ABC Formula/Conversion Table
for Water Treatment, Distribution and Laboratory Exams

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

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

Area of Circle = (.785) (Diameter^2) or (Π) (Radius^2)

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

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

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

Area of Rectangle = (Length) (Width)

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

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

Average (geometric mean) = $[(X_1)\,(X_2)\,(X_3)\,(X_4)\,(X_n)]^{1/n}$ The *n*th root of the product of *n* numbers

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

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

Circumference of Circle = (Π) (Diameter)

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

Degrees Celsius = [(Degrees Fahrenheit - 32) ($^5/_9$)] or $\frac{(^\circ F - 32)}{1.8}$

Degrees Fahrenheit = [(Degrees Celsius) ($^9/_5$) + 32] or [(Degrees Celsius) (1.8) + 32]

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

Electromotive Force (E.M.F), volts = (Current, amps) (Resistance, ohms) or E =IR

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

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

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

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

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

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

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)

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

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

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

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

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

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

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

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

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)

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

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

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

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

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

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

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

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

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

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

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

Three Normal Equation = $(N_1 \times V_1) + (N_2 \times V_2) = (N_3 \times V_3)$, where $V_1 + V_2 = V_3$

Two Normal Equation = $N1 \times V_1 = N_2 \times V_2$, where N = normality, V = volume or flow

$$\text{Velocity, ft/sec} = \frac{\text{Flow Rate cu ft / sec}}{\text{Area, sq ft}} \text{ or } \frac{\text{Distance, ft}}{\text{Time, sec}}$$

Volume of Cone = (1/3) (.785) (Diameter^2) (Height)

Volume of Cylinder = (.785) (Diameter^2) (Height)

Volume of Rectangular Tank = (Length) (Width) (Height)

Watts (AC circuit) = (Volts) (Amps) (Power Factor)

Watts (DC circuit) = (Volts) (Amps)

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

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

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

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 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 or 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 (cfs)
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 = 3.14

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	settleable solids
TTHM	Total trihalomethanes
TOC	total organic carbon
TSS	total suspended solids
VS	volatile solids