INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Conversion Table / Formula Sheet for Water Treatment and Distribution Exams

Part 1: Abbreviations and Conversions

Abbreviations

ac	acre(s)
bhp	brake horsepower
cfs	cubic feet per second
DO	dissolved oxygen
EDTA	ethylenediaminetetraacetic acid
ft or ’	foot (feet)
fps	feet per second
g	gram(s)
gal	gallon(s)
gpcd	gallons per capita per day
gpd	gallons per day
gpg	grains per gallon
gpm	gallons per minute
hp	horsepower
hr	hour(s)
HTH	high test hypochlorite
in or ”	inch(es)
kW	kilowatt
kWh	Kilowatt hour
L	liter(s)
lb(s)	pound(s)
mg	milligram(s)
mg/L	milligrams per liter
MGD	million gallons per day
mhp	motor horsepower
mil gal	million gallons
mL	milliliter
min	minute(s)
ppb	parts per billion (ppb ≈ ug/L)
ppd	pounds per day
ppm	parts per million (ppm ≈ mg/L)
psf	pounds per square foot
psi	pounds per square inch
Q	Flow
sec	second(s)
sq ft	square foot (feet)
SS	settleable solids

Abbreviations continued

TDH	total dynamic head
TTHM	total trihalomethanes
TOC	Total organic carbon
TSS	Total suspended solids
ug/L	Micrograms per liter (ug/L ≈ ppb)
VS	Volatile solids

Conversion Factors

1 acre	43,560 square ft
1 acre foot	326,000 gallons
1 cubic foot (ft^3)	7.48 gallons
1 cubic foot (ft^3)	62.4 pounds (water)
1 cubic foot per second	0.646 MGD
1 day	1,440 minutes
1 foot	0.305 meters
1 foot of water	0.433 psi
1 gallon	8.34 pounds (water)
1 gallon	3.79 liters
1 grain per gallon	17.1 mg/L
1 horsepower	0.746 kW
1 horsepower	746 watts
1 horsepower	33,000 ft lbs/min
1 mile	5,280 feet
1 million gallons per day	694 gpm
1 million gallons per day	1.55 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 (pi)	3.14159

Miscellaneous

Decimal percent = Percentage, expressed as a decimal, e.g. 65% = 0.65

Part 2: Formulas in Alphabetical Order

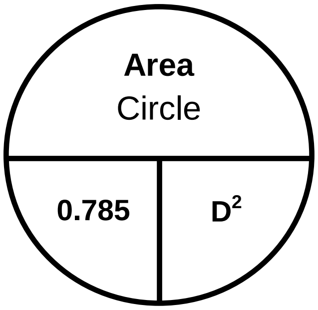
	Formula	Alternative Formula / Notes
Alkalinity, as mg $CaCO_3$/L	$\frac{\text{(Titrant Volume, mL) (Acid Normality)(50,000)}}{\text{Sample Volume, mL}}$	
Amps	$\frac{\text{Volts}}{\text{Ohms}}$	
Area, ft^2	$\frac{(\text{Flow, Ft}^3)}{\text{(Velocity, Ft/Sec)}}$	
Area of a Circle	(0.785) (Diameter^2)	$(\pi)(\text{Radius}^2)$
Area of a Cone (lateral area)	$(\pi)(\text{Radius})\sqrt{\text{Radius}^2 + \text{Height}^2}$	
Area of a Cone (total surface area)	$(\pi)(\text{Radius})(\text{Radius}) + \sqrt{\text{Radius}^2 + \text{Height}^2}$	
Area of a Cylinder (total exterior surface area)	[Surface area of end #1] + [Surface area of end #2] + [(π)(Diameter) (Height or Depth)]	
Area of a Rectangle	(Length) (Width)	
Area of a Right Triangle	(0.5) (Base) (Height)	
Average (arithmetic mean)	$\frac{\text{Sum of all terms}}{\text{Number of terms}}$	
Average (geometric mean)	$[(X_1)(X_2)(X_3)\ldots(X_n)]^{1/n}$	The n^{th} root of the product of n numbers
Chemical dry feeder calibration, lbs/day	$\frac{\text{(Dry chemical collected, grams) (1440 min/day)}}{\text{(454 grams/lb) (Time, min)}}$	
Chemical feed pump setting, % stroke	$\frac{\text{l Desired flow x 100\% l}}{\text{Maximum flow}}$	
Chemical feed pump setting, mL/min	$\frac{\text{(Flow, MGD) (Dose, mg/L) (3.785 L/gal) (1,000,000 gal/MG)}}{\text{(Liquid, mg/mL) (1440 min/day)}}$	
Circumference of Circle	(π)(Diameter)	(2π)(Radius)
Composite sample single portion	$\frac{\text{(Instantaneous flow) (Total sample volume)}}{\text{(Number of portions) (Average flow)}}$	
CT Calculation	(Disinfectant residual concentration, mg/L) (Time, min)	
Degrees Celsius	(°F – 32) (5/9)	$\frac{\text{(°F – 32)}}{1.8}$
Degrees Fahrenheit	(°C) (9/5) + 32	(°C) (1.8) + 32
Detention time	$\frac{\text{Volume}}{\text{Flow}}$	

	Formula	Alternative Formula / Notes
Electromotive Force (EMF), volts	(Current, amps) (Resistance, ohms)	E = IR
Feed rate, lbs/day	$\frac{\text{(Dosage, mg/L) (Capacity, MGD) (8.34 lbs/gal)}}{\text{Purity, decimal percent}}$	
Feed rate, gal/min (Fluoride Saturator)	$\frac{\text{(Plant capacity, gpm) (Dosage, mg/L)}}{\text{18,000 mg/L}}$	
Feed rate, lbs/day (Fluoride)	$\frac{\text{(Dosage, mg/L) (Capacity, MGD) (8.34 lbs/gal)}}{\text{(Available Fluoride ion, decimal percent) (Purity, decimal percent)}}$	
Filter backwash rise rate, in/min	$\frac{\text{(Backwash rate, gpm/ft}^2\text{) (12 in/ft)}}{\text{7.48 gal/ft}^3}$	
Filter drop test velocity, ft/min	$\frac{\text{Water drop, ft}}{\text{Time of drop, min}}$	
Filter flow rate or backwash rate, gpm/ft^2	$\frac{\text{Flow, gpm}}{\text{Filter area, ft}^2}$	
Filter yield, lbs/hr/ft^2	$\frac{\text{(Solids loading, lbs/day) (Recovery, decimal percent)}}{\text{(Filter operation, hr/day) (Area, ft}^2\text{)}}$	
Flow rate	(Area) (Velocity)	
Force, lbs	(Pressure, psi) (Area, in^2)	
Gallons/capita/day	$\frac{\text{Volume of water produced, gpd}}{\text{Population}}$	
Hardness, as mg $CaCO_3$/L	$\frac{\text{(Titrant volume, mL) (1,000)}}{\text{Sample volume, mL}}$	Note: only when the titration factor is 1.00 of EDTA
Horsepower, brake (bhp)	$\frac{\text{(Flow, gpm) (Head, ft)}}{\text{(3,960) (Pump efficiency, decimal percent)}}$	
Horsepower, motor (mhp)	$\frac{\text{(Flow, gpm) (Head, ft)}}{\text{(3,960) (Pump efficiency, decimal percent) (Motor efficiency, decimal percent)}}$	
Horsepower, water (whp)	$\frac{\text{(Flow, gpm) (Head, ft)}}{\text{3,960}}$	
Hydraulic loading rate, gpd/ft^2	$\frac{\text{Total flow applied, gpd}}{\text{Area, ft}^2}$	
Hypochlorite strength, %	$\frac{\text{Chlorine required, lbs x 100\%}}{\text{(Hypochlorite solution needed, gal) (8.34 lbs/gal)}}$	
Langelier Index	$pH - pH_S$	
Leakage, gpd	$\frac{\text{Volume, gallons}}{\text{Time, days}}$	
Mass, lbs	(Volume, MG) (Concentration, mg/L) (8.34 lbs/gal)	

	Formula	Alternative Formula / Notes
Mass flux, lbs/day	(Flow, MGD) (Concentration, mg/L) (8.34 lbs/gal)	
Milliequivalent	(mL) (Normality)	
Molarity	$\frac{\text{Moles of solute}}{\text{Liters of solution}}$	
Normality	$\frac{\text{Number of equivalent weights of solute}}{\text{Liters of solution}}$	
Number of equivalent weights	$\frac{\text{Total weight}}{\text{Equivalent weight}}$	
Number of moles	$\frac{\text{Total weight}}{\text{Molecular weight}}$	
Reduction in flow, %	$\frac{\text{(Original flow – Reduced flow) x100\%}}{\text{Original flow}}$	
Removal, %	$\frac{\text{(In – Out) x 100\%}}{\text{In}}$	
Reservoir Surface Area, acres	$\frac{(\text{Surface area, ft}^2)}{43{,}560\ \text{ft}^2/\text{ac}}$	
Slope, %	$\frac{\text{Drop or Rise x 100\%}}{\text{Distance}}$	
Solids, mg/L	$\frac{\text{(Dry solids, grams) (1,000,000)}}{\text{Sample volume, mL}}$	
Solids Concentration, mg/L	$\frac{\text{Weight, mg}}{\text{Volume, L}}$	
Specific Gravity	$\frac{\text{Specific weight of substance, lbs/gal}}{\text{Specific weight of water, lbs/gal}}$	
Surface loading (overflow) rate, gpd/ft^2	$\frac{\text{Flow, gpd}}{\text{Area, ft}^2}$	
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	$N_1 \times V_1 = N_2 \times V_2$	N = normality V = volume or flow
Velocity, ft/sec	$\frac{\text{Flow rate, ft}^3/\text{sec}}{\text{Area, ft}^2}$	$\frac{\text{Distance, ft}}{\text{Time, sec}}$
Volume of Cone	(1/3) (0.785) (Diameter^2) (Height)	(1/3) [(π) (Radius^2) (Height)]
Volume of Cylinder	(0.785) (Diameter^2) (Height)	(π) (Radius^2) (Height)
Volume of Sphere	(4/3)(π)(Radius^3)	
Volume of Rectangular Tank	(Length) (Width) (Height)	

	Formula	Alternative Formula / Notes
Watts (AC circuit)	(Volts) (Amps) (Power Factor)	
Watts (DC circuit)	(Volts) (Amps)	
Weir Overflow Rate, gpd/ft	$\frac{\text{Flow, gpd}}{\text{Weir length, ft}}$	
Wire-to-Water Efficiency, %	$\frac{\text{Water horsepower, hp x 100\%}}{\text{Power input, hp or Motor hp}}$	
Wire-to-Water Efficiency, %	$\frac{\text{(Flow, gpm) (Total dynamic head, ft) (0.746 kW/hp) x 100\%}}{\text{(3,960) (Electrical demand, kW)}}$	

Area of Circle

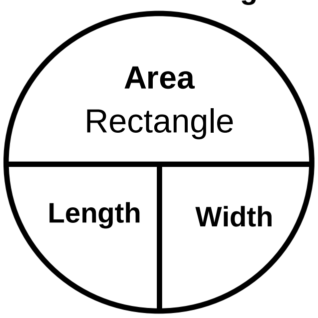


*Pie wheels

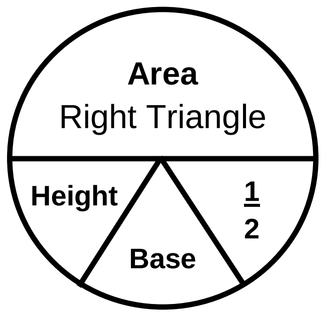
- To find the quantity above the horizontal line, multiply the pie wedges below the line together.
- To solve for one of the pie wedges below the horizontal line, cover that pie wedge, then divide the remaining pie wedge(s) into the quantity above the horizontal line.

Given units must match the units shown in the pie wheel.

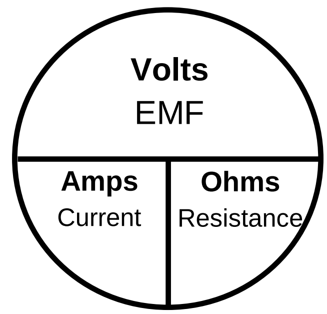
Area of Rectangle



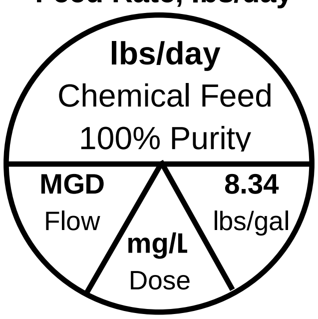
Area of Right Triangle



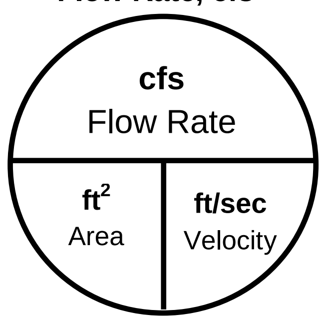
Electromotive Force (EMF), volts



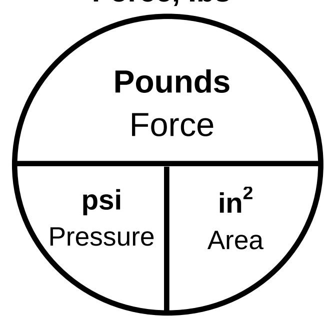
Feed Rate, lbs/day



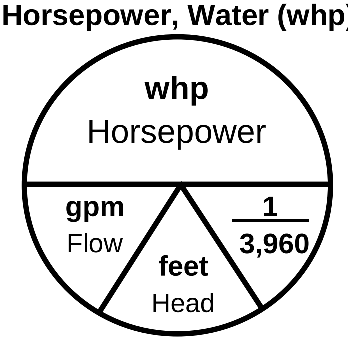
Flow Rate, cfs



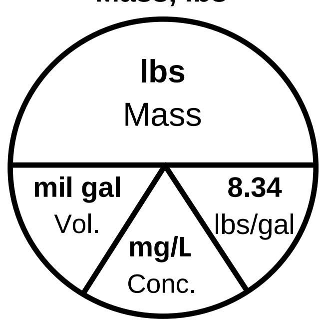
Force, lbs



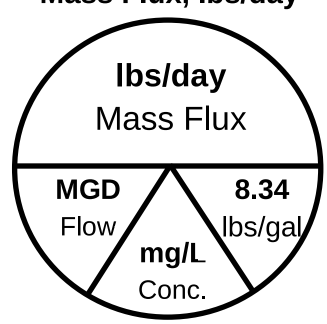
Horsepower, Water (whp)



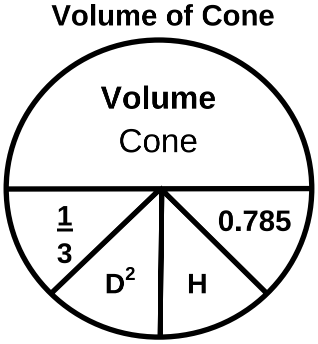
Mass, lbs



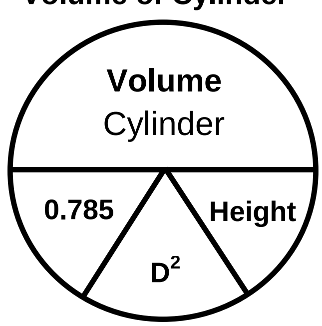
Mass Flux, lbs/day



Volume of Cone



Volume of Cylinder



Volume of Rectangular Tank