

CLASS 1 WATER OPERATOR EXAM FORMULA SHEET

CONVERSION FACTORS

1 foot = 12 inches	1 minutes = 60 seconds	cfs = cubic feet per second
1 inch = 2.54 centimeters	1 hour = 60 minutes	gpm = gallons per minute
1 gallon = 8 pints	1 day = 86,400 seconds	gpd = gallon per day
1 gallon = 8.34 pounds	1 day = 1440 minutes	MGD = million gallons per day
1 gallon = 3.785 liters	1 % = 10,000 ppm	mg/L = milligrams per Liter
1 liter = 1000 milliliters	1 mg/L = 1 ppm	ppm = parts per million
1 cubic foot = 7.48 gallons	1 cubic foot = 62.38 pounds	psi = pounds per square inch
1 cfs = 448 gpm	1 MGD = 1.55 cfs	fps = feet per second
1 gpm = 1440 gpd	1 MGD = 694.4 gpm	sq ft = square feet
1 psi = 2.31 ft	π (pi) = 3.14	cu ft = cubic feet
1 grain per gallon = 17.12 mg/L	1 lb = 454 gram	gpg=grains per gallon

TEMPERATURE

Fahrenheit (°F) = (1.8 x °C) + 32 Celsius (°C) = 0.56 x (°F - 32)

CIRCUMFERENCE, AREA & VOLUME

Circumference (C, ft) = π x diameter (D, ft)

Area of a rectangle (A, square feet, sq ft) = (length, ft) x (width, ft)

Area of a circle (A, square feet, sq ft) = $0.785 \times (\text{diameter, ft})^2 = \pi \times (\text{radius, ft})^2$

Volume of a rectangle (V, cubic feet, cu ft) = (length, ft) x (width, ft) x (height, ft)

Volume of a rectangle (V, gal) = (length, ft) x (width, ft) x (height, ft) x 7.48 gal/cu ft

Volume of a cylinder (V, cubic feet, cu ft) = $0.785 \times (\text{diameter, ft})^2 \times (\text{height, ft})$

Volume of a cylinder (V, gal) = $0.785 \times (\text{diameter, ft})^2 \times (\text{height, ft}) \times 7.48 \text{ gal/cu ft}$

CHLORINATION

Chlorine dose, mg/L = chlorine demand, mg/L + chlorine residual, mg/L

Total chlorine residual, mg/L = free chlorine residual, mg/L + combined chlorine residual, mg/L

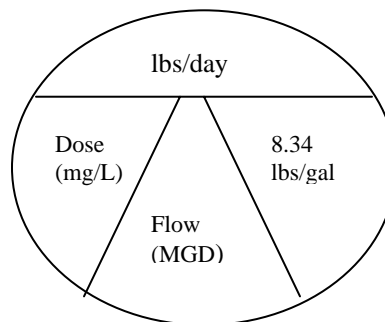
POUNDS, DOSAGE & FLOW

Dose, mg/L = lbs/day ÷ (Flow, MGD) ÷ (8.34 lbs/gal)

Flow, MGD = lbs/day ÷ (dose, mg/L) ÷ (8.34 lbs/gal)

lbs/day = (dose, mg/L)(flow, MGD)(8.34 lbs/gal)

lbs/day = (dose, mg/L)(flow, MGD)(8.34 lbs/gal) ÷ % purity (decimal)



FLOW

Flow (Q, gpm) = Volume (Vol, gal) ÷ time (t, minutes)

Flow (Q, cfs) = velocity (v, fps) x area (sq ft)

DETENTION TIME

Detention time (DT, min) = volume (Vol, gal) ÷ flow (Q, gpm)

PERCENT

Percent (%) = part ÷ whole x 100
Part = whole x percent ÷ 100

CLASS II, III & IV WATER OPERATOR EXAM FORMULA SHEET

$$\text{HP} = \frac{\text{gpm} \times \text{TDH}}{3960 \times \text{efficiency}}$$

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

$$\text{Calibration of a Dry Chemical Feeder (lbs/day)} = \frac{\text{Chemical Applied, lbs}}{\text{Length of Application, day}}$$

$$\text{Calibration of Solution Chemical Feeder (lbs/day)} = \frac{(\text{Chem Conc, mg/L})(\text{Vol pumped, mL})(1440 \text{ min/day})}{(\text{Time pumped, min})(1000 \text{ mL/L})(1000 \text{ mg/g})(454 \text{ g/lb})}$$

$$\text{Filtration rate (gpm/sq ft)} = \frac{\text{Flow, gpm}}{\text{Surface area, sq ft}}$$

$$\text{Unit Filter Rate Volume (UFRV)} = (\text{Filtration Rate, gpm/sq ft})(\text{Filter Run, hr})(60 \text{ min/hr})$$

$$\text{Backwash water, gal} = (\text{Backwash flow, gpm})(\text{Backwash time, min})$$

$$\text{Backwash \%} = \frac{(\text{Backwash water, gal})(100\%)}{(\text{Water Filtered, gal})}$$

$$\text{pH}_s = \text{A} + \text{B} + \log(\text{Ca}^{2+}) + \log(\text{Alk})$$

$$\text{Langlier Index} = \text{pH} - \text{pH}_s$$

$$\text{Polymer, lbs} = \frac{(\text{Polymer Solution, gal})(8.34 \text{ lbs/gal})(\text{Polymer, \%})(\text{Sp Gr})}{100\%}$$

$$\text{Hypochlorite Flow, gpd} = \frac{(\text{Container area, sq ft})(\text{Drop, ft})(7.48 \text{ gal/cu ft})(24 \text{ hr/day})}{(\text{Time, hr})}$$

$$\text{Feed Rate, gal/day} = \frac{(\text{Feed Rate, lbs/day})(\text{Feed Dose, mg/L})}{\text{Feed Solution, mg/L}}$$

$$\text{Feed Rate, lbs/day} = \frac{\text{Feeder Setting, lbs/day}}{24 \text{ hr/day}}$$

$$\text{CT, mg/L-min} = \frac{(\text{Vol, gal})(T_{10})(\text{Free Chlorine Residual, mg/L})}{\text{Flow, gpm}}$$

$$\text{Free Chlorine Residual, mg/L} = \frac{(\text{CT, mg/L-min})}{T_{10}, \text{ min}}$$

$$\text{Fluoride Feed rate (lbs/day)} = \frac{\text{Dose (mg/L)} \times \text{Capacity (MGD)} \times 8.34 \text{ lbs/gal}}{(\text{Available Fluoride Ion, AFI})(\text{chemical purity, as decimal})}$$

$$\text{Fluoride Feed rate (gpd)} = \frac{\text{Dose (mg/L)} \times \text{Capacity (gpm)}}{18,000 \text{ mg/L}}$$

Chemical	Formula	Available Fluoride Ion (AFI) Concentration	Purity
Sodium Fluoride	NaF	0.453	98%
Sodium Fluorosilicate	Na ₂ SiF ₆	0.607	98%
Fluorosilicic Acid	H ₂ SiF ₆	0.792	23%