Certified Pool/Spa Operator® Course
Pool Calculations

AMOUNT CONVERSIONS

a) Ounces to Pounds	Ounces ÷ 16 = Pounds
b) Fluid Ounces to Gallons	Fluid Ounces ÷ 128 = Gallons

DISTANCE CONVERSIONS

a) Yards to Feet	Yards X 3 = Feet
b) Meters to Feet	Meters X 3.28 = Feet

SURFACE AREA

a) Rectangle or Square	Length X Width = Surface Area in Sq. Ft.
b) Circle	Radius X Radius X 3.14 = Surface Area in Sq. Ft.

AVERAGE DEPTH

For constant slope bottom pools — Shallow depth + deep depth ÷ 2 = Average depth

POOL VOLUME

a) Rectangle or Square	Surface Area (SA) X Depth (D) X 7.5 = Gallons of water
b) Circle	Surface Area (SA) X Depth (D) X 7.5 = Gallons of water

GALLONS LOST IN ONE INCH — Surface Area (SA) X 0.0833 (D) X 7.5 = Gallons of water

CALCULATING COMBINED CHLORINE (CHLORAMINES)

Total Chlorine – Free Chlorine = Combined Chlorine (Chloramines)

Calculating Breakpoint Additional Chlorine to be Added

(Combined Chlorine X 10) – Existing Free Chlorine already in Pool = Additional Chlorine PPM

TURNOVER RATE

Pool Volume ÷ Flow Rate ÷ 60 = Turnover Rate (TOR) in hours

FLOW RATE REQUIRED FOR TURNOVER RATE

Pool Volume ÷ Turnover Rate ÷ 60 = Flow Rate in gpm (gallons per minute)

FLOW RATE BASED ON FILTER SIZE AND FILTERING RATE

Filter Surface Area X Filtering Rate (FMR) = Flow rate in gpm (gallons per minute)

FILTER SIZE REQUIRED (FILTER SURFACE AREA)

Flow Rate ÷ Filter Media Rate (FMR) = Square feet of filter surface area required

SPA WATER DUMPING

Recommended: Dump when Total Dissolved Solids (TDS) rises 1500 ppm above start up reading
OR:
Spa Volume ÷ 3 ÷ Avg. # of users daily = Number of days until water should be dumped

HEATER SIZING

Volume x 8.33 x Degrees raised (change) = BTU's needed to achieve temperature rise

TOTAL DYNAMIC HEAD

Multiply Pump PRESSURE gauge reading by 2.31 = feet of head on pressure side
Multiply Pump VACUUM gauge reading by 1.13 = feet of head on vacuum side
ADD THESE TWO RESULTS TOGETHER; RESULT IS TOTAL DYNAMIC HEAD OF SYSTEM

Certified Pool/Spa Operator® Course
Chemical Dose Chart
Dosages required to chemically treat 10,000 gallons of water

USE WITH "CHEMICAL ADJUSTMENT" WORKSHEET (information also on page 262 in manual)

FUNCTION/CHEMICAL	*AMOUNT NEEDED* *(put in box #1)*	**CHANGE IT MAKES (put in box #4)**
Increase Free Available Chlorine		
Chlorine Gas (gas)	*1.3 ounces*	**1 PPM**
Calcium Hypochlorite (tablets, granules)	*2.0 ounces*	**1 PPM**
Sodium Hypochlorite (liquid)	*10.7 fluid ounces*	**1 PPM**
Lithium Hypochlorite (sticks, granular)	*3.8 ounces*	**1 PPM**
Trichlor (tablets, sticks, granular)	*1.5 ounces*	**1 PPM**
Dichlor (tablets, sticks, granular)	*2.4 ounces*	**1 PPM**
Neutralize Free Available Chlorine		
Sodium Thiosulfate	*2.6 ounces*	**1 PPM**
Sodium Sulfite	*2.4 ounces*	**1 PPM**
Increase Total Alkalinity		
Sodium Bicarbonate (Baking Soda)	*1.4 pounds*	**10 PPM**
Sodium Carbonate (Raises pH about .5)	*14 ounces*	**10 PPM**
Sodium Sesquicarbonate	*1.25 pounds*	**10 PPM**
Decrease Total Alkalinity		
Muriatic Acid (31.4%)	*26 fluid ounces*	**10 PPM**
Sodium Bisulfate (Dry Acid)	*2.1 pounds*	**10 PPM**
Increase pH		
Sodium Carbonate (Soda Ash)	*6 ounces* *(also raises Total Alkalinity 5 ppm)*	**0.2 PPM**
Sodium Hydroxide 50% (Caustic Soda)	*5.5 fluid ounces*	**0.2 PPM**
Decrease pH		
Muriatic Acid	*12 fluid ounces*	**0.2 PPM**
Carbon Dioxide (CO2)	*1.0 pound*	**0.2 PPM**
Increase Calcium Hardness		
Calcium Chloride (100%)	*.9 pounds*	**10 PPM**
Calcium Chloride (77%)	*1.2 pounds*	**10 PPM**
Increase Chlorine Stabilizer – This product may NOT be used in NY State!		
Cyanuric Acid(granular)	*13 oz*	**10 PPM**

Certified Pool/Spa Operator® Course
Breakpoint Chlorination Worksheet p.1
(See P.2 for additional information)

STEP 1: TC _____ - **FC** _____ = CC _____

STEP 2: CC _____ X 10 = BPC _____ (**B**reak **P**oint **C**hlorine)

STEP 3: BPC _____ - **FC** _____ = ADJUSTMENT _____

STEP 4: USE "THE FORMULA"

CHEMICAL TO BE USED	POOL VOLUME (GIVEN OR CALCULATED)	CHANGE (ADJUSTMENT)
_____	Box #2	Box #3

÷ 10,000 Gal. ÷ **1.0 PPM**

AMOUNT OF CHEMICAL (FROM DOSE CHART)

Box #1

X_____ X_____ = _____

"DIVIDE GOING DOWN.....MULTIPLY GOING ACROSS"

Chemical Dose Chart

FUNCTION/CHEMICAL	*AMOUNT*	**CHANGE**
Increase Free Available Chlorine		
Chlorine Gas (gas)	*1.3 ounces*	**1 PPM**
Calcium Hypochlorite (tablets, granules)	*2.0 ounces*	**1 PPM**
Sodium Hypochlorite (liquid)	*10.7 fluid ounces*	**1 PPM**
Dry Oz. ÷ 16 = Pounds	**Fluid Oz. ÷ 128 = Gallons**	

Certified Pool/Spa Operator® Course
Breakpoint Chlorination Worksheet p.2
HOW TO USE THIS WORKSHEET

1. In ‘step one’, record your total chlorine and free chlorine readings; subtract the free from the total. If the result is greater than .2 ppm, you must proceed to step #2.

2. In ‘step two’, multiply the cc amount by 10, and record the result. This will be your “Break Point Chlorine” amount.

3. In ‘step three’, subtract the existing (tested) free chlorine from your break point chlorine; this will give you the adjustment which you must make to your water. Put this result in box #3 in the worksheet.

4. Choose the form of chlorine you will use to reach Breakpoint; look up the amount needed on the chemical dose chart and write that amount into box #1. Remember to write the unit of measure from the chemical dose chart into box #1. Whatever unit of measure you start with in this box, you will end up with when you do your multiplications in step #6.

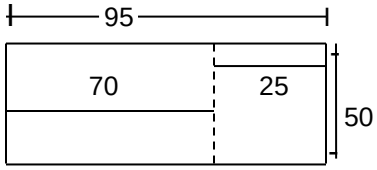
5. Put the volume of the pool into box #2.

6. With all three boxes now filled in, simply divide going down in the pool volume and change/adjustment columns. Write the asnwers on the lines at the bottom of each column.

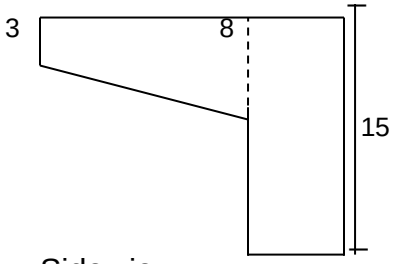
7. Multiply the three numbers at the bottom of the page, going across from left to right. Place the result on the last line on the right hand side of the page. If needed, convert to the correct unit of measure. The result is how much chlorine you must add to the pool to achieve Breakpoint.

CPO EXAM PRACTICE QUESTIONS

Diagram for question 1



Top view



Side view

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1. You are the operator for a pool that is 95 feet long and 50 feet wide. The pool is divided into two areas: a swimming area, and a diving area. The swimming area is 70 feet long. with a depth range of 3 feet to 8 feet, and a constant slope. The diving area is 25 feet long with a constant depth of 15 feet.

a b c d What is the volume in gallons for this facility?
(a) 350,000 gals (b) 285,000 gals (c) 1,285,000 gals (d) 569,375 gals

2. a b c d What is the flow rate, in gallons per minute (GPM) for a pool of 445,000 gallons of water and a turnover rate of 6 hours?
(a) 3,261 gpm (b) 6,321 gpm (c) 1,236 gpm (d) 2,632 gpm

3. a b c d Using a high rate sand filter with a filter media rate of 12 GPM per square foot And a flow rate of 4,459, what size filter is necessary to achieve water clarity?
(a) 372 sq. ft. (b) 425 sq. ft. (c) 320 sq. ft. (d) 463 sq. ft.

4. You are the operator of a 150,000 gallon outdoor pool. The water tests give you the following readings: Total alkalinity is 50 ppm, pH is 6.9, calcium hardness is 100, temperature is 76 degrees, and Total Dissolved Solids is 800. What is the Saturation Index (SI) for this pool?

a b c d The Saturation Index (SI) for this pool is: (a) +1.3 (b) -1.0 (c) –1.3 (d) 0

a b c The calculated SI indicates that this water is? (a) scaling (b) corrosive (c) balanced

5. a b c d What is the ideal Calcium Hardness range for a Spa with a temperature of 102°?
(a) 100- 1000 ppm (b) 200-400 ppm (c) 80-120 ppm (d) 150-250 ppm

6. a b c d What are the 2 types of chemical feeders that we primarily use for swimming pool acid?
(a) Large & Small (b) Periodic and Continuous (c) Diaphragm & Peristaltic
(d) Fast & Slow

EXAM PRACTICE QUESTIONS PAGE TWO

Circle the correct answer in each of the following problems:

1. Your pool is 75 feet long by 75 feet wide, and the average depth is four feet. You return to the pool on Monday morning and find that the auto-fill feature has failed to work, and the pool water level is 2 inches too low. How many gallons of water must be added to return the water to the proper level?
(a) 2,750 gals (b) 3,514 gals (c) 5,272 gals (d) 7,028 gals

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2. You operate a 330,000 gallon indoor pool, and your chemical test readings are: total available chlorine is 1.3, and the free available chlorine is .6. How much calcium hypochlorite is needed to reach breakpoint and remove the chloramines?
(a) 17.25 lbs (b) 26.4 lbs (c) 29 lbs (d) 22.5 lbs

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3. You have a 30,000 gallon hotel pool with a calcium hardness level of 100 ppm. How much calcium chloride (77%) would be required to increase the calcium hardness to 300 ppm?
(a) 18 lbs. (b) 36 lbs. (c) 72 lbs. (d) 720 lbs.

4. A red or reddish brown pool is usually an indication of?
(a) Blood in the water (b) High pH levels (c) Iron in the water (d) Too much DPD in the water

5. If your pool has 50,000 gallons of water, and the total alkalinity is 60 ppm, how many pounds of sodium bicarbonate will be needed to increase the total alkalinity to 100 ppm?
(a) 2.8 lbs. (b) 25 lbs (c) 28 lbs (d) 35 lbs

6. What is the formula used to calculate surface area of an oblong shaped pool?
(a) R X R X 3.14 + (LXW) (b) R X 3.14 X L X W (c) L X W X R X 3.14
(d) Circumference X R X R X 3.14

7. When Total Alkalinity falls below 60, you may experience what problem?
(a) Bleaching of swimsuits (b) pH Lock (c) pH Bounce (c) Calcium buildup

8. What is the acceptable pH range for pool/spa water?
(a) 7.0 – 7.6 (b) 7.2 – 7.8 (c) 7.1 – 7.9 (d) 6.9 – 7.5

9. What is the total surface area of a D.E. filter that has 8 screens, each of which measures 4 ft. high by 6 ft wide and which filter from both sides of the screen?
(a) 1152 sq. ft. (b) 192 sq. ft. (c) 248 sq. ft. (d) 384 sq. ft.

10. You operate a seasonal outdoor swimming pool. You have been asked by the pool manager to calculate the Total Dynamic Head for the pool. The Pressure gauge reading is 14 pounds of pressure (psi), and the Vacuum gauge reading is 9 inches of mercury (in. Hg). What is the TDH of your pool?
(a) 425 (b) 48.75 (c) 42.5 (d) 52.4

Answer Key:
Page 1
1.B
2.C
3.A
4.C, B
5.D
6. C

page two:
1D
2B
3C
4C
5C
6A
7C
8B
9D
10C