The drinking water in a community has detected lead in its drinking water at a level of 2.5 ppb. The EPA’s MCL is set at 15 ppb. Express the difference between these two values as a ratio strength.

\[
\frac{15 \text{ ppb} - 2.5 \text{ ppb}}{12.5 \text{ ppb}} = \frac{12.5}{1,000,000,000} = \frac{1}{80,000,000}, \text{ answer.}
\]

**PRACTICE PROBLEMS**

**Weight-in-Volume Calculations**

1. **R** Antipyrine 5%  
   Glycerin ad 60  
   Sig: Five drops in right ear.  
   How many grams of antipyrine should be used in preparing the prescription?

2. **R** Ofloxacin Ophthalmic Solution 0.3%  
   Disp. 10 mL  
   Sig: 2 drops into eyes q 4 hours × 2 days; then 2 drops q 6 hours × 4 days.  
   A pharmacist filled the prescription with OCUFLOX. How many milligrams of ofloxacin are contained in the dispensed prescription?

3. **R** Dexamethasone Sodium Phosphate 100 mg  
   Sterile Water for Injection ad 100 mL  
   Sig: 2 drops into eyes q 4 hours × 2 days; then 2 drops q 6 hours × 4 days.  
   Calculate the percent strength of dexamethasone sodium phosphate in the prescription.

4. If 100 mL of a pharmaceutical preparation contains 20 μL of a 50% w/v solution of benzalkonium chloride, what is the percentage strength of that agent in the solution?

5. A tissue plasminogen activator (TPA) ophthalmic solution is prepared to contain 25 μg/100 μL.  
   (a) Calculate the percentage concentration of TPA in the solution.

(b) What volume of a solution containing TPA, 50 mg/50 mL, should be used to prepare each 100 μL of the ophthalmic solution?

6. How many milligrams of methylparaben are needed to prepare 8 fluidounces of a solution containing 0.12% (w/v) of methylparaben?

7. If a pharmacist dissolved the contents of eight capsules, each containing 300 mg of clindamycin phosphate, into a sufficient amount of an astringent liquid base to prepare 60 mL of topical solution, what would be the percentage strength (w/v) of clindamycin phosphate in the prescription?

8. **R** ACULAR (ketorolac tromethamine)  
   Ophthalmic Solution 0.5%  
   Disp. 5 mL  
   Sig: One drop q.i.d. prn allergic conjunctivitis  
   How many milligrams of the active constituent would be present in each drop of the ophthalmic solution if the dropper service delivers 20 drops per milliliter?  
   (a) 0.25 mg  
   (b) 25 mg  
   (c) 0.025 mg  
   (d) 1.25 mg

9. A formula for an antifungal shampoo contains 2% w/v ketoconazole. How many grams of ketoconazole would be needed to prepare 25 liters of the shampoo?
10. The biotechnology drug interferon gamma-1b (ACTIMMUNE) contains 100 mcg/0.5 mL. Calculate the percentage strength of the solution.

11. NEUPOGEN (filgrastim) prefilled syringes contain 480 mcg of active constituent in each 0.8 mL. The equivalent concentration is:
   (a) 0.6%
   (b) 0.384 mg/mL
   (c) 0.06%
   (d) 0.6 g/mL

12. LEVAQUIN (levofloxacin) injection contains 5 mg/mL of levofloxacin and 5% of dextrose. How much of each would be delivered to a patient upon the administration of a 100-mL injection?
   (a) 5 g levofloxacin and 5 g dextrose
   (b) 50 mg levofloxacin and 5 g dextrose
   (c) 500 mg levofloxacin and 500 mg dextrose
   (d) 0.5 g levofloxacin and 5 g dextrose

13. An ear drop formula contains 54 mg of antipyrine and 14 mg of benzocaine in each milliliter of solution. Calculate the percentage strength (w/v) of each ingredient in the formula.

14. An injection of adalimumab (HUMIRA) contains 40 mg/0.8 mL. Calculate the percentage concentration of the injection.

15. Erythromycin Lactobionate 500 mg
    Dexamethasone Sodium Phosphate 100 mg
    Glycerin 2.5 mL
    Sterile Water for Injection ad 100 mL

   (a) What is the percentage strength of erythromycin lactobionate in the prescription?
   (b) If glycerin has a specific gravity of 1.25, what is its concentration (w/v) in the prescription?

16. How many milliliters of a 0.9% (w/v) solution of sodium chloride can be prepared from 50 tablets, each containing 2.25 g of sodium chloride?

17. If an intravenous injection contains 20% (w/v) of mannitol, how many milliliters of the injection should be administered to provide a patient with 100 g of mannitol?

18. A prefilled syringe contains 50 mg of lidocaine hydrochloride per 5 mL of injection. Express the percentage concentration of lidocaine hydrochloride in the injection.

19. A blood volume expansion solution contains 6% (w/v) of hetastarch and 0.9% (w/v) of sodium chloride. How many grams of each agent would be present in 250 mL of the solution?

20. A pharmacist adds 10 mL of a 20% (w/v) solution of a drug to 500 mL of D5W for parenteral infusion. What is the percentage strength of the drug in the infusion solution?
   (a) 2% v/v
   (b) 2% w/v
   (c) 1.96% w/v
   (d) 0.39% w/v

21. Calculate the percentage strength of an injection that contains 2 mg of hydromorphone hydrochloride in each milliliter of injection.

22. VIRAMUNE Oral Suspension contains 1% w/v of nevirapine. Calculate the milligrams of nevirapine present in a 240 mL bottle of the suspension.

23. Misoprostol 200-μg tablets 12 tablets
    Lidocaine Hydrochloride 1 g
    Glycerin qs ad 100 mL

   Calculate the strength of misoprostol in the prescription.
   (a) 2.4% w/v misoprostol
   (b) 0.0002% w/v misoprostol
   (c) 0.024 mg/mL misoprostol
   (d) 2.4 mcg/mL misoprostol
24. Fentanyl Citrate 20 µg/mL Bupivacaine Hydrochloride 0.125 % Sodium Chloride (0.9%) Injection ad 100 mL
Calculate the percentage concentration of fentanyl citrate in the prescription.

25. ATROVENT Nasal Spray contains 0.03% of ipratropium bromide in a 30-mL metered dose container. If the container is calibrated to deliver 345 sprays, calculate the volume of each spray, in microliters, and the medication content of each spray, in micrograms.

26. If 100 mL of a solution for patient-controlled anesthesia contains 200 mg of morphine sulfate and 8 mg of droperidol, calculate the percentage strength of each of these ingredients in the solution.

27. Oxycodone hydrochloride oral concentrate solution (OXYFAST) contains 20 mg/1 mL. If a dose of 0.75 mL is added to 30 mL of juice prior to administration, calculate (a) the milligrams of oxycodone hydrochloride administered, and (b) the percentage concentration (w/v) of oxycodone hydrochloride in the drink.

28. A morphine sulfate extended-release liposome injection (DEPODUR) contains morphine sulfate 10 mg/mL of injection. Calculate the percentage strength of morphine sulfate in the injection.

29. A topical solution contains 3% w/v hydroquinone. How many liters of the solution can be prepared from 30 g of hydroquinone?

Volume-in-Volume Calculations

30. What is the percentage strength (v/v) if 225 g of a liquid having a specific gravity of 0.8 is added to enough water to make 1.5 liters of the solution?

31. How many liters of a mouthwash can be prepared from 100 mL of cinnamon flavor if its concentration is to be 0.5% (v/v)?

32. A lotion vehicle contains 15% (v/v) of glycerin. How much glycerin should be used in preparing 5 gallons of the lotion?
(a) 2271 g glycerin
(b) 3339.7 mL glycerin
(c) 2671.8 g glycerin
(d) 3548.4 g glycerin

33. The formula for 1 liter of an elixir contains 0.25 mL of a flavoring oil. What is the percentage (v/v) of the flavoring oil in the elixir?

34. A dermatologic lotion contains 1.25 mL of liquefied phenol in 500 mL. Calculate the percentage (v/v) of liquefied phenol in the lotion.

Weight-in-Weight Calculations

35. How many grams of sucrose must be added to 475 mL of water to make a 65% (w/w) solution?

36. How many grams of a drug substance should be added to 1800 mL of water to make a 10% (w/w) solution?

37. What is the percentage strength (w/w) of a solution made by dissolving 62.5 g of potassium chloride in 187.5 mL of water?

38. If 500 g of dextrose are dissolved in 600 mL of water with a resultant final volume of 1 liter, what is the percentage strength of dextrose in the solution on a w/w basis?

39. Hydromorphone hydrochloride suppositories contain 3 mg of active ingredient and weigh approximately 2 grams each. What is the equivalent percentage strength?
(a) 1.5%
(b) 0.15%
(c) 0.015%
(d) none of the above

40. A metronidazole vaginal gel contains 0.75% of drug in 70-g tubes. An applicator will hold 5 g of gel for each administration. How much drug will be contained in each application?
(a) 0.0375 mg metronidazole
(b) 3.75 mg metronidazole
(c) 37.5 mg metronidazole
(d) 375 mg metronidazole

41. \( \text{ZOVIRAX (acyclovir) 5\% Cream} \)
\( \text{Lidocaine 4\% Cream aa. 15g} \)

The percent of acyclovir and quantity of lidocaine in the filled prescription are:
(a) 3.75% acyclovir, 0.3 g lidocaine
(b) 5% acyclovir, 1.2 g lidocaine
(c) 2.5% acyclovir, 0.6 g lidocaine
(d) 2.5% acyclovir, 1.2 g lidocaine

42. How many grams of hydrocortisone should be used in preparing 120 suppositories, each weighing 2 g and containing 1% of hydrocortisone?

43. If a topical cream contains 1.8% (w/w) of hydrocortisone, which of the following strengths is equivalent?
(a) 2.7 mg hydrocortisone in 15 g of cream
(b) 27 mg hydrocortisone in 15 g of cream
(c) 0.54 g hydrocortisone in 30 g of cream
(d) 54 mg hydrocortisone in 30 g of cream

44. \( \text{Benzoin Tincture} \)
\( \text{18 mL} \)
\( \text{Peru Balsam} \)
\( \text{10 g} \)
\( \text{Cold Cream} \)
\( \text{70 g} \)

Sig: cold sore ointment

If benzoin tincture has a specific gravity of 0.88, calculate its percentage strength (w/w) in the mixture.
(a) 1.26% w/w
(b) 25.7% w/w
(c) 22.5% w/w
(d) 16.5% w/w

45. Alclometasone dipropionate (ACLOVATE) ointment contains 0.05% w/w of the drug in 15-g and 45-g tubes. Calculate the difference in the quantity of drug between the two tube sizes.

46. How many grams of azelaic acid (FINACEA) are contained in 30-g tubes of the 15% w/w ointment?

47. Tretinoin gel (RETIN-A MICRO) is available in two strengths: 0.1% w/w and 0.04% w/w. Which of these represents equivalent concentrations of the two strengths?
(a) 15 mg/15 g and 30 mg/30 g
(b) 5 mg/5 g and 0.06 g/15 g
(c) 15 mg/15 g and 60 mg/15 g
(d) 30 mg/30 g and 6 mg/15 g

Mixed Percent Calculations

48. \( \text{Progesterone, micronized} \)
\( \text{4 g} \)
\( \text{Glycerin} \)
\( \text{5 mL} \)

\( \text{Methylcellulose (1\%) Solution} \)
\( \text{50 mL} \)

\( \text{Cherry Syrup ad} \)
\( \text{100 mL} \)

(a) What is the percentage concentration (w/v) of progesterone in the prescription?
(b) What is the percentage concentration (w/v) of methylcellulose in the prescription?
(c) What is the percentage concentration (v/v and w/v) of glycerin (sp gr 1.25) in the prescription?

49. \( \text{Lactic Acid} \)
\( \text{4 g} \)
\( \text{Salicylic Acid} \)
\( \text{5 g} \)

\( \text{Trichloroacetic Acid} \)
\( \text{2 g} \)

\( \text{Flexible Collodion q.s. ad} \)
\( \text{100 g} \)

Sig: wart remover. Use as directed.

(a) Flexible collodion contains 20% w/w camphor and 30% w/w castor oil. How many grams of each would be contained in 30 g of the mixture?
(b) The specific gravity of castor oil is 0.955. How many milliliters of the oil are contained in 30 g of the mixture?
(c) If the specific gravity of the mixture is 0.781, what are the w/v concentrations of lactic acid, salicylic acid, and trichloroacetic acid in the mixture?
Ratio Strength Calculations

50. Express each of the following as a percentage strength:
   (a) 1:1500
   (b) 1:10,000
   (c) 1:250
   (d) 1:400
   (e) 1:3300
   (f) 1:4000

51. Express each of the following as a ratio strength:
   (a) 0.125%
   (b) 2.5%
   (c) 0.80%
   (d) 0.6%
   (e) 1/3%
   (f) 1/20%

52. Express each of the following concentrations as a ratio strength:
   (a) 2 mg of active ingredient in 2 mL of solution
   (b) 0.275 mg of active ingredient in 5 mL of solution
   (c) 2 g of active ingredient in 250 mL of solution
   (d) 1 mg of active ingredient in 0.5 mL of solution

53. A vaginal cream contains 0.01% (w/v) of dienestrol. Express this concentration as a ratio strength.

54. A doxycycline calcium syrup is preserved with 0.08% (w/v) of methylparaben, 0.02% (w/v) of propylparaben, and 0.10% (w/v) of sodium metabisulfite. Express these concentrations as ratio strengths.

55. An ophthalmic solution is preserved with 0.0008% (w/v) of an antibacterial. Express this concentration as a ratio strength.

56. An injection contains 0.50% (w/v) of lidocaine hydrochloride and 1:200,000 (w/v) of epinephrine. Express the concentration of lidocaine hydrochloride as a ratio strength and that of epinephrine as a percentage.

57. A sample of white petrolatum contains 10 mg of tocopherol per kilogram as a preservative. Express the amount of tocopherol as a ratio strength.

58. Calcium hydroxide topical solution contains 170 mg of calcium hydroxide per 100 mL at 15°C. Express this concentration as a ratio strength.

59. An assay for ergocalciferol calls for the dissolution of 0.5 mg of ergocalciferol with chloroform up to 5 mL, and the addition of 0.3 mL of acetic anhydride and 0.2 mL of sulfuric acid. Calculate the ratio strength of ergocalciferol in the mixture.

60. Potassium Permanganate

   Tablets 0.2 g
   Disp. #100
   Sig: two tablets in 4 pt of water and use as directed.

   Express the concentration, as a ratio strength, of the solution prepared according to the directions given in the prescription.

61. Hepatitis B virus vaccine inactivated is activated with 1:4000 (w/v) of formalin. Express this ratio strength as a percentage strength.

62. VERSED Injection contains 5 mg of midazolam per milliliter of injection. Calculate the ratio strength of midazolam in the injection.

63. If a liquid vitamin preparation contains 0.16 μg of vitamin B₁₂ per 5 mL, what is the ratio strength of the preparation?

64. A skin test for fire ant allergy involves the intradermal skin prick of 0.05 mL of a 1:1,000,000 (w/v) dilution of fire ant extract. How many micrograms of extract would be administered in this manner?

65. In acute hypersensitivity reactions, 0.5 mL of a 1:1000 (w/v) solution of epinephrine may be administered subcutaneously or intramuscularly. Calculate the milligrams of epinephrine given.
66. Tetracaine Hydrochloride \( \% \), 0.75%  
Epinephrine Hydrochloride \( 1:4000 \),  
Cocaine Hydrochloride \( 3\% \),  
Sodium Chloride, qs  
Sterile Water ad 30 mL  

How many milligrams each of tetracaine hydrochloride, epinephrine hydrochloride, and cocaine hydrochloride are needed to fill the prescription?

**Parts per Million Calculations**

67. Purified water contains not more than 10 ppm of total solids. Express this concentration as a percentage.

**Answers to "Case in Point" and Practice Problems**

**Case in Point 6.1**

(a) 58 g (weight of filled pycnometer) – 28 g (weight of filled pycnometer) = 30 g (weight of 25 mL of albumin solution);  
30 g ÷ 25 mL = 1.2, specific gravity of albumin solution, answer.  
(b) 2000 mL \( \times 0.05 \) (5%) = 100 g of albumin needed;  
\[
\frac{25 \text{ g}}{100 \text{ mL}} = \frac{100 \text{ g}}{x \text{ mL}}, \quad x = 400 \text{ mL},
\]
albumin solution needed, answer.  
(c) 400 mL \( \times 1.2 \) (specific gravity) = 480 g, albumin solution needed, answer.  
(d) 2000 mL (total solution) - 400 mL (albumin solution) = 1600 mL (0.9% sodium chloride solution);  
1600 mL \( \times 1.05 \) (specific gravity) = 1680 g (weight of 0.9% sodium chloride solution);  
1680 g + 480 g = 2160 g (total weight of the 2000 mL);  
2160 g ÷ 2000 mL = 1.08, specific gravity of the mixture, answer.

**Case in Point 6.2**

(a) 30 g \( \times 0.015 \) (1.5% w/w) = 0.45 g hydrocortisone needed, answer.  
(b) \[
\frac{0.1 \text{ g}}{1 \text{ mL}} = \frac{0.45 \text{ g}}{x \text{ mL}}, \quad x = 4.5 \text{ mL} \text{ hydrocortisone injection}, \text{ answer.}
\]
(c) 4.5 mL \( \times 1.5 \) (specific gravity) = 6.75 g (weight of hydrocortisone injection);  
30 g - 6.75 g = 23.25 g cold cream needed, answer.

**Practice Problems**

1. 3 g antipyrine  
2. 30 mg ofloxacin  
3. 0.1% w/v dexamethasone sodium phosphate  
4. 0.01% w/v benzalkonium chloride  
5. (a) 0.025% w/v TPA  
   (b) 0.025 mL  
6. 283.9 mg methylparaben  
7. 4% w/v clindamycin phosphate  
8. (a) 0.25 mg ketorolac tromethamine  
9. 500 g ketoconazole
10. 0.02% w/v interferon gamma-1b
11. (c) 0.06%
12. (d) 0.5 g levofloxacin and 5 g dextrose
13. (a) 5.4% w/v antipyrine
   (b) 1.4% w/v benzocaine
14. 5% w/v adalimumab
15. (a) 0.5% w/v erythromycin lactobionate
   (b) 3.125% w/v glyc erin
16. 12,500 mL
17. 500 mL
18. 1% w/v lidocaine hydrochloride
19. 15 g hetastarch
   2.25 g sodium chloride
20. (d) 0.39% w/v
21. 0.2% w/v hydromorphone
22. 2400 mg nevirapine
23. (c) 0.024 mg/mL misoprostol
24. 0.002% w/v fentanyl citrate
25. 86.96 µL/spray and 26.09 µg ipratropium
26. 0.2% w/v morphine sulfate and 0.008% w/v droperidol
27. (a) 15 mg oxycodone hydrochloride
   (b) 0.049% w/v oxycodone hydrochloride
28. 1% w/v morphine sulfate
29. 1 liter
30. 18.75% v/v
31. 20 liters
32. (d) 3548.4 g glycerin
33. 0.025% v/v flavoring oil
34. 0.25% v/v liquefied phenol
35. 882.14 g sucrose
36. 200 g
37. 25% w/w potassium chloride
38. 45.45% w/w dextrose
39. (b) 0.15%
40. (c) 37.5 mg metronidazole
41. (c) 2.5% acyclovir, 0.6 g lidocaine
42. 2.4 g hydrocortisone
43. (c) 0.54 g hydrocortisone in 30 g of cream
44. (d) 16.5% w/w
45. 15 mg alclometasone dipropionate
46. 4.5 g azelaic acid
47. (d) 30 mg/30 g and 6 mg/15 g
48. (a) 4% w/v progesterone
   (b) 0.5% w/v methylcellulose
   (c) 5% v/v and 6.25% w/v glyc erin
49. (a) 5.34 g camphor and 8.01 g castor oil
   (b) 8.39 mL castor oil
   (c) 3.12% w/v lactic acid, 3.91% w/v salicylic acid, and 1.56% w/v trichloroacetic acid
50. (a) 0.067%
   (b) 0.01%
   (c) 0.4 %
   (d) 0.25%
   (e) 0.03%
   (f) 0.025%
51. (a) 1:800
   (b) 1:40
   (c) 1:125
   (d) 1:166.67 or 1:167
   (e) 1:300
   (f) 1:2000
52. (a) 1:1000
   (b) 1:18,182
   (c) 1:125
   (d) 1:500
53. 1:10,000 w/v
54. 1:1250 w/v methylparaben
   1:5000 w/v propylparaben
   1:1000 w/v sodium metabisulfite
55. 1:125,000 w/v
56. 1:200 w/v lidocaine hydrochloride 0.0005% w/v epinephrine
57. 1:100,000 w/w tocopherol
58. 1:588 w/v calcium hydroxide
59. 1:11,000 w/v ergocalciferol
60. 1:4730 w/v potassium permanganate
61. 0.025% w/v formalin
62. 1:200 w/v midazolam
63. 1:31,250,000 w/v vitamin B₁₂
64. 0.05 μg fire ant extract
65. 0.5 mg epinephrine
66. 225 mg tetracaine hydrochloride 7.5 mg epinephrine hydrochloride 900 mg cocaine hydrochloride
67. 0.001% w/v
68. 115 g sodium fluoride
69. 9462.5 g nitrate ion
70. 10 μg proinsulin

REFERENCES