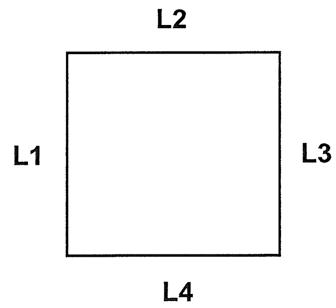
Perimeter / Circumference

Square or Rectangle:

Perimeter = L1 + L2 + L3 + L4



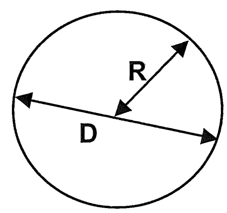
Circle:

$Circumference = \pi D$

or

$Circumference = \pi \times (2R)$

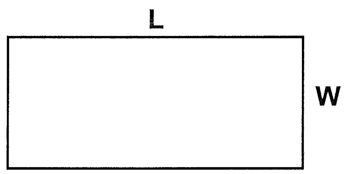
Where π = 3.14



Area

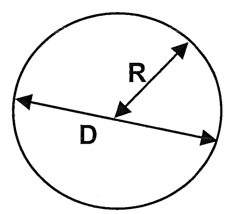
Square or Rectangle:

$A = L \times W$



Circle:

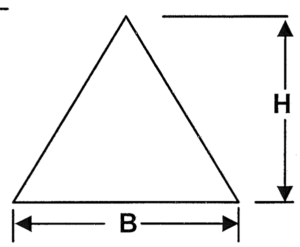
$A = \pi R^2$ **or** $A = 0.785\, D^2$



Where π = 3.14

Triangle:

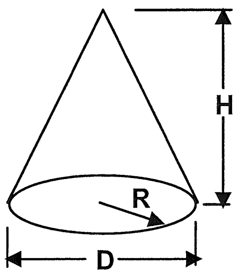
$A = \frac{B \times H}{2}$



Volume

Cone:

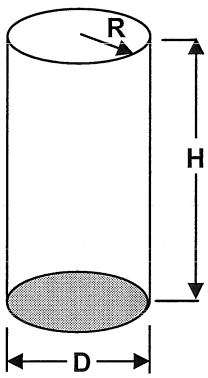
$$V = \frac{\pi R^2 H}{3} \quad \text{or} \quad V = \frac{0.785\ D^2 H}{3}$$



Where π = 3.14

Cylinder:

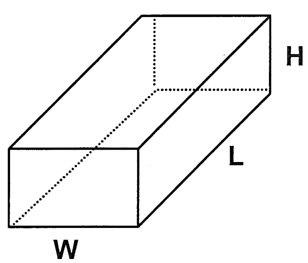
$$V = \pi R^2 H \quad \text{or} \quad V = 0.785\ D^2 H$$



Where π = 3.14

Cube:

$$V = L \times W \times H$$



Formula/Conversion Table for Water Treatment and Water Distribution Exams

Alkalinity, as mg $CaCO_3$/L = $\frac{(\text{Titrant Volume, mL}) \times (\text{Acid Normality}) \times (50{,}000)}{\text{Sample Volume, mL}}$

Amps = $\frac{\text{Volts}}{\text{Ohms}}$

Area of Circle = $(0.785) \times (\text{Diameter}^2)$ *OR* $(\pi) \times (\text{Radius}^2)$

Area of Cone (lateral area) = $(\pi) \times (\text{Radius}) \times \sqrt{\text{Radius}^2 + \text{Height}^2}$

Area of Cone (total surface area) = $(\pi) \times (\text{Radius}) \times \left(\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2}\right)$

Area of Cylinder = [Surface Area of End #1] + [Surface Area of End #2] + [$(\pi) \times$ (Diameter) $\times$ (Height or Depth)]
(total outside surface area)

Area of Rectangle = (Length) × (Width)

Area of a Right Triangle = $\frac{(\text{Base}) \times (\text{Height})}{2}$

Average (arithmetic mean) = $\frac{\text{Sum of All Terms}}{\text{Number of Terms}}$

Average (geometric mean) = $[(x_1) \times (x_2) \times (x_3) \times (x_4) \times (x_n)]^{1/n}$ The *n*th root of the product of *n* numbers

Chemical Feed Pump Setting, % Stroke = $\frac{(\text{Desired Flow}) \times (100\%)}{\text{Maximum Flow}}$

Chemical Feed Pump Setting, mL/min = $\frac{(\text{Flow, MGD}) \times (\text{Dose, mg/L}) \times (3.785\text{ L/gal}) \times (1{,}000{,}000\text{ gal/MG})}{(\text{Liquid, mg/mL}) \times (24\text{ hr/day}) \times (60\text{ min/hr})}$

Circumference of Circle = $(\pi) \times$ (Diameter)

Composite Sample Single Portion = $\frac{(\text{Instantaneous Flow}) \times (\text{Total Sample Volume})}{(\text{Number of Portions}) \times (\text{Average Flow})}$

Degrees, Celsius (°C) = (Degrees, Fahrenheit − 32) × $\left(\frac{5}{9}\right)$ *OR* $\frac{(°F-32)}{1.8}$

Degrees, Fahrenheit (°F)= (Degrees, Celsius) × $\left(\frac{9}{5}\right)$ + 32 *OR* (°C) × (1.8) + 32

Detention Time = $\frac{\text{Volume}}{\text{Flow}}$ Note: Units must be compatible.

Electromotive Force (E.M.F or $\mathcal{E}$), volts = (Current, amps) × (Resistance, ohms) *OR* $\mathcal{E}$ =IR

Feed Rate, lbs/day = $\frac{(\text{Dosage,mg/L}) \times (\text{Capacity,MGD}) \times (8.34\text{ lbs/gal})}{(\text{Purity,decimal percentage})}$

Feed Rate, gal/min (Fluoride Saturator) = $\frac{(\text{Plant capacity, gal/min}) \times (\text{Dosage, mg/L})}{(18{,}000\text{ mg/L})}$

Filter Backwash Rise Rate, in/min= $\frac{\text{(Backwash Rate, GPM/sq ft)} \times \text{(12 in/ft)}}{\text{(7.48 gal/cu ft)}}$

Filter Drop Test Velocity, ft/min = $\frac{\text{Water Drop, ft}}{\text{Time of Drop, min}}$

Filter Flow Rate or Backwash Rate, gpm/sq ft = $\frac{\text{Flow, gpm}}{\text{Filter Area, sq ft}}$

Filter Yield, lbs/hr/sq ft = $\frac{\text{(Solids Loading, lbs/day)} \times \text{(Recovery, \% / 100\%)}}{\text{(Filter operation, hr/day)} \times \text{(Area, sq ft)}}$

Flow Rate, cfs = (Area, sq ft) × (Velocity, ft/sec) or Q = AV where: Q = flow rate, A = area, V= velocity

Force, pounds = (Pressure, psi) × (Area, sq in)

Gallons/Capita/Day = $\frac{\text{Volume of Water Produced, gpd}}{\text{Population}}$

Hardness, as mg $CaCO_3$/L = $\frac{\text{(Titrant Volume, mL)} \times \text{(1,000)}}{\text{Sample Volume, mL}}$ Only when the titration factor is 1.00 of EDTA

Horsepower, Brake (bhp) = $\frac{\text{(Flow, gpm)} \times \text{(Head, ft)}}{\text{(3,960)} \times \text{(Decimal Pump Efficiency)}}$

Horsepower, Motor (mhp) = $\frac{\text{(Flow, gpm)} \times \text{(Head, ft)}}{\text{(3,960)} \times \text{(Decimal Pump Efficiency)} \times \text{(Decimal Motor Efficiency)}}$

Horsepower, Water (whp) = $\frac{\text{(Flow, gpm)} \times \text{(Head, ft)}}{3{,}960}$

Hydraulic Loading Rate = $\frac{\text{Total Flow Applied, gpd}}{\text{Area, sq ft}}$

Hypochlorite Strength, % = $\frac{\text{(Chlorine Required, lbs)} \times \text{(100)}}{\text{(Hypochlorite Solution Needed, gal)} \times \text{(8.34 lbs/gal)}}$

Leakage, gpd = $\frac{\text{Volume, gallons}}{\text{Time, days}}$

Mass, lbs = (Volume, MG) × (Concentration, mg/L) × (8.34 lbs/gal)

Mass Flux, lbs/day = (Flow, MGD) × (Concentration, mg/L) × (8.34 lbs/gal)

Milliequivalent = (mL) × (Normality)

Molarity = $\frac{\text{Moles of Solute}}{\text{Liters of Solute}}$

$$\text{Normality} = \frac{\text{Number of Equivalent Weights of Solute}}{\text{Liters of Solution}}$$

$$\text{Number of Equivalent Weights} = \frac{\text{Total Weight}}{\text{Equivalent Weight}}$$

$$\text{Number of Moles} = \frac{\text{Total Weight}}{\text{Molecular Weight}}$$

$$\text{Reduction in Flow, \%} = \frac{(\text{Original Flow - Reduced Flow}) \times (100\%)}{\text{Original Flow}}$$

$$\text{Removal, \%} = \frac{(\text{In} - \text{Out}) \times (100)}{\text{In}}$$

$$\text{Slope, \%} = \frac{\text{Drop or Rise}}{\text{Distance}} \times 100$$

$$\text{Solids Concentration, mg/L} = \frac{\text{Weight, mg}}{\text{Volume, L}}$$

$$\text{Solids, mg/L} = \frac{(\text{Dry Solids, grams}) \times (1{,}000{,}000)}{\text{Sample Volume, mL}}$$

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lbs/gal}}{\text{Specific Weight of Water, lbs/gal}}$$

$$\text{Specific Yield} = \frac{\text{Well Yield, gpm}}{\text{Drawdown, ft}}$$

$$\text{Surface Loading Rate/Surface Overflow Rate, gpd/sq ft} = \frac{\text{Flow, gpd}}{\text{Area, sq ft}}$$

$$\text{Three Normal Equation} = (N_1 \text{ x } V_1) + (N_2 \text{ x } V_2) = (N_3 \text{ x } V_3)\text{, where } V_1 + V_2 = V_3$$

$$\text{Two Normal Equation} = N_1 \text{ x } V_1 = N_2 \text{ x } V_2\text{, where N = concentration, V = volume or flow}$$

$$\text{Velocity, ft/sec} = \frac{\text{Flow Rate cu ft / sec}}{\text{Area, sq ft}} \; \underline{\textit{OR}} \; \frac{\text{Distance, ft}}{\text{Time, sec}}$$

$$\text{Volume of Cone} = \left(\frac{1}{3}\right) \times (0.785) \times (\text{Diameter}^2) \times (\text{Height})$$

$$\text{Volume of Cylinder} = (0.785) \times (\text{Diameter}^2) \times (\text{Height})$$

$$\text{Volume of Rectangular Tank} = (\text{Length}) \times (\text{Width}) \times (\text{Height})$$

$$\text{Watts (AC circuit)} = (\text{Volts}) \times (\text{Amps}) \times (\text{Power Factor})$$

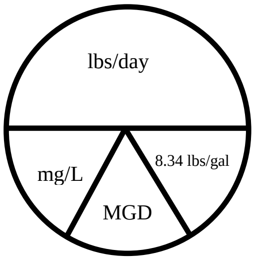
$$\text{Watts (DC circuit)} = (\text{Volts}) \times (\text{Amps})$$

$$\text{Weir Overflow Rate, gpd/ft} = \frac{\text{Flow, gpd}}{\text{Weir Length, ft}}$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{\text{Water Horsepower, HP}}{\text{Power Input, HP or Motor HP}} \times 100$$

$$\text{Wire-to-Water Efficiency, \%} = \frac{(\text{Flow, gpm}) \times (\text{Total Dynamic Head, ft}) \times (0.746\ \text{kw/hp}) \times (100)}{(3{,}960) \times (\text{Electrical Demand, kilowatts})}$$

Davidson Pie Diagram: Dosage Formula



Mass Flux, lbs/day = (Flow, MGD) × (Concentration, mg/L) × (8.34 lbs/gal)

Alkalinity Relationships:

Alkalinity, mg/L as $CaCO_3$

Result of Titration	Hydroxide Alkalinity as $CaCO_3$	Carbonate Alkalinity as $CaCO_3$	Bicarbonate Concentration as $CaCO_3$
P = 0	0	0	T
P < ½T	0	2P	T – 2P
P = ½T	0	2P	0
P > ½T	2P – T	2(T – P)	0
P = T	T	0	0

*Key: P – phenolphthalein alkalinity; T – total alkalinity

Conversion Factors:

1 acre = 43,560 square feet
1 acre foot = 326,000 gallons
1 cubic foot = 7.48 gallons
1 cubic foot = 62.4 pounds
1 cubic foot per second = 0.646 MGD
1 cubic foot per second = 448.8 gallons per minute
1 foot = 0.305 meters
1 foot of water = 0.433 psi
1 gallon = 3.79 liters
1 gallon = 8.34 pounds
1 grain per gallon = 17.1 mg/L

1 horsepower = 0.746 kW or 746 watts
1 horsepower = 33,000 ft. lbs./min.
1 mile = 5,280 feet
1 million gallons per day = 694 gallons per minute
1 million gallons per day = 1.55 cubic feet per second
1 pound = 0.454 kilograms
1 pound per square inch = 2.31 feet of water
1 ton = 2,000 pounds
1% = 10,000 mg/L
π or pi = 3.14159

Abbreviations:

cfs	cubic feet per second
DO	dissolved oxygen
ft	feet
g	grams
gpd	gallons per day
gpg	grains per gallon
gpm	gallons per minute
in	inches
kW	kilowatt
lbs	pounds
mg/L	milligrams per liter
MGD	million gallons per day
mL	milliliter
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
Q	flow
SS	suspended solids
TOC	total organic carbon
TSS	total suspended solids
TTHM	Total trihalomethanes
VS	volatile solids