SELECTED MATH PROBLEMS FOR COLLECTION AND DISTRIBUTION

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Math Problem Solving Strategy

1. Read the question carefully and underline what they are asking you to find.
2. Write down the formula you need to solve the problem. Look in the front of the test booklet if necessary.
3. Fill in everything you know. Sometimes filling in what you know might require you to find something else first like area or volume.
4. Check your units! Make sure they are correct for the formula and agree with each other.
5. Convert units where needed.
6. Put the new units into the formula.
7. Solve.
8. Check the units of your answer. Are they what the question asked for?
9. Convert units if necessary.

C&D Math Problems

Name: _____

Date: _____ Period: _____

1. A repair job can be done by 7 people in 8.5 hours. How long will it take for 4 people to complete the same job?
   (A) 4 hr 30 min
   (B) 14 hr 9 min
   (C) 14 hr 53 min
   (D) 4 hr 51 min

2. During a 24-hour period, a lift station in a system serving a community of 27,000 people pumped 5000 gpm of wastewater. What was the quantity of wastewater generated per capita expressed on a daily basis? Assume the pump station ran 10 hours on the day in question.
   (A) 420 L/d
   (B) 195 gpd
   (C) 1008 L/d
   (D) 78 gpd

3. A pump has a capacity of 8500 gpm and lifts wastewater against a total head of 39 feet. If the pump efficiency is 85%, what size kW motor is required?
   (A) 95 KW
   (B) 194 HP
   (C) 74 KW
   (D) 162 HP

4. The interior of 1,275 feet of 60-inch pipe is uniformly coated with 2.75 inches of grease. How many gallons will this pipe hold when filled with water?
   (A) 154,446
   (B) 33, 811
   (C) 26,541,375
   (D) 172,178

5. If flow through a 10-in, pipe is 722 gpm, what is the velocity in feet per second?
   (A) 5 ft/sec
   (B) 8 ft/sec
   (C) 3 ft/sec
   (D) 2 ft/sec

6. An 8-in, main line needs to be flushed. The length of pipeline to be flushed is 250 ft. How many minutes will it take to flush the line at 25 gpm?
   (A) 7 min
   (B) 31 min
   (C) 26 min
   (D) 13 min

7. Calculate the pounds per square inch pressure at the bottom of a tank, if the water level is 33.11 ft deep?
   (A) 33.1 psi
   (B) 76.5 psi
   (C) 14.3 psi
   (D) 28.6 psi

8. A centrifugal pump delivers 1890 Liters per minute against a head of 300 feet with a combined pump and motor efficiency of 70%. What is the cost of the electrical power required to operate the pump 12 hours per day for 2 months? Assume each month has 31 days. The electrical cost is $0.06 per kWh.
   (A) $1798
   (B) $1405
   (C) $925
   (D) $775

9. A map with a scale of 0.875 inches = 100 feet indicates that manhole “A” is 11.20 inches from manhole “B”. What is the actual distance between manholes?
   (A) 1,280.0 ft
   (B) 881.3 ft
   (C) 2,343.8 ft
   (D) 980.0 ft

10. A wet well is 12 feet by 6 feet by 15 deep and the influent rate is 600 GPM. With the 2 pumps running, the level decreases 3' 9”. In 18 minutes. If pump “A” has a pumping rate of 425 GPM, what is the pumping rate of pump “B”? (answer in GPM)
   (A) 537 gpm
   (B) 175 gpm
   (C) 488 gpm
   (D) 287 gpm

11. A ball is dropped into a manhole, 2 min. 18 seconds later it is observed 500' away in a downstream manhole. What is the velocity of the flow in FPS?
   (A) 3.62 ft/sec
   (B) 6.22 ft/sec
   (C) 3.90 ft/sec
   (D) 1.59 ft/sec

12. How many gallons are there in a pipe that is 18 in. in diameter and 216 ft long?
   (A) 2,430 gal
   (B) 2,854 gal
   (C) 1,908 gal
   (D) 2,561 gal

13. A contractor is building a house with a basement elevation of 884.6 ft. The stub-out connection elevation is 876.5 ft. If the minimum allowable slope is 3/8 inch per foot, how far from the road can the builder place the house?
   (A) 259.2 ft
   (B) 27.4 ft
   (C) 246.5 ft
   (D) 331.7 ft

14. Find the total head, in feet, for a pump with a total static head of 19 ft and a head loss of 3.7 ft.
   (A) 15.3 ft
   (B) 22.7 ft
   (C) 5.1 ft
   (D) 70.3 ft

15. A four cylinder positive displacement pump has a cylinder bore of 4.5 inches with a stroke of 5.5 inches. The pump operates at 1,700 rpm. How long will it take to empty a 72-inch diameter wet well, 33.0 ft deep if it has an inflow of 2,500 gpm?
   (A) 1 hr 34 min
   (B) 1 hr 0.7 min
   (C) 1 hr 87 min
   (D) 0 hr 3 min

16. What is the pressure head at a fire hydrant in feet, if the pressure gauge reads 121 psi?
   (A) 141 ft
   (B) 86 ft
   (C) 52 ft
   (D) 280 ft

17. How many gallons of 6.00% sodium hypochlorite solution are needed to disinfect a 1.0-ft diameter pipeline that is 752 ft long. The required dosage is 25.0 mg/L.
   (A) 0.92 gal
   (B) 1.84 gal
   (C) 15.30 gal
   (D) 4.43 gal

18. Two columns of water are filled completely at sea level to a height of 88 ft. Column A is 0.5 in. in diameter. Column B is 5 in. in diameter. What will the two pressure gauges, each attached to the bottom of each column, read?
    (A) A = 38.0 psi, B = 38.0 psi
    (B) A = 3.8 psi, B = 38.0 psi
    (C) A = 8.8 psi, B = 8.0 psi
    (D) A = 20.3 psi, B = 20.3 psi

19. What should the flow meter read in gallons per minute, if a 12-in. diameter main is to be flushed at 5.0 fps?
    (A) 1,762 gpm
    (B) 2,900 gpm
    (C) 3,920 gpm
    (D) 3,600 gpm

20. The following flows were recorded for the months of February, March, and April: Feb = 197.3 cfs, March = 100,186.2 gpm, April = 255.7 mgd. What was the average daily flow for this three month period?
    (A) 127.3 mgd
    (B) 175.8 mgd
    (C) 4.7 mgd
    (D) 527.2 mgd

21. Determine the volume of water in gallons for the following distribution system: Distribution pipe “A” is 1,376 ft in length and 3.0 ft in diameter. Distribution pipe “B” is 833 ft in length and 2.0 ft in diameter. Storage tank is 120 ft in diameter with a water height of 30.73 ft.
    (A) 5,400,000 gal
    (B) 73,000 gal
    (C) 2,700,000 gal
    (D) 93,000 gal

22. A crew surveys a sewer from STA. 11 + 3.00 to STA. 23 + 58.35 If the elevation of the manhole farthest to the treatment plant is 665.3 feet, what is the elevation of the second manhole if the grade is 0.0011 ft/ft?
    (A) 663.9 ft
    (B) 666.7 ft
    (C) 1.4 ft
    (D) 6.6 ft

23. A chemical was dosed at 31 mg/L to treat a flow of 7,525,000 gpd. The chemical cost is $1.37 per pound. A jar test determined that a dose of 17 mg/L would achieve the same level of treatment. How much money could be saved each month by switching to the lower dose? Assume a month has 30 days.
    (A) $79,961
    (B) $32,388
    (C) $36,111
    (D) $43,849

24. What is the area of a trench that is 22.4 ft long and 3.3 ft wide?
    (A) 187 ft^2
    (B) 26 ft^2
    (C) 74 ft^2
    (D) 143 ft^2

25. A meter indicates water is flowing from a fire hydrant at 2.6 cfm. How many gallons will flow from the hydrant if it is flushed for 35 minutes?
    (A) 910 gal
    (B) 681 gal
    (C) 91 gal
    (D) 20 gal

26. What capacity blower is required to ventilate a manhole 60” in diameter and 53' deep, if 23 air change(s) are required every 36 minutes?
    (A) 664 CFM
    (B) 173 CFM
    (C) 3,120 CFM
    (D) 1,248 CFM

27. Root control chemical is added to the sewer at a dose of 51 mg/L. The sewer is 54-inches in diameter and 2,127 feet long. If the chemical contains 41% active ingredient, how many pounds of the chemical solution must be added to the sewer?
    (A) 44 lbs
    (B) 293 lbs
    (C) 6,351 lbs
    (D) 262 lbs

28. A sewer jet with a 1475 gallon tank has an 80 gpm pump. If the operator has to fill the truck 5 times in an 8 hour day, how much time is actually spent cleaning sewers during the day?
    (A) 1 hr 32 min
    (B) 2 hr 28 min
    (C) 11 hr 31 min
    (D) 3 hr 50 min

29. If a pump outputs 625 gpm against a total dynamic head of 211 feet and the pump is 71% efficient, what is the brake HP? Assume the fluid being pumped has a specific gravity of 1.12
    (A) 4.2 HP
    (B) 52.6 HP
    (C) 32.3 HP
    (D) 26.5 HP

30. A 2.50-mil gal storage tank needs to be disinfected with a 62.5% calcium hypochlorite solution. If the chlorine dosage desired is 50.0 mg/L, how many gallons of calcium hypochlorite solution are required?
    (A) 200 gal
    (B) 125 gal
    (C) 1,040 gal
    (D) 1,563 gal

31. A 480v AC pump motor draws 22 amps. What is the horsepower output of the motor if the power factor is .78 and the pump efficiency is 89%?
    (A) 11.04 HP
    (B) 9.83 HP
    (C) 7.33 HP
    (D) 12.41 HP

32. A small tank containing 1,500 gal of water needs to be disinfected in order to be put back in service. If the dosage needed is 35 mg/L, how many pounds of calcium hypochlorite (60.5% available chlorine) are required?
    (A) 1.5 lb
    (B) 0.72 lb
    (C) 25 lb
    (D) 43 lb

33. A certain town's household flow rate is measured at 85 GPCD. If the plant receives 3.0 MGD, but 15% of that is inflow and infiltration, then what is the population of the town?
    (A) 235,294 people
    (B) 27,900 people
    (C) 382,500 people
    (D) 30,000 people

34. A wet well is 9 feet deep by 21 feet in diameter. When the pump is not running, the water rises 33 inches in 2 minutes and 52 seconds. If thee level falls 5.2 inches in 14 minutes while the pump is running, what is the pump rate in gpm?
    (A) 2,404 gpm
    (B) 2,680 gpm
    (C) 2,564 gpm
    (D) 11,740 gpm

35. A trench is 430 ft long, 4.0 ft wide, and 5.5 ft deep. How many cubic yards of soil are excavated?
(A) 350 yd^3
(B) 215 yd^3
(C) 9,460 yd^3
(D) 788 yd^3

36. If a 24" pipe and a 48" pipe are running full and meet at a manhole, what size outlet pipe will be required?
(A) 72 in
(B) 60 in
(C) 48 in
(D) 54 in

37. What is the percent lime in a slurry, if 12 lb of lime are mixed in a 55-gal drum that contains 52 gal of water?
(A) 9.0 %
(B) 5.4 %
(C) 4.5 %
(D) 2.7 %

38. A well produces 365 gpm with a drawdown of 22.5 ft. What is the specific yield in gallons per minute per foot?
(A) 32.4 gpm/ft
(B) 16.2 gpm/ft
(C) 36.5 gpm/ft
(D) 22.5 gpm/ft

39. Rain falls for two hours on a parking lot that is 205 feet by 185 feet. The amount of rain that fell was measured at 2.5 inches. Calculate the amount of flow in GPM.
(A) 549 gpm
(B) 492 gpm
(C) 5,910 gpm
(D) 1740 gpm

40. A water treatment plant injects chlorine at a dosage rate of 3.00 mg/L after the filters. The chlorine residual is 1.45 mg/L at a distant point in the distribution system. Calculate the chlorine demand between the two sampling points.
(A) 1.45 mg/L
(B) 2.90 mg/L
(C) 4.45 mg/L
(D) 1.55 mg/L

41. If the grade of a sanitary sewer has a slope of 0.10% for 1,200 feet, what is the rise of the pipe?
(A) 1201.2 ft
(B) 0.01 ft
(C) 1.20 ft
(D) 0.12 ft

42. An 11 foot wide by 2,650 foot long trench must be excavated and the spoils removed from the premises. The spoil weighs 3600 lbs per cubic yard and each truck can carry 11 tons. How many truck loads are required if the trench is 14 feet deep?
(A) 7,420 trucks
(B) 4,946 trucks
(C) 2,473 trucks
(D) 2,474 trucks

43. Your department uses 80 units of an item per week. You are required to maintain a 10-week reserve of this item at all times and it requires 4 weeks to obtain a new supply. What is the minimum reorder point?
(A) 2,240 units
(B) 320 units
(C) 800 units
(D) 1,120 units

44. An employee receives an hourly wage of $13.25 plus overtime pay of 1.5 times the hourly wage. Overtime pay is given for each hour worked over 40 hours per week. If an employee works 48 hours during a week, what is the compensation before taxes?
    (A) $159.00
    (B) $530.00
    (C) $689.00
    (D) $848.00

45. What should the flow meter read in gallons per minute if a 12-in. diameter main is to be flushed at 5.0 fps?
    (A) 78.5 gpm
    (B) 1,762 gpm
    (C) 392 gpm
    (D) 39.2 gpm

46. Chlorine is fed at a rate of 25 lb/day for a flow rate of 7 cfs. To maintain the same dosage, what adjustment to the chlorinator should be made when the flow rate is increased to 12 cfs?
    (A) 43 lb/day
    (B) 63 lb/day
    (C) 50 lb/day
    (D) 30 lb/day

47. A circular tank is 6ft. 6 inches in diameter and 25' deep. If the tank is completely full and a 300 GPM pump is supplied, how long will it take to remove 36” of water from the tank?
    (A) 2.5 min
    (B) 33 min
    (C) 25 min
    (D) 248 min

48. A 6-in, pipeline needs to be flushed. If the desired length of pipeline to be flushed is 316 ft, how many minutes will it take to flush the line at 31 gpm?
    (A) 15 min
    (B) 10 min
    (C) 60 min
    (D) 30 min

49. The interior of 200 feet of a 10-inch diameter pipe is uniformly coated with a 1-inch thick layer of grease. Approximately how much will this pipe hold when filled with water?
    (A) 860 gal
    (B) 660 gal
    (C) 522 gal
    (D) 1180 gal

50. What is the motor horsepower (mhp) for a pump with the following parameters? Motor efficiency:87%, Total Head (TH): 107 ft, Pump efficiency: 79%, Flow: 2.544 mgd
    (A) 87 mhp
    (B) 79 mhp
    (C) 25 mhp
    (D) 69 mhp

51. What is the internal surface area of a cylindrical tank (bottom, top, and the cylinder wall), if it is 125.0 ft in diameter and 48.5 ft high?
    (A) 24,531 ft^2
    (B) 6,063 ft^2
    (C) 19,036 ft^2
    (D) 43,567 ft^2

52. Given the following information, would it be less expensive to finish the job in 2 days or finish the job in one day by working overtime? Actual job time = 13 hours, Travel time and set-up time = 1.25 hours, Average work day = 8 hours, Hourly pay rate = $21.25, Overtime is 1.50 times the normal hourly rate
    (A) Cheaper to do the work in two days
    (B) Cheaper to do the work with OT
    (C) Costs the same either way
    (D) None of the above

53. A water tank with a capacity of 3.0 mil gal is being filled at a rate of 4,810 gpm. How many hours will it take to fill the tank?
(A) 3.0 hr
(B) 1.4 hr
(C) 28.8 hr
(D) 10.4 hr

54. What is the pounds per square inch pressure at the bottom of a tank, if the water level is 38.29 ft?
(A) 53.9 psi
(B) 88.4 psi
(C) 16.6 psi
(D) 7.3 psi

55. A trench that averages 4.2 ft wide and 5.4 ft in depth is dug for the purpose of installing a 24-in, diameter pipeline. If the trench is 1,287 ft long, how much soil in cubic feet will be put in the trench after the pipe is in place, assuming that the only soil left over is that which the pipe now occupies?
(A) 25,000 ft^3
(B) 1,300 ft^3
(C) 29,000 ft^3
(D) 4,000 ft^3

56. Given the following data, determine the detention time in hours,
- Distribution pipe from water plant to storage tank is 2,485 ft in length and 12-in, in diameter
- Storage tank averages 1,875,000 gal of water at any given time
- Flow through system is 6.82 mgd

(A) 6.65 hr
(B) 18.89 hr
(C) 14.63 hr
(D) 12.55 hr

57. Given the following data, calculate the total kilowatts needed to operate the following small facility when everything is running: Raw water pump = 300 hp, Flocculators = 60 hp, Filter pump for backwashing = 100 hp, Chlorination = 25 hp, Clear water pump = 100 hp, Lighting = 11 hp, Instrumentation = 4 hp
(A) 1,386 KW
(B) 260 KW
(C) 600 KW
(D) 448 KW

58. A degreasing agent is added to a 11.5 foot diameter wet well that is 9.5 feet deep. 4.5 pounds of degreasing agent is required for every square foot of surface area. If the degreaser weighs 3.5 pounds per gallon and has a concentration of 16.4 mg/L, how many pounds of chemical must be added to the well?
(A) 467.2 lbs
(B) 3,494.5 lbs
(C) 0.48 lbs
(D) 4,438.1 lbs

59. What should the setting be on a chlorinator in pounds per day, if the dosage desired is 2.90 mg/L and the pumping rate from the well is 975 gpm?
(A) 29 lb/day
(B) 34 lb/day
(C) 336 lb/day
(D) 41 lb/day

60. Colored dye is dumped into a manhole. The first dye appears 3 minutes and 17 seconds later in a manhole located 1,850 feet downstream and disappears 21 minutes and 49 seconds after it was dumped into the first manhole. What is the velocity of flow in the sewer?
(A) 2.46 ft/sec
(B) 1.41 ft/sec
(C) 9.39 ft/sec
(D) 0.81 ft/sec

61. The interior of 750 ft of 24 in. pipe is uniformly coated with 1.5 inches of grease. How many gallons will this pipe hold when filled with water?
    (A) 15,482 gal.
    (B) 13,487 gal.
    (C) 17,165 gal.
    (D) 12,534 gal.

62. If a sewer must have a flow rate of 27 mgd with a velocity between 1.50 ft/sec and 2.75 ft/sec, what mush the minimum size be?
    (A) 71 in
    (B) 72 in
    (C) 53 in
    (D) 52 in

63. What is the median value of the following data: 100, 300, 580, 250, 275, 335, 580
    (A) 580
    (B) 346
    (C) 300
    (D) 250

64. Convert 425 degrees Fahrenheit to Celsius
    (A) 236 °C
    (B) 218 °C
    (C) 797 °C
    (D) 457 °C

65. An electric motor is supplied by 480 volts and 32 amps, given no loss, what horsepower can the motor supply to the water?
    (A) 11.2 HP
    (B) 20.6 HP
    (C) 15.4 HP
    (D) 22.4 HP

C&D Math Problems
Answer Key

1.	C	23.	C	45.	B
2.	A	24.	C	46.	A
3.	C	25.	B	47.	A
4.	A	26.	A	48.	A
5.	C	27.	D	49.	C
6.	C	28.	A	50.	D
7.	C	29.	B	51.	D
8.	A	30.	A	52.	A
9.	A	31.	B	53.	D
10.	D	32.	B	54.	C
11.	A	33.	D	55.	A
12.	B	34.	C	56.	A
13.	A	35.	A	57.	D
14.	B	36.	D	58.	A
15.	A	37.	D	59.	B
16.	D	38.	B	60.	A
17.	B	39.	B	61.	B
18.	A	40.	D	62.	C
19.	A	41.	C	63.	D
20.	B	42.	D	64.	B
21.	C	43.	D	65.	B
22.	A	44.	C		

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1. $C_1V_1 = C_2V_2$

$(7\ \cancel{people})(8.5\ hr) = (4\ \cancel{people})(V_2)$

$59.5\ hr = 4\ V_2$

$\frac{59.5\ hr}{4} = V_2$

$14.875\ hr = V_2$ $\qquad \frac{0.875\ \cancel{hr}}{1\ \cancel{hr}} \times 60\ min = 52.5\ min$

14 hrs 53 min $= V_2$

2. $\frac{5{,}000\ gal}{\cancel{min}} \times \frac{60\ \cancel{min}}{1\ \cancel{hr}} \times \frac{10\ \cancel{hr}}{1\ day} = \frac{3{,}000{,}000\ gal}{day}$

$\frac{3{,}000{,}000\ gal/day}{27{,}000\ people} = 111\ gpcd$ ← not a choice, convert!

$\frac{111\ \cancel{gal}}{c\ \ day} \times \frac{3.785\ L}{1\ \cancel{gal}} =$ **420 L/day**

3. $HP = \frac{(gpm)(head,\ ft)}{(3{,}960)(E_p)}$

$HP = \frac{(8{,}500\ gpm)(39\ ft)}{(3{,}960)(0.85)}$

$HP = 98.48$

$98.48\ \cancel{HP} \times \frac{0.746\ KW}{1\ \cancel{HP}} = 73.46\ KW =$ **74 KW**

4. 60 inch diameter - (2.75 in)(2 times)

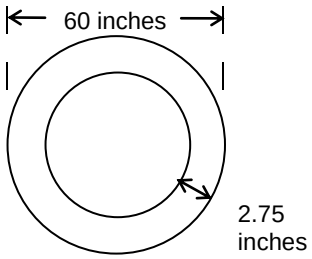
new diameter = 54.5 in = 4.542 ft

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(4.542\ ft)^2\ (1{,}275\ ft)$

Volume = $20{,}647.82\ ft^3$

$20{,}647.82\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} =$ **154,446 gal**



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5. $10\ \cancel{in} \times \frac{1\ ft}{12\ \cancel{in}} = 0.833\ ft$

$Area = 0.785\ d^2$

$Area = (0.785)(0.833\ ft)^2$

$Area = 0.545\ ft^2$

$Velocity = \frac{Flow}{Area}$ $\qquad Flow = \frac{722\ \cancel{gal}}{\cancel{min}} \times \frac{1\ \cancel{min}}{60\ sec} \times \frac{1\ ft^3}{7.48\ \cancel{gal}} = \frac{1.61\ ft^3}{sec}$

$Velocity = \frac{1.61\ ft^3/s}{0.545\ \cancel{ft}^2}$

$Velocity = 2.95\ ft/sec = \mathbf{3\ ft/sec}$

6. $8\ \cancel{in} \times \frac{1\ ft}{12\ \cancel{in}} = 0.667\ ft$

$Volume = 0.785\ d^2\ h$

$Volume = (0.785)(0.667\ ft)^2\ (250\ ft)$

$Volume = 87.3\ ft^3$

$time = \frac{Volume}{Flow}$ $\qquad Flow = 87.3\ \cancel{ft}^3 \times \frac{7.48\ gal}{1\ \cancel{ft}^3} = 653\ gal$

$time = \frac{653\ \cancel{gal}}{25\ \cancel{gal}/min}$

$time = \mathbf{26\ min}$

7. $33.11\ \cancel{ft} \times \frac{0.433\ psi}{1\ \cancel{ft}} = \mathbf{14.3\ psi}$

8. $\frac{1890\ \cancel{L}}{min} \times \frac{1\ gal}{3.785\ \cancel{L}} = \mathbf{499.3\ gal/min}$

$HP = \frac{(gpm)(TDH, ft)}{(3{,}960)(E_p)(E_m)}$

$HP = \frac{(499.3\ gpm)(300\ ft)}{(3{,}960)(0.70)}$

$HP = 54$

$54\ \cancel{HP} \times \frac{0.746\ \cancel{KW}}{1\ \cancel{HP}} \times \frac{\$0.06}{1\ \cancel{KWH}} \times \frac{12\ \cancel{hrs}}{\cancel{day}} \times \frac{31\ \cancel{day}}{month} \times 2 = \mathbf{\$1{,}798\ month}$

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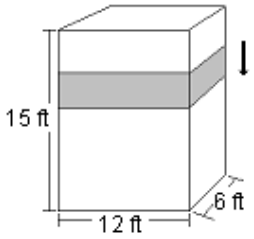
9. $\frac{0.875\ \cancel{in}}{100\ ft} = \frac{11.20\ \cancel{in}}{X}$

$0.875\ X = (11.20)(100\ ft)$

$X = \mathbf{1{,}280\ ft}$

10.



Drops 3' 9" in 18 min

$9\ \cancel{in} \times \frac{1\ ft}{12\ \cancel{in}} = 0.75\ ft$

Volume = l x w x h

Volume = (12 ft)(6 ft)(3.75 ft)

Volume = 270 ft^3

$\frac{270\ \cancel{ft^3}}{18\ min} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = 112\ gal/min$

} pump station

Since the level dropped, the total flow pumped is:

influent flow + drop in water level

600 gpm + 112 gpm = 712 gpm

Total Flow = Pump A + Pump B

712 gpm = 425 gpm + Pump B

287 gpm = Pump B

11. Velocity = $\frac{distance}{time}$

2 min 18 sec = 138 sec

Velocity = $\frac{500\ ft}{138\ sec}$

Velocity = **3.62 ft/sec**

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12. 18 inches = 1.5 ft

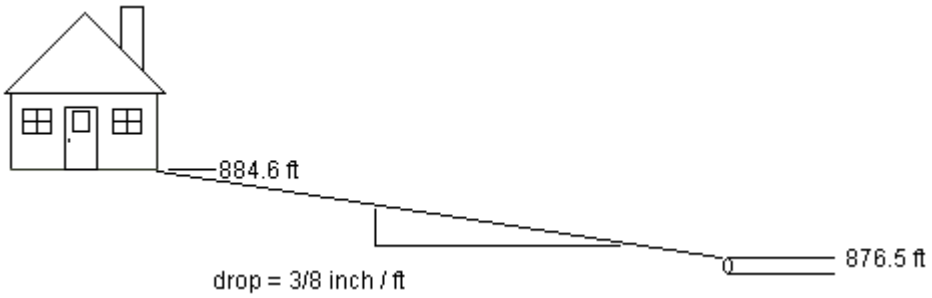
Volume = $0.785\ d^2\ h$

Volume = $(0.785)(1.5\text{ ft})^2(216\text{ ft})$

Volume = $381.51\ ft^3$

$$381.51\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = \mathbf{2{,}854\ gal}$$

13.



$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{height difference}}{\text{pipe length}}$$

3/8 in = 0.375 in

$$\frac{0.375\ \cancel{in}}{12\ \cancel{in}} = \frac{884.6\text{ ft} - 876.5\text{ ft}}{\text{pipe length}}$$

$$0.03125 = \frac{8.1\text{ ft}}{\text{pipe length}}$$

$$\text{pipe length} = \frac{8.1\text{ ft}}{0.03125}$$

pipe length = **259.2 ft**

14. Total Head = Static Head + Losses

Total Head = 19 ft + 3.7 ft

Total Head = **22.7 ft**

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15. Find volume per stroke, then pump rate

4.5 in = 0.375 ft Volume = $0.785\ d^2\ h$

5.5 in = 0.458 ft Volume = $(0.785)(0.375\ ft)^2(0.458\ ft)$

Volume = $0.0506\ ft^3$

$$\frac{0.0506\ \cancel{ft^3}}{\cancel{stroke}} \times \frac{4\ \cancel{strokes}}{1\ \cancel{rev}} \times \frac{1700\ \cancel{rev}}{min} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = 2{,}574\ gal/min$$

Find volume of wet well

72 inches = 6 ft

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(6\ ft)^2(33\ ft)$

Volume = $932.58\ ft^3$

$$932.58\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = 6{,}976\ gal$$

If the influent flow is 2,500 gpm, the net pump rate is:

2,574 gpm - 2,500 gpm = 74 gpm

$$time = \frac{Volume}{Flow}$$

$$time = \frac{6{,}976\ \cancel{gal}}{74\ \cancel{gal}/min}$$

time = 94 min

time = **1 hr 34 min**

16.

$$121\ \cancel{psi} \times \frac{1\ ft}{0.433\ \cancel{psi}} = \mathbf{280\ ft}$$

17. Volume = $0.785\ d^2\ h$

Volume = $(0.785)(1\ ft)^2(752\ ft)$

Volume = $590.32\ ft^3$

$$590.32\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = 4{,}416\ gal$$

$C_1V_1 = C_2V_2$

$(60{,}000\ \cancel{mg/L})(V_1) = (25\ \cancel{mg/L})(4{,}416\ gal)$

V_1 = **1.84 gal**

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18. $88\ \cancel{ft} \times \frac{0.433 psi}{1\ \cancel{ft}} =$ **38.0 psi** **They are both the same**

19. $Velocity = \frac{flow}{area}$

$5.0\ ft/s = \frac{flow}{0.785\ ft^2}$

$3.925\ ft^3/s = flow$

$\frac{3.925\ \cancel{ft^3}}{\cancel{sec}} \times \frac{60\ \cancel{sec}}{1\ min} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} =$ **1,762 gpm**

$Area = 0.785\ d^2$

$Area = (0.785)(1\ ft)^2$

$Area = 0.785\ ft^2$

20. $197.3\ ft^3/s$
$100{,}186.2\ gpm$
$255.7\ mgd$
} convert all units to gpm

$\frac{197.3\ \cancel{ft^3}}{\cancel{sec}} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} \times \frac{60\ \cancel{sec}}{1\ min} =$ 88,548 gpm

$\frac{255.7\ \cancel{mg}}{\cancel{day}} \times \frac{1\ \cancel{day}}{1440\ min} \times \frac{1{,}000{,}000\ gal}{1\ \cancel{mg}} =$ 177,569 gpm

88,548 gpm
100,186 gpm
+ 177,569 gpm
366,303 gpm

divide by 3 for average = 122,101 gpm

$\frac{122{,}101\ \cancel{gal}}{\cancel{min}} \times \frac{1440\ \cancel{min}}{1\ day} \times \frac{1\ mg}{1{,}000{,}000\ \cancel{gal}} =$ **175.8 mgd**

21. Pipe A = $0.785\ d^2\ h$

Pipe A = $(0.785)(3\ ft)^2(1{,}376\ ft)$

Pipe A = $9{,}721\ ft^3$

Pipe B = $0.785\ d^2\ h$

Pipe B = $(0.785)(2\ ft)^2(833\ ft)$

Pipe B = $2{,}615\ ft^3$

Tank = $0.785\ d^2\ h$

Tank = $(0.785)(120\ ft)^2(30.73\ ft)$

Tank = $347{,}372\ ft^3$

Total Volume = $9{,}721\ ft^3 + 2{,}615\ ft^3 + 347{,}372\ ft^3 = 359{,}708\ ft^3$

$359{,}708\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} =$ **2,690,616 gal**

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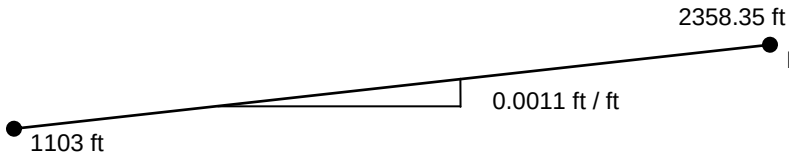
22.



STA 11 + 3 = 1103 ft

STA 23 + 58.35 = 2358.35 ft

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

$$0.0011 \text{ ft / ft} = \frac{(665.3 \text{ ft} - X)}{(2358.35 \text{ ft} - 1103 \text{ ft})}$$

$$0.0011 \text{ ft / ft} = \frac{(665.3 \text{ ft} - X)}{1255.35 \text{ ft}}$$

$$\textbf{1.4 ft} = (665.3 \text{ ft} - X)$$

23.

$$\text{ppd} = (\text{mg/L})(\text{Q, mgd})(8.34)$$

$$\text{ppd} = (31\text{mg/L} - 17\text{mg/L})(7.525 \text{ mgd})(8.34)$$

$$\text{ppd} = (14\text{mg/L})(7.525 \text{ mgd})(8.34)$$

$$\text{ppd} = 878.619 \text{ lb}$$

$$878.619 \text{ lb} \times \frac{\$1.37}{1 \text{ lb}} = \$1203.71 \text{ saved per day}$$

$$\$1203.71 \times 30 \text{ days} = \textbf{\$36,111}$$

24.

$$\text{Area} = l \times w$$

$$\text{Area} = (22.4 \text{ ft})(3.3 \text{ ft})$$

$$\text{Area} = \textbf{74 ft}^2$$

25.

$$\frac{2.6 \text{ ft}^3}{\text{min}} \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} = \frac{19.45 \text{ gal}}{\text{min}}$$

$$\frac{19.45 \text{ gal}}{\text{min}} \times 35 \text{ min} = \textbf{681 gal}$$

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26. Volume = $0.785\ d^2\ h$

Volume = $(0.785)(5\text{ ft})^2(53\text{ ft})$

Volume = 1040 ft^3

$(1040\text{ ft}^3)(23\text{ air changes}) = 23{,}923\text{ ft}^3$

$$\frac{23{,}923\text{ ft}^3}{36\text{ min}} = \textbf{664 cfm}$$

27. Volume = $0.785\ d^2\ h$ 54 in = 4.5 ft

Volume = $(0.785)(4.5\text{ ft})^2(2{,}127\text{ ft})$

Volume = $33{,}811.32\text{ ft}^3$

$$33{,}811.32\ \cancel{\text{ft}^3} \times \frac{7.48\ \cancel{\text{gal}}}{1\ \cancel{\text{ft}^3}} \times \frac{1\text{ MG}}{1{,}000{,}000\ \cancel{\text{gal}}} = 0.253\text{ MG}$$

$$\text{Dose} = \frac{(\text{mg/L})(\text{Q, mg})(8.34)}{\%}$$

$$\text{Dose} = \frac{(51\text{ mg/L})(0.253\text{ mg})(8.34)}{0.41}$$

Dose = **262 lb**

28. $$\text{time} = \frac{\text{Volume}}{\text{Flow}}$$

$$\text{time} = \frac{1475\text{ gal}}{80\text{ gpm}}$$

time = 18.4375 min

Filled 5 times, so:

(18.4375 min)(5) = 92 min

= **1 hr 32 min**

29. $$\text{HP} = \frac{(\text{gpm})(\text{TDH, ft})(8.34)(\text{p})}{(33{,}000)(\text{Ep})}$$

$$\text{HP} = \frac{(625\text{ gpm})(211\text{ ft})(8.34)(1.12)}{(33{,}000)(0.71)}$$

HP = **52.6**

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30. $$\text{Dose, ppd} = \frac{\text{(mg/L)(Q, mg)(8.34)}}{\text{\% purity}}$$

$$\text{Dose, ppd} = \frac{\text{(50 mg/L)(2.50 mg)(8.34)}}{0.625}$$

$$\text{Dose, ppd} = 1668 \text{ lbs}$$

$$1668 \text{ lb} \times \frac{1 \text{ gal}}{8.34 \text{ lb}} = \mathbf{200 \text{ gal}}$$

31. $$\text{Watts}_{\text{AC Motor}} = \text{(Volts)(Amps)(Power Factor)}$$

$$\text{Watts}_{\text{AC Motor}} = \text{(480 V)(22 A)(.078)}$$

$$\text{Watts}_{\text{AC Motor}} = 8237 \text{ Watts}$$

$$8237 \text{ Watts} \times \frac{1 \text{ KW}}{1000 \text{ Watts}} \times \frac{1 \text{ HP}}{0.746 \text{ KW}} = \mathbf{11.04 \text{ HP}}$$

32. $$\text{lbs} = \frac{\text{(mg/L)(mgd)(8.34)}}{\text{\% purity}}$$

$$\text{lbs} = \frac{\text{(35 mg/L)(0.0015 mgd)(8.34)}}{0.605}$$

$$\text{lbs} = \mathbf{0.72}$$

33. $$\text{(3,000,000 gpd)(0.85)} = \text{2,550,000 gpd}$$

$$\frac{\text{2,550,000 gpd}}{\text{85 gpcd}} = \mathbf{30{,}000 \text{ people}}$$

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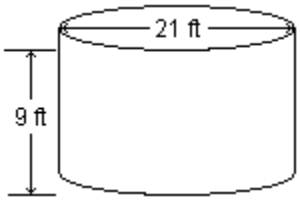
34.



Pump Rate = Influent Flow + Drop

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(21\text{ ft})^2(33\text{ inches})$

Volume = $(0.785)(21\text{ ft})^2(2.75\text{ ft})$

Volume = 952 ft^3

$$\frac{952\text{ ft}^3}{172\text{ sec}} \times \frac{7.48\text{ gal}}{1\text{ ft}^3} \times \frac{60\text{ sec}}{1\text{ min}} = 2{,}484\text{ gpm}$$

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(21\text{ ft})^2(0.433\text{ ft})$

Volume = 150 ft^3

$$\frac{952\ \cancel{\text{ft}^3}}{14\text{ min}} \times \frac{7.48\text{ gal}}{1\ \cancel{\text{ft}^3}} = 80\text{gpm}$$

Total Pump Rate = 2,484 gpm + 80gpm = **2,564 gpm**

35. Volume = l x w x h

Volume = (430 ft)(4.0 ft)(5.5 ft)

Volume = $9{,}460\text{ ft}^3$

$$9{,}460\ \cancel{\text{ft}^3} \times \frac{1\text{ yd}^3}{27\ \cancel{\text{ft}^3}} = \textbf{350 yd}^3$$

36. Area = $0.785\ d^2$

Area = $(0.785)(24\text{ in})^2$

Area = 452.16 in^2

Area = $0.785\ d^2$

Area = $(0.785)(48\text{ in})^2$

Area = $1{,}808.64\text{ in}^2$

Total Area = $2{,}260.8\text{ in}^2$

New Diameter:

Area = $0.785\ d^2$

$2{,}260.8\text{ in}^2 = (0.785)(d^2)$

$2{,}280\text{ in}^2 = d^2$

54 in = d

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37. $52\ \cancel{gal} \times \frac{8.34\ lbs}{1\ \cancel{gal}} = 433.68\ lb$

$$\% = \frac{Part}{Whole} \times 100$$

$$\% = \frac{12\ \cancel{lb}\ lime}{433.68\ \cancel{lb} + 12\ \cancel{lb}} \times 100$$

$$\% = \mathbf{2.7}$$

38. $$Specific\ Yield = \frac{Yield}{Drawdown} = \frac{365\ gpm}{22.5\ ft} = \mathbf{16.22\ gpm / ft}$$

39. $Volume = l \times w \times h$

$Volume = (205\ ft)(185\ ft)(2.5\ inches)$

$Volume = (205\ ft)(185\ ft)(0.2083\ ft)$

$Volume = 7{,}901\ ft^3$

$2\ hr = 120\ min$

$$\frac{7{,}901\ \cancel{ft^3}}{120\ min} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = \mathbf{492\ gpm}$$

40. $Dose = Residual + Demand$

$3.0\ mg/L = 1.45\ mg/L + Demand$

$\mathbf{1.55\ mg/L} = Demand$

41. $$Slope = \frac{Rise}{Run}$$

$$0.10\ \% = \frac{Rise}{1200\ ft}$$

$\mathbf{1.2\ ft} = Rise$

42. $Volume = l \times w \times h$

$Volume = (2{,}650\ ft)(11\ ft)(14\ ft)$

$Volume = 408{,}100\ ft^3$

$$408{,}100\ \cancel{ft^3} \times \frac{1\ \cancel{yd^3}}{27\ \cancel{ft^3}} \times \frac{3{,}600\ \cancel{lb}}{1\ \cancel{yd^3}} \times \frac{1\ \cancel{Ton}}{2{,}000\ \cancel{lb}} \times \frac{1\ Truck}{11\ \cancel{Tons}} = \mathbf{2{,}473\ Trucks}$$

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43. 10 week reserve + 4 weeks = 14 week supply

(80 units)(14 weeks) = **1,120 units**

44. (40)($13.25) = $530 regular pay

(8)($13.25)(1.5) = $159 overtime pay

$689 total pay

45. $\text{Velocity} = \frac{\text{Flow}}{\text{Area}}$

$5.0 \text{ ft/s} = \frac{\text{Flow}}{0.785 \text{ ft}^2}$

$3.925 \text{ ft}^3 / \text{sec} = \text{Flow}$

12 inches = 1 ft

Area = 0.785 d^2

Area = $(0.785)(1 \text{ ft})^2$

Area = 0.785 ft^2

$$\frac{3.925 \text{ ft}^3}{\text{sec}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} = \mathbf{1{,}762 \text{ gpm}}$$

46. $\frac{25 \text{ lbs/day}}{7 \text{ cfs}} = \frac{X}{12 \text{ cfs}}$

$300 \text{ lb/day} = 7X$

$42.85 \text{ lb/day} = X$

43 lb / day

47. $\text{time} = \frac{\text{Volume}}{\text{Flow}}$

$\text{time} = \frac{744 \text{ gal}}{300 \text{ gpm}}$

time = **2.5 min**

Volume = $0.785 \text{ d}^2 \text{ h}$

Volume = $(0.785)(6 \text{ ft. } 6 \text{ in.})^2(36 \text{ in.})$

Volume = $(0.785)(6.5 \text{ ft.})^2(3 \text{ ft.})$

Volume = 99.5 ft^3

$$99.5 \text{ ft}^3 \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} = 744 \text{gal}$$

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48. Volume = $0.785\ d^2\ h$

Volume = $(0.785)(\ 6\ in.)^2(316\ ft.)$

Volume = $(0.785)(0.5\ ft.)^2(316\ ft.)$

Volume = $62.015\ ft^3$

$$408{,}100\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} \times 463.87\ gal$$

$$time = \frac{Volume}{Flow}$$

$$time = \frac{463.87\ \cancel{gal}}{31\ \cancel{g}pm}$$

time = 14.96 min = **15 min**

49. 10 inch diameter - (1 in)(2 times)

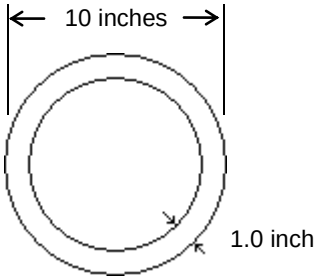
new diameter = 8 in = .6667 feet

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(.6667\ ft)^2\ (200\ ft)$

Volume = $69.78\ ft^3$

$$69.78\ \cancel{ft^3} \times \frac{7.48\ gal}{1\ \cancel{ft^3}} = \textbf{522 gal}$$



50. $$\frac{2.544\ \cancel{mg}}{\cancel{day}} \times \frac{1\ \cancel{day}}{1440\ min} \times \frac{1{,}000{,}000\ gal}{1\ \cancel{mg}} = 1767\ gpm$$

$$HP_{MOTOR} = \frac{(gpm)(TDH,\ ft)}{(3{,}960)(E_P)(E_M)}$$

$$HP_{MOTOR} = \frac{(1{,}767\ gpm)(107\ ft)}{(3{,}960)(0.79)(0.87)}$$

HP_{MOTOR} = **69**

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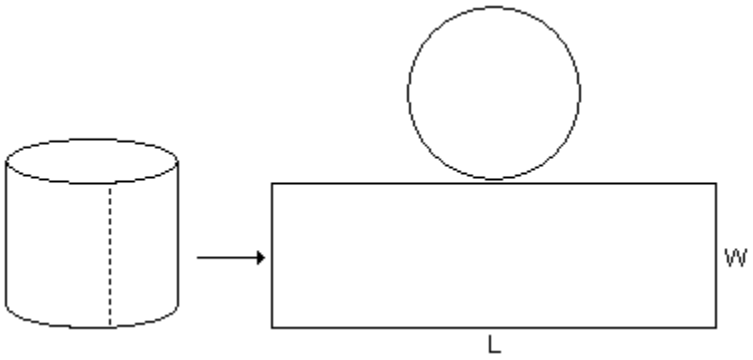
51.



length = perimeter of circle = πd

$Area_{circle} = 0.785\ d^2$

$Area_{circle} = (0.785)(125\ ft)^2$

$Area_{circle} = 12{,}265.625\ ft^2$

$Area_{rectangle} = L \times W$

$Area_{rectangle} = \pi d \times W$

$Area_{rectangle} = (3.14)(125\ ft)(48.5\ ft)$

$Area_{rectangle} = 19{,}036.25\ ft^2$

You need > 1 rectangle, 2 circles

Total Area = **43,567 ft^2**

52. Job in 2 days

Job time = 13 hrs

Travel time = 1.25 hrs x 2 = 2.5 hrs

Total time = 15.5 hrs

(15.5 ~~hr~~)($21.25/~~hr~~) = $329.38

Job in 1 day

Job time = 13 hrs

Travel time = 1.25 hrs

Total time = 14.25 hrs

8 hrs @ straight time rate

14.25 – 8 hrs @ overtime rate

(8 ~~hr~~)($21.25/~~hr~~) = $170.00

(6.25 ~~hr~~)($21.25/~~hr~~)(1.5) = $199.22

Total = $369.22 **Cheaper to do the work in 2 days**

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53. $\text{time} = \frac{\text{Volume}}{\text{Flow}}$

$\text{time} = \frac{3{,}000{,}000\ \cancel{\text{gal}}}{4810\ \cancel{\text{g}}\text{pm}}$

$\text{time} = 623.7\ \text{min}$

$623.7\ \cancel{\text{min}} \times \frac{1\ \text{hr}}{60\ \cancel{\text{min}}} = \mathbf{10.4\ hrs}$

54. $38.29\ \cancel{\text{ft}} \times \frac{0.433\ \text{psi}}{1\ \cancel{\text{ft}}} = \mathbf{16.6\ psi}$

55. $V_{trench} = L \times W \times H$

$V_{trench} = (1{,}287\ \text{ft})(4.2\ \text{ft})(5.4\ \text{ft})$

$V_{trench} = 29{,}189\ \text{ft}^3$

$V_{pipe} = 0.785\ d^2\ h$

$V_{pipe} = (0.785)(2\ \text{ft})^2(1{,}287\ \text{ft})$

$V_{pipe} = 4{,}041\ \text{ft}^3$

$V_{trench,}\ \text{ft}^3 - V_{pipe,}\ \text{ft}^3 = \text{soil, ft}^3$

$29{,}189\ \text{ft}^3 - 4{,}041\ \text{ft}^3 = \mathbf{25{,}147\ ft^3}$

56. $\text{Volume} = 0.785\ d^2\ h$

$\text{Volume} = (0.785)(1\ \text{ft})^2(2{,}485\ \text{ft})$

$\text{Volume} = 1{,}950.725\ \text{ft}^3$

$1{,}950.725\ \cancel{\text{ft}^3} \times \frac{7.48\ \text{gal}}{\cancel{\text{ft}^3}} = 14{,}591\ \text{gal}$

$\text{time} = \frac{\text{Volume}}{\text{Flow}}$

$\text{time} = \frac{1{,}875{,}000\ \cancel{\text{gal}} + 14{,}591\ \cancel{\text{gal}}}{6{,}820{,}000\ \cancel{\text{g}}\text{pd}}$

$\text{time} = 0.2771\ \text{days}$

$0.2771\ \cancel{\text{day}} \times \frac{24\ \text{hr}}{1\ \cancel{\text{day}}} = \mathbf{6.65\ hr}$

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57.

	300	HP
	60	HP
	100	HP
	25	HP
	100	HP
	11	HP
+	4	HP
	600	HP

$$600\ HP \times \frac{0.746\ KW}{1\ HP} = \mathbf{448\ KW}$$

58.

$$Area = 0.785\ d^2$$

$$Area = (0.785)(11.5\ ft)^2$$

$$Area = 103.82\ ft^2$$

$$103.82\ \cancel{ft^2} \times \frac{4.5\ lbs\ degreaser}{1\ \cancel{ft^2}} = \mathbf{467.2\ lb}$$

59.

$$\frac{975\ \cancel{gal}}{1\ \cancel{min}} \times \frac{1440\ \cancel{min}}{1\ day} \times \frac{1\ MG}{1{,}000{,}000\ \cancel{gal}} = 1.404\ mgd$$

$$lb / day = (mg/L)(Q, mgd)(8.34)$$

$$lb / day = (2.90\ mg/L)(1.404\ mgd)(8.34)$$

$$lb / day = 33.96\ lb / day = \mathbf{34\ lb / day}$$

60.

$$3\ min\ 17\ sec = (3)(60) + 17 = 197\ sec$$

$$21\ min\ 49\ sec = (21)(60) + 49 = 1{,}309\ sec$$

$$Average\ time = \frac{197\ sec + 1{,}309\ sec}{2} = 753\ sec$$

$$Velocity = \frac{distance}{time}$$

$$Velocity = \frac{1{,}850\ ft}{753\ sec}$$

$$Velocity = \mathbf{2.46\ ft/sec}$$

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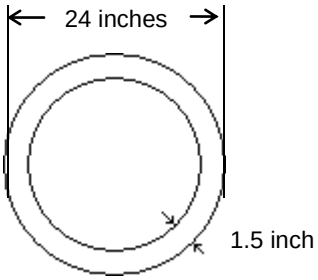
49. Original diameter - 24 in



new diameter = 24 in - (1.5 in)(2 times)

new diameter = 24 in - 3 in

new diameter = 21 in

$$21 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 1.75 \text{ ft}$$

Volume = $0.785\ d^2\ h$

Volume = $(0.785)(1.75 \text{ ft})^2\ (750 \text{ ft})$

Volume = $1{,}803 \text{ ft}^3$

$$1{,}803 \text{ ft}^3 \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} = \mathbf{13{,}487 \text{ gal}}$$

62. $\text{Velocity} = \frac{\text{Flow}}{\text{Area}}$

$$\text{Flow} = 27 \text{ mgd} \times \frac{1.55 \text{ cfs}}{1 \text{ mgd}} = 41.85 \text{ cfs}$$

$$2.75 \text{ ft/s} = \frac{41.85 \text{ ft}^3/\text{s}}{\text{Area}}$$

$$\text{Area} = \frac{41.85 \text{ ft}^3/\text{s}}{2.75 \text{ ft/s}}$$

Area = 15.22 ft^2

Area = $0.785\ d^2$

$15.22 \text{ ft}^2 = 0.785\ d^2$

$19.39 \text{ ft}^2 = d^2$

4.4 ft = d

$$4.4 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} = \mathbf{53 \text{ in}}$$

63. Put them in order.

100 250 275 **300** 335 580 580

Pick the middle value.

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64.

$$^\circ F = \frac{9}{5}\,^\circ C + 32^\circ$$

$$^\circ F = 1.8^\circ C + 32^\circ$$

$$425^\circ = 1.8^\circ C + 32^\circ$$

$$393^\circ = 1.8^\circ C$$

$$\mathbf{218^\circ} = {}^\circ C$$

65.

$$Watts_{AC} = (Volts)(Amps)(Power\ Factor)$$

$$Watts_{AC} = (480\ Volts)(32\ Amps)(1)$$

$$Watts_{AC} = 15{,}360$$

$$15{,}360\ \cancel{Watts} \times \frac{1\ \cancel{KW}}{1{,}000\ \cancel{Watts}} \times \frac{1\ HP}{0.746\ \cancel{KW}} = \mathbf{20.6\ HP}$$