Collections

Name: _____

Date: _____ Period: _____

1. PS9. If the wet well level is above the center line of the pump impeller, then the suction head is
   (A) Positive
   (B) Two feet lower than the discharge head
   (C) Negative
   (D) About equal to the discharge head

2. PS10. Total dynamic head is the sum of the static head and
   (A) All of these are correct.
   (B) Discharge head
   (C) Suction head
   (D) Head losses within the discharge pipeline due to friction

3. 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) Intercepting Sewers
   (B) Building Sewers
   (C) Pressure Mains
   (D) Trunk Sewers
   (E) Junction Structure
   (F) Grinder Pumps
   (G) Backflow Preventer
   (H) Cleanout

4. 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) 1000 feet
   (B) 400 feet
   (C) Manholes should be placed every place there is a change in direction, slope, pipe size, or junction.
   (D) 100 feet

5. P21. The minimum self-cleansing velocity for a gravity sewer line is accepted as:
   (A) 2 ft/min
   (B) 10 ft/sec
   (C) 1 m/sec
   (D) 2 ft/sec

6. P36. Velocities higher than _____ should be avoided in collection systems.
   (A) 5 fps
   (B) 10 fps
   (C) 1 fps
   (D) 2 fps

7. 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) 4.9 ft/sec
   (B) 18.0 ft/sec
   (C) 5.3 ft/s
   (D) 18.85 ft/sec

8. 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) Flow Regulator
    (B) Grinder Pumps
    (C) Trunk Sewers
    (D) Inverted Siphon
    (E) Junction Structure
    (F) Main Sewers
    (G) Building Sewers
    (H) Cleanout

9. 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

10. PS5. Suction head on a pump is
    (A) Negative
    (B) Either negative or positive
    (C) Positive

11. P34. As pipe diameters increase, the minimum amount of slope required to maintain a particular flow velocity
    (A) Decreases
    (B) Is not affected by the pipe diameter
    (C) Increases

12. 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) Air Jumper
    (B) Main Sewers
    (C) Pressure Mains
    (D) Trunk Sewers
    (E) Building Sewers
    (F) Grinder Pumps
    (G) Cleanout
    (H) Flow Regulator

13. P1. To prevent solids from settling in the pipe, flow velocities should be kept at or above this minimum velocity.
    (A) 1.0 fps
    (B) 0.5 fpm
    (C) 2.0 fps
    (D) 3.0 fpm

14. 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) 32.2 ft/sec
    (B) 11.2 ft/sec
    (C) 3.2 ft/sec
    (D) 1.2 ft.sec

15. 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) 37.5 cfs
    (C) 15 cfs
    (D) 4.75 mgd

16. PS8. The discharge head on a pump is always measured from
    (A) The wet well level to the centerline of the pump intake
    (B) The wet well level to the elevation that is being pumped to
    (C) The centerline of the pump discharge
    (D) The bottom of the pump discharge

17. PS12. Cavitation may be caused by all of these things EXCEPT
    (A) Restrictions in the suction line
    (B) Air leaks on the suction side of the pump
    (C) Excessive tip speed of the impeller
    (D) Entrained solids

18. P15. As population increases and the size of the collection area expands, the peaking factor used to estimate peak hour flows
    (A) Decreases
    (B) Depends on the number of lift stations in the system
    (C) Remains about the same
    (D) Increases

19. P26. The density of water is
    (A) 32.5 lbm/cuft
    (B) 8.34 lbm/cuft
    (C) 7.48 lbm/cuft
    (D) 62.4 lbm/cuft

20. P19. Combined sewer systems collect these flows
    (A) Domestic wastewater
    (B) Both domestic wastewater and untreated industrial discharges
    (C) Untreated industrial discharges
    (D) Both domestic wastewater and stormwater
    (E) Storm water

21. P27. Hydrostatic pressure is a function of
    (A) Mass
    (B) Depth and Volume
    (C) Volume
    (D) Depth

22. P14. Scouring velocities should be reached or exceeded
    (A) Only during storm events
    (B) At average daily flow
    (C) During peak flows
    (D) Throughout the day

23. D8. This type of sewer does not depend on gravity or minimum slope
    (A) Inverted Siphon
    (B) Main Sewers
    (C) Lateral and Branch Sewers
    (D) Trunk Sewers
    (E) Lift Stations
    (F) Air Jumper
    (G) Flow Regulator
    (H) Pressure Mains

24. PS2. Install one of these devices at the highest point in a force main to get entrained air out of the system.
    (A) Backflow preventer
    (B) Air release valve
    (C) Inverted siphon
    (D) Vacuum release valve

25. P3. Collection systems are comprised of these types of pipes
    (A) Laterals and gravity lines
    (B) Force mains and interceptors
    (C) Interceptors and Laterals
    (D) Gravity lines and force mains

26. D2. These gravity lines are located at the beginning or outermost portions of the collection system.
    (A) Lift Stations
    (B) Sewer Vent Trap
    (C) Lateral and Branch Sewers
    (D) Backflow Preventer
    (E) Intercepting Sewers
    (F) Air Jumper
    (G) Inverted Siphon
    (H) Main Sewers

27. 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) False
    (B) True

28. PS7. If the wet well level is below the center line of the pump impeller, then the suction head is
    (A) Positive
    (B) Two feet lower than the discharge head
    (C) About equal to the discharge head
    (D) Negative

29. 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) 200 minutes
    (C) 50 minutes
    (D) 100 minutes

30. P12. The most accurate way to determine the flow velocity in a pipe is
    (A) Hazen-Williams Equation
    (B) Mannings Equation
    (C) Measure it directly
    (D) Estimate using d/D ratio tables

31. P11. Velocity is defined as
    (A) The minimum water speed necessary to keep solids in suspension
    (B) Flow divided by pipe volume
    (C) Flow divided by cross-sectional area
    (D) Cross-sectional area divided by flow

32. 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

33. P37. If flow velocities exceed 10 fps in the collection system, all of these problems may occur. CHECK ALL THAT APPLY.
    (A) Off gassing
    (B) Surcharging
    (C) Deposition of material on the pipe wall
    (D) Excessive turbulence at junctions
    (E) Buildup of hydrogen sulfide
    (F) Erosion of the sewer line

34. D9. The device pictured here may be used with a pig to remove debris from the collection system. <d9.jpg>
    (A) Main Sewers
    (B) Grinder Pumps
    (C) Lift Stations
    (D) Cleanout
    (E) Sewer Vent Trap
    (F) Lateral and Branch Sewers
    (G) Building Sewers
    (H) Intercepting Sewers

35. 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) Trunk Sewers
    (B) Building Sewers
    (C) Pressure Mains
    (D) Lateral and Branch Sewers
    (E) Junction Structure
    (F) Grinder Pumps
    (G) Intercepting Sewers
    (H) Inverted Siphon

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) 44 gpm
    (C) 440 gpm
    (D) 338.5 gpm

37. P23. For a gravity sewer line, the depth of flow at the design flow rate should be
    (A) 100% of the pipe diameter during peak flow
    (B) Based on groundwater infiltration during a 100 year storm event
    (C) Calculated prior to accounting for inflow and infiltration loads
    (D) 70 to 80% of the pipe diameter

38. P8. An average person generates this much wastewater per day
    (A) 200 to 250 gallons
    (B) 70 to 100 gallons
    (C) 100 to 200 gallons
    (D) 40 to 70 gallons

39. P6. This term is used to describe groundwater that seeps into the collection system through defective or cracked pipes, manhole walls, and joints.
    (A) I&&I
    (B) Seepage
    (C) Inflow
    (D) Infiltration

40. P5. The three types of collection systems are: CHECK ALL THAT APPLY.
    (A) Drinking Water
    (B) Irrigation
    (C) Combined
    (D) Storm water
    (E) Open Ditch
    (F) Sanitary

41. D10. The device pictured here ensures that wastewater can only flow in the desired direction. <d10.gif>
    (A) Flow Regulator
    (B) Trunk Sewers
    (C) Intercepting Sewers
    (D) Lift Stations
    (E) Air Jumper
    (F) Backflow Preventer
    (G) Cleanout
    (H) Sewer Vent Trap

42. PS16. Wet well sizes must be large enough to minimize _____ but small enough to _____.
    (A) Pump cycles per hour / maximize release of toxic gasses
    (B) Pump cycles per hour / minimize the accumulation of solids in the wet well
    (C) The pump size required / minimize the accumulation of solids in the wet well
    (D) Overflow of raw sewage / minimize hydrogen sulfide generation

43. P17. Find the flow velocity in a 15-inch sewer line that is flowing half full when the flow rate is 3 cfs.
    (A) 4.9 fps
    (B) 1.8 fps
    (C) 2.4 fps
    (D) 22.5 fps

44. D3. These gravity lines are intermediate. They connect lateral and branch sewers to larger trunk sewers.
    (A) Pressure Mains
    (B) Main Sewers
    (C) Inverted Siphon
    (D) Air Jumper
    (E) Trunk Sewers
    (F) Lateral and Branch Sewers
    (G) Backflow Preventer
    (H) Lift Stations

45. P2. Wastewater contains solids in these two forms
    (A) Dissolved and suspended
    (B) Total and volatile
    (C) Suspended and volatile
    (D) Dissolved and Total

46. D11. The device pictured here is one way to prevent sewer gases from entering buildings. <d11.jpg>
    (A) Trunk Sewers
    (B) Backflow Preventer
    (C) Flow Regulator
    (D) Intercepting Sewers
    (E) Building Sewers
    (F) Sewer Vent Trap
    (G) Junction Structure
    (H) Cleanout

47. 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) Junction Structure
    (B) Cleanout
    (C) Air Jumper
    (D) Pressure Mains
    (E) Backflow Preventer
    (F) Lift Stations
    (G) Building Sewers
    (H) Intercepting Sewers

48. 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) Inverted Siphon
    (B) Sewer Vent Trap
    (C) Intercepting Sewers
    (D) Main Sewers
    (E) Cleanout
    (F) Pressure Mains
    (G) Junction Structure
    (H) Grinder Pumps

49. P24. This bacterium is responsible for hydrogen sulfide gas production in sewer lines
    (A) Thermoaquaticus
    (B) Pseudomonas
    (C) Nitrosomonas
    (D) Citrobacter
    (E) Thiobacillus

50. 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) 70 gpm
    (B) 45 gpm
    (C) 29 gpm
    (D) 15 gpm

51. PS1. This type of pump is installed inside a wet well.
    (A) Positive displacement
    (B) Centrifugal
    (C) Piston
    (D) Submersible

52. PS4. Air and vacuum release valves can be cleaned this way
    (A) Disassemble and soak in muriatic acid
    (B) Backflushing with clean water
    (C) Sanding with a mild abrasive like Commet
    (D) Forcing pressurized air through operating mechanism

53. PS13. The primary difference between lift stations and pump station is
    (A) The length of the discharge pipe
    (B) Lift stations employ air lift or ejectors while pump stations use pumps
    (C) Lift stations have the pumps in a dry well while pump stations use submersible pumps
    (D) The volume of water being pumped

54. PS3. If air release valves are not installed at the high points of force mains, this condition may result.
    (A) Cavitation
    (B) Crown corrosion
    (C) Pipe breakage
    (D) Water hammer

55. P22. This equation is used to size gravity sewer lines.
    (A) Shusmeyer
    (B) Henry-Weisbach
    (C) Manning
    (D) Darcy

56. 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) 2.5 inch
    (C) 7.5 inch
    (D) 5.0 inch

57. 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) 12.9
    (B) 7.05
    (C) 3530
    (D) 3160

58. P4. Collection systems are designed to convey flow by gravity for this reason:
    (A) The wastewater treatment plant is always at the lowest point in the system
    (B) Gravity lines stay cleaner than force mains
    (C) Most pipe materials can't be pressurized
    (D) Pumping wastewater is costly and requires more maintenance than gravity lines

59. PS11. Dynamic head depends on the pipe diameter, pipe material, and
    (A) Suction head
    (B) Pump discharge diameter
    (C) Velocity of the water through the pipe
    (D) Atmospheric pressure

60. 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) 1.3
    (C) 0.013
    (D) 0.002

61. P28. For every 1 foot of water depth, this amount of pressure is exerted
    (A) 0.491 psi
    (B) 2.31 psi
    (C) 2.036 psi
    (D) 0.433 psi

62. 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) 300
    (B) 50
    (C) 500
    (D) 100

63. P25. Hydrogen sulfide production in sewer mains is problematic because
    (A) It binds irreversibly to the pipe interior causing scale buildup
    (B) Hydrogen sulfide causes iron precipitation
    (C) It combines with oxygen and is converted to sulfuric acid which attacks the crowns of concrete pipes
    (D) Extremely low concentrations of hydrogen sulfide are toxic to other more beneficial microorganisms in the collection system

64. P13. Flow velocity must be estimated for a partially full gravity pipe. Drag and drop the following steps into the correct order.
    (A) Calculate the d/D ratio
    (B) Multiply the cross-sectional area of the pipe by the d/D correction factor to find the area in flow
    (C) Calculate flow velocity using the area in flow and the flow rate
    (D) Calculate the cross-sectional area of the pipe
    (E) Find the diameter of the pipe and the depth of flow
    (F) Look up the d/D correction factor

    Arrange in proper sequence: _____

65. 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) Seepage
    (B) I&&I
    (C) Inflow
    (D) Infiltration

66. PS17. Aluminum should not come into direct contact with concrete. If it does, this will happen
    (A) Accumulation of hydrogen sulfide crystals at the contact point
    (B) Localized softening of the concrete due to a chemical reaction
    (C) Corrosion of the aluminum
    (D) Sparking

67. PS6. If the wet well level is above the center line of the pump impeller, then the suction head is
    (A) Negative
    (B) About equal to the discharge head
    (C) Positive
    (D) Two feet lower than the discharge head

68. P9. Collection systems are designed for this type of flow
    (A) Maximum day
    (B) Maximum month
    (C) Peak hour
    (D) Average daily

Collections

Answer Key

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

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