




Bottled Water Math Study Guide



**Kentucky Division of Compliance Assistance
Certification and Licensing Branch**

This study guide is intended to help students become more familiar with the variety of math equations within the Bottled Water manual and exam.

Below is a chart of where math can be found in the training manual.

Chapter	Name	Page	Concept
4	Storage	59	Area/Volume/ Conversion
4	Storage	63	Flow $Q=A \times V$
5	Disinfection	92	Dosage, Demand, Residual Math
5	Disinfection	98-101	Pounds, ppm, purity
5	Disinfection	104	Specific Gravity
5	Disinfection	105	Strength of Solution

Work through each problem introduced in each chapter and the math questions (if any) at the end of each chapter.

1. If 50 pounds of chemical is added to 100 gallons of water, what would the strength of solution (SOS) be?

- A. 0.0565%
- B. 5.65%
- C. 0.060%
- D. 6.00%

2. If a facility treats 375,000 gallons of water a day and needs to meet a dosage specification of 3 ppm, how many pounds of bleach at 5.25% purity will need to be added?

- A. 1.8 pounds
- B. 9.4 pounds
- C. 171.7 pounds
- D. 250.8 pounds

3. If 25 milliliters a minute were added over 18 hours to a flow of 150,000 gallons a day, how many gallons would be dispersed into the water?

- A. 7.14 gallons
- B. 453.6 gallons
- C. 27,000 gallons
- D. 59.5 gallons

4. How many gallons of 12% bleach would need to be added to a flow of 750,000 gallons per day to achieve a dosage of 1.7 mg/L.

The bleach has a specific gravity of 1.2.

- A. 73.8 or 74 gallons
- B. 88.61 or 89 gallons
- C. 10.63 or 11 gallons
- D. 8.85 or 9 gallons

5. If water is flowing through a 10 inch pipe at 450 gpm, what is the velocity of the water?

- A. 0.54 ft/sec
- B. 1.00 ft/sec
- C. 1.85 ft/sec
- D. 4.48 ft/sec

6. A tank has a radius of 20 feet and is 35 feet deep. How many gallons of water will this tank hold when full?

- A. 43,960 gallons
- B. 328,820.8 gallons
- C. 10,990 gallons
- D. 82,205.2 gallons

7. Water is traveling through a 16 inch line at 1.5 feet per second. What is the flow in that line?

- A. 1.39 ft³/sec
- B. 1.50 ft³/sec
- C. 2.09 ft³/sec
- D. 1.08 ft³/sec

8. If 128 fluid ounces are equivalent to one gallon and your facility produces 15,000 cases of 24, 16 ounce bottles per day, how many gallons of water are you producing each day?

- A. 1,875 gallons
- B. 2,812.5 gallons
- C. 45,000 gallons
- D. 240,000 gallons

9. You are told to cut production by 40% due to a problem in the bottling area. If your pump is currently running at 150 strokes per minute, how many strokes per minute must you run your pump to allow bottling to keep up?

- A. 60 strokes per minute
- B. 110 strokes per minute
- C. 125 strokes per minute
- D. 135 strokes per minute

10. You need to deliver 900 GPM while overcoming 45 feet of head in your plant. How many WHP (water horsepower) is needed to accomplish this?

- A. 10.22 WHP
- B. 15.04 WHP
- C. 4.4 WHP
- D. 1.96 WHP

11. A chemical has a specific gravity of 1.9. How much would one gallon of this chemical weigh?

- A. 8.34 lbs/gal
- B. 11.04 lbs/gal
- C. 13.34 lbs/gal
- D. 15.85 lbs/gal

12. Currently there is 0.05 mg/L of disinfectant being added to a flow of 400,000 gallons per day. To increase your residual to 0.3 mg/L, how many pound of additional disinfectant will need to be added each hour?

- A. 0.035 lbs. per hour
- B. 0.25 lbs. per hour
- C. 0.83 lbs. per hour
- D. 1.01 lbs. per hour

Answer Key

1. D
2. B
3. A
4. D
5. C
6. B
7. C
8. C
9. B
10. A
11. D
12. A

Solved Equations

1. If 50 pounds of chemical is added to 100 gallons, what would the strength of solution (SOS) be?

Find the weight of 100 gallons of water – $100 \times 8.34 \text{ lbs/gal} = 834 \text{ lbs}$

$$\text{SOS} = \frac{\text{Weight of chemical} \times 100}{\text{Weight of water} + \text{weight of Chemical}}$$

$$\text{SOS} = \frac{50}{834 + 50} = \frac{50}{884} = 0.0565 \times 100 = 5.65\%$$

2. If a facility treats 375,000 gallons of water a day and needs to meet a dosage specification of 3 mg/l, how many pounds of bleach at 5.25% will need to be added to the water?

$$\text{Pounds} = \frac{\text{Dosage (mg/l)} \times 8.34 \times \text{Flow, MGD}}{\% \text{purity}}$$

$$\text{Pounds} = \frac{3 \text{ mg/l} \times 8.34 \times 0.375 \text{ MGD}}{0.0525}$$

$$\text{Pounds} = \frac{9.38}{0.0525} = 178.71 \text{ pounds}$$

Solved Equations

3. If 25 milliliters a minute is added to over 18 hours to a flow of 150,000 gallons a day, how many gallons would be dispersed into the water?

First, find number of mls dispensed in 18 hours.

$$\text{Mls} = 25 \text{ ml} \times 1080 \text{ minutes in 18 hours} = 27,000 \text{ mls}$$

1 ml = 1 gram so,

$$27,000 \text{ mls} = 27,000 \text{ grams} / 453.6 \text{ gr/lb} = 59.52 \text{ lbs of chemical.}$$

$$59.52 \text{ lbs} / 8.34 \text{ lbs/gal} = 7.14 \text{ gallons}$$

4. How many gallons of 12% bleach would need to be added to a flow of 750,000 gallons per day to achieve a dosage of 1.7 mg/l. The chemical has a specific gravity of 1.2.

First calculate the pounds using the pounds formula,

$$\text{Pounds} = \frac{1.7 \text{ mg/l} \times 8.34 \times 0.75 \text{ MGD}}{0.12 (12\%)} = 88.61$$

Next calculate the weigh of a gallon of 12% bleach,

$$\text{Weight of one gallon} = 1.2 \times 8.34 = 10.01 \text{ lbs}$$

Now divide the pound of bleach needed by the weight of one gallon to get gallons

$$\text{Gallons} = 88.61 \text{ lbs} / 10.01 \text{ lbs/gallon} = 8.85 \text{ or } 9 \text{ gallons}$$

5. If water is flowing through an 10 inch pipe at 450 gpm. What is the velocity of the water?

Equation to solve: $V = Q/A$

$$A = .785 \times (10/12) \times (10/12) = 0.785 \times 0.83 \times 0.83 = 0.54 \text{ ft}^2$$

$$Q = 450 \text{ gpm} / 448.8 \text{ gpm/ft}^3 = 1.00 \text{ ft}^3/\text{sec}$$

$$V = \frac{1.00 \text{ ft}^3/\text{sec}}{0.54 \text{ ft}^2} = 1.85 \text{ ft/sec}$$

Solved Equations

6. A tank has a radius of 20 feet and is 35 feet deep. How many gallons of water will this tank hold when full.

Asking for volume of tank, Equation needed is

$$\text{Volume} = 0.785 \times \text{Dia}' \times \text{Dia}' \times \text{Depth}$$

To get diameter in feet, Diameter = 20 ft x 2 = 40 ft

$$\text{Volume (ft}^3\text{)} = .785 \times 40 \times 40 \times 35 = 43,960 \text{ ft}^3$$

$$\text{Gallons} = 43,960 \text{ ft}^3 \times 7.48 \text{ gal/ft}^3 = 328,820.8 \text{ gallons}$$

7. Water is traveling through a 16" line at 1.5 feet per second. What is the flow in that line?

Equation needed is, $Q = A \times V$

$$A = .785 \times (16/12) \times (16/12) = .785 \times 1.33 \times 1.33 = 1.39 \text{ ft}^2$$

$$Q = 1.39 \text{ ft}^2 \times 1.5 \text{ ft/sec} = 2.09 \text{ ft}^3/\text{sec}$$

8. If 128 fluid ounces are equivalent to 1 gallon and your facility produces 15,000 cases of 24, 16 ounce bottles a day, how many gallons of water are you producing per day?

First calculate total ounces produced in a day:

$$\text{Ounces} = 15,000 \text{ cases} \times 24 \text{ bottles/cs} \times 16 \text{ ounces/btl} = 5,760,000 \text{ oz}$$

$$\text{Change ounces to gallons: } 5,760,000 \text{ oz} / 128 \text{ oz/gal} = 45,000 \text{ gallons}$$

Solved Equations

9. You are told to cut production by 40% due to a problem in the bottling area. If your pump is currently running at 150 strokes per minute, how many strokes a minute must you run your pump to allow bottling to keep up?

First calculate 40% of current pump rate:

$$150 \text{ strokes/min} \times 0.40 \text{ (40\% in decimal)} = 60 \text{ strokes/min}$$

Now, subtract the 40% stroke rate from the current pumping rate to get new pump rate:

$$150 \text{ strokes/min} - 40 \text{ stroke/mins} = 110 \text{ strokes /min}$$

10. You need to deliver 900GPM while overcoming 45 feet of head in your plant. How many WHP (water horsepower) is needed to accomplish this?

$$\text{WHP} = \frac{\text{GPM} \times \text{Total Head (FT)}}{3960}$$

$$\text{WHP} = \frac{900 \text{ gpm} \times 45 \text{ ft}}{3960} = \frac{40,500}{3960} = 10.22$$

11. A chemical has a specific gravity of 1.9. How much would one gallon of this chemical weigh?

Equivalent weight of a liquid = specific gravity X weight of same volume of water

$$\text{Eq. Weight of liquid} = 1.9 \times 8.34 = 15.85 \text{ lbs/gal}$$

Solved Equations

12. You currently add 0.05 mg/l disinfectant to your flow of 400,000 gallons per day. You need to increase the residual to 0.3 mg/l. How many pounds additional disinfectant must you add each hour?

Current amount added = 0.05 mg/l. Desired amount is 0.3 mg/l. First, find the difference from desired conc - current conc.

$$\text{Increase in dosage} = 0.3 \text{ mg/l} - 0.05 \text{ mg/l} = 0.25 \text{ mg/l}$$

$$\text{lbs additional /day} = 0.25 \text{ mg/l} \times 8.34 \times 0.40 \text{ MGD} = 0.83 \text{ lbs/day}$$

$$\text{lbs additional /hour} = 0.83 / 24 \text{ hours/day} = 0.035 \text{ lbs per hour}$$



Questions or Concerns?

The Kentucky Operator Certification Program provides training and issues certifications to ensure that individuals engaged in performing many of Kentucky's critical environmental activities are qualified and capable to perform their duties. DCA staff are available to provide on-site assistance and training.

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