.
A. Torque motor(s) D. Slip ring or wound rotor motor
B. An inside rotor E. An outside stationary stator
C. Standard squirrel cage motor F. None of the Above

Torque motors
71. A ____________ is a specialized form of induction motor which 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 torque to the load (hence the name).
A. Torque motor(s) D. Slip ring or wound rotor motor
B. An inside rotor E. An outside stationary stator
C. Standard squirrel cage motor F. None of the Above

72. A common application of a _________ would be the supply- and take-up reel motors in a tape drive. In this application, driven from a low voltage, the characteristics of these motors allow a relatively-constant light tension to be applied to the tape whether or not the capstan is feeding tape past the tape heads.
A. Torque motor(s) D. Slip ring or wound rotor motor
B. An inside rotor E. An outside stationary stator
C. Standard squirrel cage motor F. None of the Above

73. Driven from a higher voltage, (and so delivering a higher torque), the torque motors can also achieve fast-forward and rewind operation without requiring any additional mechanics such as gears or clutches. In the computer world, ____________ are used with force feedback steering wheels.
A. Torque motor(s) D. Slip ring or wound rotor motor
B. An inside rotor E. An outside stationary stator
C. Standard squirrel cage motor F. None of the Above

Slip Ring

74. The _____________ is an induction machine where the rotor comprises a set of coils that are terminated in slip rings to which external impedances can be connected. The stator is the same as is used with a standard squirrel cage motor.

A. Torque motor(s)
B. Inside rotor
C. Standard squirrel cage motor
D. Slip ring or wound rotor motor
E. Outside stationary stator
F. None of the Above

75. By changing the impedance connected to the_______, the speed/current and speed/torque curves can be altered.

A. Rotor circuit
B. Rotating switch
C. Stator
D. Permanent magnet stator
E. Hall effect sensors
F. None of the Above

76. The ______________ 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. Torque motor(s)
B. Inside rotor
C. Standard squirrel cage motor
D. Slip ring motor
E. Outside stationary stator
F. None of the Above

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

A. Torque motor(s)
B. Inside rotor
C. Standard squirrel cage motor
D. Slip ring
E. Outside stationary stator
F. None of the Above

78. A secondary use of the ________________ is to provide a means of speed control.

A. Torque motor(s)
B. Inside rotor
C. Standard squirrel cage motor
D. Slip ring motor
E. Outside stationary stator
F. None of the Above

79. 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. Rotating switch
C. Stator
D. Permanent magnet stator
E. Hall effect sensors
F. None of the Above

80. If the resistance connected to the __________ is increased beyond the point where the maximum torque occurs at zero speed, the torque will be further reduced.

A. Rotor
B. Rotating switch
C. Stator
D. Permanent magnet stator
E. Hall effect sensors
F. None of the Above

81. 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. Torque motor(s)
B. An inside rotor
C. Standard squirrel cage motor
D. Load torque
E. An outside stationary stator
F. None of the Above

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

A. Rotor circuit
B. Rotating switch
C. Stator
D. Permanent magnet stator
E. Hall effect sensors
F. None of the Above

83. Operated in this manner, the ______________are dissipated in the secondary resistors and can be very significant. The speed regulation is also very poor.
A. Torque motor(s)
B. Slip losses
C. Standard squirrel cage motor
D. Slip ring or wound rotor motor
E. Stationary stator
F. None of the Above

Stepper Motors
84. Closely related in design to _________________are stepper motors, 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. Stepper motor(s)
B. AC power
C. DC motor(s)
D. Three-phase AC synchronous motor(s)
E. Brushless DC motor(s)
F. None of the Above

85. A _____________ 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. Stepper motor(s)
B. AC power
C. DC motor(s)
D. Three-phase AC synchronous motor(s)
E. Brushless DC motor(s)
F. None of the Above

86. Unlike a synchronous motor, in its application, the motor may not rotate continuously; instead, it "steps" from one position to the next as ______________are energized and de-energized in sequence. Depending on the sequence, the rotor may turn forwards or backwards.
A. Rotor circuit
B. Rotating switch
C. Stator
D. Permanent magnet stator
E. Field windings
F. None of the Above

87. Simple stepper motor drivers entirely energize or entirely de-energize the field windings, leading the rotor to "cog" to a limited number of positions; _____________can proportionally control the power to the field windings, allowing the rotors to position between the cog points and thereby rotate extremely smoothly.
A. Rotor circuit
B. Rotating switch
C. More sophisticated drivers
D. Permanent magnet stator
E. Field windings
F. None of the Above

88. Computer controlled _____________ are one of the most versatile forms of positioning systems, particularly when part of a digital servo-controlled system.
A. Stepper motor(s)
B. AC power
C. DC motor(s)
D. Three-phase AC synchronous motor(s)
E. Brushless DC motor(s)
F. None of the Above

Motor Review Section
Reviewing D-C Motors
89. An electric motor can be configured as a _____________, a stepper motor or a rotational machine.
A. DC electric motor
B. AC electric motor
C. Solenoid
D. Three-phase AC synchronous motors
E. Computer controlled stepper motors
F. None of the Above

90. In order to understand how a direct current (DC) electric motor operates, a few basic principles must be understood. Just as in Faraday's experiment, the DC motor works with ___________ and electrical current.
A. Force
B. Magnetic field(s)
C. Electric charges
D. DC motor
E. Permanent magnet
F. None of the Above

91. Centuries ago it was discovered that a stone found in Asia, referred to as a lodestone, and had an unusual property that would transfer _____________to an iron object when the stone was rubbed against it.
A. Force D. An invisible force
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

92. These lodestones were found to align with the _____________when freely hanging on a string or floated on water, and this property aided early explorers in navigating around the earth.
A. Force D. Earth's north-south axis
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

93. It was understood later that this stone was a ___________ with a field that had two poles of opposite effect, referred to as north and south.
A. Force D. Motor
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

94. The magnetic fields, just like electric charges, have __________ that are opposite in their effects.
A. Force(s) D. DC motors
B. Magnetic field(s) E. Permanent magnets
C. Electric charges F. None of the Above

95. Electric charges are either positive or negative, whereas magnetic fields have a north-south orientation. When ______________ are aligned at opposite or dissimilar poles, they'll exert considerable forces of attraction with one another, and when aligned at like or similar poles, they'll strongly repel one another.
A. Forces D. Similar poles
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

96. The magnetic field will pull or put a force upon a ferrous (magnetic) material. If iron particles are sprinkled on a paper sheet over a permanent magnet, the alignment of the iron particles maps the magnetic field, which shows that this field leaves one pole and enters the other pole with the ____________ field being unbroken.
A. Force D. DC motor
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

97. As with any kind of field (electric, magnetic or gravitational), the total quantity, or effect, of the field is referred to as the flux, while the push causing the flux to form in space is called a force. This ________field is comprised of many lines of flux, all starting at one pole and returning to the other pole.
A. Force D. Magnetic force
B. Magnetic field(s) E. Permanent magnet
C. Electric charges F. None of the Above

Pump Introduction

98. ____________________are used to move or raise fluids. They are not only very useful, but are excellent examples of hydrostatics.
A. The lift pumps D. The force and lift pumps
B. The force pumps E. Pumps
C. The Bellows F. None of the Above

99. Pumps are of two general types, hydrostatic or positive displacement pumps, and pumps depending on dynamic forces, such as______________________.
A. Centrifugal pumps D. The force and lift pumps
B. The force pumps E. The Roots blowers
C. The Bellows F. None of the Above

Pump Safety Regulations

100. Before installing and operating or performing maintenance on the pump and associated components described in this manual, it is important to ensure that it covers ______________ from high speed rotating machinery.

A. The minor and major hazards
B. The severe dangers
C. The hazards arising
D. Interest of personal safety
E. Due consideration
F. None of the Above

101. It is also important that ______________ consideration be given to those hazards which arise from the presence of electrical power, hot oil, high pressure and temperature liquids, toxic liquids and gases, and flammable liquids and gases.

A. Minor
B. Severe
C. Due
D. Interest of personal safety and
E. Little
F. None of the Above

102. Proper installation and care of protective guards, shut-down devices and over pressure protection equipment must also be considered.

A. Minor
B. Severe
C. The hazards arising
D. Interest of personal safety
E. An essential part of any safety program
F. None of the Above

103. In the following safety procedures you will encounter the words DANGER, WARNING, CAUTION, and NOTICE. These are intended to ______________in the interest of personal safety and satisfactory pump operation and maintenance.

A. Scare
B. Create fear
C. Inform of the hazards arising
D. Emphasize certain areas
E. Warn
F. None of the Above

The definitions of these words are as follows:

104. "DANGER" Danger is used to indicate the presence of a hazard which will cause____________, death, or substantial property damage if the warning is ignored.

A. Severe personal injury
B. Create fear
C. Inform of the hazards arising
D. Emphasize certain areas
E. Minor personal injury
F. None of the Above

105. "WARNING" Warning is used to indicate the presence of a hazard which can cause __________________, death, or substantial property damage if the warning is ignored.

A. Severe personal injury
B. Create fear
C. Inform of the hazards arising
D. Emphasize certain areas
E. Minor personal injury
F. None of the Above

106. "CAUTION" Caution is used to indicate the presence of a hazard which will or can cause ________________ , death, or substantial property damage if the warning is ignored.

A. Severe personal injury
B. Create fear
C. Inform of the hazards arising
D. Emphasize certain areas
E. Minor personal injury
F. None of the Above

Complicated Pumps

107. ______________ have valves allowing them to work repetitively. These are usually check valves that open to allow passage in one direction, and close automatically to prevent reverse flow. There are many kinds of valves, and they are usually the most trouble-prone and complicated part of a pump.

A. On the discharge side of pumps
B. Suction side of the pumps
C. The discharge valve on pumps
D. Vanes of the impeller on the liquid
E. Positive displacement pumps
F. None of the Above

108. ________________has two check valves in the cylinder, one for supply and the other for delivery. The supply valve opens when the cylinder volume increases, the delivery valve when the cylinder volume decreases.
A. Diaphragm pumps D. The force pump
B. The Roots blower E. Fire fighting force pumps
C. The Bicycle pump F. None of the Above

109. ______________ has a supply valve and a valve in the piston that allows the liquid to pass around it when the volume of the cylinder is reduced. The delivery in this case is from the upper part of the cylinder, which the piston does not enter.
A. The lift pump D. The force and lift pumps
B. The force pump E. The Roots blower
C. The Bellow F. None of the Above

110. _______________ 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 one side of the diaphragm.
A. Diaphragm pumps D. The free pumps
B. The Roots blower E. Fire fighting force pumps
C. The Bicycle pumps F. None of the Above

111. The force and lift pumps are typically used for water. _____________ has two valves in the cylinder, while the lift pump has one valve in the cylinder and one in the piston.
A. The lift pump D. The force and lift pump
B. The force pump E. The Roots blower
C. The Bellows F. None of the Above

112. The maximum lift, or "suction," is determined by the atmospheric pressure, ______________must be within this height of the free surface.
A. On the discharge side D. Vanes of the impeller on the liquid
B. Suction side of the pump E. And either cylinder
C. The discharge valve F. None of the Above

113. ________________, however, can give an arbitrarily large pressure to the discharged fluid, as in the case of a diesel engine injector. A nozzle can be used to convert the pressure to velocity, to produce a jet, as for firefighting.
A. The lift pump D. The force and lift pump
B. The force pump E. The Roots blower
C. The Bellows F. None of the Above

114. __________ usually have two cylinders feeding one receiver alternately. The air space in the receiver helps to make the water pressure uniform.
A. Diaphragm pumps D. Diaphragm pumps
B. The Roots blower E. Fire fighting force pumps
C. The Bicycle pump F. None of the Above

115. ________________ has no valves, their place taken by the sliding contact between the rotors and the housing.
A. The lift pump D. The force and lift pumps
B. The force pump E. The Roots blower
C. The Bellows F. None of the Above

116. ____________ can either exhaust a receiver or provide air under moderate pressure, in large volumes.
A. Diaphragm pumps D. Diaphragm pumps
B. The Roots blower E. Fire fighting force pumps
C. The Bicycle pump F. None of the Above

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

A. The lift pump
B. The force pump
C. The Bellows
D. The force and lift pumps
E. The Roots blower
F. None of the Above

Fluid Properties

The properties of the fluids being pumped can significantly affect the choice of pump. Key considerations include:

118. Acidity/alkalinity (pH) and chemical composition. _____________can degrade pumps, and should be considered when selecting pump materials.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Corrosive and basic fluids
E. Corrosive and acidic fluids
F. None of the Above

119. Operating temperature. Pump materials and expansion, mechanical seal components, and packing materials need to be considered with______________________.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Pumped fluids that are hotter than 200°F
E. Corrosive and acidic fluids
F. None of the Above

120. Solids concentrations/particle sizes. 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 ______________________.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Pump materials
E. Volumetric percentage of solids
F. None of the Above

121. Specific gravity. The fluid specific gravity is the ratio of the _______________to that of water under specified conditions.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Pump materials
E. Corrosive and acidic fluids
F. None of the Above

122. ____________________affects the energy required to lift and move the fluid, and must be considered when determining pump power requirements.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Pump materials
E. Specific gravity
F. None of the Above

123. Vapor pressure. A fluid's vapor pressure is the force per unit area that a fluid exerts in an effort to change phase from a liquid to a vapor, and depends on the fluid's chemical and physical properties. Proper consideration of the fluid's vapor pressure will help to minimize the____________________.

A. Fluid's vapor pressure
B. Fluid density
C. Kinematic viscosity
D. Material size
E. Risk of cavitation
F. None of the Above

Types of Pumps

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

A. Kinetic Energy
B. Centrifugal
C. Dynamic
D. Vanes of the impeller
E. Positive displacement
F. None of the Above

Dynamic Pumps (Centrifugal Pump)
Centrifugal pumps are classified into three general categories:
125. Radial flow—a centrifugal pump in which the pressure is developed wholly by _______________.
A. Kinetic Energy
B. Centrifugal force
C. Dynamic
D. Vanes of the impeller
E. Positive displacement
F. None of the Above

126. Mixed flow—a centrifugal pump in which the pressure is developed partly by centrifugal force and partly by the lift of the ________________________.
A. On the discharge side
B. Suction side of the pump
C. The discharge valve
D. Vanes of the impeller on the liquid
E. Positive displacement
F. None of the Above

127. Axial flow—a centrifugal pump in which the pressure is developed by the propelling or lifting action of the __________________ on the liquid.
A. Kinetic Energy
B. Centrifugal force
C. Dynamic
D. Vanes of the impeller
E. Positive displacement
F. None of the Above

A centrifugal pump has two main components:
128. I. A rotating component comprised of________________. II. A stationary component comprised of a casing, casing cover, and bearings.
A. An impeller and a shaft
B. Suction side of the pump
C. The discharge valve
D. Vanes of the impeller on the liquid
E. Positive displacement
F. None of the Above

Pump Types come in Two Main Categories
129. Centrifugal Pumps and Positive Displacement Pumps as classified according to the method of how the energy is imparted to the fluid – _________________ and again each of these categories having many pump types.
A. Reciprocating and rotary
B. Increases and decreases
C. Increase the pressure
D. Kinetic Energy or Positive Displacement
E. Unlike a Centrifugal Pump
F. None of the Above

Centrifugal Pump
130. Types the ____________ type which imparts velocity energy to the pumped medium which is converted to pressure energy when discharging the pump casing and can be grouped according to several criteria, further to that a specific pump can belong to different groups.
A. Kinetic Energy
B. Centrifugal
C. Dynamic
D. Vanes of the impeller
E. Positive displacement
F. None of the Above

Positive Displacement Pump
131. Types impart energy by mechanical displacement, these are of a lower flow range and are pulsating. PD pumps divided into two classes – __________________.
A. Reciprocating and rotary
B. Increases and decreases
C. Increase the pressure
D. Kinetic Energy or Positive Displacement
E. Unlike a Centrifugal Pump
F. None of the Above

Plunger Pumps
132. Plunger pumps have a cylinder with a reciprocating plunger. The suction and discharge valves are mounted in the head of cylinder. The suction stroke pulls the plunger back, suction valve opens and fluid is sucked into the cylinder. The discharge stroke pushes the plunger forward closing ____________and pushing fluid out of the discharge valve.
A. On the discharge side
B. Suction side of the pump
C. The discharge valve
D. Suction valve
E. Positive displacement suction valve
F. None of the Above

Diaphragm Pumps

133. Diaphragm pump types simply put use the plunger to pressurize either air or hydraulic fluid on one side which flexes the diaphragm which ________________ the volumetric area in the pumping chamber; non-return check valves ensure no back flow of the fluid.

A. Increases
B. Increases and decreases
C. Increases the pressure
D. Decreases the kinetic Energy
E. Unlike a Centrifugal pump and increases
F. None of the Above

Positive Displacement Pumps

134. A Positive Displacement Pump has an expanding cavity on the suction side of the pump and _________.

A. Increases the pressure
B. Suction side of the pump
C. The discharge valve
D. A decreasing cavity on the discharge side
E. Positive displacement
F. None of the Above

135. 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____________________.

A. On the discharge side
B. Suction side of the pump
C. The discharge valve
D. Vanes of the impeller on the liquid
E. The cavity collapses
F. None of the Above

136. A Positive Displacement Pump, unlike a Centrifugal Pump, will produce the same flow at a given RPM no matter what________________________.

A. The discharge pressure is
B. Atmospheric pressure
C. The vertical distance
D. Gas volumetrically displacing a disproportion of liquid
E. Build-up of pressure
F. None of the Above

137. A Positive Displacement Pump cannot be operated against a closed valve on the discharge side of the pump, i.e. it does not have a shut-off head like_______________________.

A. A Centrifugal Pump does
B. Suction side of the pump
C. The discharge valve
D. Vanes of the impeller on the liquid
E. Positive displacement
F. None of the Above

138. If a Positive Displacement Pump is allowed to operate against a closed discharge valve it will continue to produce flow which will _______________until either the line bursts or the pump is severely damaged or both.

A. Discharge
B. Increase the water level
C. Increase the boiling point
D. Increase the suction feet (or meters) of head
E. Increase the pressure in the discharge line
F. None of the Above

Plunger Pump

139. The plunger pump is a positive displacement pump that uses a plunger or piston to force _________________to the discharge side of the pump. It is used for heavy sludge.

A. Liquid from the suction side
B. Atmospheric pressure
C. The vertical distance
D. Gas volumetrically displacing a disproportion of liquid
E. Build-up of pressure
F. None of the Above

140. The movement of the plunger or piston inside the pump creates pressure inside the pump, so you have to be careful that this kind of pump is never operated_________________________.

A. Discharge side of the pump
B. Against any water level
C. Against any boiling point
D. Against any closed discharge valve
E. With a particular combination of flow rate and head
F. None of the Above

141. All discharge valves must be open before the pump is started, to prevent ______________ that could damage the pump.

A. Cavitation bubbles
B. Atmospheric pressure
C. The vertical distance
D. Gas volumetrically displacing a disproportion of liquid
E. Any fast build-up of pressure
F. None of the Above

Diaphragm Pumps

142. In this type of pump, a diaphragm provides _____________used to force liquid from the suction to the discharge side of the pump.

A. Discharge side of the pump
B. The mechanical action
C. The robot dance action
D. Suction
E. A particular combination of flow rate and head
F. None of the Above

Pump Specifications

143. Pumps are commonly rated by horsepower, flow rate, ______________in meters (or feet) of head, inlet suction in suction feet (or meters) of head.

A. Discharge side of the pump
B. Water level
C. Outlet pressure
D. Suction feet (or meters) of head
E. A particular combination of flow rate and head
F. None of the Above

Suction Lift Chart

144. The vertical distance that a pump may be placed above ___________ (and be able to draw water) is determined by pump design and limits dictated by altitude.

A. The water level
B. Atmospheric pressure
C. The vertical distance
D. Gas volumetrically displacing a disproportion of liquid
E. To prevent any fast build-up of pressure
F. None of the Above

145. The closer the pump is to the ____________, the easier and quicker it will be to prime.

A. Discharge side of the pump
B. Water level
C. Boiling point
D. Suction
E. Flow rate and head
F. None of the Above

146. Fluid flows from areas of high pressure to areas of low pressure. Pumps operate by creating low pressure at the inlet which allows the liquid to be pushed into the pump by ______________(pressure due to the liquid's surface being above the centerline of the pump).

A. Discharge side of the pump
B. Water level
C. Atmospheric or head pressure
D. Suction feet (or meters) of head
E. A particular combination of flow rate and head
F. None of the Above

Pump Efficiency

147. 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 _____________________and therefore also operating head.

A. Dynamic
B. Discharge
C. Pump performance data
D. Point of its maximum efficiency
E. Motor efficiency
F. None of the Above

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

A. Dynamic
B. Pump efficiency
C. Pump performance data
D. Point of its maximum efficiency
E. Peak efficiency
F. None of the Above

149. Pump performance data such as this is usually supplied by the manufacturer before pump selection. _____________________tend to decline over time due to wear (e.g. increasing clearances as impellers reduce in size).

A. Dynamic efficiency
B. Motor efficiency
C. Pump performance data
D. Point of its maximum efficiency
E. Pump efficiencies
F. None of the Above

150. When a system design includes a centrifugal pump, an important issue it its design is matching the head loss-flow characteristic with the pump so that it operates at or close to the point of_________________.
A. Dynamic efficiency D. Its maximum efficiency
B. Pump efficiency E. Motor efficiency
C. Pump performance data F. None of the Above

You are finished with your assignment. Please fax or email the answer key and registration form and call us to ensure we received it.