

Collections Questions by Indigo Water Group

More Questions Coming Soon!

Name: _____

Date: _____ Period: _____

1. PS43. When the motor is mounted parallel to the pump intake in a centrifugal pump, the pump is described as:
 - (A) Vertical centrifugal
 - (B) Dual suction
 - (C) Split case
 - (D) Horizontal end-suction
2. IT13. One method of televising through flooded low spots or dips in a sewer line is to:
 - (A) Install high-power lamp on camera
 - (B) Use a high velocity cleaner to push water clear of the dip
 - (C) Dip up the low spot and repair the sewer
 - (D) Ram the camera through the low spot
3. D2. These gravity lines are located at the beginning or outermost portions of the collection system.
 - (A) Lateral and Branch Sewers
 - (B) Flow Regulator
 - (C) Backflow Preventer
 - (D) Junction Structure
 - (E) Sewer Vent Trap
 - (F) Intercepting Sewers
 - (G) Lift Stations
 - (H) Grinder Pumps
4. PS41. Discharge cavitation results when pumped water creates eddies at the edges of the impeller rather than leaving through the discharge line. Turbulence is created at the impeller edge. Discharge cavitation may be caused by all of the following EXCEPT:
 - (A) Pumping against excessive head
 - (B) Discharge line diameter too small
 - (C) Excessive suction head
 - (D) Partially clogged discharge line
5. P9. Collection systems are designed for this type of flow
 - (A) Average daily
 - (B) Peak hour
 - (C) Maximum day
 - (D) Maximum month
6. SG2. Hydrogen sulfide is a toxic gas that smells like _____. At high concentrations of hydrogen sulfide; however, the sense of smell is deadened and no odor is detected.
 - (A) Fuel gas
 - (B) Dead fish
 - (C) Rotten eggs
 - (D) Rotten cabbage
7. Chlorine dose is always equal to
 - (A) The measured free chlorine
 - (B) The measured residual chlorine
 - (C) Demand minus residual
 - (D) The chlorinator setting less the residual
 - (E) Residual plus demand
8. SG16. Biological activity in long, sluggish-flow, flat-grade sewer lines will likely
 - (A) Increase the carrying capacity of the line
 - (B) Create oxygen deficiency in the air in manholes, sewers, or wet wells in that area
 - (C) Decrease line sediment
 - (D) Stop toxic gas production

9. PS6. If the wet well level is above the center line of the pump impeller, then the suction head is
- (A) Negative
 - (B) Two feet lower than the discharge head
 - (C) About equal to the discharge head
 - (D) Positive
10. PS16. Wet well sizes must be large enough to minimize _____ but small enough to _____.
- (A) Overflow of raw sewage / minimize hydrogen sulfide generation
 - (B) The pump size required / minimize the accumulation of solids in the wet well
 - (C) Pump cycles per hour / maximize release of toxic gasses
 - (D) Pump cycles per hour / minimize the accumulation of solids in the wet well
11. P30. What is the average flow velocity in ft/sec in a 12-in diameter force main carrying a daily flow of 2.5 mgd?
- (A) 5.3 ft/s
 - (B) 18.0 ft/sec
 - (C) 18.85 ft/sec
 - (D) 4.9 ft/sec
12. IT23. Grease should never be allowed to accumulate on the CCTV camera lense for this reason.
- (A) Heat from the lamp could ignite the grease and damage the lamp
 - (B) It can become baked onto the lens and is very difficult to remove later
 - (C) Grease can attract additional dirt
 - (D) Grease smears the camera image making it difficult to avoid obstructions in the pipe
13. P26. The density of water is
- (A) 62.4 lbm/cuft
 - (B) 32.5 lbm/cuft
 - (C) 8.34 lbm/cuft
 - (D) 7.48 lbm/cuft
14. PS39. The primary cause of pump cavitation is insufficient energy in the form of pressure head at the inlet to the pump.
- (A) False
 - (B) True
15. IT2. When opening a power rodder properly, do the following:
- (A) Make sure all the torque is out of a broken rod before handling
 - (B) Rod past dropped joints or through a crushed pipe
 - (C) Push the rodding tool into an obstruction and hold it there to break up the obstruction
 - (D) Rotate the rod in one position
16. PS44. A centrifugal pump is discharging greater than the desired amount of flow. The operator can decrease the amount of flow by
- (A) Ensuring all intake valves are in the open position
 - (B) Increasing motor speed
 - (C) Increasing the size of the impeller
 - (D) Partially closing a downstream valve
17. PS15. A wet well is 8 ft diameter. The low level water level is 2 feet and the high water level is 10 feet. Water is entering the lift station at a rate of 10 gpm. If the maximum number of pump on/off cycles per hour desired is 3, what capacity pump should be installed? Express your answer in gpm.
- (A) 29 gpm
 - (B) 70 gpm
 - (C) 15 gpm
 - (D) 45 gpm
18. P15. As population increases and the size of the collection area expands, the peaking factor used to estimate peak hour flows
- (A) Remains about the same
 - (B) Depends on the number of lift stations in the system
 - (C) Increases
 - (D) Decreases
19. PS57. Progressive cavity pumps consist primarily of these components
- (A) Rotor and stator
 - (B) Lobes and Rotor
 - (C) Impeller and motor
 - (D) Vanes and stator

20. P3. Collection systems are comprised of these types of pipes
 (A) Laterals and gravity lines
 (B) Interceptors and Laterals
 (C) Gravity lines and force mains
 (D) Force mains and interceptors
21. IT9. Accumulated air in force mains may be released by
 (A) Altitude control valves
 (B) Check valves
 (C) Air release valves
 (D) Blowers
22. P17. Find the flow velocity in a 15-inch sewer line that is flowing half full when the flow rate is 3 cfs.
 (A) 22.5 fps
 (B) 1.8 fps
 (C) 4.9 fps
 (D) 2.4 fps
23. The Occupational Safety and Health Administration (OSHA) has set the PEL limit for chlorine at 0.5 ppm as an 8 hour average. OSHA further stipulates that the chlorine concentration may not exceed _____ at any time.
 (A) 500 ppm
 (B) 30 ppm
 (C) 1 ppm
 (D) 5 ppm
24. PS75. The purpose of a check valve is to
 (A) Prevent the pump from losing prime
 (B) Adjust the discharge from the pump
 (C) Minimize clogging
 (D) Prevent the force main from draining back into the wet well
25. IT24. One method for locating sources of inflow and infiltration
 (A) Dye testing
 (B) Sewer balling
 (C) Smoke testing
 (D) Jetting
26. P35. The main interceptor in a collection system is 3.2 miles long and 24 inches in diameter. If the starting elevation is 4935 feet and the ending elevation is 4712 feet, what is the slope of the pipeline?
 (A) 0.147
 (B) 0.002
 (C) 0.013
 (D) 1.3
27. What is the Permissible Exposure Limit (PEL) for chlorine gas?
 (A) 30 ppm
 (B) 1.0 ppm
 (C) 5 ppm
 (D) 0.5ppm
28. D11. The device pictured here is one way to prevent sewer gases from entering buildings. <d11.jpg>
 (A) Trunk Sewers
 (B) Junction Structure
 (C) Cleanout
 (D) Sewer Vent Trap
 (E) Lateral and Branch Sewers
 (F) Main Sewers
 (G) Backflow Preventer
 (H) Air Jumper
29. PS19. Check valves are used on the discharge side of centrifugal pumps to:
 (A) Equalize the pressure on both sides of the impeller
 (B) Regulate the rate of water flow through the discharge pipe
 (C) Prevent water in the discharge line from flowing back through the pump
 (D) Prevent water in the suction line from flowing back into the reservoir

30. IT6. When the carrying capacity of a pipe is exceeded, this condition may result
- (A) Surcharging
 - (B) Inflow
 - (C) Increased flow velocity
 - (D) Infiltration
31. P25. Hydrogen sulfide production in sewer mains is problematic because
- (A) Hydrogen sulfide causes iron precipitation
 - (B) Extremely low concentrations of hydrogen sulfide are toxic to other more beneficial microorganisms in the collection system
 - (C) It combines with oxygen and is converted to sulfuric acid which attacks the crowns of concrete pipes
 - (D) It binds irreversibly to the pipe interior causing scale buildup
32. PS40. Suction cavitation is caused by exceeding the atmospheric pressure required to keep liquid in a liquid state. Instead, the liquid reacts as though it were boiling.
- (A) True
 - (B) False
33. PS3. If air release valves are not installed at the high points of force mains, this condition may result.
- (A) Crown corrosion
 - (B) Pipe breakage
 - (C) Cavitation
 - (D) Water hammer
34. IT20. The CCTV camera lens has become covered with dirt and debris after moving through some standing water in the sewer line. The operator should
- (A) Back the camera slowly up to the first manhole, remove it, and clean the lens
 - (B) Continue forward in the hopes that the dirt and debris will work themselves loose
 - (C) Move the camera back and forth in the water to create a wave over the front of the camera
 - (D) Send a high pressure cleaner up from the downstream manhole to meet the camera and clean the lens
35. SG12. If you were in charge of a large operation with four foremen, three whose work was exceptionally good and a fourth whose work was substandard, what should you do?
- (A) Ridicule the substandard foreman in front of his crew
 - (B) Find a replacement, then fire the substandard foreman
 - (C) Wait to see if the substandard foreman does better
 - (D) Demote the substandard foreman and bring up a replacement from the ranks
 - (E) Discuss the problem with the substandard foreman and offer to help before any other action is taken
36. P29. What is the flow rate (gpm) from a pump with a discharge diameter of 6" and a velocity of 5 ft/sec?
- (A) 198 gpm
 - (B) 440 gpm
 - (C) 338.5 gpm
 - (D) 44 gpm
37. P19. Combined sewer systems collect these flows
- (A) Storm water
 - (B) Untreated industrial discharges
 - (C) Both domestic wastewater and untreated industrial discharges
 - (D) Domestic wastewater
 - (E) Both domestic wastewater and stormwater
38. SG20. Shoring must protrude _____ above the top of the excavation
- (A) 1 foot
 - (B) 24 inches
 - (C) 18 inches
 - (D) 3 feet
39. SG17. Biological hazards in collection system operations include:
- (A) Noxious or toxic gases
 - (B) Hepatitis A
 - (C) Oxygen deficiency
 - (D) Physical injuries

40. PS59. The firm pumping capacity of a lift station may be defined as
- (A) The pumping capacity of the largest pump in the station
 - (B) The combined pumping capacity of all the pumps in the station multiplied by a safety factor of 0.8
 - (C) The pumping capacity of the station when the largest pump is out of service
 - (D) The average pumping capacity of all pumps in the station
41. HTH stands for
- (A) Hyper Thymine Hypochlorite
 - (B) High sTrengh Hypochlorite
 - (C) High Test Hypochlorite
 - (D) Hypochlorite Tablet Holder
42. Chloramines are formed when chlorine reacts with this compound
- (A) Amino acids
 - (B) Amyl Nitrile
 - (C) Amylase
 - (D) Ammonia
43. PS5. Suction head on a pump is
- (A) Negative
 - (B) Either negative or positive
 - (C) Positive
44. PS64. Hydrogen sulfide can be detected by the human nose at concentrations as low as
- (A) Hydrogen sulfide is odorless
 - (B) 0.1 mg/L
 - (C) 10 mg/L
 - (D) 1.0 mg/L
45. PS24. Enclosed, open, and recessed are terms used for the designation and selection of
- (A) Sleeves
 - (B) Stuffing boxes
 - (C) Lantern rings
 - (D) Impellers
46. PS46. The brake horsepower calculation includes energy losses in this component
- (A) Motor
 - (B) Pump, motor, and downstream piping
 - (C) Pump and motor
 - (D) Pump
47. IT34. This testing method can prove beyond a doubt that a building is connected to the sanitary sewer.
- (A) Smoke testing
 - (B) CCTV
 - (C) Lamping
 - (D) Dye testing
48. P21. The minimum self-cleansing velocity for a gravity sewer line is accepted as:
- (A) 1 m/sec
 - (B) 10 ft/sec
 - (C) 2 ft/min
 - (D) 2 ft/sec
49. PS58. A pump is used to pump wastewater from a wet well uphill 250 feet to the next manhole. Wastewater enters the wetwell at 1.5 cfs and the pump removes it at the same rate. The pump is 90% efficient and the motor is 85% efficient. What is the wire to water efficiency?
- (A) 90 percent
 - (B) 76.5 percent
 - (C) 85 percent
 - (D) 94.4 percent
50. PS29. In a centrifugal pump, where does water enter the volute?
- (A) At the eye of the impeller
 - (B) Through the stuffing box
 - (C) Horizontally with respect to the pump discharge
 - (D) Adjacent to the lantern ring

51. IT29. Smoke testing is excellent for proving a positive connection to the collection system. It cannot be used to locate
- (A) A missing cap on a cleanout
 - (B) An basement sump pump improperly connected to the sanitary sewer
 - (C) Cracked pipes underground
 - (D) Broken service connections
52. PS12. Cavitation may be caused by all of these things EXCEPT
- (A) Air leaks on the suction side of the pump
 - (B) Restrictions in the suction line
 - (C) Entrained solids
 - (D) Excessive tip speed of the impeller
53. PS2. Install one of these devices at the highest point in a force main to get entrained air out of the system.
- (A) Inverted siphon
 - (B) Backflow preventer
 - (C) Air release valve
 - (D) Vacuum release valve
54. P14. Scouring velocities should be reached or exceeded
- (A) Only during storm events
 - (B) During peak flows
 - (C) At average daily flow
 - (D) Throughout the day
55. PS4. Air and vacuum release valves may not function properly if this is allowed to happen
- (A) Valve seat contaminated with grit
 - (B) Grease accumulation in valve body or operating mechanism
 - (C) Pressure in force main exceeds 15 psi
 - (D) Vacuum in force main exceeds -2.4 torr
56. SG5. If a sewer must have a flow rate of 33 mgd with a velocity between 1.09 fps and 2.25 fps, what must the minimum size be?
- (A) 93-inch
 - (B) 65-inch
 - (C) 64-inch
 - (D) 92-inch
57. The Occupational Health and Safety Administration (OSHA) set the PEL for chlorine at 0.5 ppm. This is the concentration
- (A) Safe for AVERAGE exposure concentration during an 8 hour workday
 - (B) Acceptable inside gas cylinder storage rooms
 - (C) Safe for MAXIMUM exposure concentration for two hours of an 8 hour workday
 - (D) Requiring Personal Protective Equipment (PPE) such as respirators
58. IT25. Smoke testing will be ineffective if this condition exists
- (A) Broken or crushed pipes
 - (B) Calm, clear outdoor conditions
 - (C) Partially full sewer lines
 - (D) Groundwater higher than tops of sewer pipes
59. PS60. Pump on/off cycles are controlled using
- (A) A central computer
 - (B) Lead / Lag programming
 - (C) Level
 - (D) Motor run time
60. The exhaust vents is a chlorine gas room should be located here
- (A) At the ceiling
 - (B) Near the floor
 - (C) Wherever they won't be in the way
 - (D) As close to the cylinders as possible
61. PS52. The flow output of a screw pump can be adjusted by
- (A) Partially closing a downstream valve or "throttling" the pump
 - (B) Adjust the angle of the screw
 - (C) Introducing air into the suction line
 - (D) Shortening the stroke length

62. P36. Velocities higher than _____ should be avoided in collection systems.
- (A) 5 fps
 - (B) 10 fps
 - (C) 1 fps
 - (D) 2 fps
63. IT17. When using a CCTV camera, the operator should
- (A) Use the camera as a battering ram to move past small obstructions such as grease or a protruding service
 - (B) Move the camera down the line as quickly as possible
 - (C) Never look away from the monitoring screen when the camera is moving
 - (D) Always pull the camera against the direct of flow
64. IT30. During smoke testing, an operator notices smoke rising out of the ground near a home's foundation indicating
- (A) Service connection pulled away from the foundation
 - (B) Previously unidentified manhole
 - (C) High groundwater at that location
 - (D) Illegal connection
65. SG8. Task least likely to be performed by collections systems personnel
- (A) Maintaining collection systems equipment
 - (B) Cleaning sewer blockages
 - (C) Making water tap connections
 - (D) Inspecting and testing manholes
66. PS56. This type of pump uses a mechanical operator or compressed air to move a flexible membrane up and down. Moving the membrane creates the pump cavity.
- (A) Diaphragm
 - (B) Peristaltic
 - (C) Rotary Lobe
 - (D) Plunger
 - (E) Centrifugal
67. PS21. A lantern ring is a
- (A) Metal ring for lowering an explosive-gas detector candle into manholes and wet wells
 - (B) Type of coupling for joining pipes that will not be covered or put in the dark for at least 5 days
 - (C) Shaft coupling that has been worn completely through in spots or that has "daylighted"
 - (D) Spacer ring in a pump packing gland used to improve seal water distribution
68. P10. Calculate the peak hour flow rate given the following information. Population of 50,000 people. Wastewater generation rate of 85 gpcd. Inflow and infiltration contributes an additional 10 gpcd. The ratio of average daily flow to maximum daily flow is 2.5
- (A) 11.9 mgd
 - (B) 15 cfs
 - (C) 37.5 cfs
 - (D) 4.75 mgd
69. SG13. Which of the following is a type of shore?
- (A) Aluminum hydraulic
 - (B) Sand
 - (C) Truss
 - (D) Bar
70. PS8. The discharge head on a pump is always measured from
- (A) The wet well level to the elevation that is being pumped to
 - (B) The centerline of the pump discharge
 - (C) The bottom of the pump discharge
 - (D) The wet well level to the centerline of the pump intake
71. P2. Wastewater contains solids in these two forms
- (A) Suspended and volatile
 - (B) Dissolved and suspended
 - (C) Dissolved and Total
 - (D) Total and volatile
72. PS62. Lift station wet wells should be dewatered, cleaned, and inspected
- (A) At least twice a year
 - (B) Once every five to ten years
 - (C) Every time pump maintenance is performed
 - (D) Only when there is a blockage or other issue

73. Chlorine gas is heavier than air. How much heavier?
 (A) 2.5 times
 (B) 20 percent
 (C) 35 percent
 (D) 5 times
74. Chlorine gas is detectable by most people at these concentrations because of its distinctive odor
 (A) 5.2 to 7.3 mg/L
 (B) 0.02 to 0.2 ppm
 (C) 1.0 to 2.5 ppb
 (D) 1.0 to 2.5 ppm
75. PS61. All of these are potential hazards of a confined space EXCEPT:
 (A) Oxygen deficiency
 (B) Drowning
 (C) Hydrogen sulfide
 (D) Plenty of room for working
 (E) Combustible gases
76. Chlorine may be safely stored with
 (A) Organic compounds
 (B) Oils and Solvents
 (C) Greasy machinery
 (D) None of the above
77. PS14. Calculate the total time per pump cycle (pump on to pump on) in minutes. The wet well is 20 feet square. The low level water level is 2 feet and the high water level is 12 feet. Water is entering the lift station at a rate of 200 gpm. The lead pump is capable of pumping 500 gpm.
 (A) 25 minutes
 (B) 100 minutes
 (C) 50 minutes
 (D) 200 minutes
78. PS31. Wear rings are installed within the pump housing at either end of the shaft. Wear rings are designed to
 (A) Provide a point of reference for aligning the pump shaft to the motor coupling
 (B) Transfer energy, wear, and tear from the pump shaft directly to the impeller
 (C) Assist with replacement of the stuffing box packing
 (D) Provide an easy to replace surface for the pump shaft to rub against
79. PS36. When replacing packing material in a stuffing box, the operator
 (A) Replace only the obviously damaged or worn packing
 (B) Should remove all of the packing material and replace it with new
 (C) Simply add a new ring or two of packing on top of the old
 (D) Soak new rings of packing in oil prior to placement in the stuffing box
80. PS76. Pumps draw more power when starting than during normal operation because
 (A) Downstream valves must be pushed open
 (B) Energy is needed to start the pump and motor turning
 (C) Pipe friction losses are greater
 (D) Suction head is at its greatest during startup
81. SG11. Why are gasoline and volatile solvents objectionable where present in a sewer?
 (A) They represent wasted resources
 (B) They are an explosion hazard
 (C) They tend to cause the solids to vaporize
 (D) They will coagulate floatables and cause stoppages
82. IT22. Winch cabling can be pulled rapidly through an operators hands so long as he is wearing leather work gloves.
 (A) False
 (B) True

83. D6. These are used to move wastewater from low points in the collection system to higher points in the collect system. Wastewater flows by gravity into them and by force out of them.
- (A) Lateral and Branch Sewers
 - (B) Main Sewers
 - (C) Lift Stations
 - (D) Inverted Siphon
 - (E) Air Jumper
 - (F) Trunk Sewers
 - (G) Building Sewers
 - (H) Flow Regulator
84. PS58. A pump is used to pump wastewater from a wet well uphill 250 feet to the next manhole. Wastewater enters the wetwell at 1.5 cfs and the pump removes it at the same rate. The pump is 90% efficient and the motor is 85% efficient. What is the brake horsepower?
- (A) 55 hp
 - (B) 42 hp
 - (C) 47 hp
 - (D) 12 hp
85. D9. The device pictured here may be used with a pig to remove debris from the collection system. <d9.jpg>
- (A) Inverted Siphon
 - (B) Sewer Vent Trap
 - (C) Main Sewers
 - (D) Intercepting Sewers
 - (E) Junction Structure
 - (F) Building Sewers
 - (G) Flow Regulator
 - (H) Cleanout
86. SG23. According to "Ten States Standards", when a sewer is installed parallel to a water line, it must be a minimum of _____ away (measured from the outside diameters)
- (A) 10 feet
 - (B) 6 feet
 - (C) 36 inches
 - (D) 48 inches
87. PS37. This condition may result if air bubbles are allowed to enter or form inside the pump
- (A) Nitrite lock
 - (B) Cavitation
 - (C) Tuburculation
 - (D) Red water
88. PS26. In a centrifugal pump, the suction is always _____ relative to the discharge
- (A) Expressed as a percentage
 - (B) Greater
 - (C) Larger diameter
 - (D) Ninety degrees
89. PS9. If the wet well level is above the center line of the pump impeller, then the suction head is
- (A) Two feet lower than the discharge head
 - (B) About equal to the discharge head
 - (C) Positive
 - (D) Negative
90. P34. As pipe diameters increase, the minimum amount of slope required to maintain a particular flow velocity
- (A) Increases
 - (B) Is not affected by the pipe diameter
 - (C) Decreases
91. PS7. If the wet well level is below the center line of the pump impeller, then the suction head is
- (A) Positive
 - (B) Negative
 - (C) About equal to the discharge head
 - (D) Two feet lower than the discharge head

92. IT15. This method may be used to monitor and estimate flows due to Inflow and Infiltration (I&I)
- (A) Flow measurement
 - (B) CCTV
 - (C) Lamping
 - (D) Slip lining
93. PS49. The type of pump is often used to pump chemicals because it comes in a wide range of sizes and because the pumped liquid remains separate from the pump mechanism.
- (A) Postive Displacement
 - (B) Rotary Lobe
 - (C) Peristaltic or hose
 - (D) Centrifugal
94. IT26. Prior to beginning smoke testing, the operator should
- (A) Notify the fire department and residents that smoke testing will take place
 - (B) Use a blower to establish positive air flow in the collection system
 - (C) Verify that the ground is saturated with water
 - (D) Install pipe plugs to isolate the section of pipe being tested
 - (E) Both a and b
 - (F) Answers a, b, and d are correct
95. SG10. What information must be on a warning tag attached to a switch that has been locked out?
- (A) Name of the nearest physician to call in case of an emergency
 - (B) Time to unlock the switch
 - (C) Directions for removing the tag
 - (D) Signature of the person who locked out the switch and who is the only person authorized to remove the tag
96. PS17. Aluminum should not come into direct contact with concrete. If it does, this will happen
- (A) Sparking
 - (B) Accumulation of hydrogen sulfide crystals at the contact point
 - (C) Corrosion of the aluminum
 - (D) Localized softening of the concrete due to a chemical reaction
97. IT21. This common household substance can help prevent a CCTV camera lens from fogging
- (A) Comet
 - (B) Sodium hypochlorite solution
 - (C) Spit
 - (D) Yellow dish soap
98. IT16. This inspection technique can help locate illegal connections
- (A) Lamping
 - (B) Hydraulic modeling
 - (C) Dye testing
 - (D) CCTV
99. PS13. The primary difference between lift stations and pump station is
- (A) Lift stations employ air lift or ejectors while pump stations use pumps
 - (B) The volume of water being pumped
 - (C) Lift stations have the pumps in a dry well while pump stations use submersible pumps
 - (D) The length of the discharge pipe
- 100.SG22. Any excavation over _____ must have a ladder for the worker to get in and out of the trench
- (A) 8 feet deep
 - (B) 25 feet long
 - (C) 3 feet wide
 - (D) 4 feet deep
- 101.P23. For a gravity sewer line, the depth of flow at the design flow rate should be
- (A) Based on groundwater infiltration during a 100 year storm event
 - (B) 70 to 80% of the pipe diameter
 - (C) 100% of the pipe diameter during peak flow
 - (D) Calculated prior to accounting for inflow and infiltration loads
- 102.SG24. What is the minimum distance from the edge of the spoils to the edge of the trench?
- (A) 10 feet
 - (B) 6 feet
 - (C) 2 feet
 - (D) 18 inches

- 103.SG15. What must be checked before entering a manhole?
- (A) Atmosphere in the manhole
 - (B) Safety equipment
 - (C) Proper barricades or warning devices around a manhole
 - (D) All of the above
- 104.D10. The device pictured here ensures that wastewater can only flow in the desired direction. <d10.gif>
- (A) Air Jumper
 - (B) Junction Structure
 - (C) Lift Stations
 - (D) Lateral and Branch Sewers
 - (E) Flow Regulator
 - (F) Grinder Pumps
 - (G) Trunk Sewers
 - (H) Backflow Preventer
- 105.IT28. During smoke testing, an operator notices smoke rising from the roof vent of a building. The operator should:
- (A) Notify the home owner that one or more of their p-traps may be empty allowing smoke to enter the home
 - (B) Make a note on the log to indicate a possible cross connection point
 - (C) Call a supervisor and then the fire department
 - (D) Do nothing. Smoke should exit from the roof vent when a building is connected to the sewer system.
- 106.IT4. This term describes water that enters the collection system through cracks and holes such as broken service connections, cracked pipes, and leaky manholes.
- (A) Inflow
 - (B) Infiltration
 - (C) Subsidence
 - (D) I&I
- 107.SG25. The bottom of a water line crossing a sewer line must be _____ from the crown of the sewer
- (A) 3 feet
 - (B) 24 inches
 - (C) 18 inches
 - (D) 10 feet
- 108.PS33. A stuffing box in a centrifugal pump
- (A) Prevents air from being sucked into the volute along the pump shaft
 - (B) Prevents the pumped liquid from moving down the pump shaft to the motor
 - (C) Aids in lubrication of the shaft
 - (D) Contains the lantern ring
 - (E) All of the above
- 109.P5. The three types of collection systems are: CHECK ALL THAT APPLY.
- (A) Sanitary
 - (B) Irrigation
 - (C) Combined
 - (D) Drinking Water
 - (E) Storm water
 - (F) Open Ditch
- 110.P18. A sixteen-inch diameter force main is flowing full. The flow velocity is 5 fps. What is the flow rate in gallons per minute?
- (A) 3530
 - (B) 12.9
 - (C) 3160
 - (D) 7.05
- 111.SG21. In a trench deep enough to require a ladder, the worker must not be required to travel more than _____ to get to the ladder
- (A) 15 feet
 - (B) Three steps
 - (C) 25 feet
 - (D) 10 feet

- 112.SG18. In sewer maintenance, what is a pig?
 (A) A power rod
 (B) A bullet shaped object that is passed through a force main to remove blockages
 (C) Manufacturer of hydraulic rodding trucks
 (D) Any foul smelling piece of equipment
- 113.IT18. When using a CCTV camera, it is safe to move the camera past jump joints.
 (A) True
 (B) False
- 114.PS45. A centrifugal pump is discharging a higher flow rate than desired. What is the best method for permanently decreasing the pump output while maintaining overall efficiency?
 (A) Install a smaller impeller
 (B) Throttle the pump intake
 (C) Ensure all downstream valves are in the full open position
 (D) Purchase a smaller pump
- 115.P12. The most accurate way to determine the flow velocity in a pipe is
 (A) Estimate using d/D ratio tables
 (B) Hazen-Williams Equation
 (C) Mannings Equation
 (D) Measure it directly
- 116.PS48. A positive displacement pump should never be operated against a closed or partially closed valve for this reason.
 (A) Resultant pressure buildup can damage pump and lines
 (B) Operator may not remember to open valve after successful pump start-up
 (C) Material may back up in the discharge line
 (D) Pump may lose prime
- 117.D4. These gravity lines are some of the largest in the collection system and may be considered to be main "arteries". They convey flow to even larger interceptors.
 (A) Lift Stations
 (B) Building Sewers
 (C) Cleanout
 (D) Trunk Sewers
 (E) Pressure Mains
 (F) Sewer Vent Trap
 (G) Intercepting Sewers
 (H) Grinder Pumps
- 118.PS20. Given the following information, what is the most likely cause of the lift station problem? Wet well inlet is normal. Wet well level drops when pump #1 is running. Wet well level rises slowly when pump #2 or pump #3 is running. Run amperage is the same for all three pumps. One of the pump motors turns backwards when the pump is not running. Level system is reading correctly. Electrical controls are all in automatic.
 (A) Pump #1 check valve is stuck open
 (B) Either pump #1 or pump #2 is wired backwards
 (C) Check valve on pump #3 is clogged
 (D) Pump #1 and #2 are air-bound
- 119.Chlorine gas is this color
 (A) Bright green
 (B) Colorless
 (C) Greenish yellow
 (D) Clear amber
- 120.PS50. Screw pumps are best suited to these applications
 (A) Low head and high volume
 (B) Low head and low volume
 (C) High head and low volume
 (D) High head and high volume
- 121.P28. For every 1 foot of water depth, this amount of pressure is exerted
 (A) 2.31 psi
 (B) 0.491 psi
 (C) 0.433 psi
 (D) 2.036 psi

- 122.P31. Given the following data, calculate the average velocity in the channel. 2.5 ft wide channel, flow depth is 1.4 ft, flow rate is 7.2 MGD
- (A) 11.2 ft/sec
 - (B) 32.2 ft/sec
 - (C) 3.2 ft/sec
 - (D) 1.2 ft.sec
- 123.When sodium hypochlorite is added to water, the pH
- (A) Increases
 - (B) Who cares?
 - (C) Decreases
 - (D) Remains the same
- 124.SG6. What factors should be considered when providing trench shoring?
- (A) Grade of sewer
 - (B) Pipe material
 - (C) Structures or sources of vibration near trenches
 - (D) All of the above
- 125.PS4. Air and vacuum release valves can be cleaned this way
- (A) Sanding with a mild abrasive like Commet
 - (B) Disassemble and soak in muriatic acid
 - (C) Forcing pressurized air through operating mechanism
 - (D) Backflushing with clean water
- 126.D3. These gravity lines are intermediate. They connect lateral and branch sewers to larger trunk sewers.
- (A) Backflow Preventer
 - (B) Inverted Siphon
 - (C) Intercepting Sewers
 - (D) Grinder Pumps
 - (E) Pressure Mains
 - (F) Junction Structure
 - (G) Lateral and Branch Sewers
 - (H) Main Sewers
- 127.SG19. Employers must provide employees with information about the possible health effects from contact with hazardous materials. This is called "right-to-know" legislation. Which document provides this information?
- (A) Material safety data sheet
 - (B) Job description
 - (C) Sewer ordinance
 - (D) NPDES permit
- 128.PS27. Centrifugal pumps are based on this basic principal
- (A) Centrifugal force
 - (B) Totally enclosed fan cooled motors
 - (C) Rotation
 - (D) Positive displacement of the fluid being pumped
- 129.PS35. An operator is performing a routine inspection of a centrifugal pump. He notices a slow drip of water coming from the stuffing box. He should
- (A) Tighten the gland until the leak stops
 - (B) Turn down the flow of seal water going to the pump
 - (C) Make a note of the drip rate and pump ID for later maintenance
 - (D) Do nothing
- 130.PS42. A mechanical seal takes the place of a stuffing box on a centrifugal pump. The primary advantage of a mechanical seal is that it
- (A) Does not need an external water supply for lubrication
 - (B) Requires less maintenance
 - (C) Has a lower initial cost than a stuffing box
 - (D) Operates at lower pressures
- 131.PS54. Positive displacement pumps are most often used when pumping
- (A) Return activated sludge
 - (B) Raw influent
 - (C) Corrosive chemicals
 - (D) Liquids containing high solids, usually greater than 4%

- 132.P20. Infiltration occurs when water enters the collection system through cracks and poor joints in old or broken lines. Infiltration should be kept below _____ gpd/mi-in.
- (A) 500
 - (B) 50
 - (C) 100
 - (D) 300
- 133.PS1. This type of pump is installed inside a wet well.
- (A) Piston
 - (B) Positive displacement
 - (C) Centrifugal
 - (D) Submersible
- 134.IT8. A twelve-inch diameter pipe is uniformly coated with three inches of grease. How much has the capacity of the pipe been decreased?
- (A) 25 percent
 - (B) 75 percent
 - (C) 50 percent
 - (D) 56 percent
- 135.PS53. This type of pump is often used in lift stations or plant headworks because it can pump large volumes of water up short distances of less than 30 feet. It also aerates the wastewater as it lifts.
- (A) Centrifugal pump
 - (B) Positive displacement pump
 - (C) Screw pump
 - (D) Air lift pump
- 136.P11. Velocity is defined as
- (A) Flow divided by cross-sectional area
 - (B) Flow divided by pipe volume
 - (C) Cross-sectional area divided by flow
 - (D) The minimum water speed necessary to keep solids in suspension
- 137.One disadvantage of using sodium hypochlorite for disinfection is that it degrades over time. Sodium hypochlorite solution should be used within this many days to ensure potency.
- (A) 60
 - (B) 90
 - (C) 30
 - (D) 120
- 138.PS34. A packing gland should be gradually tightened over a period of several hours to prevent
- (A) Misalignment between the pump shaft and motor
 - (B) Excessive seal water leakage
 - (C) Damage to the lantern ring
 - (D) Overtightening
- 139.P4. Collection systems are designed to convey flow by gravity for this reason:
- (A) Most pipe materials can't be pressurized
 - (B) Pumping wastewater is costly and requires more maintenance than gravity lines
 - (C) Gravity lines stay cleaner than force mains
 - (D) The wastewater treatment plant is always at the lowest point in the system
- 140.IT27. Smoke testing is being conducted on a section of the collection system. The operator notices smoke coming from a storm drain entrance. He should:
- (A) Enter the storm sewer immediately to determine where the smoke is entering
 - (B) Make a note of the location for later inspection as it could indicate a cross connection
 - (C) Ignore the smoke at this location. Smoke should exit through all entrance points.
- 141.IT11. When the carrying capacity of a section of pipe is exceeded, flow will back up in the pipe and pressurize it. As a result:
- (A) Exfiltration can occur at joints and cracks
 - (B) Water velocity through the pipe increases
 - (C) Hydrogen sulfide corrosion is accelerated
 - (D) Infiltration rates may increase
- 142.IT5. This term describes water that enters the collection system through defined points or openings such as below grade manholes, uncovered cleanouts, storm sewer cross connections, and incorrectly connected basement sump pumps.
- (A) Subsidence
 - (B) Infiltration
 - (C) I&I
 - (D) Inflow

- 143.PS28. Pumps contain two or more bearings. What is their purpose?
 (A) They minimize friction between the impeller and pump housing
 (B) They hold the lubricant necessary for smooth rotation of the motor
 (C) They prevent movement of the shaft sleeve
 (D) They support the shaft and help to minimize deflection
- 144.P27. Hydrostatic pressure is a function of
 (A) Depth
 (B) Mass
 (C) Volume
 (D) Depth and Volume
- 145.IT31. During smoke testing, an operator notices smoke rising from a home's rain gutters. Smoke is also coming from the building roof vents. What is the most likely problem?
 (A) A basement sump pump is improperly connected to the sanitary sewer
 (B) Roof leaders are improperly connected to the sanitary sewer
 (C) Pipe may be broken at the foundation
 (D) P-traps are dried out
- 146.P16. One way to estimate flow velocities within a collection system is to inject a tracer dye at one manhole and measure the time of travel to the next manhole.
 (A) True
 (B) False
- 147.SG9. Which one of the following would NOT be considered a natural event
 (A) Tornado
 (B) Explosion
 (C) Lightning
 (D) Flood
- 148.SG1. If a 36-inch pipe and a 42-inch pipe are running full and meet at a manhole, what minimum size outlet pipe will be required?
 (A) 71-inch
 (B) 44-inch
 (C) 78-inch
 (D) 56-inch
- 149.P22. This equation is used to size gravity sewer lines.
 (A) Manning
 (B) Henry-Weisbach
 (C) Darcy
 (D) Shusmeyer
- 150.PS22. Leakage of seal water around the packing on a centrifugal pump is required because it acts as a(n)
 (A) Coolant
 (B) Adhesive
 (C) Vapor barrier
 (D) Lubricant
- 151.SG7. Sewer "A" has 17,000 people at 95 gpcd. Sewer "B" has 13,800 people at 90 gpcd. Sewer "C" has 9,850 people at 85 gpcd. What percent of the flow is due to I&I if the total flow at the wastewater treatment plant is 4.5 mgd?
 (A) 17.9 percent
 (B) 82.1 percent
 (C) 65.7 percent
 (D) 21.5 percent
- 152.PS18. The largest diameter waste that should ever be present in a wastewater pump station is _____. This is the largest diameter sphere that can pass through most home toilets and disposal systems.
 (A) 1.5 inch
 (B) 5.0 inch
 (C) 7.5 inch
 (D) 2.5 inch
- 153.P33. As the slope of a sewer line increases, flow velocity will _____. Assume the flow rate remains the same.
 (A) Increase
 (B) Remain the same
 (C) Decrease

- 154.D8. This type of sewer does not depend on gravity or minimum slope
- (A) Trunk Sewers
 - (B) Main Sewers
 - (C) Sewer Vent Trap
 - (D) Pressure Mains
 - (E) Inverted Siphon
 - (F) Building Sewers
 - (G) Grinder Pumps
 - (H) Lift Stations
- 155.PS10. Total dynamic head is the sum of the static head and
- (A) Discharge head
 - (B) All of these are correct.
 - (C) Head losses within the discharge pipeline due to friction
 - (D) Suction head
- 156.P13. Flow velocity must be estimated for a partially full gravity pipe. Drag and drop the following steps into the correct order.
- (A) Look up the d/D correction factor
 - (B) Calculate the d/D ratio
 - (C) Calculate the cross-sectional area of the pipe
 - (D) Multiply the cross-sectional area of the pipe by the d/D correction factor to find the area in flow
 - (E) Calculate flow velocity using the area in flow and the flow rate
 - (F) Find the diameter of the pipe and the depth of flow
- Arrange in proper sequence: _____
- 157.D1. This type of sewer connects a home or businesses internal plumbing to the collection system. It marks the official location where the building owner's responsibility ends and the collection system worker's responsibility begins.
- (A) Grinder Pumps
 - (B) Building Sewers
 - (C) Lateral and Branch Sewers
 - (D) Air Jumper
 - (E) Flow Regulator
 - (F) Cleanout
 - (G) Pressure Mains
 - (H) Main Sewers
- 158.SG14. You should never attempt to install, troubleshoot, maintain, or replace electrical equipment panels, controls, wiring, or circuits unless:
- (A) A manhole is overflowing down a street
 - (B) You are receiving lots of odor complaints
 - (C) You know what you are doing, are qualified, and are authorized
 - (D) A pump is unplugged
- 159.P32. Manholes should be installed at regular intervals along gravity sewer lines. The maximum distance between manholes should be about _____. Otherwise, cleaning equipment may not be able to reach the entire length of pipe between manholes.
- (A) 400 feet
 - (B) 1000 feet
 - (C) 100 feet
 - (D) Manholes should be placed every place there is a change in direction, slope, pipe size, or junction.
- 160.P1. To prevent solids from settling in the pipe, flow velocities should be kept at or above this minimum velocity.
- (A) 3.0 fpm
 - (B) 0.5 fpm
 - (C) 2.0 fps
 - (D) 1.0 fps
- 161.IT7. This simple visual inspection technique is still in use by many municipalities because it does not require specialized equipment. It allows the operator to see the first ten to fifteen feet of sewer line.
- (A) Dye testing
 - (B) Lamping
 - (C) CCTV
 - (D) Smoke testing

- 162.PS32. The gland on a packing box should
- (A) Directly contact the lantern ring
 - (B) Be hand tightened on original installation followed by one three-quarter turn
 - (C) Contain at least six rings of packing material
 - (D) Be tightened gradually over a period of several hours
- 163.IT32. During smoke testing, an operator notices smoke inside of a building. The smoke has most likely entered the building by
- (A) Basement sump pump
 - (B) Passing through a dried out p-trap
 - (C) Foundation
 - (D) Broken service connection
- 164.IT10. Sewers are surcharged when the
- (A) More water enters the pipe than it can convey
 - (B) Jet truck passes up the line too quickly
 - (C) Homeowner refuses to pay their bill
 - (D) Flow from exfiltration exceeds the infiltration flow
- 165.P7. This term is used to describe water that enters the collection system from sources like foundation drains, holes in manhole covers, surface runoff, and cross connections between sanitary and storm sewers.
- (A) Inflow
 - (B) I&I
 - (C) Infiltration
 - (D) Seepage
- 166.PS38. Which of the following statements is NOT true regarding application of a centrifugal pump?
- (A) Pumps can be controlled to match rate of inflow to the wet well
 - (B) Wet well level can be controlled to mimic influent sewer's normal depth curve
 - (C) Pumps must never operate at less than the manufacturer's listed minimum flow
 - (D) Pumps must always operate at less than the manufacturer's listed minimum flow
- 167.PS30. This piece of sacrificial metal is used to absorb wear and tear which prevents damage to the shaft
- (A) Stuffing box
 - (B) Wear rings
 - (C) Shaft sleeve
 - (D) Shaft cushion
- 168.D7. In addition to reducing the size of solid material moving through the collection system, these units pressurize wastewater to help move it through the system.
- (A) Lift Stations
 - (B) Flow Regulator
 - (C) Junction Structure
 - (D) Building Sewers
 - (E) Grinder Pumps
 - (F) Sewer Vent Trap
 - (G) Lateral and Branch Sewers
 - (H) Air Jumper
- 169.D12. This type of sewer line is used to get under obstructions like streams, ditches, and sunken roadways. Although flow isn't pumped, it is under pressure. <SiphonDiagram.jpg>
- (A) Pressure Mains
 - (B) Lift Stations
 - (C) Junction Structure
 - (D) Building Sewers
 - (E) Inverted Siphon
 - (F) Lateral and Branch Sewers
 - (G) Main Sewers
 - (H) Trunk Sewers
- 170.SG4. A pH of 6.0 is
- (A) Neutral
 - (B) Basic
 - (C) Acid
 - (D) Alkaline
- 171.IT33. Smoke testing can prove that a building is not connected to the sanitary sewer.
- (A) False
 - (B) True

- 172.PS55. One or more of the following pumps can be run dry without damaging the pump. Select ALL of them.
- (A) Screw
 - (B) Submersible
 - (C) Grinder
 - (D) Centrifugal
 - (E) Diaphragm
 - (F) Peristaltic
- 173.P24. This bacterium is responsible for hydrogen sulfide gas production in sewer lines
- (A) Thiobacillus
 - (B) Thermoaquaticus
 - (C) Pseudomonas
 - (D) Citrobacter
 - (E) Nitrosomonas
- 174.IT14. CCTV inspection may be used to identify and locate all of the following EXCEPT
- (A) Protruding service connections
 - (B) Root intrusion
 - (C) Infiltration
 - (D) Exfiltration
 - (E) Low spots or bellies
 - (F) Grease buildup
- 175.PS23. The seal water pressure in a water-lubricated pump should be at least _____ the maximum discharge pressure
- (A) 10 psi less than
 - (B) 10 psi more than
 - (C) 5 psi more than
 - (D) 5 psi less than
- 176.IT19. CCTV camera should always be moved
- (A) Through standing water when found in the pipe
 - (B) From upstream manhole to downstream manhole or in the direction of flow
 - (C) As quickly as possible to avoid sending the camera up service lines
 - (D) From the downstream manhole to the upstream manhole or against the flow
- 177.PS47. The primary advantage of a diaphragm pump is
- (A) Ability to produce extremely high pressure discharge
 - (B) Separation between the mechanism and the fluid being pumped
 - (C) Intermittent discharge
 - (D) Increased overall pumping costs over other pump types
- 178.P8. An average person generates this much wastewater per day
- (A) 100 to 200 gallons
 - (B) 200 to 250 gallons
 - (C) 70 to 100 gallons
 - (D) 40 to 70 gallons
- 179.P6. This term is used to describe groundwater that seeps into the collection system through defective or cracked pipes, manhole walls, and joints.
- (A) Infiltration
 - (B) I&I
 - (C) Inflow
 - (D) Seepage
- 180.P37. If flow velocities exceed 10 fps in the collection system, all of these problems may occur. CHECK ALL THAT APPLY.
- (A) Surcharging
 - (B) Deposition of material on the pipe wall
 - (C) Off gassing
 - (D) Excessive turbulence at junctions
 - (E) Buildup of hydrogen sulfide
 - (F) Erosion of the sewer line
- 181.IT12. Lamping is a technique that is used to
- (A) Determine if a sewer line is straight and free from obstructions
 - (B) Check for pipe breakages and cracks up to 400 feet between manholes
 - (C) Accurately pinpoint the location of roots
 - (D) Test new sewers for final acceptance from the contractor

182. What is the IDLH (Immediately Dangerous to Life or Health) concentration for chlorine?
- (A) 200 ppm
 - (B) 500 ppm
 - (C) 1 ppm
 - (D) 30 ppm
183. IT1. The purpose of ribs on the outside of a Wayne Sewer Ball is to:
- (A) Reinforce (strengthen) the ball
 - (B) Allow the ball's weight to be closer to the ball's center
 - (C) Cause jet action to aid in the hydraulic flushing of the sewer line
 - (D) Avoid patent infringement that would apply if a non-ribbed ball were used
184. PS11. Dynamic head depends on the pipe diameter, pipe material, and
- (A) Atmospheric pressure
 - (B) Velocity of the water through the pipe
 - (C) Pump discharge diameter
 - (D) Suction head
185. D5. These gravity lines are the largest in the collection system. They convey flow from all other types of gravity lines to the wastewater treatment plant. Often, these large gravity lines follow the natural drainages created by rivers and streams.
- (A) Backflow Preventer
 - (B) Intercepting Sewers
 - (C) Inverted Siphon
 - (D) Cleanout
 - (E) Air Jumper
 - (F) Flow Regulator
 - (G) Lateral and Branch Sewers
 - (H) Sewer Vent Trap
186. PS25. What will happen if the discharge valve on a centrifugal pump is partially closed during pumping?
- (A) Flow will decrease and discharge head will increase
 - (B) Flow will decrease and discharge head will decrease
 - (C) Flow will increase and discharge head will increase
 - (D) Flow will decrease and discharge head will remain constant
187. PS51. All of these are parts of a centrifugal pump EXCEPT:
- (A) Bearings
 - (B) Shaft
 - (C) Stuffing Box
 - (D) Mechanical Seal
 - (E) Volute
 - (F) Impeller
 - (G) Stator
188. IT3. Grease is problematic in the collection system because it
- (A) Decreases the carrying capacity of the pipe
 - (B) Can cause sanitary sewer overflows
 - (C) Often results in blockages
 - (D) Traps other debris
 - (E) All of the above
189. SG3. What capacity blower is required to ventilate a manhole 48-inches in diameter and 62-feet deep if 3 air changes is required every 6 minutes?
- (A) 130 cfm
 - (B) 934 cfm
 - (C) 2336 cfm
 - (D) 389 cfm
190. PS63. Hydrogen sulfide corrosion in lift stations can be minimized by
- (A) Adding sulfur reducing bacteria to the wet well
 - (B) Maintaining a pH less than 7
 - (C) Maintaining a pH greater than 7
 - (D) Increasing turbulence

Collections Questions by Indigo Water Group

More Questions Coming Soon!

Answer Key

1. D
2. B
3. A
4. C
5. B
6. C
7. E
8. B
9. D
10. D
11. D
12. A
13. A
14. B
15. A
16. D
17. C
18. D
19. A
20. C
21. C
22. C
23. C
24. D
25. C
26. C
27. D
28. D
29. C
30. A

31. C
32. A
33. D
34. C
35. E
36. B
37. E
38. C
39. B
40. C
41. C
42. D
43. B
44. B
45. D
46. D
47. D
48. D
49. B
50. A
51. B
52. C
53. C
54. B
55. B
56. B
57. A
58. D
59. C
60. B
61. B
62. B
63. C
64. A
65. C
66. A
67. D

- 68. A
- 69. A
- 70. B
- 71. B
- 72. A
- 73. A
- 74. B
- 75. D
- 76. D
- 77. B
- 78. D
- 79. B
- 80. B
- 81. B
- 82. A
- 83. C
- 84. C
- 85. H
- 86. A
- 87. B
- 88. D
- 89. C
- 90. C
- 91. B
- 92. A
- 93. C
- 94. F
- 95. D
- 96. C
- 97. D
- 98. D
- 99. D
- 100. D
- 101. B
- 102. C
- 103. D
- 104. H

- 105. D
- 106. B
- 107. C
- 108. E
- 109. A, C, E
- 110. C
- 111. C
- 112. B
- 113. A
- 114. A
- 115. D
- 116. A
- 117. D
- 118. A
- 119. C
- 120. A
- 121. C
- 122. C
- 123. A
- 124. C
- 125. D
- 126. H
- 127. A
- 128. A
- 129. D
- 130. B
- 131. D
- 132. A
- 133. D
- 134. B
- 135. C
- 136. A
- 137. A
- 138. D
- 139. B
- 140. B
- 141. A

- 142. D
- 143. D
- 144. A
- 145. B
- 146. A
- 147. B
- 148. D
- 149. A
- 150. D
- 151. A
- 152. D
- 153. A
- 154. D
- 155. C
- 156. Sequence = C, B, D, E, F, A
- 157. B
- 158. C
- 159. A
- 160. C
- 161. B
- 162. D
- 163. B
- 164. A
- 165. A
- 166. D
- 167. C
- 168. E
- 169. E
- 170. C
- 171. A
- 172. A, E, F
- 173. A
- 174. D
- 175. C
- 176. B
- 177. B
- 178. C

179. A

180. D, F

181. A

182. D

183. C

184. B

185. B

186. A

187. G

188. E

189. D

190. C