Specific Volume:

Sp. Volume= $\frac{\text{Volume of a substance}}{\text{Equal volume of water}}$

Q- Find the specific gravity and specific volume if 20 mL of glycerin weighs 25 g ?

Sp. Gravity

$$\frac{\text{Weight of the substance}}{\text{Weight water}} = \frac{\textbf{25 g of glycerin}}{\textbf{20 g of water}} = \textbf{1.25}$$

Sp. Volume

$$\frac{\text{Volume of 25 g of glycerin}}{\text{Volume of 25 g of water}} = \frac{20\ (\text{mL})}{25\ (\text{mL})} = 0.8$$

Percentage, Ratio Strength, and Other Expressions of Concentration

Percent weight-in-volume (w/v):

Expresses the number of grams of a constituent in 100 mL of solution or liquid preparation and is used regardless of whether water or another liquid isthe solvent or vehicle. Expressed as: % w/v.

Percent volume-in-volume (v/v):

Expresses the number of milliliters of a constituent in 100mL of solution or liquid preparation. Expressed as: % v/v.

Percent weight-in-weight (w/w):

Expresses the number of grams of a constituent in 100 g of solution or preparation. Expressed as: % w/w.

Percentage, Ratio Strength, and Other Expressions of Concentration

Special consideration:

Weight-in-volume Solutions (e.g., ophthalmic, nasal, otic, topical, large-volume parenterals),and lotions

Volume-in-volume Aromatic waters, topical solutions, and emulsions

Weight-in-weight Ointments, creams, and gels.

Percentage Weight-in-Volume

In a *true* expression of *percentage (i.e., parts per 100 parts),* the percentage of a liquid preparation (e.g., solution, suspension, lotion) would represent the *grams* of solute or constituent in *100 g* of the liquid preparation.

Weight-in-volume expressions, the ‘‘correct’’ strength of a 1% (w/v) solution or other liquid preparation is defined as containing 1 g of constituent in 100 mL of product.

How many grams of dextrose are required to prepare 4000 mL of a 5% solution?

5% means 5 g of dextrose in 100 mL of solution

X g of dextrose in 4000 mL of solution

X= (4000 mL*5 g) /100 mL = 200 g

Percentage Weight-in-Volume

How many grams of potassium permanganate should be used in compounding the following prescription?

Potassium Permanganate 0.02%
Purified Water ad 250 mL
Sig. as directed.

Potassium Permanganate = 0.02 g in 100 mL of solution
X g in 250 mL of solution

X= (250 mL*0.02 g)/ 100 mL = 0.05 g

Percentage Weight-in-Volume

How many grams of aminobenzoic acid should be used in preparing 8 fluidounces of a 5% solution in 70% alcohol?

*8 fl. Oz. = 8*29.57 mL = 236.56 mL*

5% means:

5 g of aminobenzoic acid in 100 mL of (70% alcohol)

X g of aminobenzoic acid in 236.56 mL of (70% alcohol)

X= (236.56 mL 5 g)/ 100 mL = 11.83 g*

Percentage Volume-in-Volume

Liquids are usually measured by volume, and the percentage strength indicates the number of parts by volume of an ingredient contained in the total volume of the solution or liquid preparation considered as 100 parts by volume. e.g., *10% v/v.*

How many milliliters of liquefied phenol should be used in compounding the following prescription?

Liquefied Phenol 2.5% Calamine Lotion ad 240 mL Sig. For external use.

2.5 mL of liquefied Phenol in 100 mL of liquid preparation

X mL of liquefied Phenol in 240 mL of liquid preparation

X= (240 mL* 2.5 mL)/ 100 mL = 6 mL of liquefied Phenol

Percentage Weight-in-Weight

Percentage weight-in-weight (*true percentage* or *percentage by weight*) indicates the number of parts by weight of active ingredient contained in the total weight of the solution or mixture considered as 100 parts by weight.

How many grams of phenol should be used to prepare 240 g of a 5% (w/w) solution in water?

Total weight is 240 g

5 % means 5 g in a 100 g of preparation

X g in a 240 g of preparation

X= (240 g* 5 g)/100 g = 12 g

Percentage Weight-in-Weight

How many grams of a drug substance are required to make 120 mL of a 20% (w/w) solution having a specific gravity of 1.15?

*120 mL ===➔ g ==➔ 120 mL * 1.15 = 138 g (total weight)*

20 % means 20 g in 100 g of preparation

X g in 138 g of preparation

X= (138 g 20 g)/100 g = 27.6 g*

Calculating Percentage Strength Weight-in-Weight

If 1500 g of a solution contains 75 g of a drug substance, what is the percentage strength (w/w) of the solution?

75 g in total 1500 g (75 drug and 1425 g of different substance)

75 g in 1500 g
X g in 100 g

*X = (100 g * 75 g)/ 1500 g = 5 g*

5 g of drug substance in 100 g of solution makes 5% (w/w)

Use of Percent in Compendial Standards

Percent is used in the *United States Pharmacopeia* to express the degree of tolerance permitted in the purity of single-chemical entities and in the labeled quantities of ingredients in dosage forms

If ibuprofen tablets are permitted to contain not less than 90% and not more than 110% of the labeled amount of ibuprofen, what would be the permissible range in content of the drug, expressed in milligrams, for ibuprofen tablets labeled 200 mg each?

Ratio Strength

5% means *5 parts per 100* or *5100*. Although *5 parts per 100* designates a ratio strength, it is customary to translate this designation into a ratio, the first figure of which is *1;* thus, *5:100 1:20*.

Express 0.02% as a ratio strength?

0.02 part in 100 parts

1 part in X parts

X = (100 parts * 1 part)/ 0.02 part = 5000

Ratio strength = 1:5000

Simple Conversions of Concentration to "mg/mL"

In patient care settings you might need to *convert rapidly* product concentrations expressed as percentage strength, ratio strength, or as grams per liter (as in IV infusions) *to milligrams per milliliter* (mg/mL)

Convert 4% (w/v) to mg/mL?

4 g in 100 mL

4000 mg in 100 mL

40 mg in 1 mL

Answer = 40 mg/mL

Parts per Million (PPM) and Parts per Billion (PPB)

The strengths of very dilute solutions are commonly expressed in terms of *parts per million (ppm)* or *parts per billion (ppb)*, i.e., the number of parts of the agent per 1 million or 1 billion parts of the whole. These are *standards set by the United States Environmental Protection Agency (EPA). The EPA has established* ***maximum contaminant levels (MCLs)*** *which quantify the highest level of a contaminant that is allowed in drinking water*

Q- Express 5 ppm of iron in water in percentage strength and ratio strength?

5 ppm 5 parts in 1,000,000 parts 1:200,000, ratio strength, *and*

0.0005%, percentage strength, *answers*.

Q- 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. 15 ppb 2.5 ppb 12.5 ppb 12.5:1,000,000,000 1:80,000,000