AL- Mustaqbal University College
Pharmacy Department

Principles of Pharmacy Practice

Lectuer: 4
Prof. Dr. Jabar Faraj AL-Wakeel
Assist. Prof. Dr. Shaimaa Munther

Pharmaceutical Measurement

Objectives:

Upon successful completion of this chapter, the student will be able to:

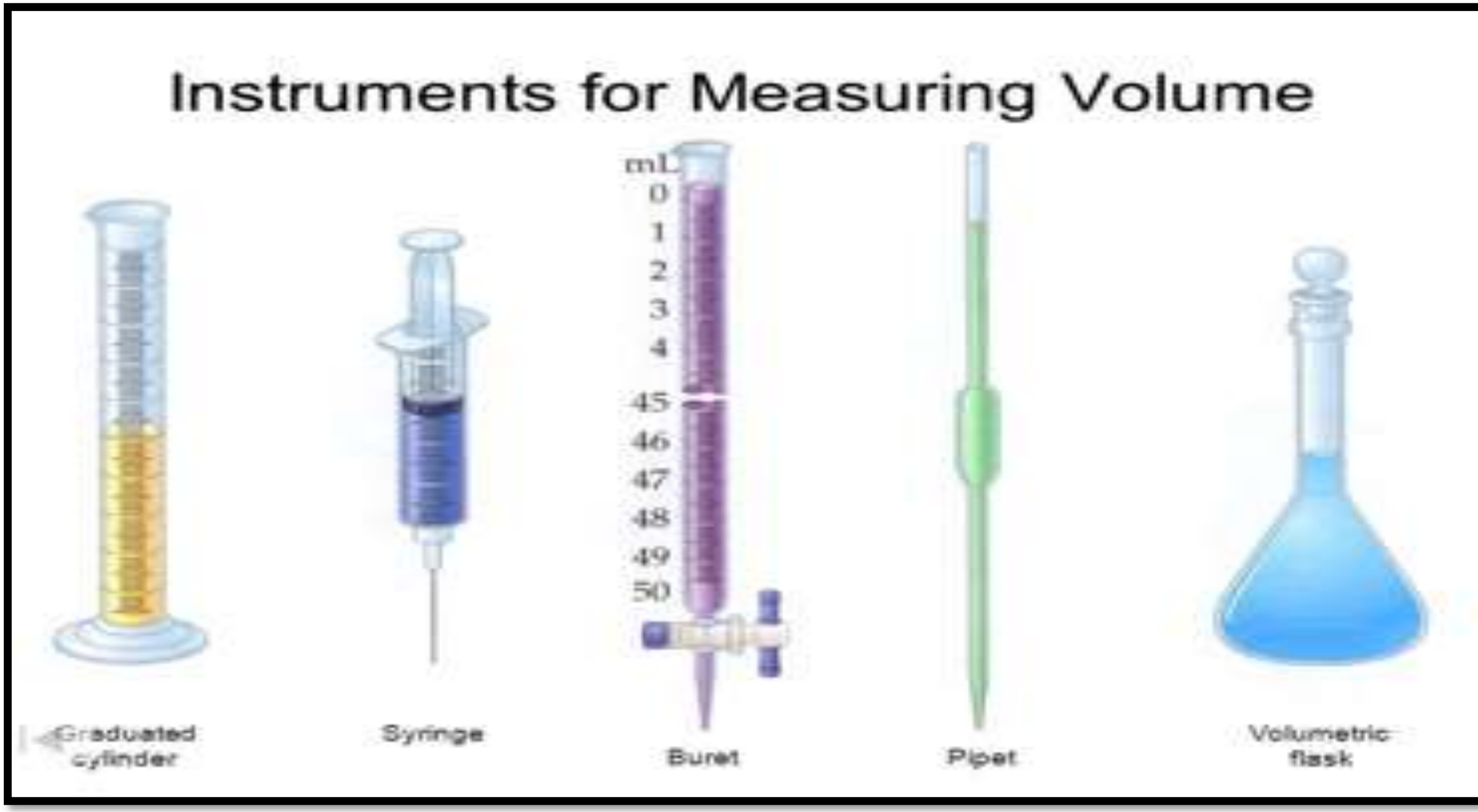
- ✓ Describe instruments for volumetric measurement and characterize their differences in application and accuracy.
- ✓ Describe the correct procedure when using a pharmaceutical balance.
- ✓ Define sensitivity requirement and apply it in calculations.
- ✓ Perform calculations by the aliquot method.
- ✓ Demonstrate an understanding of percentage of error in pharmaceutical measurement.

Why we need to learn about pharmaceutical measurements?

- The role of the pharmacist in providing pharmaceutical care includes the ability and responsibility to compound that is, to accurately weigh, measure volume, and combine individual therapeutic and pharmaceutical components in the formulation and preparation of prescriptions and medication orders

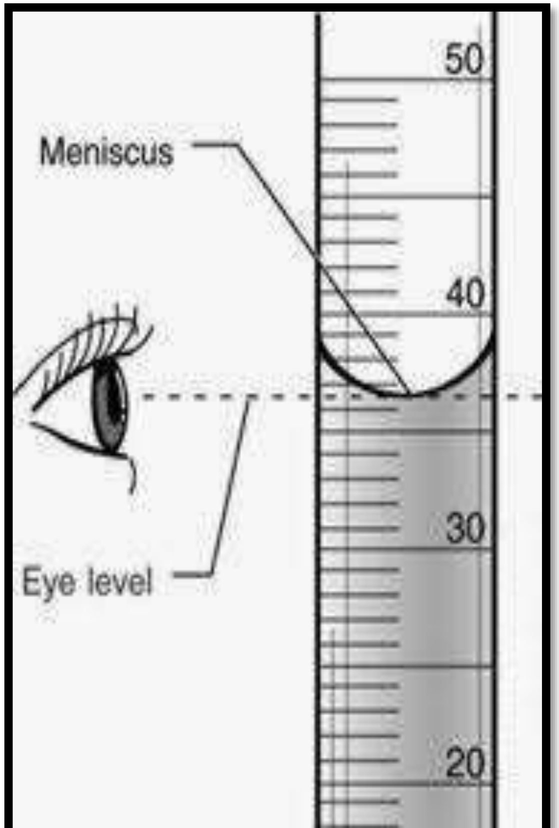
1- Measurement of volume

- Common instruments for the pharmaceutical measurement of volume range from micropipettes and burettes used in analytic procedures to large, industrial-size calibrated vessels.
- The selection of measuring instrument should be based on the level of precision required
- In pharmacy practice, the most common instruments for measuring volume are cylindric and conical (cone-shaped) graduates. For the measurement of small volumes, however, the pharmacist often uses a calibrated syringe or, when required, a pipette.
- cylindric graduates are calibrated in SI or metric units, conical graduates are usually dual-scale, that is, calibrated in both metric and apothecary units of volume.
- Select the graduate with a capacity equal to or just exceeding the volume to be measured
    - ➢ The narrower the bore or chamber, the lesser the error in reading the meniscus and the more accurate the measurement



Micropipettes

Beaker Conical flask



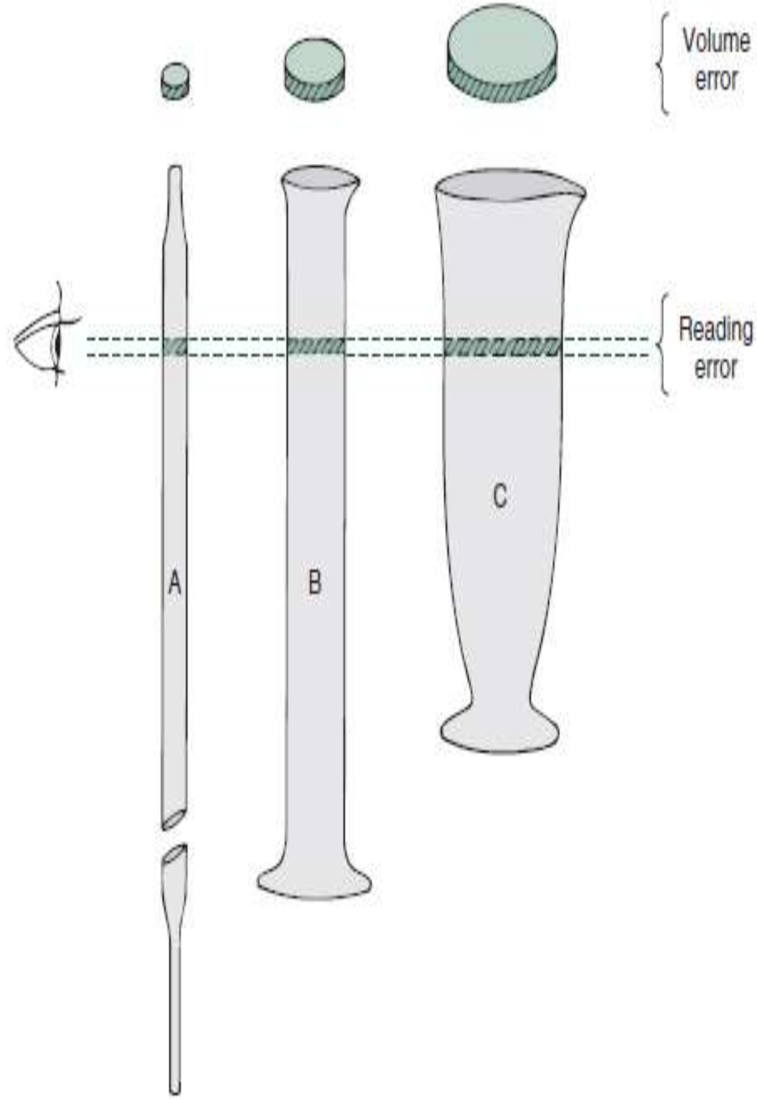


FIGURE 3.2 Volume error differentials due to instrument diameters. **(A)**, volumetric pipet; **(B)**, cylindric graduate; and **(C)**, conical graduate.

Measurements of weight

Sensitivity requirement: The load that will cause a change of one division on the index plate of the balance.

- Class A prescription balance has a sensitivity requirement (SR) of 6 milligrams or less with no load and with a load of 10 grams in each pan.

- To avoid errors of greater than 5% when using this balance, the pharmacist should not weigh less than 120 milligrams of material (i.e., a 5% error in a weighing of 120 milligrams is 6 milligrams).

Weight measurement instruments

It is compulsory to provide them as a part of the pharmacy setting and requirements of the National Bureau of Standards (NBS).

1-Class A prescription balance

It is a torsion balance present either as

1- A two-pan balance.

2-Balances with beam and rider.

2-Ultrasensitive electronic balance (Ohaus balance)

sensitivity requirement may be determined by the following procedure:
1. Level the balance.
2. Determine the rest point of the balance.
3. Determine the smallest weight that causes the rest point to shift one division on the index plate.
✓ Most commercially available Class A balances have a maximum capacity of 120 grams



Electronic analytical balance

✓ Capable of weighing accurately 0.1 milligram

✓ Self-calibrating

✓ Equipped with convenient digital readout features.

✓ The usual maximum capacities for balances of this precision range from about 60 grams to 210 grams depending upon the model

Aliquot method of weight and measurement

- Why use this method?
- When a degree of precision in measurement required is beyond the capacity of the available instrument.
- Aliquot is a fraction, portion, or part that is contained an exact number of times in another..

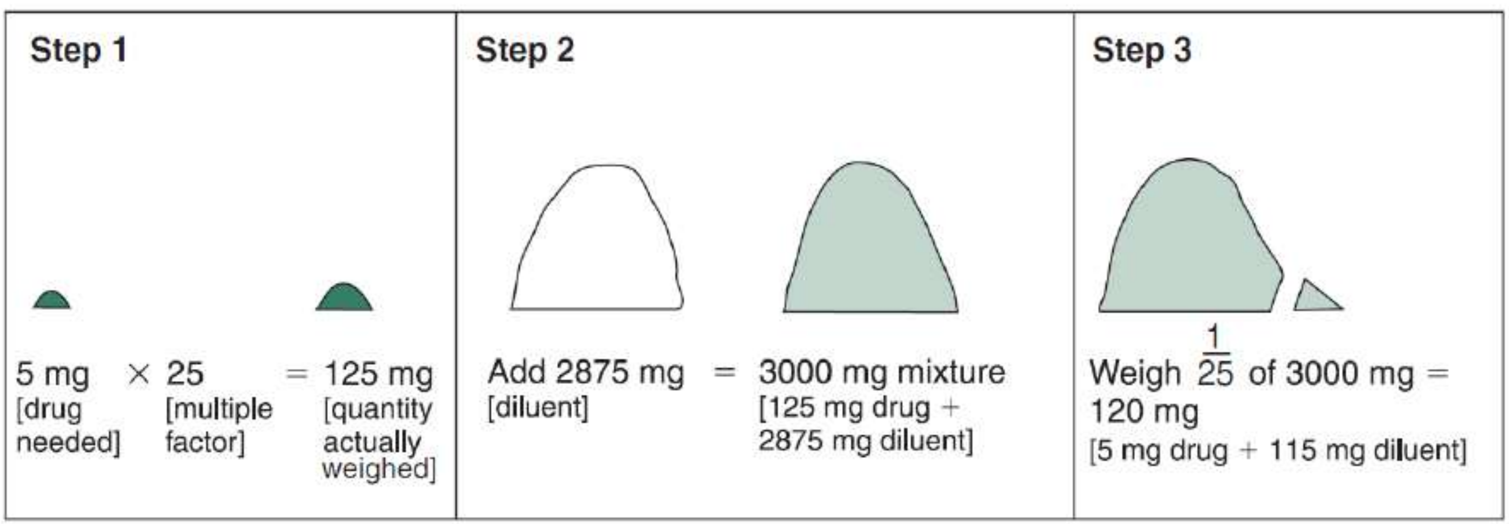


FIGURE 3.6 Depiction of the aliquot method of weighing using the example described on the next page.

Aliquot method of weight and measurement

Step 1: Calculate the smallest quantity of a substance that can be weighed on a balance with the desired precision

$$\frac{100\% \times \text{Sensitivity Requirement (mg)}}{\text{Acceptable Error (\%)}} = \text{Smallest Quantity (mg)}$$

Example:

On a balance with an SR of 6 mg, and with an acceptable error of no greater than 5%, a quantity of not less than 120 mg must be weighed.

$$\frac{100\% \times 6 \text{ mg}}{5\%} = 120 \text{ mg}$$

Step 2: Weigh an amount of the drug equal to or greater than the least weighable amount and calculate the enlargement factor.

Enlargement factor = weighed amount/desired amount

Aliquot method of weight and measurement

Step 3: choose aliquot weight equal to or larger than the smallest weighable amount

Step 4: determine Mixture weight = aliquot X factor

Step 5: calculate weight of Diluent needed = mixture – drug

Example: A torsion prescription balance has a SR of 6 mg, and with an acceptable error of no greater than 5%. Explain how would you weigh 5 mg of drug required to fill the prescription, using lactose as a diluent of not less than 120 mg must be weighed?

$$\frac{100\% \times \text{Sensitivity Requirement (mg)}}{\text{Acceptable Error (\%)}} = \text{Smallest Quantity (mg)}$$

Example: A torsion prescription balance has a SR of 6 mg, and with an acceptable error of no greater than 5%. Explain how would you weigh 5 mg of drug required to fill the prescription, using lactose as a diluent?

Step 1:

$$\frac{100\% \times \text{Sensitivity Requirement (mg)}}{\text{Acceptable Error (\%)}} = \text{Smallest Quantity (mg)}$$

$$\frac{100\% \times 6 \text{ mg}}{5\%} = 120 \text{ mg}$$

not less than **120** mg must be weighed

Step 2: weigh 125 mg, factor = 125/5 = 25

Step 3: choose aliquot weight equal to or larger than the smallest weighable amount, choose **120** mg

Step 4: determine mixture weight = aliquot x factor = 120 x 25 = 3000

Step 5: calculate weight of diluent needed = mixture – drug

= 3000 – 125 = 2875 mg

In other word:

Drug quantity actually weighed	Mixture (drug + diluent)
125 mg	**3000 mg**
5 mg	**?**
Amount of drug required to fill the prescription	

$$? = \frac{3000 \times 5}{125} = \mathbf{120\ mg}$$

Aliquot amount of the mixture required to be weighed to get the desired amount of the drug

Example:

A torsion prescription balance has a sensitivity requirement of 6 milligrams. Explain how you would weigh 4 milligrams of atropine sulfate with an accuracy of ± 5%, using lactose as the diluent?

Sensitivity requirement = 6.5 mg

$$smallest\ quantity = \frac{100\% \times SR}{\text{error } \%} = 130 \text{ mg}$$

1. Smallest amount = 130 mg
2. Weight 150 mg atropine sulfate (130/15 = 8.6 so we choose 150 to get an easy-to-use factor) factor =150/15 = 10
3. Choose aliquot weight 130 mg
4. Mixture weight = aliquot X factor = 130 X 10 = 1300
5. Calculate weight of diluent needed = mixture – drug = 1300 mg – 150 = 1150 mg
6. Check to make sure 130 mg contains 15 mg drug:

150 mg drug 1300 mg mixture

? 130 mg mixture ? = 150 X 130 /1300 = 15 mg

Measuring volume by the aliquot method

Examples: A formula calls for 0.5 millilitre of hydrochloric acid. Using a 10-milliliter graduate calibrated from 2 to 10 millilitres in 1-milliliter divisions, explain how you would obtain the desired quantity of hydrochloric acid by the aliquot method.

Step 1: Select a multiple of the desired quantity that can be measured with the required precision.

Step 2: Dilute the multiple quantity with a compatible diluent (usually a solvent for the liquid to be measured) to an amount evenly divisible by the multiple selected.

Step 3: Measure the aliquot of the dilution that contains the quantity originally desired

If 4 is chosen as the multiple, and if 2 millilitres is set as the volume of the aliquot, then:

1. Measure 4 x 0.5 mL, or 2 mL of the acid
2. Dilute with 6 mL of water
   to make 8 mL of dilution
3. Measure 1⁄4 of dilution, or 2 mL of dilution, which will contain 0.5 mL of hydrochloric acid

Examples:

A prescription calls for 0.2 mL of clove oil. Using a 5-mL graduate calibrated in units of 0.5 mL, how would you obtain the required amount of clove oil using the aliquot method and alcohol as the diluent?

If 5 is chosen as the multiple, then:

1. Measure 5 x 0.2 mL, or 1 mL of clove oil
2. Dilute with 4 mL of alcohol

   to make 5 mL of dilution
3. Measure 1⁄5 of the dilution, or 1 mL, which contains 0.2 mL of clove oil

Percentage of Error

- Because measurements in the community pharmacy are never absolutely accurate, it is important for the pharmacist to recognize the limitations of the instruments used and the magnitude of the errors that may be incurred.
- When a pharmacist measures a volume of liquid or weighs a material, two quantities become important:
  1. The apparent weight or volume measured
  2. The possible excess or deficiency in the actual quantity obtained.
- Percentage of error may be defined as the maximum potential error multiplied by 100 and divided by the quantity desired. The calculation may be formulated as follows:

$$\frac{\text{Error} \times 100\%}{\text{Quantity desired}} = \text{Percentage of error}$$

Calculating Percentage of Error in Volumetric Measurement

Example:

Using a graduated cylinder, a pharmacist measured 30 millilitres of a liquid. On subsequent examination, using a narrow-gauge burette, it was determined that the pharmacist had actually measured 32 millilitres. What was the percentage of error in the original measurement?

$$Percentage\ of\ error = \frac{Error \times 100\%}{Quantity\ desired}$$

$$32 \text{ milliliters} - 30 \text{ milliliters} = 2 \text{ milliliters, the volume of error}$$

$$\frac{2 \text{ mL} \times 100\%}{30 \text{ mL}} = 6.7\%, \textit{answer.}$$

Calculating Percentage of Error in Weighing

Example:

A prescription calls for 800 milligrams of a substance. After weighing this amount on a balance, the pharmacist decides to check by weighing it again on a more sensitive balance, which registers only 750 milligrams. Because the first weighing was 50 milligrams short of the desired amount, what was the percentage of error?

$$Percentage\ of\ error = \frac{Error \times 100\%}{Quantity\ desired}$$

50 mg the weight of error

(50 mg X 100%)/800 mg = 6.25%

CASE IN POINT 3.1: A pharmacist is asked to compound the following formula for the preparation of 100 capsules:[3]

Estriol	200 mg
Estrone	25 mg
Estradiol	25 mg
Methocel E4M	10 g
Lactose	23.75 g

Using a balance that has an SR of 6 mg, the aliquot method of weighing, lactose as the diluent, and an error in weighing of 4%, show, by calculations, how the correct quantity of estrone can be obtained to accurately compound the formula.

The smallest quantity that should be weighed on the balance:

$$\frac{100\% \times 6 \text{ mg}}{4\%} = 150 \text{ mg}$$

Quantity desired (estrone): 25 mg
Multiple factor selected: 6
Aliquot portion selected: 150 mg

Estrone (25 × 6)	150 mg
Lactose	750 mg
Aliquot mixture	900 mg
Aliquot portion (900 mg ÷ 6)	150 mg of mixture will provide 25 mg estrone, *answer*


thank you