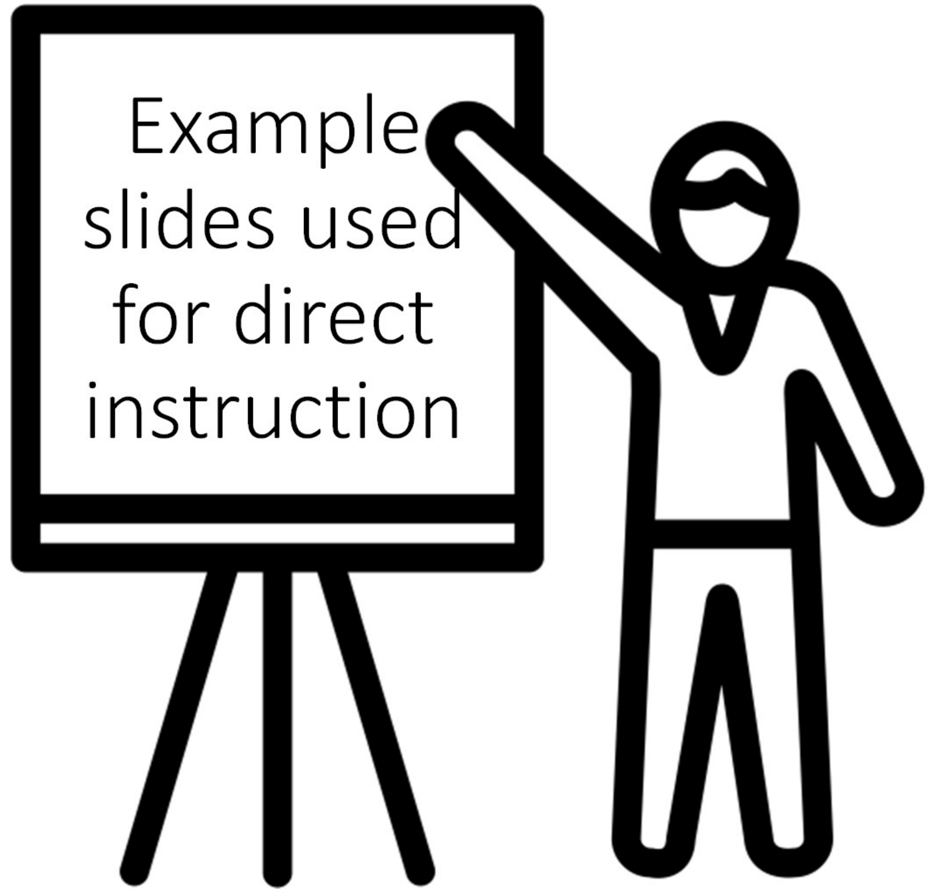

Example slides used for direct instruction

6

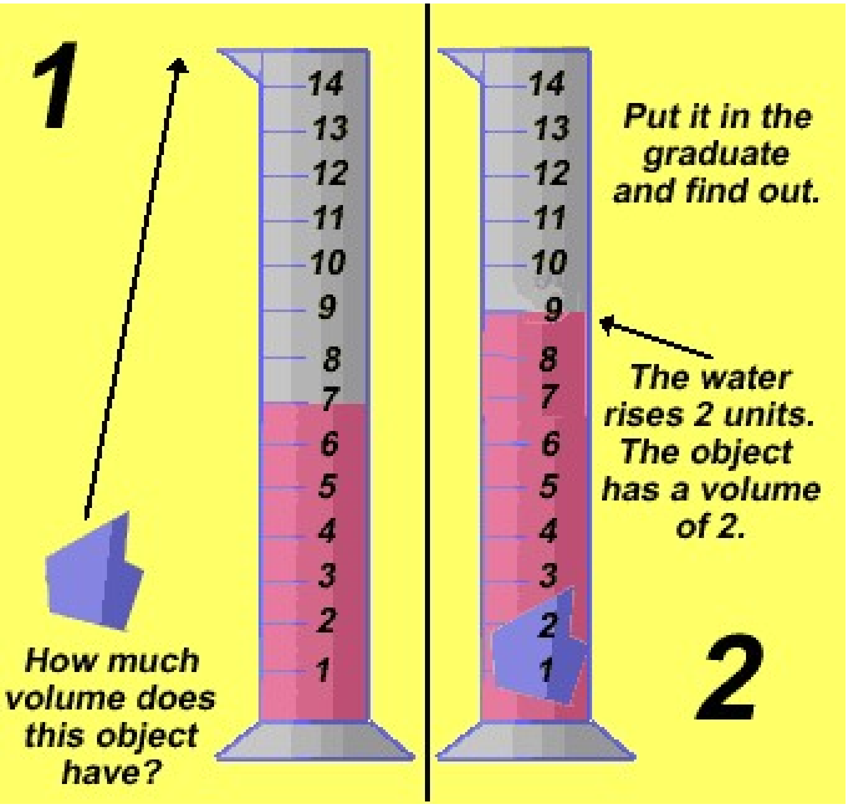
Powder Volume

Learning Objectives: After completing this module, you will be able to:

- Define diluent, solvent, solute, solution, and suspension
- Determine the amount of solvent required to prepare oral and parenteral powder medication
- Explain why some medications are available in powder form
- Calculate the volume to be measured when given a specific dose.
- Calculate the amount of medication in a given volume.
- Calculate powder volume, diluent, total concentration and final volume of constituted/reconstituted medications.

Summary of the entire concept

- Solids take up space



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.stjosephswetherby.com%2Fclasses%2Fyear-6%2Fattachment%2Fwater-displacement%2F&psig=AOvVaw2P9k3cBrzXq7t9_yY-_W8c&ust=1681566786904000&source=images&cd=vfe&ved=0CBIQjhxqFwoTCMjepNDCqf4CFQAAAAAdAAAAABAD

Demonstration Videos

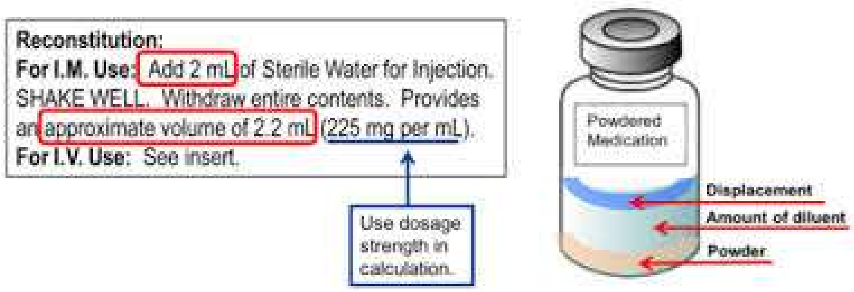
- This video demonstrates a reconstitution of an IV medication

- [Reconstitution of lyophilized injectable]

- This video is a product demo but it shows how to properly constitute oral medications. Reality with theory – Yes, powder takes up space but it also clumps. Remember to add about 1/3 of the diluent volume first, shake it up, then add the remainder. I also thought it was really cool how you could add flavors at the same time with this product.
- Fillmaster Auto Demo Video | FLAVORx – YouTube
- Fill Master Systems LLC Website

Examples

- Example of an injectable to be reconstituted



See directions on the left

Amoxicillin 200 mg / 5 mL

- It is hard to see, but all of these bottles are the same concentration of amoxicillin – 200mg/5mL. They are available from the manufacturer in bottles that once reconstituted will equal either 50 mL, 75 mL or 100 mL.

Augmentin

- This is an example of the company using different colors to help distinguish different concentrations. *(Although in my opinion, they could have used something a bit more contrasting that pink and violet but maybe they are colors that don't effect people with issues with color blindness??)*

Small volume for an oral, no room for error.

台大醫院 NTUH

Zithromax for Suspension

(azithromycin 600 mg/15mL/bottle)

Shake bottle to loosen powder. To open, push down on the bottle cap while twisting the cap counterclockwise.

Measure 9 mL of cold water using the syringe then pour the water into the bottle.

Shake the bottle well. The total volume of the suspension will be 15 mL.

Open the bottle cap. Push plastic stopper into bottle top.

Insert syringe into bottle top. Push down on syringe handle to allow air into bottle. Reverse bottle and pull back syringe handle, drawing prescribed dose of medicine into syringe.

- Do not use the medicine and an antacid at the same time. If needed, take this medicine one hour before, or two hours after taking an antacid.
- This medicine can be taken with or without food. If diarrhea, nausea, or vomiting occurs, take it with food.
- Before reconstitution, keep tightly closed and store in a dry place below 30℃
- Once dispensed, the suspension can be stored at room temperature (5-30℃) and used within 10 days.
- Shake the medicine well just before measuring each dose
- If you miss a dose or forget to use your medicine, use it as soon as you can. If it is almost time for your next dose, wait until then to use the medicine and skip the missed dose. Do not use extra medicine to make up for a missed dose.
- Reconstitute a new bottle of medicine after running out of an old one.

Solutions Using Powders

- In the preparation of solutions, the active ingredient is discussed in terms of weight, but it also occupies a certain amount of space.
  - For lyophilized (freeze-dried) pharmaceuticals that are packaged in a sterile vial and used for reconstitution, this space is referred to as **powder volume (pv)**.
  - Powder volume equals the difference between the *final volume (fv)* and the volume of the diluting ingredient, or the *diluent volume (dv)*.

powder volume (pv) = final volume (fv) - diluent volume (dv)

or

pv = fv - dv

Solutions Using Powders (continued)

Example

A powdered antibiotic must be reconstituted for use. The label states that the dry powder occupies 0.5 mL. Using the formula for solving for powder volume, determine the diluent volume (the amount of solvent added) for each of the final volumes listed below.

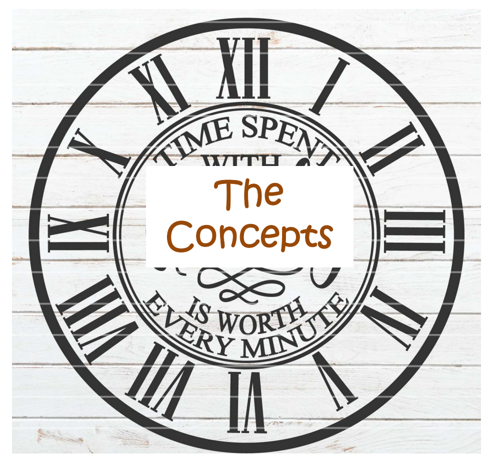
Final Volume	**Powder Volume**
2 mL	0.5 mL
5 mL	0.5 mL
10 mL	0.5 mL

Do you like puzzles?
Here are my keys to solving these problems.

- Five potential X values, so you may have to do more than one calculation

- You may be missing more than one value and have to calculate it from the information given

- Spend time with the next few slides really understanding the basics.



5 Potential X Values

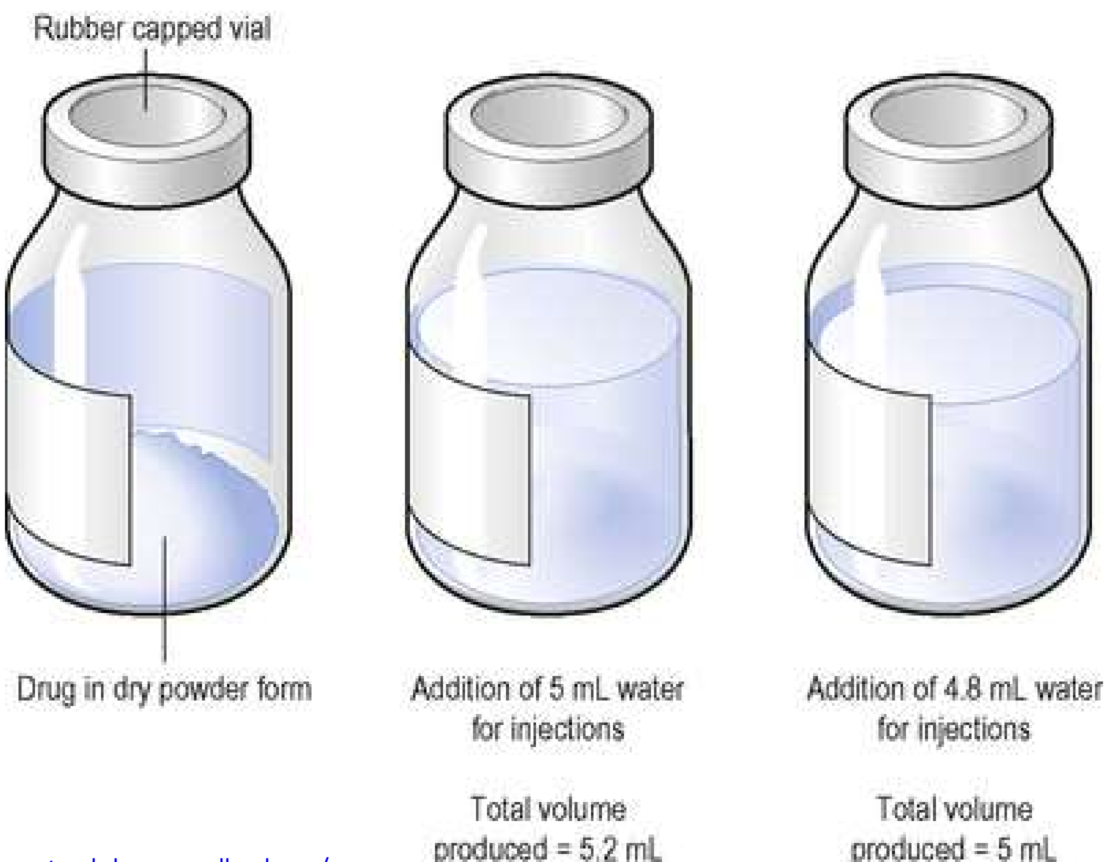
1. **Amount of Drug**
2. **Amount of Diluent**
3. **Powder Volume**
4. **Total Volume of Drug Mixture**
5. **Concentration of Drug Mixture**

Amount of Drug

- **Amount of Drug**

- **Amount of Diluent**

Amount of Diluent + Powder Volume = Total Volume of Drug Mixture



https://nursekey.com/calculating-parenteral-doses-small-volume/

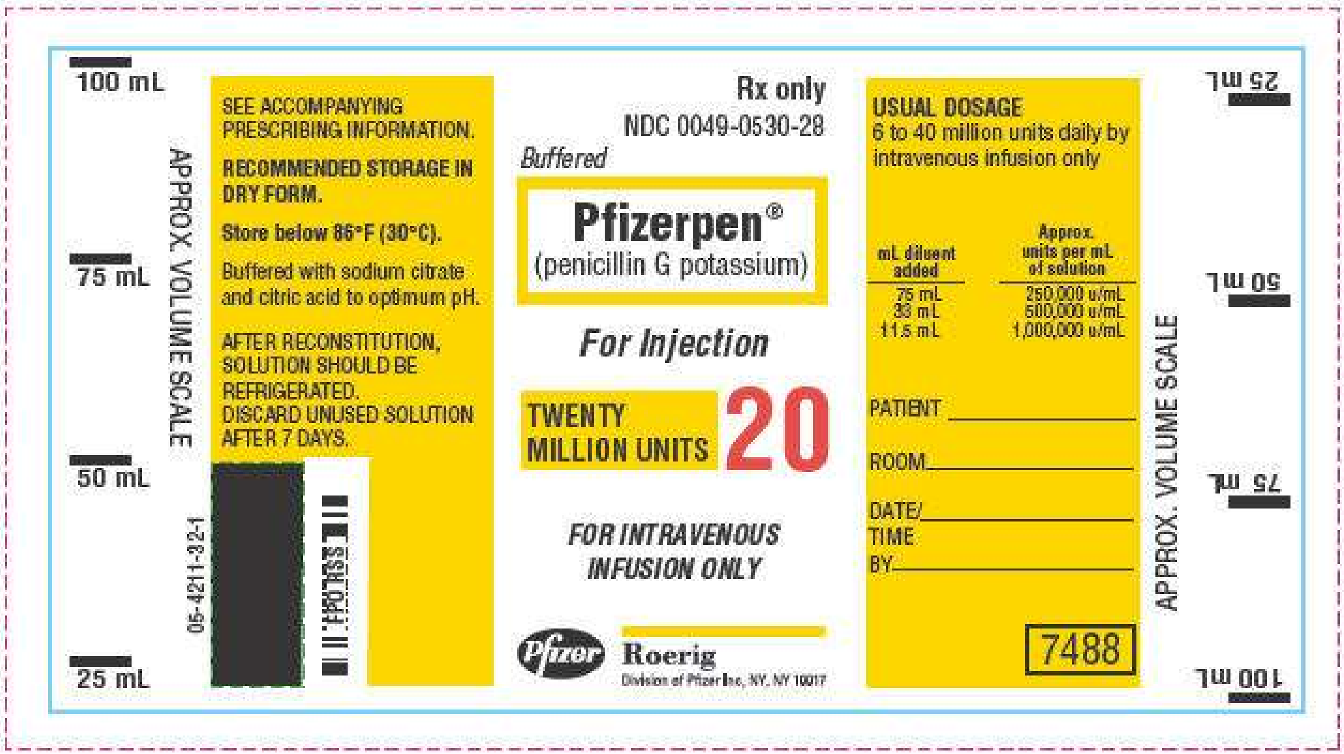
Concentration of Drug Mixture It can be written in many different ways and sometimes in multiple ways.

23.4%

23.4 G / 100 mL

234mg/mL

This one gives you choices of volumes to add for different final concentrations.
We can do this for other drugs using our knowledge of powder volume.



Solutions Using Powders (continued)

Example (continued)

Rearrange the formula to dv = fv – pv

pv = fv – dv

pv + dv = fv

dv = fv – pv

dv = 2 mL – 0.5 mL = 1.5 mL

dv = 5 mL – 0.5 mL = 4.5 mL

dv = 10 mL – 0.5 mL = 9.5 mL

Solutions Using Powders (continued)

Example

You are to reconstitute 1 g of dry powder. The label states that you are to add 9.3 mL of diluent to make a final solution of 100 mg/mL. What is the powder volume?

To determine the powder volume, you must also know the final volume and diluent volume. The diluent volume has already been provided, so begin by calculating the final volume. You can find the final volume by using the final concentration of the solution.

Solutions Using Powders (continued)

Example (continued)

Using the ratio-proportion method:

Convert 1 g to 1,000 mg.

$$\frac{1{,}000 \text{ mg}}{x \text{ mL}} = \frac{100 \text{ mg}}{1 \text{ mL}}$$

$$x \text{ mL } (100 \text{ mg}) = 1 \text{ mL } (1{,}000 \text{ mg})$$

$$\frac{x \text{ mL } (\cancel{100 \text{ mg}})}{\cancel{100 \text{ mg}}} = \frac{1 \text{ mL } (1{,}000 \cancel{\text{ mg}})}{100 \cancel{\text{ mg}}}$$

$$x = 10 \text{ mL}$$

Solutions Using Powders (continued)

Example (continued)

Using the dimensional analysis method:

$$1\,\cancel{\text{g}} \times \frac{1{,}000\,\cancel{\text{mg}}}{1\,\cancel{\text{g}}} \times \frac{1\text{ mL}}{100\,\cancel{\text{mg}}} = 10\text{ mL}$$

Then, using the calculated final volume and the given diluent volume, determine the powder volume.

$$\text{pv} = \text{fv} - \text{dv}$$

$$\text{pv} = 10\text{ mL} - 9.3\text{ mL}$$

$$\text{pv} = 0.7\text{ mL}$$

Example 1

- The label of a 10 g vancomycin vial states that if you add 95 mL of sterile water to the vial's contents you will get a concentration of 1g/10mL.

  What concentration do you get if you add

  45 mL?

1 Amount of Drug = ___________

2 Amount of Diluent = ___________

3 Powder Volume = _____________

4 Total Volume of Drug Mixture = ____________

5 Concentration of Drug Mixture = __________

Use blank space below to work problem in class

Amount of Diluent + Powder Volume = Total Volume of Drug Mixture

***Use blank space below to work problem in class**

So now, what do we know?

1 **Amount of Drug = 10 g**
2 **Amount of Diluent = 95 mL**
3 **Powder Volume = 5 mL**
4 **Total Volume of Drug Mixture = 100 mL**
5 **Concentration of Drug Mixture = 1 g/ 10 mL**

But, what did the question ask? The question want to know WHAT CONCENTRATION do you get if you add 45 mL? So our X is now # 4 but with a new # 2. So if we plug in what we know with the new diluent value se have…

1 **Amount of Drug = 10 g**

2 **Amount of Diluent = 45 mL**

3 **Powder Volume = 5 mL**

4 **Total Volume of Drug Mixture = X**

5 **Concentration of Drug Mixture = X**

We still have 2 unknowns (Xs) but make sure you understand that the powder volume does not change. It will always be the same so no need to calculate that again. Now to get the total volume (# 4), just add the amount of diluent to the powder volume (45 mL + 5 mL = 50 mL)

1 **Amount of Drug = 10 g**

2 **Amount of Diluent = 45 mL**

3 **Powder Volume = 5 mL**

4 **Total Volume of Drug Mixture = 50 mL**

5 **Concentration of Drug Mixture = X**

- So now to get the final concentration we just need to know how much drug per mL of drug product (solution or suspension)

- Still have 10 g of vancomycin in now 50 mL so

I will tell you it will need to be converted to mg so 10 g = 10,000mg.

$$\frac{10{,}000\text{mg}}{50\text{ mL}} = \frac{x\text{ mg}}{1\text{ mL}} \qquad X = 200\text{mg/mL}$$

Solutions Using Powders (continued)

Example (continued)

Rearrange the formula to dv = fv – pv

pv = fv – dv

pv + dv = fv

dv = fv – pv

dv = 2 mL – 0.5 mL = 1.5 mL

dv = 5 mL – 0.5 mL = 4.5 mL

dv = 10 mL – 0.5 mL = 9.5 mL

Solutions Using Powders (continued)

Example

You are to reconstitute 1 g of dry powder. The label states that you are to add 9.3 mL of diluent to make a final solution of 100 mg/mL. What is the powder volume?

To determine the powder volume, you must also know the final volume and diluent volume. The diluent volume has already been provided, so begin by calculating the final volume. You can find the final volume by using the final concentration of the solution.

Solutions Using Powders (continued)

Example (continued)

Using the ratio-proportion method:

Convert 1 g to 1,000 mg.

$$\frac{1{,}000 \text{ mg}}{x \text{ mL}} = \frac{100 \text{ mg}}{1 \text{ mL}}$$

$$x \text{ mL } (100 \text{ mg}) = 1 \text{ mL } (1{,}000 \text{ mg})$$

$$\frac{x \text{ mL } (\cancel{100 \text{ mg}})}{\cancel{100 \text{ mg}}} = \frac{1 \text{ mL } (1{,}000 \cancel{\text{ mg}})}{100 \cancel{\text{ mg}}}$$

$$x = 10 \text{ mL}$$

Solutions Using Powders (continued)

Example (continued)

Using the dimensional analysis method:

$$1\,\cancel{\text{g}} \times \frac{1{,}000\,\cancel{\text{mg}}}{1\,\cancel{\text{g}}} \times \frac{1\text{ mL}}{100\,\cancel{\text{mg}}} = 10\text{ mL}$$

Then, using the calculated final volume and the given diluent volume, determine the powder volume.

$$\text{pv} = \text{fv} - \text{dv}$$

$$\text{pv} = 10\text{ mL} - 9.3\text{ mL}$$

$$\text{pv} = 0.7\text{ mL}$$

PHM 115 Week 9

- Read pages 198 – 201 of Pharmacy Calculations for Technicians (PCfT)
- Complete the learning materials
- Compete problems 17 – 25 on pages 202-203