Basic Math Explanations

Conversions

1. **A Large storage tank has a volume of 25 cu. Ft. How many gallons of water can this tank hold when full?**

Step 1 - Starting Material

25 cu. ft. ***(information in question)***

? gal. ***(answer unit)***

1 cu. ft. = 7.48 gal. ***(found on "conversion table")***

Step 2 – conversion

$$\frac{\textbf{25 cu. ft.}}{\textbf{1}} \qquad \frac{\textbf{7.48 gal}}{\textbf{1 cu. ft.}}$$

1. Start with the piece of information that has a single unit and write it over 1.

$$\frac{25 \text{ cu. ft.}}{1}$$

2. On the second line we will start with the unit that we want to cancel (cu. ft.) on bottom.

$$\frac{25 \text{ cu. ft.}}{1} \qquad \frac{\qquad}{\text{cu. ft.}}$$

3. Fill in with equivalency using the line as an "equal sign".

$$\frac{25 \text{ ~~cu. ft.~~}}{1} \qquad \frac{7.48 \text{ gal}}{1 \text{ ~~cu. ft.~~}}$$

4. Check that your answer unit is on top at the end.

$$\frac{25 \text{ cu. ft.}}{1} \qquad \frac{7.48 \text{ gal}}{1 \text{ cu. ft.}}$$

Step 3 – Calculation

25 x 7.48 = ?

Start with the first number. Multiply by numbers on top. Divide by numbers on bottom.

187 Gallons

2. **A water tower that is 15.4 yards tall shows a pressure of how many psi at the bottom?**

Step 1 - Starting Material

15.4 yd *(information in question)*

? psi *(answer unit)*

1 psi = 2.31 ft *(found on "conversion table")*

1 yd = 3 ft *(known equivalency)*

Step 2 – conversion

$$\frac{\textbf{15.4 yd}}{\textbf{1}} \quad \frac{\textbf{3 ft}}{\textbf{1 yd}} \quad \frac{\textbf{1 psi}}{\textbf{2.31 ft}}$$

1. Start with the piece of information that has a single unit and write it over 1.

$$\frac{15.4\ \text{yd}}{1}$$

2. On the second line we will start with the unit that we want to cancel (yd) on bottom.

$$\frac{15.4\ \text{yd}}{1} \quad \frac{\quad}{\text{yd}}$$

3. Fill in with equivalency using the line as an "equal sign".

$$\frac{15.4\ \cancel{\text{yd}}}{1} \quad \frac{3\ \text{ft}}{1\ \cancel{\text{yd}}}$$

4. Repeat #1 and #2

$$\frac{15.4\ \cancel{\text{yd}}}{1} \quad \frac{3\ \cancel{\text{ft}}}{1\ \cancel{\text{yd}}} \quad \frac{1\ \text{psi}}{2.31\ \cancel{\text{ft}}}$$

5. Check that your answer unit is on top at the end.

$$\frac{15.4\ \cancel{\text{yd}}}{1} \quad \frac{3\ \cancel{\text{ft}}}{1\ \cancel{\text{yd}}} \quad \frac{1\ \text{psi}}{2.31\ \cancel{\text{ft}}}$$

Step 3 – Calculation

15.4 x 3 ÷ 2.31 = ?

Start with the first number. Multiply by numbers on top. Divide by numbers on bottom.

20 psi

3. **A residential water softener holds 1 cubic foot of resin with a hardness removal capacity of 30,000 grains per cubic foot. The water being treated contains 15 gpg total hardness. The household uses 250 gallons per day. How many days can this softener run before total exhaustion?**

Step 1 - Starting Material

1 cu. ft. *(information in question)*

30,000 gr per cu. ft. *(convert to equivalency)* **30,000 gr = 1 cu. ft.**

15 gr per gal *(convert to equivalency)* **15 gr = 1 gal**

250 gal per day *(convert to equivalency)* **250 gal = 1 day**

? day *(answer unit)*

Step 2 – conversion

1 cu. ft.	30,000 gr	1 gal	1 day
1	1 cu. ft.	15 gr	250 gal

1. Start with the piece of information that has a single unit and write it over 1.

$$\frac{1 \text{ cu. ft.}}{1}$$

2. On the second line we will start with the unit that we want to cancel (cu. ft.) on bottom.

$$\frac{1 \text{ cu. ft.}}{1} \quad \frac{\quad}{\text{cu. ft.}}$$

3. Fill in with equivalency using the line as an "equal sign".

$$\frac{1 \text{ cu. ft.}}{1} \quad \frac{30{,}000 \text{ gr}}{1 \text{ cu. ft.}}$$

4. Repeat #1 and #2 for all conversions

$$\frac{1 \text{ cu. ft.}}{1} \quad \frac{30{,}000 \text{ gr}}{1 \text{ cu. ft.}} \quad \frac{1 \text{ gal}}{15 \text{ gr}} \quad \frac{1 \text{ day}}{250 \text{ gal}}$$

5. Check that your answer unit is on top at the end.

$$\frac{1 \text{ cu. ft.}}{1} \quad \frac{30{,}000 \text{ gr}}{1 \text{ cu. ft.}} \quad \frac{1 \text{ gal}}{15 \text{ gr}} \quad \frac{1 \text{ day}}{250 \text{ gal}}$$

Step 3 – Calculation

1 x 30,000 ÷ 15 ÷ 250 = ?

Start with the first number. Multiply by numbers on top. Divide by numbers on bottom.

8 days

4. **A commercial softener holds 50 cubic feet of resin with a hardness removal capacity of 30,000 grains per cubic foot. The water being treated contains 25 gpg total hardness. How many gallons of water can be treated before the exchange capacity is exhausted?**

Step 1 - Starting Material

50 cu. ft. ***(information in question)***

30,000 gr per cu. ft. ***(convert to equivalency)*** **30,000 gr = 1 cu. ft.**

25 gr per gal ***(convert to equivalency)*** **25 gr = 1 gal**

? gal ***(answer unit)***

Step 2 – conversion

$$\frac{\text{50 cu. ft.}}{1}\ \frac{\text{30,000 gr}}{\text{1 cu. ft.}}\ \frac{\text{1 gal}}{\text{25 gr}}$$

1. Start with the piece of information that has a single unit and write it over 1.

$$\frac{\text{50 cu. ft.}}{1}$$

2. On the second line we will start with the unit that we want to cancel (cu. ft.) on bottom.

$$\frac{\text{50 cu. ft.}}{1}\ \frac{\quad}{\text{cu. ft.}}$$

3. Fill in with equivalency using the line as an "equal sign".

$$\frac{\text{50 cu. ft.}}{1}\ \frac{\text{30,000 gr}}{1\ \cancel{\text{cu. ft.}}}$$

4. Repeat #1 and #2 for all conversions

$$\frac{\text{50 cu. ft.}}{1}\ \frac{\text{30,000 }\cancel{\text{gr}}}{1\ \cancel{\text{cu. ft.}}}\ \frac{\text{1 gal}}{\text{25 }\cancel{\text{gr}}}$$

5. Check that your answer unit is on top at the end.

$$\frac{\text{50 cu. ft.}}{1}\ \frac{\text{30,000 }\cancel{\text{gr}}}{1\ \cancel{\text{cu. ft.}}}\ \frac{\text{1 gal}}{\text{25 }\cancel{\text{gr}}}$$

Step 3 – Calculation

1 x 30,000 ÷ 25 = ?

Start with the first number. Multiply by numbers on top. Divide by numbers on bottom.

60,000 gal

Math Strategies

4-Step Process for Word Problems:

1. **Write down given numbers with units.**
2. **Write down the correct formula.**
3. **Fill numbers into formula.**
4. **Calculate and convert to correct units.**

Disinfection formulas use million gallons (MG):

- **Move decimal 6 places to the left from gallons value**
  - **150,000 gallons ➔ 0.15 MG**

Change chlorine percentage to a decimal:

- **Move decimal 2 places to the left from percent value**
  - **15% ➔ 0.15**
  - **5% ➔ 0.05**

ALWAYS change to feet, NEVER leave in inches!

Volume

1. **A rectangular tank is 2 ft tall, 2 ft wide, and 4 ft long. How many gallons of water can this tank hold when full?**

Step 1 - Starting Material

Height = 2 ft *(information in question)*

Width = 2 ft *(information in question)*

Length = 4 ft *(information in question)*

? gal *(answer unit)*

Step 2 – Write down the formula.

Volume = Length x Width x Height

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

? = 2 ft x 2 ft x 4 ft

Step 4 – Calculate and convert.

2 ft x 2 ft x 4 ft = 16 cu. ft.

Make sure that your answer is in the unit that the question asked for.

16 x 7.48 = 120 gal

2. **A rectangular tank is 96 in. tall, 36 in. wide, and 48 in. long. How many gallons of water can this tank hold when full?**

Step 1 - Starting Material

Height = 96 in *(information in question, ALWAYS convert to feet)* ***8 ft***

Width = 36 in *(information in question, ALWAYS convert to feet)* **3 ft**

Length = 48 in *(information in question, ALWAYS convert to feet)* ***4 ft***

? gal *(answer unit)*

Step 2 – Write down the formula.

Volume = Length x Width x Height

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

? = 4 ft x 3 ft x 8 ft

Step 4 – Calculate and convert.

4 ft x 3 ft x 8 ft = 96 cu. ft.

Make sure that your answer is in the unit that the question asked for.

96 x 7.48 = 718 gal

3. **A cylindrical tank is 2 ft. in diameter and 4 ft. to the overflow. How many gallons of water can this tank hold when full?**

Step 1 - Starting Material

Diameter = 2 ft ***(information in question)***

Radius = 1 ft ***(radius is half the diameter)***

Height = 4 ft ***(information in question,)***

? gal ***(answer unit)***

Step 2 – Write down the formula.

Volume = π r^2 x height

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

Volume = 3.14 x 1 ft x 1 ft x 4 ft

r^2 = r x r

Step 4 – Calculate and convert.

3.14 x 1 ft x 1 ft x 4 ft = 12.56 cu. ft.

Make sure that your answer is in the unit that the question asked for.

12.56 x 7.48 = 93.9 gal

4. **A cylindrical tank is 36 in. in diameter and 72 in. to the overflow. How many gallons of water can this tank hold when full?**

Step 1 - Starting Material

Diameter = 36 in *(information in question, ALWAYS convert to feet)* ***3 ft***

Radius = 1.5 ft *(radius is half the diameter)*

Height = 72 in *(information in question, ALWAYS convert to feet)* ***6 ft***

? gal *(answer unit)*

Step 2 – Write down the formula.

Volume = π r^2 x height

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

Volume = 3.14 x 1.5 ft x 1.5 ft x 6 ft

r^2 = r x r

Step 4 – Calculate and convert.

3.14 x 1.5 ft x 1.5 ft x 6 ft = 42.4 cu. ft.

Make sure that your answer is in the unit that the question asked for.

42.4 x 7.48 = 317 gal

5. A 6 in water main is 50 ft. long. How many cubic feet of water can this pipe hold when full?

Step 1 - Starting Material

Diameter = 6 in *(information in question, ALWAYS convert to feet)* ***0.5 ft***

Radius = 0.25 ft *(radius is half the diameter)*

Length = 50 ft *(information in question)*

? cu. ft. *(answer unit)*

Step 2 – Write down the formula.

Volume = π r^2 x length

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

Volume = 3.14 x 0.25 ft x 0.25 ft x 50 ft

r^2 = r x r

Step 4 – Calculate and convert.

3.14 x 0.25 ft x 0.25 ft x 50 ft = 9.8 cu. ft.

Make sure that your answer is in the unit that the question asked for.

Disinfection 1

1. **Determine the chlorine dosage needed to achieve a 0.7 mg/l residual in a system with a demand of 9.3 mg/l.**

Step 1 - Starting Material

Residual = 0.7 mg/l *(information in question)*

Demand =9.3 mg/l *(information in question)*

Dosage = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage = Demand + Residual

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

Dosage = 9.3 mg/l + 0.7 mg/l

Step 4 – Calculate

9.3 mg/l + 0.7 mg/l = <u>10 mg/l</u>

2. **Determine the chlorine dosage needed to achieve a 3.5 mg/l residual in a system with a demand of 8.0 mg/l.**

Step 1 - Starting Material

Residual = 3.5 mg/l *(information in question)*

Demand =8.0 mg/l *(information in question)*

Dosage = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage = Demand + Residual

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

Dosage = 8.0 mg/l + 3.5 mg/l

Step 4 – Calculate

8.0 mg/l + 3.5 mg/l = <u>11.5 mg/l</u>

3. **Determine the demand if a residual of 0.5 mg/l is sustained in a system after dosing 3.2 mg/l chlorine.**

Step 1 - Starting Material

Residual = 0.5 mg/l *(information in question)*

Dosage = 3.2 mg/l *(information in question)*

Demand = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage = Demand + Residual

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

3.2 mg/l = Demand + 0.5 mg/l

Unknown value must be by itself. Move and term next to it to the other side of the "=" and change to the opposite operation (+/--) (x/÷)

Demand = 3.2 mg/l – 0.5 mg/l

Step 4 – Calculate

3.2 mg/l - 0.5 mg/l = <u>2.7 mg/l</u>

4. **Determine the demand if a residual of 0.8 mg/l is sustained in a system after dosing 9.6 mg/l chlorine.**

Step 1 - Starting Material

Residual = 0.8 mg/l *(information in question)*

Dosage = 9.6 mg/l *(information in question)*

Demand = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage = Demand + Residual

Found on the "Conversion Table". Write entire formula.

Step 3 – Fill numbers into the formula.

9.6 mg/l = Demand + 0.8 mg/l

Unknown value must be by itself. Move and term next to it to the other side of the "=" and change to the opposite operation (+/--) (x/÷)

Demand = 9.6 mg/l – 0.8 mg/l

Step 4 – Calculate

9.6 mg/l - 0.8 mg/l = <u>8.8 mg/l</u>

5.

Disinfection 2

1. **Determine how much 100% chlorine must be added to 350,000 gallons of water to produce a 2.5 mg/l dosage.**

Step 1 - Starting Material

350,000 gal *(information in question)*

➔MG = 0.35 *(move decimal to the left 6 places)*

Dosage = 2.5 mg/l *(Information in question)*

Lbs. = ? *(chlorine is measured in pounds)*

Step 2 – Write down the formula.

(MG) (mg/l) (8.34) = lbs.

(mg/l refers to dosage) (lbs. refers to pure chlorine)

Step 3 – Fill numbers into the formula.

(0.35) (2.5) (8.34) = Lbs.

Parenesis indicate numbers should be multiplied.

Step 4 – Calculate

0.35 x 2.5 x 8.34 = <u>7.3 Lbs. pure chlorine</u>

2. **Determine how much 100% chlorine must be added to 1,250,000 gallons of water to produce a 5.8 mg/l dosage.**

Step 1 - Starting Material

1,250,000 gal *(information in question)*

➔**MG = 1.25** *(move decimal to the left 6 places)*

Dosage = 5.8 mg/l *(Information in question)*

Lbs. = ? *(chlorine is measured in pounds)*

Step 2 – Write down the formula.

(MG) (mg/l) (8.34) = lbs.

(mg/l refers to dosage) (lbs. refers to pure chlorine)

Step 3 – Fill numbers into the formula.

(1.25) (5.8) (8.34) = Lbs.

Parenesis indicate numbers should be multiplied.

Step 4 – Calculate

1.25 x 5.8 x 8.34 = 60.5 Lbs. pure chlorine

3. **Determine how much 100% chlorine must be added to 15,000 gallons of water to produce a 2.0 mg/l dosage.**

Step 1 - Starting Material

15,000 gal *(information in question)*

➔MG = 0.015 *(move decimal to the left 6 places)*

Dosage = 2.0 mg/l *(Information in question)*

Lbs. = ? *(chlorine is measured in pounds)*

Step 2 – Write down the formula.

(MG) (mg/l) (8.34) = lbs.

(mg/l refers to dosage) (lbs. refers to pure chlorine)

Step 3 – Fill numbers into the formula.

(0.015) (2.0) (8.34) = Lbs.

Parenesis indicate numbers should be multiplied.

Step 4 – Calculate

0.015 x 2.0 x 8.34 = <u>0.25 Lbs. pure chlorine</u>

Disinfection 3

1. **How many pounds of 5% bleach are needed to equal 25 pounds of 100% chlorine?**

Step 1 - Starting Material

5% chlorine *(information in question)*

➔**Chlorine strength = 0.05** *(move decimal to the left 2 places)*

Pure chlorine = 25 lbs. *(Information in question, 100% chlorine is pure)*

Compound chlorine = ? *(compound is less than 100%)*

Step 2 – Write down the formula.

Lbs. of compound = Lbs. pure chlorine divided by % chlorine

(chlorine strength must be a decimal)

Step 3 – Fill numbers into the formula.

Lbs. of compound = 25 lbs. ÷ 0.05

Step 4 – Calculate

25 ÷ 0.05 = <u>500 Lbs. bleach</u>

(there is ALWAYS more compound than pure)

2. **How many pounds of 65% calcium hypochlorite are needed to equal 10 pounds of 100% chlorine?**

Step 1 - Starting Material

65% chlorine *(information in question)*

➔Chlorine strength = 0.65 *(move decimal to the left 2 places)*

Pure chlorine = 10 lbs. *(Information in question, 100% chlorine is pure)*

Compound chlorine = ? *(compound is less than 100%)*

Step 2 – Write down the formula.

Lbs. of compound = Lbs. pure chlorine divided by % chlorine

(chlorine strength must be a decimal)

Step 3 – Fill numbers into the formula.

Lbs. of compound = 10 lbs. ÷ 0.65

Step 4 – Calculate

10 ÷ 0.65 = <u>15.4 Lbs. Calcium Hypochlorite</u>

(there is ALWAYS more compound than pure)

3. **How many pounds of 100% chlorine are needed to equal 50 pounds of 15% bleach?**

Step 1 - Starting Material

15% chlorine *(information in question)*

➔**Chlorine strength = 0.15** *(move decimal to the left 2 places)*

Compound chlorine = 50 lbs.*(Information in question, compound is less than 100%)*

Pure chlorine = ? *(100% chlorine is pure)*

Step 2 – Write down the formula.

Lbs. of compound = Lbs. pure chlorine divided by % chlorine

(chlorine strength must be a decimal)

Step 3 – Fill numbers into the formula.

50 lbs. =Lbs. pure chlorine ÷ 0.15

Unknown value must be by itself. Move and term next to it to the other side of the "=" and change to the opposite operation (+/--) (x/÷)

Lbs. pure chlorine = 50 lbs. x 0.15

Step 4 – Calculate

50 x 0.15 = <u>7.5 Lbs. pure chlorine</u>

(there is ALWAYS more compound than pure)

4. **How many pounds of 100% chlorine are needed to equal 63 pounds of 85% calcium hypochlorite?**

Step 1 - Starting Material

85% chlorine *(information in question)*

➔**Chlorine strength = 0.85** *(move decimal to the left 2 places)*

Compound chlorine = 63 lbs.*(Information in question, compound is less than 100%)*

Pure chlorine = ? *(100% chlorine is pure)*

Step 2 – Write down the formula.

Lbs. of compound = Lbs. pure chlorine divided by % chlorine

(chlorine strength must be a decimal)

Step 3 – Fill numbers into the formula.

63 lbs. =Lbs. pure chlorine ÷ 0.85

Unknown value must be by itself. Move and term next to it to the other side of the "=" and change to the opposite operation (+/--) (x/÷)

Lbs. pure chlorine = 63 lbs. x 0.85

Step 4 – Calculate

63 x 0.85 = 53.6 Lbs. pure chlorine

(there is ALWAYS more compound than pure)

Disinfection 4

1. **Determine the dosage when you add 20 pounds of pure chlorine to a storage tank that holds 12,000 gallons of water.**

Step 1 - Starting Material

Pure chlorine = 20 lbs. *(information in question)*

12,000 gal *(information in question)*

➔MG = 0.012 *(move decimal to the left 6 places)*

Dosage = ? *(what you are looking for)*

Step 2 – Write down the formula.

$$\text{Dosage in mg/l} = \frac{\text{Lbs. chemical}}{\text{MGD} \times 8.34}$$

(MGD is the same as MG, Lbs. chemical is PURE chlorine)

Step 3 – Fill numbers into the formula.

$$\text{Dosage in mg/l} = \frac{20 \text{ lbs.}}{0.012 \times 8.34}$$

Step 4 – Calculate

$$\text{Dosage in mg/l} = \frac{20 \text{ lbs.}}{0.1}$$

You must do what is on bottom first. Write down & clear Calculator

20 ÷ 0.1 = 200 mg/l dosage

2. **Determine the dosage when you add 100 pounds of pure chlorine to a storage tank that holds 24,000,000 gallons of water.**

Step 1 - Starting Material

Pure chlorine = 100 lbs. *(information in question)*

24,000,000 gal *(information in question)*

➔MG = 24 *(move decimal to the left 6 places)*

Dosage = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage in mg/l = Lbs. chemical

MGD x 8.34

(MGD is the same as MG, Lbs. chemical is PURE chlorine)

Step 3 – Fill numbers into the formula.

Dosage in mg/l = 100 lbs.

24 x 8.34

Step 4 – Calculate

Dosage in mg/l = 100 lbs.

200.16

You must do what is on bottom first. Write down & clear Calculator

100 ÷ 200.16 = 0.5 mg/l dosage

3. **Determine the dosage when you add 27 pounds of pure chlorine to a storage tank that holds 360,000 gallons of water.**

Step 1 - Starting Material

Pure chlorine = 27 lbs. *(information in question)*

360,000 gal *(information in question)*

➔MG = 0.36 *(move decimal to the left 6 places)*

Dosage = ? *(what you are looking for)*

Step 2 – Write down the formula.

Dosage in mg/l = Lbs. chemical

MGD x 8.34

(MGD is the same as MG, Lbs. chemical is PURE chlorine)

Step 3 – Fill numbers into the formula.

Dosage in mg/l = 27 lbs.

0.36 x 8.34

Step 4 – Calculate

Dosage in mg/l = 27 lbs.

3

You must do what is on bottom first. Write down & clear Calculator

27 ÷ 3 = 9 mg/l dosage