CLEARDECK · CERTIFIED POOL & SPA OPERATOR

The Ultimate Pool Water Chemistry Cheat Sheet

Pin this above the chemical store.

1 Water Quality Operating Ranges

The numbers a health inspector reads a log against. The minimum free chlorine moves with whether the venue uses cyanuric acid, which is the part most often got wrong.

PARAMETER	MINIMUM	MAXIMUM	SECTION
Free chlorine, no cyanuric acid	1.0 ppm	10.0 ppm	5.7.3.1.1.2.1
Free chlorine, with cyanuric acid	2.0 ppm	10.0 ppm	5.7.3.1.1.2.2
Free chlorine, spas	3.0 ppm	10.0 ppm	5.7.3.1.1.2.3
Total bromine, pools	3.0 ppm	8.0 ppm	5.7.3.1.2.2
Total bromine, spas	4.0 ppm	8.0 ppm	5.7.3.1.2.2
pH	7.0	7.8	5.7.3.4.1
Total alkalinity	60 ppm	180 ppm	5.7.4.4.1
Calcium hardness	not set	2,500 ppm	5.7.4.4.3
Cyanuric acid	not set	90 ppm	5.7.3.1.3.2
Combined chlorine	not set	act above 0.4 ppm	5.7.4.4.2
Water temperature	not set	104 F	5.7.4.7.2

Source: 2023 MAHC 5.7.3 and 5.7.4

2 The Formulas Worth Memorising

The exam is open book, but the arithmetic questions are where candidates run out of time. Knowing these cold is what buys the time to look up everything else.

WHAT YOU WANT	FORMULA
Volume in gallons	area x average depth x 7.48
Area, rectangle	length x width
Area, circle	3.14 x radius x radius
Turnover time in hours	gallons / flow rate / 60
Flow rate needed	gallons / turnover hours / 60
Filter loading rate	flow rate / filter area
Pounds of chemical	ppm x gallons x 8.34 / 1,000,000
Ounces of chemical	pounds x 16
Allowing for strength	divide by the strength as a decimal
Combined chlorine	total chlorine - free chlorine
Breakpoint level	combined chlorine x 10
Saturation index	pH + TF + CF + AF - 12.1
Btu to heat water	gallons x 8.34 x temperature rise
Water replacement	bathers per day x 4 gallons

Source: Standard pool operator arithmetic

3 What Each Chemical Does to the Other Readings

Most exam scenarios turn on the second effect rather than the first. A pool fed on trichlor drifts down in pH and up in cyanuric acid without anyone adding either on purpose.

PRODUCT	RAISES	SIDE EFFECT
Calcium hypochlorite 65%	free chlorine	raises calcium hardness and pH
Sodium hypochlorite 12.5%	free chlorine	raises pH
Dichlor 56%	free chlorine	raises cyanuric acid, roughly 0.9 per 1
Trichlor 90%	free chlorine	raises cyanuric acid and lowers pH hard
Lithium hypochlorite 35%	free chlorine	no calcium, no stabiliser
Sodium bicarbonate	total alkalinity	very little pH movement
Soda ash	pH	raises alkalinity as well
Muriatic acid	nothing	lowers pH and alkalinity together
Sodium bisulfate	nothing	lowers pH and alkalinity, raises solids
Calcium chloride	calcium hardness	gives off heat when dissolving
Cyanuric acid	cyanuric acid	slow to dissolve, test after 24 hours

Source: Product chemistry

4 Maximum Filtration Rates

The spread across filter types is enormous. A cartridge filter is allowed one fortieth the rate of a high rate sand filter, so a plant converted from one to the other without resizing is out of compliance the day it is commissioned.

FILTER TYPE	MAXIMUM RATE	SECTION
High rate sand, bed 15 in or deeper	15 gpm/sq ft	4.7.2.2.3.1
High rate sand, bed under 15 in	12 gpm/sq ft	4.7.2.2.3.1.1
Vacuum precoat with continuous body feed	2.5 gpm/sq ft	4.7.2.3.1.1
Vacuum precoat	2.0 gpm/sq ft	4.7.2.3.1.1
Pressure precoat (DE)	2.0 gpm/sq ft	4.7.2.3.1.2
Cartridge, design rate	0.30 gpm/sq ft	4.7.2.4.1
Cartridge, maximum operating rate	0.375 gpm/sq ft	5.7.2.4.2
Granular media backwash, minimum	15 gpm/sq ft	4.7.2.2.3.2

Source: 2023 MAHC 4.7.2 and 5.7.2

Doing this by hand at the pool?

- A pool log that checks every reading against the 2023 MAHC as you save it
- Chemical dose, water balance, breakpoint and turnover, with the working shown
- 450 CPO practice questions, flashcards and a timed mock test
- Free in your browser, and it works offline once opened

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A study and field aid. The MAHC is a model code: check every figure against your local health code, the product label and the equipment manufacturer's instructions before you rely on it.