WATER TREATMENT AND DISTRIBUTION OPERATOR MATH REFERENCE SHEET

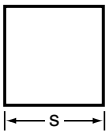
Frequently used formulas and conversions

KEY FORMULAS FOR MATH

Area Formulas

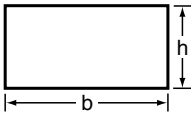
Square

area = $s \times s$
diagonal = $1.414 \times s$



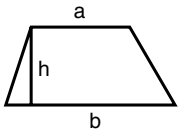
Rectangle or Parallelogram

area = $b \times h$
diagonal = square root ($b^2 + h^2$)



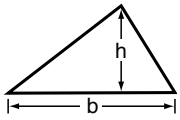
Trapezoid

$$\text{area} = \frac{(a+b)\,h}{2}$$



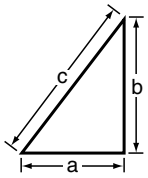
Any Triangle

$$\text{area} = \frac{b \times h}{2}$$



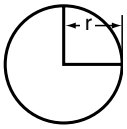
Right-Angle Triangle

$a^2 + b^2 = c^2$



Circle

area = $\pi \times r^2$
circumference = $2 \times \pi \times r$



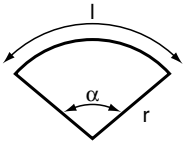
Sector of a Circle

$$\text{area} = \frac{\pi \times r \times r \times \alpha}{360}$$

length = $0.01745 \times r \times \alpha$

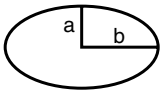
$$\text{angle} = \frac{1}{0.01745 \times r}$$

$$\text{radius} = \frac{1}{0.01745 \times \alpha}$$



Ellipse

area = $\pi \times a \times b$



Base SI Units

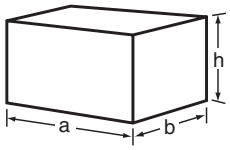
Quantity	Unit	Abbreviation
length	meter	m
mass	kilogram	kg
time	second	sec
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

Volume Formulas

Rectangular Solid

volume = h × a × b

surface area = (2 × a × b) + (2 × b × h) + (2 × a × b)

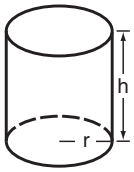


Cylinder

volume = $\pi \times r^2 \times h$

surface area = $2 \times \pi \times rh$

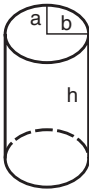
$\pi = 3.142$



Elliptical Cylinder

volume = $\pi \times a \times b \times h$

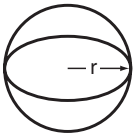
area = $6.283 \times \frac{\sqrt{a^2 + b^2}}{2} \times h + 6.283 \times a \times b$



Sphere

volume = $\frac{4 \times \pi \times r^3}{3}$

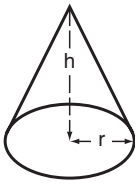
surface area = $4 \times \pi \times r^2$



Cone

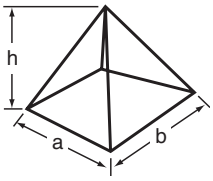
volume = $\frac{\pi \times r^2 \times h}{3}$

surface area = $\pi \times r \times \sqrt{r^2} \times (r + h) \times h$



Pyramid

volume = $\frac{a \times b \times h}{3}$



Other Formulas

theoretical water horsepower = $\frac{\text{gal/min} \times \text{total head, ft}}{3{,}960}$ = $\frac{\text{gal/min} \times \text{lb/in.}}{1{,}715}$

brake horsepower = $\frac{\text{theoretical water horsepower}}{\text{pump efficiency}}$

detention time, min = $\frac{\text{volume of basin, gal}}{\text{flow rate, gpm}}$

filter backwash rate, gal/min/ft^2 = $\frac{\text{flow, gpm}}{\text{area of filter, ft}^2}$

surface overflow rate = $\frac{\text{flow, gpm}}{\text{area, ft}^2}$

weir overflow rate = $\frac{\text{flow, gpm}}{\text{weir length, ft}}$

pounds per mil gal = parts per million × 8.34

parts per million = pounds per mil gal × 0.12

parts per million = percent strength of solution × 10,000

pounds per day = volume, mgd × dosage, mg/L × 8.34 lb/gal

dosage, mg/L = $\frac{\text{feed, lb/day}}{\text{volume, mgd} \times \text{8.34 lb/gal}}$

rectangular basin volume, ft^3 = length, ft × width, ft × height, ft

rectangular basin volume, gal = length, ft × width, ft × height, ft × 7.48 gal/ft^3

right cylinder volume, ft^3 = 0.785 × diameter^2, ft × height or depth, ft

right cylinder volume, gal = 0.785 × diameter^2, ft × height or depth, ft × 7.48 gal/ft^3

gallons per capita per day, average water usage = $\frac{\text{volume, gpd}}{\text{population served/day}}$

supply, days (full to tank dry) = $\frac{\text{volume, gpd}}{\text{population served} \times \text{gpcd}}$

gallons per day of water consumption, (demand/day) = population × gpcd

Consumption Averages, per capita

winter = 170 gpcd

spring = 225 gpcd

summer = 325 gpcd

CONVERSION OF US CUSTOMARY UNITS

Linear Measurement

fathoms	× 6	=	feet (ft)
feet (ft)	× 12	=	inches (in.)
inches (in.)	× 0.0833	=	feet (ft)
miles (mi)	× 5,280	=	feet (ft)
yards (yd)	× 3	=	feet (ft)
yards (yd)	× 36	=	inches (in.)

Circular Measurement

degrees (angle)	× 60	=	minutes (angle)
degrees (angle)	× 0.01745	=	radians

Area Measurement

acres	× 43,560	=	square feet (ft^2)
square feet (ft^2)	× 144	=	square inches ($in.^2$)
square inches ($in.^2$)	× 0.00695	=	square feet (ft^2)
square miles (mi^2)	× 640	=	acres
square miles (mi^2)	× 27,880,000	=	square feet (ft^2)
square miles (mi^2)	× 3,098,000	=	square yards (yd^2)
square yards (yd^2)	× 9	=	square feet (ft^2)

Volume Measurement

acre-feet (acre-ft)	× 43,560	=	cubic feet (ft^3)
acre-feet (acre-ft)	× 325,851	=	gallons (gal)
barrels (bbl)	× 42	=	gallons (gal)
board foot (fbm)		=	144 square inches × 1 inch
cubic feet (ft^3)	× 1,728	=	cubic inches ($in.^3$)
cubic feet (ft^3)	× 7.48052	=	gallons (gal)
cubic feet (ft^3)	× 29.92	=	quarts (qt)
cubic feet (ft^3)	× 59.84	=	pints (pt)
cubic feet (ft^3)	× 0.000023	=	acre feet (acre-ft)
cubic inches ($in.^3$)	× 0.00433	=	gallons (gal)
cubic inches ($in.^3$)	× 0.00058	=	cubic feet (ft^3)
drops	× 60	=	teaspoons (tsp)
gallons (gal)	× 0.1337	=	cubic feet (ft^3)
gallons (gal)	× 231	=	cubic inches ($in.^3$)
gallons (gal)	× 0.0238	=	barrels (bbl)
gallons (gal)	× 4	=	quarts (qt)
gallons (gal)	× 8	=	pints (pt)
gallons, US	× 0.83267	=	gallons, Imperial
gallons (gal)	× 0.00000308	=	acre-feet (acre-ft)

gallons (gal)	× 128	=	ounces (oz)
gallons (gal)	× 0.0238	=	barrels (42 gal) (bbl)
gallons, Imperial	× 1.20095	=	gallons, US
pints (pt)	× 2	=	quarts (qt)
quarts (qt)	× 4	=	gallons (gal)
quarts (qt)	× 57.75	=	cubic inches ($in.^3$)

Pressure Measurement

atmospheres	× 29.92	=	inches of mercury
atmospheres	× 33.90	=	feet of water
atmospheres	× 14.70	=	pounds per square inch ($lb/in.^2$)
feet of water	× 0.8826	=	inches of mercury
feet of water	× 0.02950	=	atmospheres
feet of water	× 0.4335	=	pounds per square inch ($lb/in.^2$)
feet of water	× 62.43	=	pounds per square foot (lb/ft^2)
feet of water	× 0.8876	=	inches of mercury
inches of mercury	× 1.133	=	feet of water
inches of mercury	× 0.03342	=	atmospheres
inches of mercury	× 0.4912	=	pounds per square inch ($lb/in.^2$)
inches of water	× 0.002458	=	atmospheres
inches of water	× 0.07355	=	inches of mercury
inches of water	× 0.03613	=	pounds per square inch ($lb/in.^2$)
pounds/square in. ($lb/in.^2$)	× 0.01602	=	feet of water
pounds/square foot (lb/ft^2)	× 6,954	=	pounds per square inch ($lb/in.^2$)
pounds/square in. ($lb/in.^2$)	× 2.307	=	feet of water
pounds/square inch ($lb/in.^2$)	× 2.036	=	inches of mercury
pounds/square inch ($lb/in.^2$)	× 27.70	=	inches of water
feet suction lift of water	× 0.882	=	inches of mercury

Weight Measurement

cubic feet of ice	× 57.2	=	pounds (lb)
cubic feet of water (50°F)	× 62.4	=	pounds of water
cubic inches of water	× 0.036	=	pounds of water
gallons water (50°F)	× 8.3453	=	pounds of water
milligrams/liter (mg/L)	× 0.0584	=	grains per gallon (US) (gpg)
milligrams/liter (mg/L)	× 0.07016	=	grains per gallon (Imp)
milligrams/liter (mg/L)	× 8.345	=	pounds per million gallons (lb/mil gal)
ounces (oz)	× 437.5	=	grains (gr)
parts per million (ppm)	×	=	milligrams per liter (mg/L) (for normal water applications)
grains per gallon (gpg)	× 17.118	=	parts per million (ppm)

grains per gallon (gpg)	× 142.86	=	pounds per million gallons (lb/mil gal)
percent solution	× 10,000	=	milligrams per liter (mg/L)
pounds (lb)	× 16	=	ounces (oz)
pounds (lb)	× 7,000	=	grains (gr)
pounds (lb)	× 0.0004114	=	tons (short)
pounds/cubic inch (lb/in.^{3})	× 1,728	=	pounds per cubic foot (lb/ft^3)
pounds of water	× 0.0166032	=	cubic feet (ft^3)
pounds of water	× 2,768	=	cubic inches (in.^{3})
pounds of water	× 0.1198	=	gallons (gal)
tons (short)	× 2,000	=	pounds (lb)
tons (short)	× 0.89287	=	tons (long)
tons (long)	× 2,240	=	pounds (lb)
cubic feet air (@ 60°F and 29.92 in. mercury)	× 0.0763	=	pounds (lb)

Flow Measurement

barrels per hour (bbl/hr)	× 0.70	=	gallons per minute (gpm)
acre-feet/minute	× 325.851	=	gallons per minute (gpm)
acre-feet/minute	× 726	=	cubic feet per second (ft^3/sec)
cubic feet/minute (ft^3/min)	× 0.1247	=	gallons per second (gps)
cubic feet/minute (ft^3/min)	× 62.43	=	pounds of water per minute
cubic feet/second (ft^3/sec)	× 448.831	=	gallons per minute (gpm)
cubic feet/second (ft^3/sec)	× 0.646317	=	million gallons per day (mgd)
cubic feet/second (ft^3/sec)	× 1.984	=	acre-feet per day (acre-ft/day)
gallons/minute (gpm)	× 1,440	=	gallons per day (gpd)
gallons/minute (gpm)	× 0.00144	=	million gallons per day (mgd)
gallons/minute (gpm)	× 0.00223	=	cubic feet per second (ft^3/sec)
gallons/minute (gpm)	× 0.1337	=	cubic feet per minute (ft^3/min)
gallons/minute (gpm)	× 8.0208	=	cubic feet per hour (ft^3/hr)
gallons/minute (gpm	× 0.00442	=	acre-feet per day (acre-ft/day)
gallons/minute (gpm)	× 1.43	=	barrels (42 gal) per day (bbl/day)
gallons water/minute	× 6.0086	=	tons of water per 24 hours
million gallons/day (mgd)	× 1.54723	=	cubic feet per second (ft^3/sec)
million gallons/day (mgd)	× 92.82	=	cubic feet per minute (ft^3/min)
million gallons/day (mgd)	× 694.4	=	gallons per minute (gpm)
million gallons/day (mgd)	× 3.07	=	acre-feet per day (acre-ft/day)
pounds of water/minute	× 26.700	=	cubic feet per second (ft^3/sec)
miner's inch		=	flow through an orifice of 1 in.^{2} under a head of 4 to 6 in.
miner's inches (9 gpm)	× 8.98	=	gallons per minute (gpm)

miner's inches (9 gpm)	× 1.2	=	cubic feet per minute (ft^3/min)
miner's inches (11.25 gpm)	× 11.22	=	gallons per minute (gpm)
miner's inches (11.25 gpm)	× 1.5	=	cubic feet per minute (ft^3/min)

Work Measurement

British thermal units (Btu)	× 777.5	=	foot-pounds (ft-lb)
British thermal units (Btu)	× 39,270	=	horsepower-hours (hp·hr)
British thermal units (Btu)	× 29,280	=	kilowatt-hours (kW·hr)
foot-pounds (ft-lb)	× 1,286	=	British thermal units (Btu)
foot-pounds (ft-lb)	× 50,500,000	=	horsepower-hours (hp·hr)
foot-pounds (ft-lb)	× 37,660,000	=	kilowatt-hours (kW·hr)
horsepower-hours (hp·hr)	× 2,547	=	British thermal units (Btu)
horsepower-hours (hp·hr)	× 0.7457	=	kilowatt-hours (kW·hr)
kilowatt-hours (kW·hr)	× 3,415	=	British thermal units (Btu)
kilowatt-hours (kW·hr)	× 1.241	=	horsepower-hours (hp·hr)

Power Measurement

boiler horsepower	× 33,480	=	British thermal units per hour (Btu/hr)
boiler horsepower	× 9.8	=	kilowatts (kW)
British thermal units/second (Btu/sec)	× 1.0551	=	kilowatts (kW)
British thermal units/minute (Btu/min)	× 12.96	=	foot-pounds per second (ft-lb/sec)
British thermal units/minute (Btu/min)	× 0.02356	=	horsepower (hp)
British thermal units/minute (Btu/min)	× 0.01757	=	kilowatts (kW)
British thermal units/hour (Btu/hr)	× 0.293	=	watts (W)
British thermal units/hour (Btu/hr)	× 12.96	=	foot-pounds per minute (ft-lb/min)
British thermal units/hour (Btu/hr)	× 0.00039	=	horsepower (hp)
foot-pounds per second (ft-lb/sec)	× 771.7	=	British thermal units per minute (Btu/min)
foot-pounds per second (ft-lb/sec)	× 1,818	=	horsepower (hp)
foot-pounds per second (ft-lb/sec)	× 1,356	=	kilowatts (kW)
foot-pounds per minute (ft-lb/min)	× 303,000	=	horsepower (hp)

foot-pounds per minute (ft-lb/min)	× 226,000	=	kilowatts (kW)
horsepower (hp)	× 42.44	=	British thermal units per minute (Btu/min)
horsepower (hp)	× 33,000	=	foot-pounds per minute (ft-lb/min)
horsepower (hp)	× 550	=	foot-pounds per second (ft-lb/sec)
horsepower (hp)	× 1,980,000	=	foot-pounds per hour (ft-lb/hr)
horsepower (hp)	× 0.7457	=	kilowatts (kW)
horsepower (hp)	× 745.7	=	watts (W)
kilowatts (kW)	× 0.9478	=	British thermal units per second (Btu/sec)
kilowatts (kW)	× 56.92	=	British thermal units per minute (Btu/min)
kilowatts (kW)	× 3,413	=	British thermal units per hour (Btu/hr)
kilowatts (kW)	× 44,250	=	foot-pounds per minute (ft-lb/min)
kilowatts (kW)	× 737.6	=	foot-pounds per second (ft-lb/sec)
kilowatts (kW)	× 1.341	=	horsepower (hp)
tons of refrig. (US)	× 288,000	=	British thermal units per 24 hours
watts (W)	× 0.05692	=	British thermal units per minute (Btu/min)
watts (W)	× 0.7376	=	foot-pounds (force) per second (ft-lb/sec)
watts (W)	× 44.26	=	foot-pounds per minute (ft-lb/min)
watts (W)	× 1,341	=	horsepower (hp)

Velocity Measurement

feet/minute (ft/min)	× 0.01667	=	feet per second (ft/sec)
feet/minute (ft/min)	× 0.01136	=	miles per hour (mph)
feet/second (ft/sec)	× 0.6818	=	miles per hour (mph)
miles/hour (mph)	× 88	=	feet per minute (ft/min)
miles/hour (mph)	× 1.467	=	feet per second (ft/sec)

Miscellaneous

grade: 1 percent (or 0.01)		=	1 foot per 100 feet

METRIC CONVERSIONS

Linear Measurement

inch (in.)	× 25.4	=	millimeters (mm)
inch (in.)	× 2.54	=	centimeters (cm)
foot (ft)	× 304.8	=	millimeters (mm)
foot (ft)	× 30.48	=	centimeters (cm)
foot (ft)	× 0.3048	=	meters (m)
yard (yd)	× 0.9144	=	meters (m)
mile (mi)	× 1,609.3	=	meters (m)
mile (mi)	× 1.6093	=	kilometers (km)
millimeter (mm)	× 0.03937	=	inches (in.)
centimeter (cm)	× 0.3937	=	inches (in.)
meter (m)	× 39.3701	=	inches (in.)
meter (m)	× 3.2808	=	feet (ft)
meter (m)	× 1.0936	=	yards (yd)
kilometer (km)	× 0.6214	=	miles (mi)

Area Measurement

square meter (m^2)	× 10,000	=	square centimeters (cm^2)
hectare (ha)	× 10,000	=	square meters (m^2)
square inch ($in.^2$)	× 6.4516	=	square centimeters (cm^2)
square foot (ft^2)	× 0.092903	=	square meters (m^2)
square yard (yd^2)	× 0.8361	=	square meters (m^2)
acre	× 0.004047	=	square kilometers (km^2)
acre	× 0.4047	=	hectares (ha)
square mile (mi^2)	× 2.59	=	square kilometers (km^2)
square centimeter (cm^2)	× 0.16	=	square inches ($in.^2$)
square meters (m^2)	× 10.7639	=	square feet (ft^2)
square meters (m^2)	× 1.1960	=	square yards (yd^2)
hectare (ha)	× 2.471	=	acres
square kilometer (km^2)	× 247.1054	=	acres
square kilometer (km^2)	× 0.3861	=	square miles (mi^2)

Volume Measurement

cubic inch ($in.^3$)	× 16.3871	=	cubic centimeters (cm^3)
cubic foot (ft^3)	× 28,317	=	cubic centimeters (cm^3)
cubic foot (ft^3)	× 0.028317	=	cubic meters (m^3)
cubic foot (ft^3)	× 28.317	=	liters (L)
cubic yard (yd^3)	× 0.7646	=	cubic meters (m^3)

acre foot (acre-ft)	× 1233.48	=	cubic meters (m^3)
ounce (US fluid) (oz)	× 0.029573	=	liters (L)
quart (liquid) (qt)	× 946.9	=	milliliters (mL)
quart (liquid) (qt)	× 0.9463	=	liters (L)
gallon (gal)	× 3.7854	=	liters (L)
gallon (gal)	× 0.0037854	=	cubic meters (m^3)
peck (pk)	× 0.881	=	decaliters (dL)
bushel (bu)	× 0.3524	=	hectoliters (hL)
cubic centimeters (cm^3)	× 0.061	=	cubic inches ($in.^3$)
cubic meter (m^3)	× 35.3183	=	cubic feet (ft^3)
cubic meter (m^3)	× 1.3079	=	cubic yards (yd^3)
cubic meter (m^3)	× 264.2	=	gallons (gal)
cubic meter (m^3)	× 0.000811	=	acre-feet (acre-ft)
liter (L)	× 1.0567	=	quart (liquid) (qt)
liter (L)	× 0.264	=	gallons (gal)
liter (L)	× 0.0353	=	cubic feet (ft^3)
decaliter (dL)	× 2.6417	=	gallons (gal)
decaliter (dL)	× 1.135	=	pecks (pk)
hectoliter (hL)	× 3.531	=	cubic feet (ft^3)
hectoliter (hL)	× 2.84	=	bushels (bu)
hectoliter (hL)	× 0.131	=	cubic yards (yd^3)
hectoliter (hL)	× 26.42	=	gallons (gal)

Pressure Measurement

pound/square inch (psi)	× 6.8948	=	kilopascals (kPa)
pound/square inch (psi)	× 0.00689	=	pascals (Pa)
pound/square inch (psi)	× 0.070307	=	kilograms/square centimeter (kg/cm^2)
pound/square foot (lb/ft^2)	× 47.8803	=	pascals (Pa)
pound/square foot (lb/ft^2)	× 0.000488	=	kilograms/square centimeter (kg/cm^2)
pound/square foot (lb/ft^2)	× 4.8824	=	kilograms/square meter (kg/m^2)
inches of mercury	× 3,376.8	=	pascals (Pa)
inches of water	× 248.84	=	pascals (Pa)
bar	× 100,000	=	newtons per square meter
pascals (Pa)	× 1	=	newtons per square meter
pascals (Pa)	× 0.000145	=	pounds/square inch (psi)
kilopascals (kPa)	× 0.145	=	pounds/square inch (psi)
pascals (Pa)	× 0.000296	=	inches of mercury (at 60°F)

kilogram/square centimeter (kg/cm^2)	× 14.22	=	pounds/square inch (psi)
kilogram/square centimeter (kg/cm^2)	× 28.959	=	inches of mercury (at 60°F)
kilogram/square meter (kg/m^2)	× 0.2048	=	pounds per square foot (lb/ft^2)
centimeters of mercury	× 0.4461	=	feet of water

Weight Measurement

ounce (oz)	× 28.3495	=	grams (g)
pound (lb)	× 0.045359	=	grams (g)
pound (lb)	× 0.4536	=	kilograms (kg)
ton (short)	× 0.9072	=	megagrams (metric ton)
pounds/cubic foot (lb/ft^3)	× 16.02	=	grams per liter (g/L)
pounds/million gallons (lb/mil gal)	× 0.1198	=	grams per cubic meter (g/m^3)
gram (g)	× 15.4324	=	grains (gr)
gram (g)	× 0.0353	=	ounces (oz)
gram (g)	× 0.0022	=	pounds (lb)
kilograms (kg)	× 2.2046	=	pounds (lb)
kilograms (kg)	× 0.0011	=	tons (short)
megagram (metric ton)	× 1.1023	=	tons (short)
grams/liter (g/L)	× 0.0624	=	pounds per cubic foot (lb/ft^3)
grams/cubic meter (g/m^3)	× 8.3454	=	pounds/million gallons (lb/mil gal)

Flow Rates

gallons/second (gps)	× 3.785	=	liters per second (L/sec)
gallons/minute (gpm)	× 0.00006308	=	cubic meters per second (m^3/sec)
gallons/minute (gpm)	× 0.06308	=	liters per second (L/sec)
gallons/hour (gph)	× 0.003785	=	cubic meters per hour (m^3/hr)
gallons/day (gpd)	× 0.000003785	=	million liters per day (ML/day)
gallons/day (gpd)	× 0.003785	=	cubic meters per day (m^3/day)
cubic feet/second (ft^3/sec)	× 0.028317	=	cubic meters per second (m^3/sec)
cubic feet/second (ft^3/sec)	× 1,699	=	liters per minute (L/min)
cubic feet/minute (ft^3/min)	× 472	=	cubic centimeters/second (cm^3/sec)
cubic feet/minute (ft^3/min)	× 0.472	=	liters per second (L/sec)
cubic feet/minute (ft^3/min)	× 1.6990	=	cubic meters per hour (m^3/hr)

million gallons/day (mgd)	× 43.8126	=	liters per second (L/sec)
million gallons/day (mgd)	× 0.003785	=	cubic meters per day (m^3/day)
million gallons/day (mgd)	× 0.043813	=	cubic meters per second (m^3/sec)
gallons/square foot (gal/ft^2)	× 40.74	=	liters per square meter (L/m^2)
gallons/acre/day (gal/acre/day)	× 0.0094	=	cubic meters/hectare/day (m^3/ha/day)
gallons/square foot/day (gal/ft^2/day)	× 0.0407	=	cubic meters/square meter/day (m^3/m^2/day)
gallons/square foot/day (gal/ft^2/day)	× 0.0283	=	liters/square meter/day (L/m^2/day)
gallons/square foot/minute (gal/ft^2/min)	× 2.444	=	cubic meters/square meter/ hour (m^3/m^2/hr) = m/hr
gallons/square foot/minute (gal/ft^2/min)	× 0.679	=	liters/square meter/second (L/m^2/sec)
gallons/square foot/minute (gal/ft^2/min)	× 40.7458	=	liters/square meter/minute (L/m^2/min)
gallons/capita/day (gpcd)	× 3.785	=	liters/day/capita (L/d per capita)
liters/second (L/sec)	× 22,824.5	=	gallons per day (gpd)
liters/second (L/sec)	× 0.0228	=	million gallons per day (mgd)
liters/second (L/sec)	× 15.8508	=	gallons per minute (gpm)
liters/second (L/sec)	× 2.119	=	cubic feet per minute (ft^3/min)
liters/minute (L/min)	× 0.0005886	=	cubic feet per second (ft^3/sec)
cubic centimeters/second (cm^3/sec)	× 0.0021	=	cubic feet per minute (ft^3/min)
cubic meters/second (m^3/sec)	× 35.3147	=	cubic feet per second (ft^3/sec)
cubic meters/second (m^3/sec)	× 22.8245	=	million gallons per day (mgd)
cubic meters/second (m^3/sec)	× 15,850.3	=	gallons per minute (gpm)
cubic meters/hour (m^3/hr)	× 0.5886	=	cubic feet per minute (ft^3/min)
cubic meters/hour (m^3/hr)	× 4.403	=	gallons per minute (gpm)
cubic meters/day (m^3/day)	× 264.1720	=	gallons per day (gpd)
cubic meters/day (m^3/day)	× 0.00026417	=	million gallons per day (mgd)
cubic meters/hectare/day (m^3/ha/day)	× 106.9064	=	gallons per acre per day (gal/acre/day)
cubic meters/square meter/day (m^3/m^2/day)	× 24.5424	=	gallons/square foot/day (gal/ft^2/day)
liters/square meter/minute (L/m^2/min)	× 0.0245	=	gallons/square foot/minute (gal/ft^2/min)
liters/square meter/minute (L/m^2/min)	× 35.3420	=	gallons/square foot/day (gal/ft^2/day)

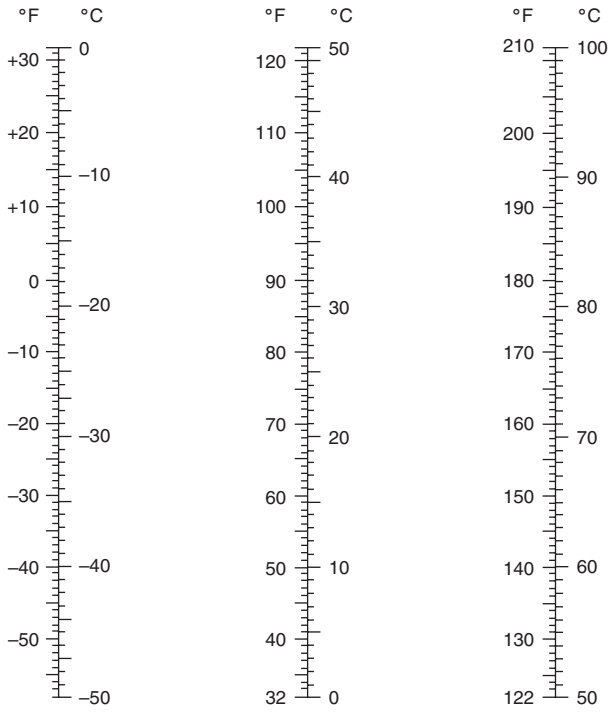
Work, Heat, and Energy

British thermal units (Btu)	× 1.0551	=	kilojoules (kJ)
British thermal units (Btu)	× 0.2520	=	kilogram-calories (kg-cal)
foot-pound (force) (ft-lb)	× 1.3558	=	joules (J)
horsepower-hour (hp•hr)	× 2.6845	=	megajoules (MJ)
watt-second (W-sec)	× 1.000	=	joules (J)
watt-hour (W•hr)	× 3.600	=	kilojoules (kJ)
kilowatt-hour (kW•hr)	× 3,600	=	kilojoules (kJ)
kilowatt-hour (kW•hr)	× 3,600,000	=	joules (J)
British thermal units per pound (Btu/lb)	× 0.5555	=	kilogram-calories per kilogram (kg-cal/kg)
British thermal units per cubic foot (Btu/ft^3)	× 8.8987	=	kilogram-calories/cubic meter (kg-cal/m^3)
kilojoule (kJ)	× 0.9478	=	British thermal units (Btu)
kilojoule (kJ)	× 0.00027778	=	kilowatt-hours (kW•hr)
kilojoule (kJ)	× 0.2778	=	watt-hours (W•hr)
joule (J)	× 0.7376	=	foot-pounds (ft-lb)
joule (J)	× 1.0000	=	watt-seconds (W-sec)
joule (J)	× 0.2399	=	calories (cal)
megajoule (MJ)	× 0.3725	=	horsepower-hour (hp•hr)
kilogram-calories (kg-cal)	× 3.9685	=	British thermal units (Btu)
kilogram-calories per kilogram (kg-cal/kg)	× 1.8000	=	British thermal units per pound (Btu/lb)
kilogram-calories per liter (kg-cal/L)	× 112.37	=	British thermal units per cubic foot (Btu/ft^3)
kilogram-calories/cubic meter (kg-cal/m^3)	× 0.1124	=	British thermal units per cubic foot (Btu/ft^3)

Velocity, Acceleration, and Force

feet per minute (ft/min)	× 18.2880	=	meters per hour (m/hr)
feet per hour (ft/hr)	× 0.3048	=	meters per hour (m/hr)
miles per hour (mph)	× 44.7	=	centimeters per second (cm/sec)
miles per hour (mph)	× 26.82	=	meters per minute (m/min)
miles per hour (mph)	× 1.609	=	kilometers per hour (km/hr)
feet/second/second (ft/sec^2)	× 0.3048	=	meters/second/second (m/sec^2)
inches/second/second (in./sec^2)	× 0.0254	=	meters/second/second (m/sec^2)
pound-force (lbf)	× 4.44482	=	newtons (N)
centimeters/second (cm/sec)	× 0.0224	=	miles per hour (mph)

meters/second (m/sec)	× 3.2808	=	feet per second (ft/sec)
meters/minute (m/min)	× 0.0373	=	miles per hour (mph)
meters per hour (m/hr)	× 0.0547	=	feet per minute (ft/min)
meters per hour (m/hr)	× 3.2808	=	feet per hour (ft/hr)
kilometers/second (km/sec)	× 2.2369	=	miles per hour (mph)
kilometers/hour (km/hr)	× 0.0103	=	miles per hour (mph)
meters/second/second (m/sec^2)	× 3.2808	=	feet/second/second (ft/sec^2)
meters/second/second (m/sec^2)	× 39.3701	=	inches/second/second ($in./sec^2$)
newtons (N)	× 0.2248	=	pounds force (lbf)



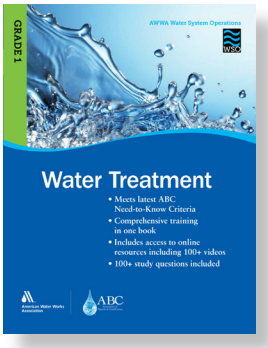
Celsius/Fahrenheit Comparison Graph

0.555 (°F – 32)	=	degrees Celsius (°C)
(1.8 × °C) + 32	=	degrees Fahrenheit (°F)
°C + 273.15	=	kelvin (K)
boiling point*	=	212°F
	=	100°C
	=	373 K
freezing point*	=	32°F
	=	0°C
	=	273 K

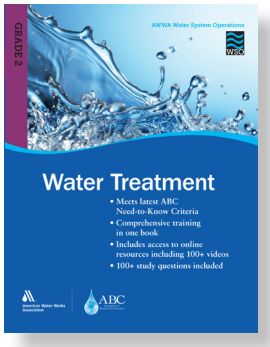
*At 14.696 psia, 101.325 kPa.

Which operator certification resource is right for me?

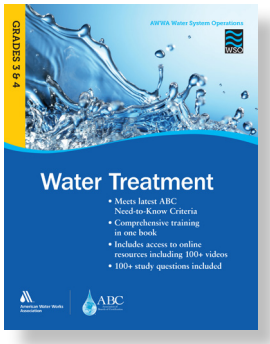
Get training on principles and practices with WSO guidebooks



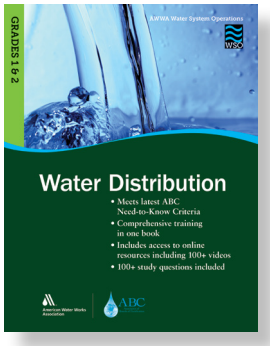
Water Treatment Grade 1



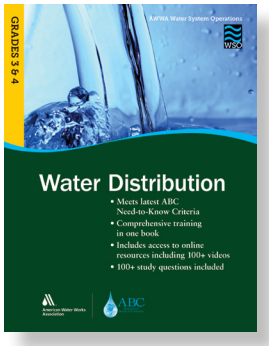
Water Treatment Grade 2



Water Treatment Grade 3 & 4



Water Distribution Grade 1 & 2



Water Distribution Grade 3 & 4

Ready for the test? Make sure with practice questions and answers:

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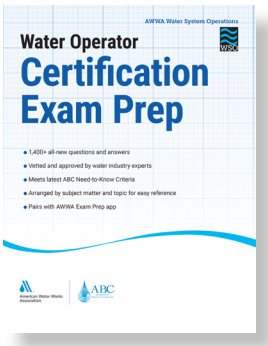

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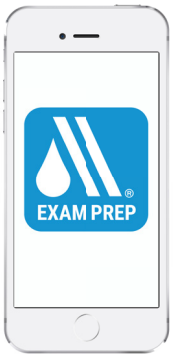

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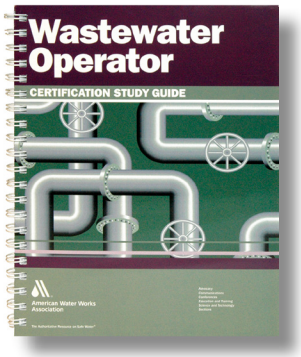
Looking for a wastewater specific resource?

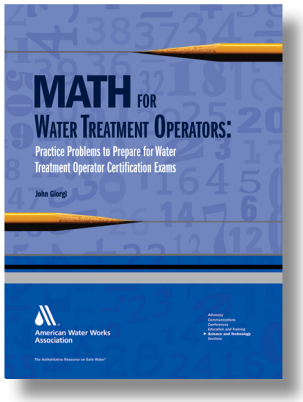


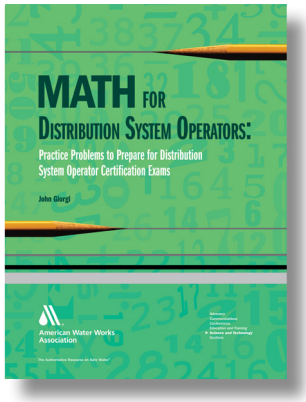
Pass our wastewater certification exam with this guide that is specially developed to give wastewater operators practice answering questions that are similar in format and content to the questions that appear on certification exams.

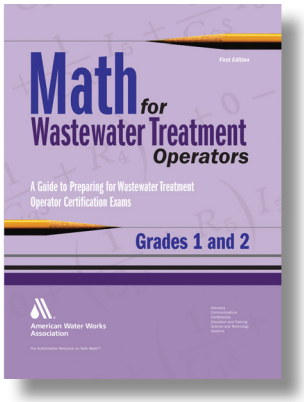
American Water Works Association

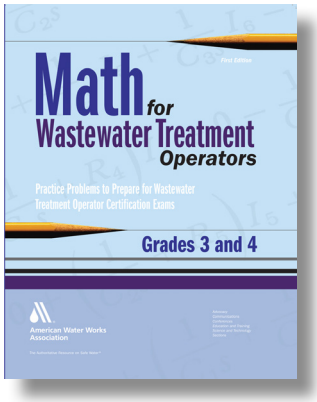
Information provided as a reference for studying only. Contact your local certification agency for information about the specific resources provided to individuals taking certification exams.

Struggling with math?

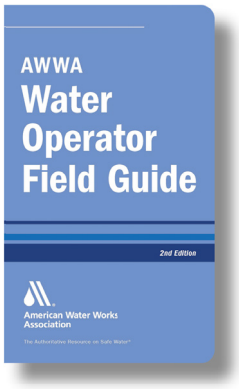


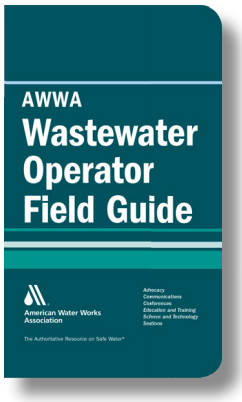






On-the-job resources





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