Collection System Certification Practice Math Problems with Answers

Class I

1. A new manhole is going in and you have to remove a circle of asphalt 35 feet in diameter. How many square feet are involved?

Area of a circle = 0.785 x D’ x D’
= 0.785 x 35’ x 35’
= **961.63 ft^2**

2. If the asphalt in the problem above is 8 inches thick, how many cubic feet of material must be removed?

a.) Convert inches to feet

$$8 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 0.67 \text{ ft}$$

b.) Volume of a Cylinder = 0.785 x D’ x D’ x Length’
= 0.785 x 35’ x 35’ x 0.67’
= **644.29 ft^3**

3. A rectangular wet well is 12 ft x 24 ft. What is the surface area in ft^2 of this wet well?

Area of a Rectangle = Length’ x Width’
= 12’ x 24’
= **288 ft^2**

4. If the wet well in the above-mentioned problem is 16 feet deep, what is the volume of the wet well in ft^3?

Volume of a Rectangle = Length’ x Width’ x Height’
= 12’ X 24’ X 16’
= **4,608 ft^3**

5. If the wet well in the above-mentioned problem is 16 feet deep, what is the volume of the wet well in gallons?

Volume of water in the above Rectangle = 4,608 ft^3

Convert volume of H_2O to gallons:

$$4608 \text{ ft}^3 \times \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} = \mathbf{34{,}467.84 \text{ gallons}}$$

6. Manhole # 22 is 475 ft from manhole # 23. On the blueprint 1 inch = 100 ft. How long is the line on the blueprint?

Conversion: 475 ft x $\frac{\text{1 inch}}{\text{100 ft}}$ = **4.75 inches**

7. The line on the blueprint is 7.5 inches long between manhole #33 and #34. Each inch is equal to 50 ft. How many feet are there between manholes #33 and #34?

Conversion: 7.5 inches x $\frac{\text{50 feet}}{\text{1 inch}}$ = **375 ft**

8. How many gallons per day would a community of 17,425 people contribute to the collection system daily?

Population X 100 gal/person/day = total gpd
17,425 persons X 100 gal/person/day = **1,742,500 gal/day**

9. A sewer has failed and 61 feet of 12-inch pipe must be replaced. How many 10 foot sections will be required?

$\frac{\text{61 ft of failed pipe}}{\text{10 ft sections}}$ = 6.1 sections of 10 ft pipe

It is necessary to have **7** ten foot sections of pipe.

10. What is the capacity of a wet well if the pump, rated at 125 gpm, requires 1 hr. 4 min. to empty? Assume no inflow.

a.) Convert hours to minutes: 1hr. = 60 min.
60 + 4 = 64 total minutes to empty well

b.) Capacity = rating x minutes required
= $\frac{\text{125 gal}}{\text{min.}}$ x 64 min.
= **8000 gallons**

11. A 12 inch wide channel is running 8 inches deep at a velocity of 3 ft per second. What is the flow rate in gallons per minute?

a.) Convert inches to feet: $12 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 1 \text{ foot}$

$$8 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 0.67 \text{ feet}$$

b.) Area of a Rectangle = Length' x Width'
= 1' x 0.67'
= 0.67 ft²

c.) Flow = Area x Velocity

$$= 0.67 \text{ ft}^2 \times \frac{3 \text{ ft}}{\text{sec}}$$

$$= \frac{2.01 \text{ ft}^3}{\text{sec}}$$

d.) Convert Flow to gps: $\frac{2.01 \text{ ft}^3}{\text{sec}} \times \frac{7.48 \text{ gal}}{\text{ft}^3} = \frac{15.03 \text{ gal}}{\text{sec}}$

e.) Convert gps to gpm : $\frac{15.03 \text{ gal}}{\text{sec}} \times \frac{60 \text{ sec}}{\text{min.}} = \mathbf{\frac{901.8 \text{ gal}}{\text{min.}}}$

Class II

12. What is the percent grade on a 2 feet rise in 300 feet?

$$\% \text{ Grade} = \frac{\text{Rise in feet}}{\text{Run in feet}} \times 100$$

$$= \frac{2 \text{ ft}}{300 \text{ ft}} \times 100$$

= **0.67 % Grade**

13. To lay a new line you must dig a trench 5 feet deep, 3 feet wide and 475 ft long (assume vertical sidewalls). How many cubic feet of material must be excavated to complete this project?

Volume of a Rectangle = Length' x Width' x Height'
= 475 x 3' x 5'
= **7125 ft³**

14. Using the data from the previous problem, if you had an 8 cubic yard dump truck, how may loads would have to be moved to stockpile the excavated material?

a.) Convert yards to feet: $8 \text{ yd}^3 \times \frac{27 \text{ ft}^3}{1 \text{ yd}^3} = 216 \text{ ft}^3$

b.) # Loads = $\frac{\text{Cubic feet of material}}{\text{Cubic feet per load}} = \frac{7125 \text{ ft}^3}{216 \text{ ft}^3} = 32.99 =$ **33 loads**

15. An 18 feet deep lift station has a diameter of 12 feet. The influent flow causes the water level to rise 4.5 ft in 22 minutes. What is the influent flow rate in gpm?

a.) Volume of a Cylinder = 0.785 x D' x D' x Length'
= 0.785 x 12' x 12' x 4.5'
= 508.68 ft^3

b.) Convert volume of H_2O to gallons

$$508.68 \text{ ft}^3 \times \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} = 3804.93 \text{ gallons}$$

c.) Influent Flow in $\frac{\text{gallons}}{\text{minute}} = \frac{3804.93 \text{ gallons}}{22 \text{ minutes}}$

$$= \mathbf{172.95 \ \frac{gallons}{minute}}$$

16. A junction box is 12 feet wide and 18 feet long and the bottom tapers from 12 feet deep on one end to 15 feet deep on the other. What is the volume in gallons of the junction box?

a.) Calculate average depth/height

$$\frac{(12' + 15')}{2} = 13.5'$$

b.) Volume of Rectangle = Length' x Width' x Height'
= 18' x 12' x 13.5'
= 2916 ft^3

c.) Convert volume of H_2O to gallons

$2916 \text{ ft}^3 \times \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} =$ **21,811.68 gallons**

17. A 25 feet deep lift station has a diameter of 20 feet. The influent flow causes the water level to rise 2 ft 9 inches in 42 minutes. What is the influent flow rate in gpm?

a.) Convert inches to feet: 9 inches x $\frac{1 \text{ foot}}{12 \text{ inches}}$ = 0.75'

2' + 0.75'= 2.75' rise in water level

b.) Volume of Cylinder = 0.785 x D' x D' x Length'
= 0.785 x 20' x 20' x 2.75'
= 863.5 ft^3

c.) Convert volume of H_2O to gallons

863.5 ft^3 x $\frac{7.48 \text{ gallons}}{1 \text{ ft}^3}$ = 6,458.98 gallons

d.) Influent flow rate in $\frac{\text{gallons}}{\text{minute}} = \frac{6{,}458.98 \text{ gallons}}{42 \text{ minutes}}$

= **153.79** $\mathbf{\frac{gallons}{minute}}$

18. The elevation at the upper manhole is 436.7 ft. The elevation at the manhole 275 ft downstream is 430.4 ft. What is the slope?

Slope = $\frac{\text{Fall in feet}}{\text{Length in feet}} = \frac{(436.7' - 430.4')}{275'}$ = **0.02º**

19. The distance between manhole #345 and #346 is 395 ft of 14 inch pipe. The grade on the plans is 4% or 0.04. How much drop in feet of elevation will there be from #345 to #346?

Difference in Elevation = Grade x Pipe run in feet
= 0.04 x 395'
= **15.8 feet**

20. The distance between manhole #645 and #646 is 455 ft of 8 inch PVC pipe. A dye packet was added to manhole #645 and 4 minutes 45 second later color was observed in manhole #646. What is the velocity of the wastewater?

a.) Convert minutes to seconds: $4 \text{ minutes} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 240 \text{ seconds}$

Total seconds = 240 + 45 = 285 seconds

b.) Velocity $= \frac{\text{Distance in feet}}{\text{Time in seconds}}$

$= \frac{455 \text{ feet}}{45 \text{ seconds}}$

$= \mathbf{\frac{1.60 \text{ feet}}{\text{second}}}$

21. A flow of 980 gpm is flowing through a 15 inch wide channel at a depth of 9 inches. What is the velocity of the flow?

a.) Convert Flow gpm to cfs: $\frac{980 \text{ gallons}}{\text{minute}} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}} = \frac{131.02 \text{ ft}^3}{\text{minute}}$

$\frac{131.02 \text{ ft}^3}{\text{minute}} \times \frac{1 \text{ min}}{60 \text{ sec}} = \frac{2.18 \text{ ft}^3}{\text{sec}}$

b) Convert inches to feet: $9 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 0.75 \text{ feet}$

$15 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 1.25 \text{ feet}$

c.) Area of a Rectangle = Length’ x Width’
= 0.75’ x 1.25’
= 0.94 ft^2

d.) Velocity $= \frac{\text{Flow ft}^3\text{/sec}}{\text{Area ft}^2}$

$= \frac{2.18 \text{ ft}^3\text{/sec}}{0.94 \text{ ft}^2}$

= **2.32 ft/sec**

22. The meter reading on lift station #76 on April 10 at 8 a.m. was 32,445,560 gallons. On April 17, at 8:00 a.m. the meter reading was 41,896,760 gallons. What is average daily flow through this lift station?

a.) Calculate gallons pumped

41,896,760 – 32,445,560 = 9,451,200 gallons

b.) $\text{Average} = \dfrac{\text{total gallons pumped}}{\text{\# of days}} = \dfrac{9{,}451{,}200 \text{ gallons}}{7 \text{ days}}$

$= \mathbf{1{,}350{,}171.43 \text{ gpd}}$

23. Using the data from the previous problem, if you were feeding 9 mg/L of chlorine for odor control, how many pounds of chlorine would be fed per day?

a.) Convert gpd to MGD (move decimal 6 places to the left)

1,350,171.43 gpd = 1.35 MGD

b.) $\dfrac{\text{Lbs.}}{\text{day}} = \text{Flow MGD} \times \dfrac{8.34 \text{ lbs.}}{1 \text{ gallon}} \times \text{Concentration } \dfrac{\text{mg}}{\text{L}}$

$= 1.35 \text{ MGD} \times \dfrac{8.34 \text{ lbs.}}{1 \text{ gallon}} \times 9 \dfrac{\text{mg}}{\text{L}}$

$= \mathbf{\dfrac{101.33 \text{ lbs.}}{\text{day}}}$

24. Using the data from the previous problem, if chlorine sells for $1.17 per pound, what is the monthly chemical bill for chlorine, given a 30 day month?

$\text{Daily Cost} = \dfrac{\text{Lbs.}}{\text{day}} \times \dfrac{\text{Cost}}{\text{Lbs.}} = \dfrac{101.33 \text{ lbs.}}{\text{day}} \times \dfrac{\$1.17}{\text{lbs.}}$

$= \dfrac{\$118.56}{\text{day}}$

$\text{Monthly Cost} = \text{cost per day} \times \dfrac{30 \text{ days}}{\text{month}} = \$\dfrac{118.56}{\text{day}} \times \dfrac{30 \text{ days}}{\text{month}}$

$= \mathbf{\dfrac{\$3{,}556.80}{\text{Month}}}$

25. Average flow to a wastewater treatment plant is 0.9 MGD. On a wet weather flow day the flow rises to 3.3 MGD. What is the % inflow and infiltration?

$$\text{Percent Flow} = \frac{\text{Actual Flow}}{\text{Average Flow}} \times 100 = \frac{3.3 \text{ MGD}}{0.9 \text{ MGD}} \times 100$$

$$= \mathbf{366.67\ \%}$$

26. The elevation of manhole #34 is 342.6 ft and the elevation of manhole #33 is 335.6 ft. They are 370 feet apart. What is the percent of slope?

$$\text{Slope} = \frac{\text{Fall in feet}}{\text{Length in feet}} = \frac{342.6' - 335.6'}{370'}$$

$$= \mathbf{1.89\%}$$

27. The wet well of a pump station is 6 feet wide by 6 feet long. With one pump running and discharging 280 gpm, the wet well level was observed to rise 2 feet in 3 minutes 15 seconds. What was the rate of flow (gpm) into the wet well?

a.) Volume of a Cube = Length' x Width' x Height'
= 6' x 6' x 2'
= 72 ft^3

b.) Convert ft^3 to gallons: $72\ ft^3 \times \frac{7.48\ gal}{ft^3} = 538.56\ gal$

c.) Convert seconds to minutes: $15\ sec. \times \frac{1\ min.}{60\ sec.} = 0.25\ min.$

3 + 0.25 = 3.25 min.

d.) Calculate the rise rate (gpm) = $\frac{\text{total gallons}}{\text{total minutes}} = \frac{538.56\ \text{gallons}}{3.25\ \text{min.}} = 165.71\ \text{gpm}$

e.) Total Inflow = gpm of rise + gpm discharged
= 165.71 gpm + 280 gpm
= **445.71 gpm**

28. The average flow to your facility is 0.85 MGD. When you receive an inch of rain your flow increases to 3.1 MGD. What is the percent inflow and infiltration?

$$\text{Percent Flow} = \frac{\text{Actual Flow}}{\text{Average Flow}} \times 100 = \frac{3.1 \text{ MGD}}{0.85 \text{ MGD}} \times 100$$

$$= \mathbf{365\ \%}$$

29. A new manhole has been installed 350 feet from an existing manhole. On a map with a scale of 1 inch equals 75 feet, how far would this new manhole be located from the existing manhole?

Conversion: $350 \text{ feet} \times \frac{1 \text{ inch}}{75 \text{ feet}} =$ **4.67 inches**

30. A 14 inch force main 4,500 feet long has a flow rate of 0.77 MGD. What is the detention time in the force main in hours?

$$\text{Detention Time} = \frac{\text{Volume gallons}}{\text{Flow gpm}}$$

a.) Convert inches to feet: $14 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 1.17 \text{ ft}$

b.) Volume of a cylinder: = 0.785 x D’ x D’ x Length’
= 0.785 x 1.17’ x 1.17’ x 4500’
= 4,835.64 ft^3

c.) Convert ft^3 to gallons: $4{,}835.64 \text{ ft}^3 \times \frac{7.48 \text{ gal}}{\text{ft}^3} = 36{,}170.56 \text{ gallons}$

d.) Convert from MGD to gpd (move decimal six places to the right)
0.77 MGD = 770,000 gpd

e.) Convert from gpd to gpm:

$$\text{Flow gpm} = \frac{770{,}000 \text{ gal}}{\text{day}} \times \frac{1 \text{ day}}{1440 \text{ min.}}$$

$$= \frac{534.72 \text{ gal.}}{\text{min.}}$$

f.) $$\text{Detention Time} = \frac{\text{Volume gallons}}{\text{Flow gpm}} = \frac{36{,}170.56 \text{ gallons}}{534.72 \text{ gpm}}$$

$$= 67.64 \text{ minutes}$$

g.) Convert minutes to hours:
$67.64 \text{ minutes} \times \frac{1 \text{ hour}}{60 \text{ minutes}} =$ **1.13 hours**

Class III

31. The invert elevation of a manhole is 422.3 ft. If the invert at the next down stream manhole is 300 ft away at a 0.033^0 slope, what will the invert elevation (IE) be?

a.) Fall' = Slope° x Length'
= 0. 033° x 300'
= 9.9 feet

b.)$IE_{\#2}$ = $IE_{\#1}$ – Fall'
= 422.3' – 9.9'
= **412.4 feet**

32. The elevation at the invert of manhole #567 is 737.8 ft. The next manhole #568 is 410 ft downstream with an invert elevation of 729.4. What is the percent grade of this run of pipe?

a.) % Grade $= \frac{\text{Difference in elevation'}}{\text{Pipe run'}} \times 100$

$= \frac{(737.8 - 729.4)}{410'} \times 100$

= **2.05 % Grade**

33. Two 12.5 HP pumps run for 7.75 hours per day each. One pump is 85% efficient and the other pump is 75% efficient. How many kilowatt hours were used in a 24 hr day?

a.) Convert HP to kW: 12.5 HP x $\frac{0.746 \text{ kW}}{1 \text{ HP}}$ = 9.33 kW

b.) kW hours = kW used x hrs. operated
= 9.33 kW x 7.75 hrs.
=72.31 kW hrs.

c.) Calculate Efficiency

Pump 1 = $\frac{72.31 \text{ kW hrs.}}{0.85 \text{ efficiency rating}}$ = 85.07 kW hrs.

Pump 2 = $\frac{72.31 \text{ kW hrs.}}{0.75 \text{ efficiency rating}}$ = 96.41 kW hrs.

d.) Total kW hrs. = Pump 1 kW hrs. + Pump 2 kW hrs.
= 85.07 kW hrs. + 96.41 kW hrs.
= **181.48 kW hrs.**

34. Using the data from the previous problem, at $0.14 per kW hr, what is the 30 day electrical cost to operate this lift station?

a.) Power cost = kW hrs. used x $\frac{\text{cost}}{\text{kW hr.}}$

$$= \frac{181.48 \text{ kW hrs.}}{\text{day}} \times \frac{\$\,0.14}{\text{kW hr.}}$$

$$= \frac{\$25.41}{\text{day}}$$

b.) Cost for 30 days = $\frac{\$25.41}{\text{day}}$ x 30 days

= **$762.30**

35. On a wet weather day the flow into a 35 ft. diameter lift station has just activated the lag pump and only one pump appears to be in operation. The water level is rising at a rate of 1 foot every 2 mins. 45 sec. If the elevation of the lag pump switch is 452.8 ft and the manhole will overflow to the street at an elevation of 466.7 feet, how long do you have to repair or replace the defective pump?

a.) Calculate the difference in elevation:

466.7 ft – 452.8 ft = 13.9 ft

b.) Convert seconds to minutes:

$$45 \text{ sec} \times \frac{1 \text{ min.}}{60 \text{ sec}} = 0.75 \text{ min.}$$

2 min. + 0.75 min. = 2.75 total min.

c.) Minutes to overflow = Difference in elevation’ x $\frac{\text{minutes}}{\text{foot}}$

$$= 13.9 \text{ ft.} \times \frac{2.75 \text{ min.}}{1 \text{ ft.}}$$

= **38.23 min.**

36. A lift station with two 12.5 HP submersible pumps operates on an alternating cycle with pump #1 running 6.7 hrs and pump #2 running 6.9 hrs. These pumps have an efficiency average of 87.2%. At $0.11 per kW hr, what will it cost to operate the lift stations for 30 day month?

a.) Convert HP to kW :

$$12.5 \text{ HP} \times \frac{0.746 \text{ kW}}{1 \text{ HP}} = 9.33 \text{ kW}$$

b.) kW hr = kW used x hrs. operated
= 9.33 kW x (6.7 hr. + 6.9 hr)
= 126.88 kW hrs.

c.) Efficiency $= \frac{126.88 \text{ kW hrs.}}{0.872 \text{ efficiency rating}} = 145.50$ kW hrs.

d.) Power cost = kW hrs. used x $\frac{\text{cost}}{\text{kW hr.}}$

$$= \frac{145.50 \text{ kW hrs.}}{\text{day}} \times \frac{\$ 0.11}{\text{kW hr.}}$$

$$= \frac{\$16.01}{\text{day}}$$

e.) Cost for 30 days = $\frac{\$16.01}{\text{day}} \times \frac{30 \text{ days}}{\text{month}}$

$$= \frac{\mathbf{\$480.30}}{\mathbf{month}}$$

37. A lift station wet well is 14 ft in diameter and 22 ft deep. At a depth of 8 ft 4 in, how many gallons of wastewater are in this wet well?

a.) Convert inches to feet: 4 inches x $\frac{1 \text{ foot}}{12 \text{ inches}}$ = 0.33 ft.

8' + 0.33' = 8.33 total feet

b.) Volume of a cylinder = 0.785 x D' x D' x length'
= 0.785 x 14' x 14' x 8.33'
=1281.65 ft³

c.) Convert volume (ft³) to gallons: 1281.65 ft³ x $\frac{7.48 \text{ gal.}}{\text{ft}^3}$ = **9,586.74 gallons**

38. What concentration of chlorine, in mg/L, is applied to a flow of 3.5 MGD if the total weight of 100% available chlorine used was 350 pounds?

$$\text{Concentration } \frac{mg}{L} = \frac{\text{Lbs. /day}}{\text{Flow MGD x 8.34 lbs./gal.}} = \frac{\text{350 lbs./day}}{\text{3.5 MGD x 8.34 lbs/gal}}$$

$$= \mathbf{11.99 \frac{mg}{L}}$$

39. A sewer line is to be filled with a root control solution containing 75 mg/L of a specific chemical. How much chemical in pounds would be needed for a 265 feet long section of 12-inch line?

a.) Volume of a Cylinder = 0.785 x D' x D' x Length'
= 0.785 x 1' x 1' x 265'
= 208.03 ft^3

b.) Convert Volume (ft^3) to gallons = 208.03 ft^3 x $\frac{7.48 \text{ gal}}{ft^3}$ = 1556.06 gallons

c.) Convert gallons to MGD: 1556.06 gallons = 0.00155606 MGD

d.) Lbs./day = Flow MGD x 8.34 lbs./gal x Concentration mg/L
= 0.00155606 MGD x 8.34 lbs./gal x 75 mg/L
= **0.97 lbs./day**

Class IV

40. A 40 HP pump runs for 18 hrs per day and is 85% efficient. How many kilowatt hours were used in a 24 hr day?

a.) Calculate kW
kW = HP x 0.746
= 40 x 0.746
= 29.84 kW

b.) Calculate kW hrs.
kW hrs. = kW used x hrs. operated/ day
= 29.84 kW x 18 hrs./day
= 537.12 $\frac{\text{kW hrs.}}{\text{day}}$

c.) Efficiency = $\frac{\text{kW hrs./day}}{\text{efficiency rating}} = \frac{\text{537.12 kW hrs./day}}{0.85}$

= **631.91 kW hrs./day**

41. Using the data from the problem above and one kilowatt hour cost $0.13; what would the total electric cost be to operate this lift station for 1 year?

a.) Power Cost = kW used x cost / kW hr.
= 631.91 kW hrs. / day x $0.13 / kW hr.
= $82.15 / day

b.) Yearly Cost = cost / day x days / yr.
= $82.15 / day x 365 days / yr.
= **$29, 984.75 / yr.**

42. A 24 inch force main is to be laid 3,675 ft from lift station #12 to the wastewater plant at an in-place cost of $202.00 per foot.

A. What is the total cost of this project?
B. If the labor cost was 13.5% of the total cost, what is the labor cost?
C. What would the excavation cost be if it was 61.2% of the total?
D. The material cost is what percentage of the total project cost?

A.) Cost of installation = $\frac{\text{price}}{\text{ft}}$ x # ft. installed

= $202 / ft. x 3675 ft
= **$742, 350**

B.) Labor Cost = Total installation cost x % Labor

= $742,350 x 0.135
= **$100,217. 25**

C.) Excavation cost = Total cost x % Excavation

= $742,350 x 0.612
= **$454,318. 20**

D.) Material Cost = Labor + Excavation + Materials
100% = 13.5 % + 61.2 % + Materials
100% = 74.7 % + Materials

Materials = 100% – 74.7%
= **25.3%**

43. You want to check the flow rate of a pump in a lift station rated at 250 gpm to determine its efficiency as compared to its rated capacity. The lift station has a diameter of 10 feet and a depth of 25 feet. The influent flow to the lift station rises, with no pump running, at a rate of 8 feet in 10 minutes and with the pump running the rise rate is 5 feet in 10 minutes

A. What is the influent rate in gpm?
B. What is the rise rate with a pump running in gpm?
C. What is the pump rate in gpm?
D. How efficient is this pump in %?

A.) step 1:
Calculate the volume of a cylinder using the influent rate (w/out pump running)
Volume = 0.785 x D' x D' x length'
= 0.785 x 10' x 10' x 8'
= 628 ft^3

step 2:
Convert ft^3 to gallons
$628\ ft^3 \times \frac{7.48\ gal}{ft^3} = 4{,}697.44$ gallons

step 3:
Influent rate $= \frac{4697.44\ \text{gallons}}{10\ \text{minutes}}$

$= \mathbf{\frac{469.74\ gallons}{minute}}$

B.) step 1:
Volume = 0.785 x D' x D' x length'
= 0.785 x 10' x 10' x 5'
= 392.5 ft^3

step 2:
Convert ft^3 to gallons
$392.5\ ft^3 \times \frac{7.48\ gal}{ft^3} = 2{,}935.9$ gallons

step 3:
Rise rate $= \frac{2{,}935.9\ \text{gallons}}{10\ \text{minutes}}$

$= \mathbf{\frac{293.59\ gallons}{minute}}$

C.) Pump rate = influent rate – rise rate
= 469.74 gpm – 293.59 gpm
= **176.15 gpm**

D.) Pump % Efficiency $= \frac{\text{Pump rate gpm}}{\text{Pump rating gpm}}$

$= \frac{176.15 \text{ gpm}}{250 \text{ gpm}} =$ **70.46 %**

44. A town has two main lift stations, 25 ft in diameter and 40 ft deep. Pump station #1 has a total of three 1,000 gpm pumps, two that alternate with the third as a back up. The two alternating pumps work at 91% efficiency. In pump station #2 there is the same set up except the pumps are 1,250 gpm that operate at 89.5% efficiency. Both of these stations feed the main in-plant station with the total flow to the treatment plant.

A. If station #1 operated for a total of 18.4 hrs how many GPD are pumped to the in-plant station?
B. If station #2 operated for 21.6 hrs how many GPD will it pump to the in-plant station?
C. What is the total flow to this plant in MGD?

A.) step 1: Convert hrs. of operation to min.: 18.4 hrs. x $\frac{60\text{min.}}{1 \text{ hr.}}$ = 1104 min.

step 2: Total gpd pumped = gpm x % efficiency x min./day
= 1000 gpm x 0.91 x 1104 min./day
= **1,004,640 gpd**

B.) step 1: Convert hrs. of operation to min.: 21.6 hrs. x $\frac{60\text{min.}}{1 \text{ hr.}}$ = 1296 min.

step 2: Total gpd pumped = gpm x % efficiency x min./day
= 1250 gpm x 0.895 x 1296 min./day
= **1,449,900 gpd**

C.) step1: Total flow = station_1 gpd + station_2 gpd
= 1,004,640 gpd + 1,449,900 gpd
= 2,454,540 gpd

step 2: Convert gpd to MGD: 2,454,540 gpd = 2.45454 MGD
= **2.45 MGD**

45. Using the data provided, what is the daily average flow rate from this lift station?

Flow meter readings:

Monday	March 20	223,234,445 gal
Monday	March 27	243,879,629 gal

a.) Calculate gallons pumped:

243,879,629 gallons – 223,234,445 gallons = 20,645,184 gallons

b.) Average = $\frac{\text{total gallons pumped}}{\text{\# of days}} = \frac{\text{20,645,184 gallons}}{\text{7 days}}$

= **2,949,312.14 gpd**