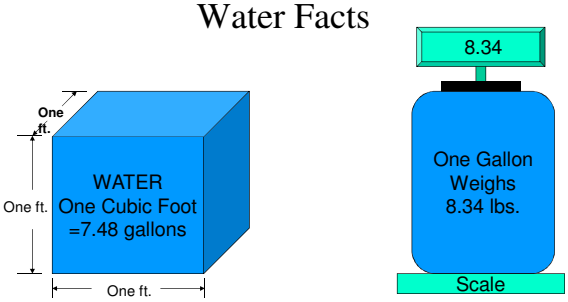
Advanced Math

Rural Water Association of Utah
Pre-certification Training

Water Facts



Formulas

- 1. Dosage: mg/L x MGD x 8.34 = lbs. per day
- 2. Square Area = Length x Width
- 3. CT = Chlorine in mg/L x time in minutes.
- 4. Circular Area = pi or 3.14 x radius^2 or diameter^2 x .785
- 5. Circumference = 3.14 x diameter
- 6. Cylinder Volume = Area x Height

Formulas

- **7. Cube Volume = width x height x length**
- **8. When figuring volume of a tank, don't forget to convert your cubic feet to gallons by multiplying your volume by 7.48 gal/ft^3**
- **9. Flow rate = Velocity (ft/sec) x Area (ft^2) or Q = V x A**
- **10. Q = ft^3/sec flow rate**

Formulas

- **11. Force = Pressure (psi) x Area (in^2)**
- **12. Detention Time: $\frac{\text{Tank Volume (gallons)}}{\text{Flow (gpm or gpd or gpd)}}$**
- **13. Filtration rate (gpm/ft^2) = $\frac{\text{Flow (gpm)}}{\text{Surface Area (ft}^2\text{)}}$**
- **14. Surface Overflow = $\frac{\text{gpd (flow)}}{\text{Tank surface area (ft}^2\text{)}}$**

Formulas

- **15. Specific Capacity = $\frac{\text{Flow (gpm)}}{\text{Drawdown (ft)}}$**
- **16. % strength by weight = $\frac{\text{weight of solute}}{\text{weight of solution}}$ x 100**
- **17. HP = $\frac{\text{feet of head x flow (gpm)}}{3960}$**

MGD Conversion

- **To convert MGD into Cubic Feet per Second (cfs) multiply by 1.55. To convert Gallons per Minute (gpm) multiply by 694.4.**
- **Multiply 120 MGD by 1.55 and you will get with 186 cfs.**
- **Multiply 120 MGD by 694.4 and you will get 83,328 gpm.**
- **To check yourself, the cfs or gpm will always be higher than the MGD.**

Gallon per Minute (gpm) to Cubic Feet per Second (cfs) Conversion

- **7.48 gal/ft³ x 60 sec./min = 448.8 $\frac{gpm}{cfs}$**
- **So, 448.8 $\frac{gpm}{cfs}$ is the conversion factor**
- **Example: 2,500 gpm divided by 448.8 = 5.6 cfs**
- **5.6 cfs multiplied by 448.8 $\frac{gpm}{cfs}$ = 2,500 gpm**

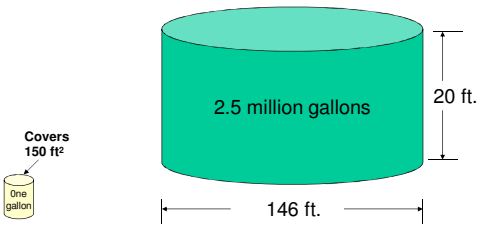
PSI to Feet Conversion

- $\frac{2.31 \text{ feet of head}}{1 \text{ psi}}$ is the conversion factor
- psi x 2.31 = feet of head
- Feet of head/2.31 = psi
- psi needs to be a little less than half of the feet of head. Example: If you have a reservoir that has 30 feet of water in it, how much pressure is reading on the pressure gauge?
- 30 ft / 2.31 = 12.99 psi

Problem Solving Rules

- Work from left to right
- Do all the multiplication and division above the line (in the numerator) and below the line (in the denominator); then do the addition and subtraction below the line.
- Perform the division (divide the numerator by the denominator)
- If problem has parentheses, do all the arithmetic inside the parentheses. Use the same order as above sentences.

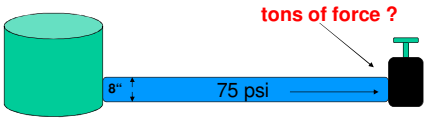
1. This year your maintenance crew has been given a work order to paint the 2.5 million gallon reservoir. You need to figure how much paint it will require to paint the reservoir inside and out. The reservoir is 146 ft in diameter and 20 ft high. A gallon of paint will cover 150 square feet (ft²).



- **Formula: Paint required= total area in square feet divided by coverage, in ft² per gallon.**
- **Top & bottom: 146' x 146' x 0.785 x 3 sides =**
- **Top & bottom: 50,199 ft²**
- **Sides = pi (π) or 3.14 x 146' dia. x 20' x 2 sides**
- **Sides = 18,338 ft²**
- **50,199 ft² + 18,338 ft² = 68,537 ft²**
- **$\frac{68{,}537 \text{ ft}^2}{150 \text{ gal/ft}^2}$ = 457 gallons of paint**

2. How much force in tons is on an 8" valve with 75 psi on one side?

- 8" x 8" x 0.785 = 50.24 in^2
- 50.24 in^2 x 75 psi = 3,768 lbs.
- $\frac{3{,}768 \text{ lbs}}{2{,}000 \text{ lbs/ton}} = 1.88$ tons



3. What is 70° Fahrenheit converted to Celsius?

- Formula:
  - Add 40
  - Multiply by 5/9
  - Subtract 40 = C°
- 70 + 40 = 110
- 110 x 5/9 = 61
- 61 – 40 = 21° C

3b. What is 21° Celcius converted to Fahrenheit?

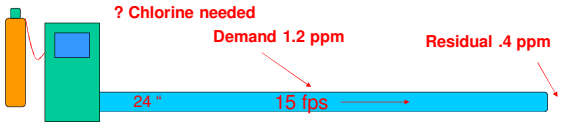
- Formula:
  - Add 40
  - Multiply by 9/5
  - Subtract 40 = deg. F
- 21 + 40 = 61
- 61 x 9/5 = 110
- 110 – 40 = 70 deg. F.

4. What is the GPM flow of a 2' by 3' open channel with a velocity of 1 fps?

- Q (cfs) = V(fps) x A(ft^2)
- A = 2' x 3'
- Q = 6 ft^2 x 1 ft/sec = 6 ft^3/sec
- 6 ft^3/sec x 448.8 gal/min/ft^3 = 2,693 GPM

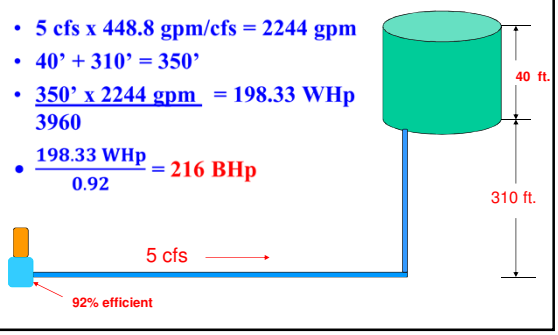
5. How much will it cost in a year to chlorinate a 24-inch pipeline flowing at 15 fps if a residual of 0.4 ppm is desired with a demand of 1.2 ppm if chlorine costs $0.81 per lb.?

- Q = V x A, Q = (2' x 2' x .785) x 15 fps
- Q = 47.1 cfs, 47.1 x 448.8 = 21138.5 GPM
- 21138.5 x 1440 = 30.4 MGD or 47.1 x .64627 = 30.4 MG
- (0.4 + 1.2) x 30.4 x 8.34 = 405.7 lbs.
- 405.7 lbs/day x 0.81 = $328.62 per day
- $328.62 x 365 days/year = $119,946



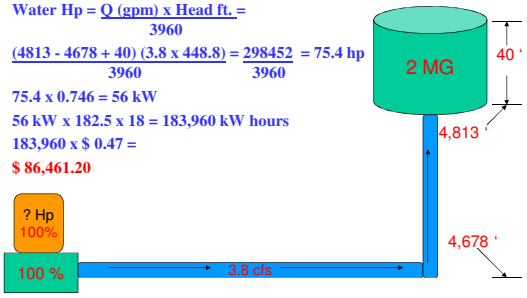
6. What horsepower of a 92% efficient pump would be required to pump 5 cfs into a 40 ft. deep tank with a diameter of 90 ft. at an elevation of 310 ft. above the pump?

- 5 cfs x 448.8 gpm/cfs = 2244 gpm
- 40' + 310' = 350'
- $\frac{350' \times 2244 \text{ gpm}}{3960} = 198.33$ WHp
- $\frac{198.33 \text{ WHp}}{0.92} = 216$ BHp



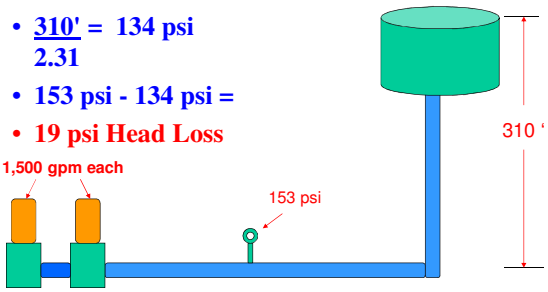
7. A pump station is located at an elevation of 4,678 feet. The pump is pumping into a 2 MG tank that is 40 feet high. The tank is located at a base elevation of 4,813 feet at a flow of 3.8 cfs, how much will it cost for electricity to run the pump for 18 hours a day for 6 months if power costs $0.47 per kilowatt hour? Assume 100% efficiency of the pump & motor.

- Water Hp = $\frac{\text{Q (gpm) x Head ft.}}{3960}$ =
- $\frac{(4813 - 4678 + 40)\ (3.8 \times 448.8)}{3960} = \frac{298452}{3960}$ = 75.4 hp
- 75.4 x 0.746 = 56 kW
- 56 kW x 182.5 x 18 = 183,960 kW hours
- 183,960 x $ 0.47 =
- $ 86,461.20



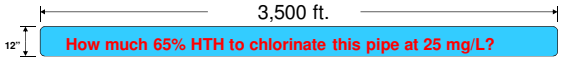
8. If two 1,500 gpm pumps are pumping with a discharge pressure gauge indicating 115 psi and the elevation difference between the pumps and the water in the tank is 310 feet, what is the head loss due to friction in psi?

- $\frac{310'}{2.31}$ = 134 psi
- 153 psi - 134 psi =
- 19 psi Head Loss



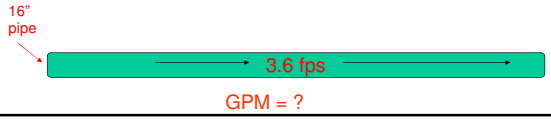
9. How much Calcium Hypochlorite at 65% is needed to disinfect 3,500' of 12" pipe to 25 mg/l?

- $\frac{12"}{12"}$ = One Foot
- 1' x 1' x 0.785 = 0.785 ft²
- 0.785 ft² x 3,500' = 2,747.5 ft³
- 2,747.5 ft³ x 7.48 gal/ft³ = 20,550 gal
- $\frac{20{,}550 \text{ gal.}}{1{,}000{,}000}$ = 0.02055 MG
- 0.02055 MG x 25 mg/L x 8.34 = 4.28 lbs.
- $\frac{4.28 \text{ lbs.}}{.65}$
- 6.6 lbs.



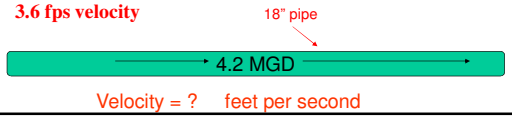
10. What is the GPM flow rate of a 18" pipe with a velocity of 3.6 fps?

- Q = A x V V = 3.6 fps A = 18 inch pipe Q = ?
- A = $\frac{18"}{12"}$ = 1.5'
- 1.5 x 1.5 x .785 = 1.766 ft²
- 1.766 ft² x 3.6 fps = 6.36 cfs
- 6.36 cfs x 448.8 gal/cfs = 2854 GPM



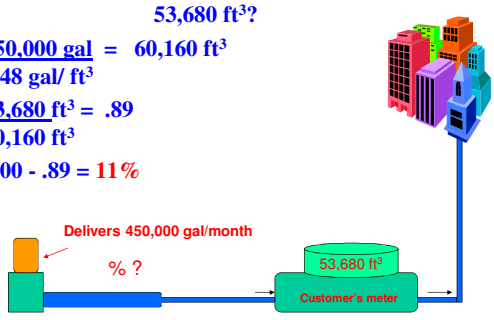
11. What is the velocity of the water in fps of an 18 inch pipe flowing at 4.2 MGD?

- V = $\frac{Q}{A}$ Q = 4.2 MGD A = 18 inch pipe
- $\frac{4{,}200{,}000 \text{ gal/day}}{1440 \text{ min/day}}$ = $\frac{2917 \text{ gal/min}}{448.8 \text{ gal/cfs}}$ = 6.5 cfs
- or $\frac{4.2 \text{ MGD}}{.64627}$ = 6.5 cfs
- $\frac{18}{12}$ = 1.5 x 1.5 x 0.785 = 1.8 ft²
- $\frac{6.5 \text{ ft}^3/\text{sec}}{1.8 \text{ ft}^2}$ =
- 3.6 fps velocity



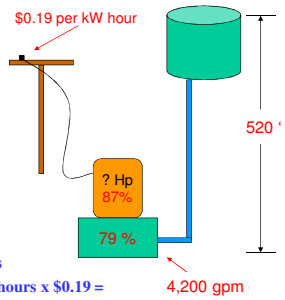
12. What is the percent of "unaccounted for" water in a system if the pump delivers 450,000 gallons in a month and the customer meter reads 53,680 ft³?

- $\frac{450{,}000 \text{ gal}}{7.48 \text{ gal/ ft}^3}$ = 60,160 ft³
- $\frac{53{,}680 \text{ ft}^3}{60{,}160 \text{ ft}^3}$ = .89
- 1.00 - .89 = 11%



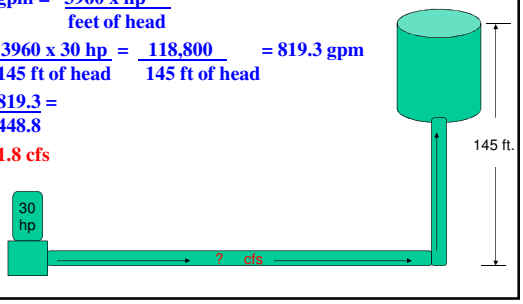
13. If a pumping station produces 4,200 gpm with 520 ft. of head and has efficiencies of 87% on the motor and 79% on the pump, what would be the average monthly power cost if the pump ran 10 hours per day and power costs $0.19 per kilowatt hour?

- Water Hp = $\frac{\text{Q (gpm) x Head ft.}}{3960}$ =
- $\frac{4{,}200 \text{ gpm x } 520 \text{ hd.ft.}}{3960}$ = 552 Whp
- Bhp = $\frac{\text{Water Horsepower}}{\text{Pump efficiency}}$
- 552 / 0.79 = 699 Bhp
- Mhp = $\frac{\text{Brake Horsepower}}{\text{Motor efficiency}}$
- 699 / 0.87 = 803 Mhp
- kW = 0.746 x Motor horsepower
- 803 Mhp x 0.746 = 599 kW
- 10 hours/day x 30 days = 300 hours
- 599 kW x 300 hours =179,700 kW hours x $0.19 =
- $34,143



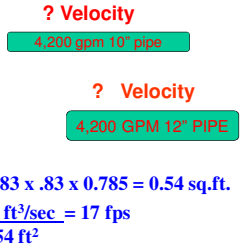
14. What would be the maximum pumping rate in cfs of a 30 hp pump with 145' of head?

- $\frac{145 \text{ ft of head x ? gpm}}{3960}$ = 30 hp
- gpm = $\frac{3960 \text{ x hp}}{\text{feet of head}}$
- $\frac{3960 \text{ x } 30 \text{ hp}}{145 \text{ ft of head}}$ = $\frac{118{,}800}{145 \text{ ft of head}}$ = 819.3 gpm
- $\frac{819.3}{448.8}$ =
- 1.8 cfs



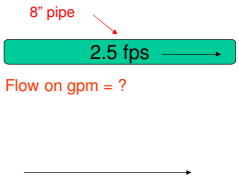
15. What is the fps difference in velocity of a 12" and 10" main with a flow of 4,200 GPM?

- V = $\frac{Q}{A}$
- $\frac{4{,}200}{448.8}$ = 9.4 cfs
- $\frac{12}{12}$ = 1 ft. & $\frac{10}{12}$ = .83 ft.
- 1 x 1 x 0.785 = 0.785 sq.ft. .83 x .83 x 0.785 = 0.54 sq.ft.
- $\frac{9.4 \text{ ft}^3/\text{sec}}{0.785 \text{ ft}^2}$ = 12 fps $\frac{9.4 \text{ ft}^3/\text{sec}}{0.54 \text{ ft}^2}$ = 17 fps
- 17 fps - 12 fps =
- 5 fps difference



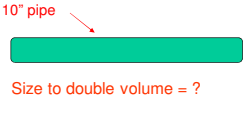
16. What would be the gpm flow of an 8 inch water pipe to achieve a velocity of 2.5 fps?

- Q = A x V V = 2.5 fps A = 8 inch pipe Q = ?
- A = $\frac{8"}{12"}$ = 0.67'
- 0.67 x 0.67 x 0.785 = 0.35 ft²
- 2.5 fps x 0.35 ft² = 0.88 cfs
- 0.88 cfs x 448.8 =
- 395 gpm



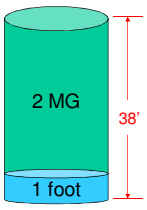
17. What size of pipe would be needed to double the volume of a 10" pipe?

- A = D x D x .785 10"divided by 12" = 0.8333'
- A = 0.8333 x 0.8333 x 0.785 =
- 0.55 x 2 = 1.10 ft²
- 1.10 ft² = .785 x D²
- $\frac{1.10}{.785}$ = 1.4 D²
- square root of 1.4 feet = 1.18 x 12 inches
- 14.2 inches



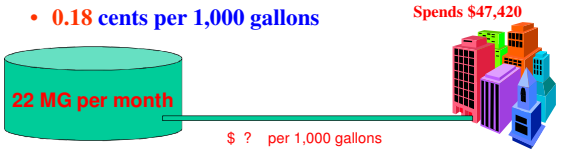
18. If a 2 MG tank is dosed at 200 mg/L chlorine at the bottom 1 foot of the tank and is then filled to the 38 ft. overflow, what would be the resulting mg/L dosage in the full tank?

- $\frac{2{,}000{,}000}{38 \text{ ft.}}$ = 52,632 gal per foot
- $\frac{52{,}632}{1{,}000{,}000}$ = .052632 MG
- ? lbs. Cl_2 = 200 mg/L x 0.052632 MG x 8.34
- 87.8 lbs. Cl_2
- $\frac{87.8 \text{ lbs. } Cl_2}{2 \text{ MG x } 8.34}$ =
- 5.3 mg/L



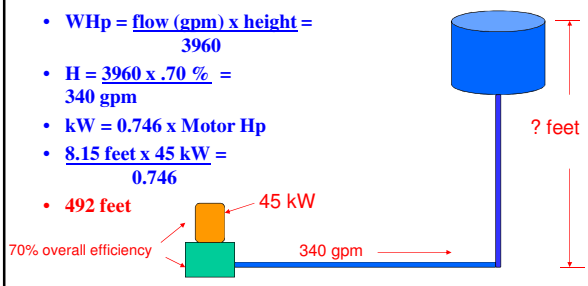
19. If the annual operating cost of a water system includes $29,000 for salaries, $7,450 for chemicals, $8,620 for utilities, and $2,350 for maintenance, and the system delivers an average of 22 MG per month, what is the annual cost per 1,000 gallons to produce water?

- $29,000 + $7,450 + $8,620 + $2,350 = $47,420
- 22,000,000 x 12 = 264,000,000 gal/year
- $47,420 / 264,000,000 gallons = $ 0.00018 per gallon
- 0.00018 x 1000 =
- 0.18 cents per 1,000 gallons



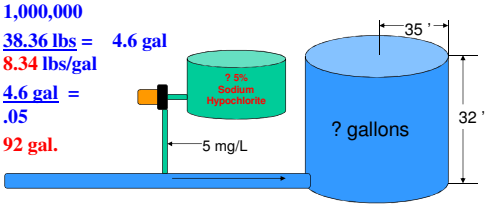
20. If a pump is delivering a flow of 340 gpm and using 45 kW, with a wire to water efficiency of 70%, what is the total head it is pumping against?

- WHp = flow (gpm) x height / 3960
- H = 3960 x .70 % / 340 gpm
- kW = 0.746 x Motor Hp
- 8.15 feet x 45 kW / 0.746
- 492 feet



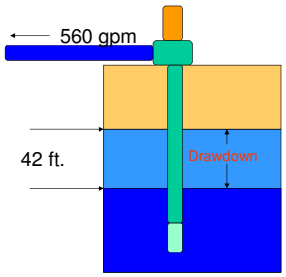
21. If a tank has a radius of 35 feet and is 32 feet high and needs to be disinfected at 5 mg/L with 5% sodium hypochlorite, how many gallons of the hypochlorite is needed?

- 35 x 35 x 3.14 = 3846.5 ft²
- 3846.5 x 32 = 123,088 ft³
- 123,088 x 7.48 = 920,698 gallons
- 920,698 gal. / 1,000,000 = 0.92 MG x 5 mg/l x 8.34 = 38.36 lbs.
- 38.36 lbs / 8.34 lbs/gal = 4.6 gal
- 4.6 gal / .05 = 92 gal.



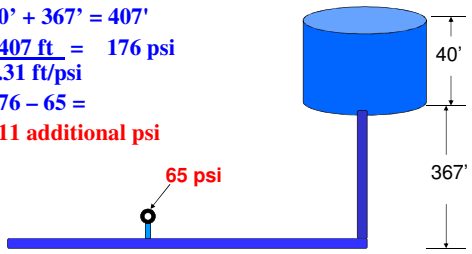
22. Determine the specific capacity of a well if it yields 560 gpm with a drawdown of 42 ft.

- 560 gpm / 42 ft. = 13.33 gpm/ft



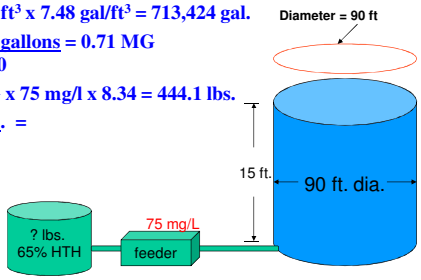
23. What additional pressure in feet of head will you need to be added to water from a pipeline with 65 psi to fill a 40' high tank located at an elevation of 367 feet above the pipeline?

- 40' + 367' = 407'
- 407 ft / 2.31 ft/psi = 176 psi
- 176 – 65 =
- 111 additional psi



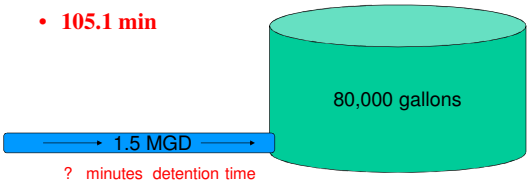
24. How much 65% HTH would be needed to close a 90 ft diameter clearwell that is 15 ft deep with a dose of 75 ppm?

- 90 ft x 90 ft x 0.785 = 6,358.5 ft²
- 6,358.5 ft² x 15 ft = 95,377.5 ft³
- 95,377.5 ft³ x 7.48 gal/ft³ = 713,424 gal.
- 713, 424 gallons / 1,000,000 = 0.71 MG
- 0.71 MG x 75 mg/l x 8.34 = 444.1 lbs.
- 444.1 lbs. / 0.65 = 683 lbs.



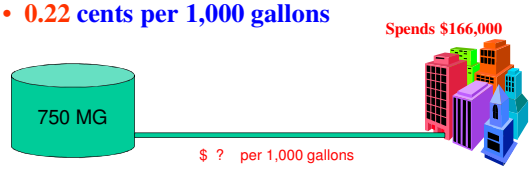
25. What is detention time in minutes of a sedimentation basin with a volume of 80,000 gallons and a flow of 1.1 MGD?

- 80,000 gallons = 1,100,000 gal/day
- 0.073 day
- 0.073 x 1440 min =
- 105.1 min



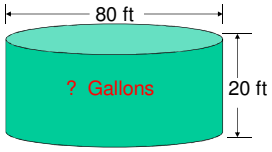
26. City spends $166,000 per year and sells 750 MG, what is cost per 1,000 gallons?

- 750 MG x 1,000,000 = 750,000,000 gallons
- 750,000,000 = 750,000 gallons / 1,000
- $166,000 = 750,000
- 0.22 cents per 1,000 gallons



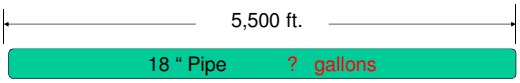
27. How many gallons in an 80' diameter tank filled 20'?

- 80' x 80' x 0.785 = 5,024 ft²
- 5,024 ft² x 20' = 100,480 ft³
- 100,480 ft³ x 7.48 gal/ft³ =
- 751,590 gal



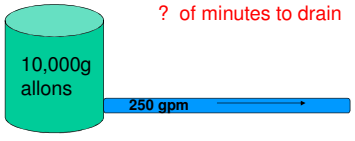
28. How many gallons of water in an 18" pipe that is 5,500' long?

- 18" / 12" = 1.5' x 1.5' x 0.785 = 1.766 ft²
- 1.766 ft2 x 5,500' = 9,714 ft³
- 9,714 ft³ x 7.48 gal/ft³ =
- 72,663 gal



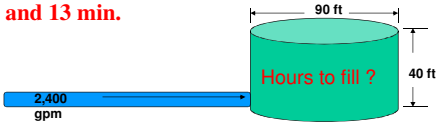
29. How long will a 10,000 gallon tank flow at 250 gpm?

- 10,000 gal / 250 gpm =
- 40 min



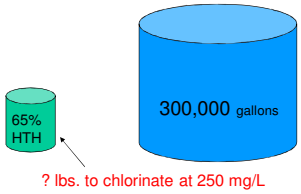
30. How many hours would it take to fill a 90' dia. tank 40 feet high pumping 2,400 gpm?

- 90' x 90' x 0.785 = 6,358.5 ft²
- 6,358.5 ft² x 40' = 254,340 ft³
- 254,340 ft³ x 7.48 gal/ft³ = 1,902,460 gal.
- 1,902,460 gal. / 2,400 gal/min = 792.7 min. 792.7 min. / 60 min./hr. =
- 13.21 hrs. 0.21 min x 60 min = 12.6 min.
- 13 hrs. and 13 min.



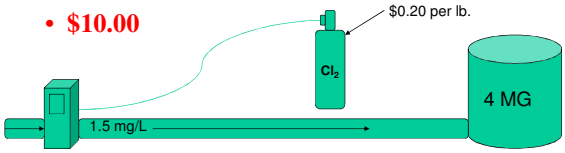
31. How many lbs. of 65% HTH would be needed to dose 300,000 gal. at 250 mg/l?

- 300,000 gal. = 0.3 MG / 1,000,000
- 0.3 x 250 mg/l x 8.34 =
- 625.5 lbs.
- 625.5 lbs. = 65%
- 962 lbs.



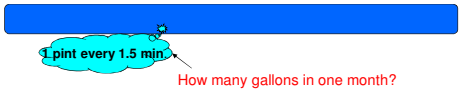
32. What would be the cost per day to chlorinate 4 MGD at 1.5 mg/l if chlorine costs 20 cents per pound?

- 4 MGD x 1.5 mg/l x 8.34 = 50.04 lbs
- 50.04 lbs. x $0.20 per lbs. =
- $10.00



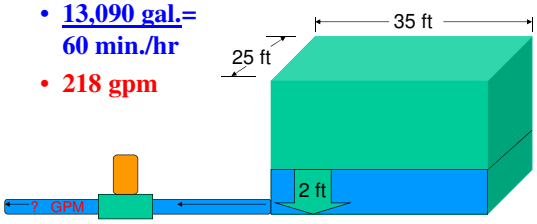
33. A leak of 1 pint every 1.5 min. would leak how many gallons in 30 days?

- 1,440 min./day = 960 pints/day / 1.5 min./pint
- 960 pints/day =120 gpd x 30 days/month= 8 pints/gal.
- 3,600 gal/month



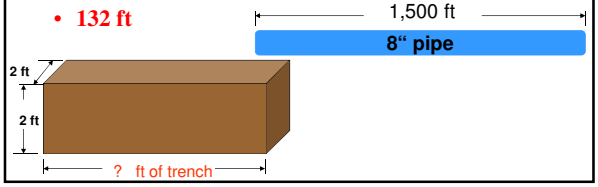
34. What is the pumping rate in gpm if the pump drains 2' out of a 25' x 35' basin in 1 hr.?

- 2' x 25' x 35' = 1,750 ft^3
- 1,750 ft3 x 7.48 gal/ft^3 = 13,090 gal.
- 13,090 gal.= 60 min./hr
- 218 gpm



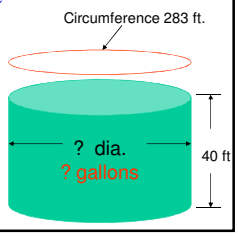
35. How long of a 2' wide by 2' deep trench will be needed to drain water from 1,500' of 8" water line?

- 8" / 12" = 0.67'
- 0.67 x 0.67' x 0.785 = 0.352 ft^2 x 1,500' =
- 528 ft^3
- 528 ft^3 / 2' x 2' = 528 ft^3 / 4 ft^2 =
- 132 ft



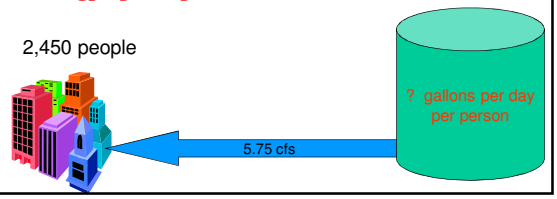
36. How many gallons will a 40' high tank with a circumference of 283' hold when it is full?

- 283 ft / 3.14 = 90 ft x 90 ft x 0.785 = 6,358.5 ft^2
- 6,358.5 ft^2 x 40 ft = 254,340 ft^3
- 254,340 ft^3 x 7.48 gal/ft^3 =
- 1,902,463 gallons



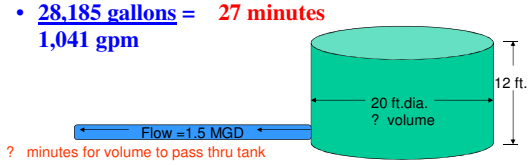
37. What is the per capita production in gallons per day of a plant that produces 5.75 cfs to a system with a population of 2,450?

- 5.75 cfs x 448.8 gpm/cf = 2580.6 gpm
  2580.6 x 1440 min/day = gpd
- 3,716,064 gpd =
  2,450 people
- 1517 gpd per capita



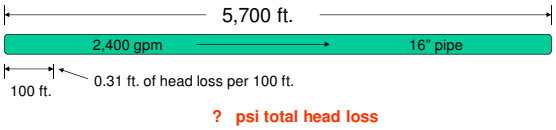
38. What is the detention time in minutes of a 20 ft. diameter, 12 ft. deep tank with a flow of 1.5 MGD?

- 1,000,000/1440 min. per day = 694 gpm
- 1.5 MGD x 694 gpm per MGD = 1,041 gpm
- 20 ft x 20 ft x 0.785 = 314 ft^2
- 314 ft^2 x 12 ft = 3,768 ft^3
- 3,768 ft^3 x 7.48 gal/ft^3 = 28,185 gallons
- 28,185 gallons = 27 minutes
  1,041 gpm



39. What is the total head loss in feet of 5,700 ft. of 16 in. pipe with a flow of 2,400 gpm if the head loss is calculated at 0.31 ft. per 100 ft.?

- 5,700 ft. = 57 x 0.31 ft. =
  100 ft.
- 17.67 ft x 0.433 =
- 7.6 psi

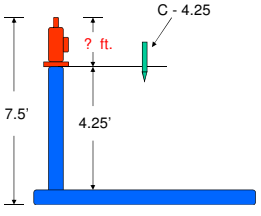


40. If a chlorine residual is 1.2 at the chlorinator and 0.5 in the distribution system, what is the chlorine demand?

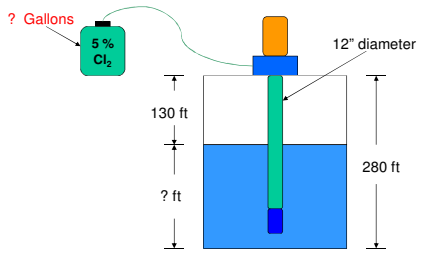
- 1.2 mg/l - 0.5 mg/l =
- 0.7 mg/l chlorine demand

41. If the cut stake for a fire hydrant is marked AC-4.25@ and the hydrant is 7 ft. 6 in. tall, how high will the top be above the finished grade?

- 6" = 0.5 ft
  12 in/ft
- 7.5 ft. - 4.25 ft. =
- 3.25 ft.



42. How many gal. of 5% sodium hypochlorite will be needed to disinfect a 12 in. diameter well that is 280 ft. deep with a static water level of 130 ft. to a dosage of 50 mg/l?



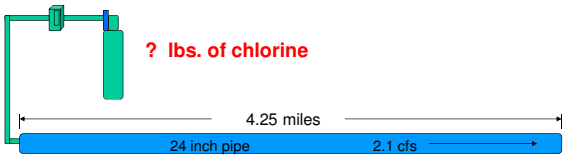
NEXT SLIDE

42. CONTINUED
How many gal. of 5% sodium hypochlorite will be needed to disinfect a 12 in. well that is 280 ft. deep with a static water level of 130 ft. to a dosage of 50 mg/l?

- **280 ft. - 130 ft. = 150 ft.**
- **$\frac{12''}{12''}$ = 1 ft. x 1 ft. x 0.785 = 0.785 ft^2**
- **0.785 ft^2 x 150 ft. = 117.75 ft^3**
- **117.75 ft^3 x 7.48 gal/ft^3 = 881 gal.**
- **$\frac{881 \text{ gal.}}{\text{gal/MGD}}$ = 0.001 x 50 mg/l x 8.34= 1,000,000**
- **0.417 lbs. $\frac{0.417 \text{ lbs.}}{0.05}$ =**
- **8.34 lbs. or 1 gallon**

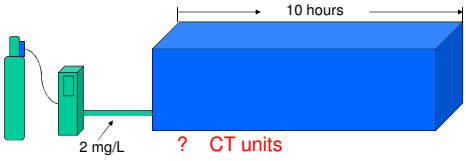
43. How many pounds of gas chlorine would be needed to dose 1.5 mg/l to a 4.25 mile section of 24 in. pipeline flowing at 2.1 cfs?

- **$\frac{2.1 \text{ cfs}}{1.55 \text{ cfs/MGD}}$ = 1.35 MGD**
- **1.35 MGD x 1.5 mg/l x 8.34 =**
- **16.9 lbs.**



44. What is the contact time for a 10 hour period of a basin being dosed at 0.2 mg/L?

- CT = Chlorine concentration x Time in min.
- 10 hr. x 60 min. = 600 min.
- 0.2 mg/L x 600 min. =
- 120 CT units



Grade Rules

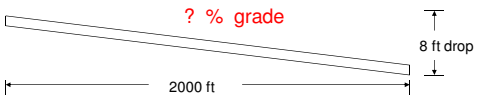
- Grade is usually expressed as a decimal number or percent, as these are easily converted from one to another:
- Decimal number = Percent
- 0.4 grade = 40% grade
- 0.1 grade = 10% grade
- 0.06 grade = 6% grade
- 0.002 grade = .2% grade
- 0.0007 grade = .07% grade

Grade Formula

- Grade = $\frac{\text{Drop in feet}}{\text{Distance in feet}}$

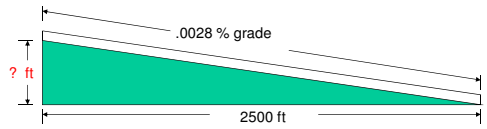
45. A sewer line of 2000 ft is laid such that the downstream end of the sewer line is 8 ft lower than the upstream end. What is the sewer grade?

- Formula: Grade = $\frac{\text{Drop in ft.}}{\text{Distance in ft.}}$
- $\frac{8 \text{ ft.}}{2000 \text{ ft.}}$ =
- 0.004 or 0.4 % grade



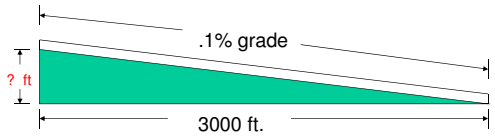
46 . A 10 inch diameter pipe is designed for optimum flow velocity at a grade of .0028. If the 2500 ft. of pipe are to be laid, how much lower will the downstream end of the pipe be than the upstream end of the pipe?

- 2500 ft x .0028 =
- 7 ft lower than the upstream end



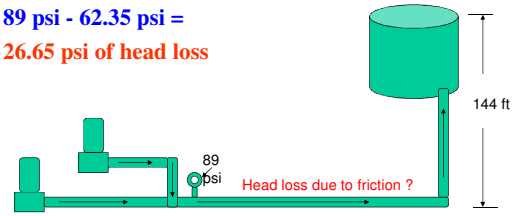
47. You are told that a pipe will be laid at a 0.1% grade. If 3000 ft of pipe is to be laid, the upstream end will be how much higher than the downstream end of the pipe?

- Convert 0.1% grade to grade = 0.001
- 0.001 x 3000 ft =
- Upstream end is 3 ft higher



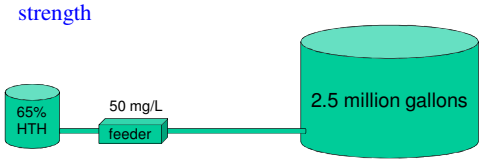
48. Two pumps are running with an output of 2500 gpm. The pressure gauges read 89 psi on the discharge pipe and the distance between the gauges and the water level in the tank is 144 ft. What is the head loss due to friction?

- **GPM has nothing to do with figuring the answer.**
- **Convert 144 ft to psi 144 x 0.433 = 62.35 psi**
- **89 psi - 62.35 psi =**
- **26.65 psi of head loss**



49. Disinfecting the Reservoir

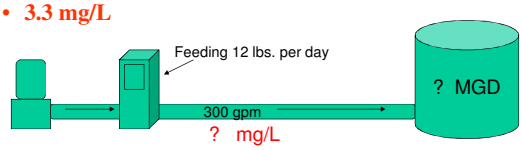
- After painting the reservoir you need to disinfect it per AWWA standards.
- Rules say to use AWWA standard C652-92
- One method states you must maintain 50 mg/L residual for 6 hours
- You are using HTH calcium hypochlorite at 65% strength



- Formula: lbs. per day= MGD x 8.34 x ppm
- Known 50 mg/L and 2.5 MGD
- 2.5 MGD x 8.34 lbs./gal x 50 mg/L =
- 1043 lbs.
- 1043 lbs./.65% =
- 1605 lbs. of HTH

50. A chlorinator is set to feed 12 lbs. per day to a flow of 300 GPM. What is the dose in mg/L?

- **Dose mg/L = $\frac{\text{lbs. per day}}{\text{(MGD)(8.34)}}$**
- **300 gpm x 60 min. x 24 hr = 432,000 GPD**
- **$\frac{\text{432,000 GPD}}{\text{1,000,000 MGD}}$ = 0.432 MGD**
- **$\frac{\text{12 lbs.per day}}{\text{(0.432)(8.34)}}$ = $\frac{\text{12 lbs.}}{\text{3.6}}$ =**
- **3.3 mg/L**



Volume of a Cone

- Formula: $\frac{0.785 \times D^2 \times H}{3} =$ Volume

51. What is the volume of a cone with a diameter of 10 feet with a depth of 5 feet?

- $\frac{.785 \times 10 \times 10 \times 5}{3} =$
- 130.83 ft^3