ABC Water & Wastewater Core Study Sheet

Conversions · treatment & distribution formulas · wastewater & collection formulas and facts

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EXAM FACTS — WPI / ABC STANDARDIZED EXAMS

Item	Fact
Form	100 scored multiple-choice questions + up to 10 unscored pre-test questions
Passing	70% in the states that publish a cut score
At the exam	WPI standardized exams are administered with a Formula/Conversion Table (one for Water Treatment / Distribution / Water Lab; one for Wastewater Treatment / Collection / Industrial Waste / Wastewater Lab)

UNIT CONVERSIONS

From	To
1 cubic foot	7.48 gallons
1 gallon of water	8.34 pounds
1 MGD	694 gpm
1 MGD	1.547 cfs

From	To
1 cfs	448.8 gpm
1 psi	2.31 feet of head
1 foot of head	0.433 psi
1 grain per gallon	17.1 mg/L

TREATMENT FORMULAS

Calculation	Formula
Chemical feed (pounds formula)	`lb/day = Flow (MGD) × Dose (mg/L) × 8.34`
Feed with purity	`actual chemical = pure lb/day ÷ purity (decimal)`
Dose from feed rate	`Dose (mg/L) = lb/day ÷ (MGD × 8.34)`
Chlorine balance	`Dosage = Demand + Residual`
CT	`residual (mg/L) × contact time (min)`
Detention time	`Time = Volume ÷ Flow`
Tank volume, rectangular	`gal = L × W × H (ft³) × 7.48`
Tank volume, cylindrical	`gal = 0.785 × D² × depth (ft³) × 7.48`
Surface / filter loading rate	`rate = Flow ÷ surface area`
Percent removal	`% = (in − out) ÷ in × 100`
Dilution	`C1V1 = C2V2`
Water horsepower	`hp = (gpm × head, ft) ÷ 3,960`

DISTRIBUTION FORMULAS & FACTS

Item	Reference
Pipe volume	`gal = 0.785 × D² × length (ft³) × 7.48`
Specific capacity	`yield (gpm) ÷ drawdown (ft)` ; a falling pumping level at constant yield means declining specific capacity
Normal working pressure	about 40–80 psi
Residual pressure during fire flow	should not drop below about 20 psi

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Hazen-Williams C-factor	new pipe ≈ 130–140; old, tuberculated iron can fall to 40–100
Hydrant bonnet / top color	red < 500 gpm · orange 500–999 · green 1,000–1,499 · light blue ≥ 1,500 gpm
New / repaired main disinfection	standard practice: fill with chlorinated water (commonly about 25 mg/L held about 24 hours, retaining a measurable residual), flush, and pass bacteriological samples — typically two consecutive satisfactory sets about 24 hours apart — before return to service
Backsiphonage / backpressure	reverse flow from negative pressure / downstream pressure exceeding supply pressure; an air gap is the most reliable protection

WASTEWATER FORMULAS & FACTS

Item	Reference
BOD5	oxygen consumed by microbes over 5 days at 20°C
Medium-strength domestic wastewater	typically ≈ 200 mg/L BOD and ≈ 200 mg/L TSS
Primary clarification removal	typically about 50–70% of TSS and 25–40% of BOD
BOD / TSS loading	`lb/day = Flow (MGD) × Concentration (mg/L) × 8.34`
F/M ratio	`BOD applied (lb/day) ÷ MLSS under aeration (lb)`; conventional operation ≈ 0.2–0.5
MCRT / SRT (sludge age)	`solids under aeration (lb) ÷ solids leaving per day`; conventional ≈ 5–15 days; controlled mainly by the WAS rate
SVI	`30-min settled volume (mL/L) × 1,000 ÷ MLSS (mg/L)`; ≈ 50–150 mL/g indicates good settling
WAS rate	`gpd = solids (lb/day) × 1,000,000 ÷ (WAS mg/L × 8.34)`
Clarifier surface overflow rate	`gpd/ft² = Flow (gpd) ÷ surface area (ft²)`
Grit channel velocity	about 1 ft/s — grit settles while lighter organics stay suspended

COLLECTION FACTS

Item	Reference
Slope	`% = fall ÷ run × 100`
Velocity / flow	`V = Q ÷ A (ft/s) · Q = A × V × 448.8 = gpm`
Self-cleansing velocity	about 2 ft/s in gravity sewers; minimum slopes decrease as pipe diameter increases
Infiltration	groundwater entering through cracks, joints, and manhole walls
Inflow	surface / storm water entering directly — roof leaders, area drains, cross-connections, manhole covers in low spots
Exfiltration	sewage leaking out of the pipe
Force main	carries pumped flow under pressure from a lift station

WHAT THIS SHEET DOESN'T COVER

- Class-by-class depth — Classes III and IV apply this same formula set to plant-upset, troubleshooting, and management scenarios.
- Blueprint-weighted scenario application across your track (Treatment, Distribution, Wastewater Treatment, or Collection).
- Timed, full-length exam simulation.
- An explanation for every answer — why the right answers are right and the wrong ones are wrong.
- A fresh set of questions on every attempt, so practice never repeats itself.

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Formulas and facts are the WPI/ABC canon as used across the PassProfessor Water and Wastewater Operator question banks (Classes I–IV). Passing standards and licensing rules are set by each state.

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