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

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

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

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 = $\dfrac{(\text{Base})\,(\text{Height})}{2}$

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

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

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

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

Circumference of Circle = (Π) (Diameter)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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:

Result of Titration	Alkalinity, mg/L as $CaCO_3$		
	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 = 3.14159

Abbreviations:

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