Laboratory OF GENERAL CHEMISTRY (1)

Chem 0303105

Chemistry Department Mutah University
Jordan

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Experiment 1:

Basic Laboratory Operations
(عمليات المختبر الأساسية)

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OBJECTIVES

Student are expected to master the following laboratory (lab) techniques (تقنيات المعمل).

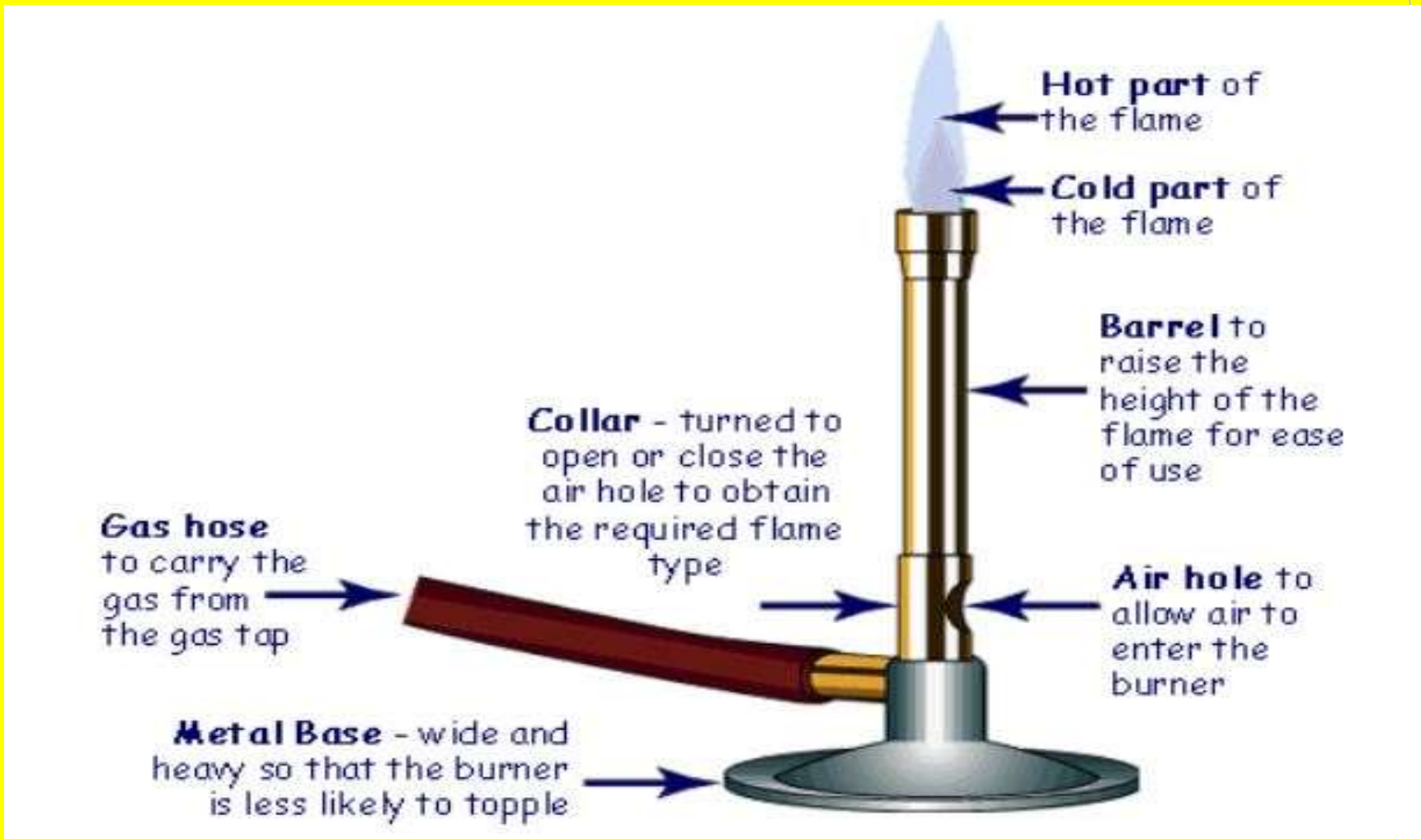
1. To light and properly adjust the flame of a Bunsen burner
2. To develop the skill for properly operating a balance
3. To determine the density of an unknown solid substance

Bunsen Burner (موقد بنسن),1853

An important piece of equipment used for heating in the lab.

Can be very dangerous if care is not taken.

Parts of the Bunsen Burner

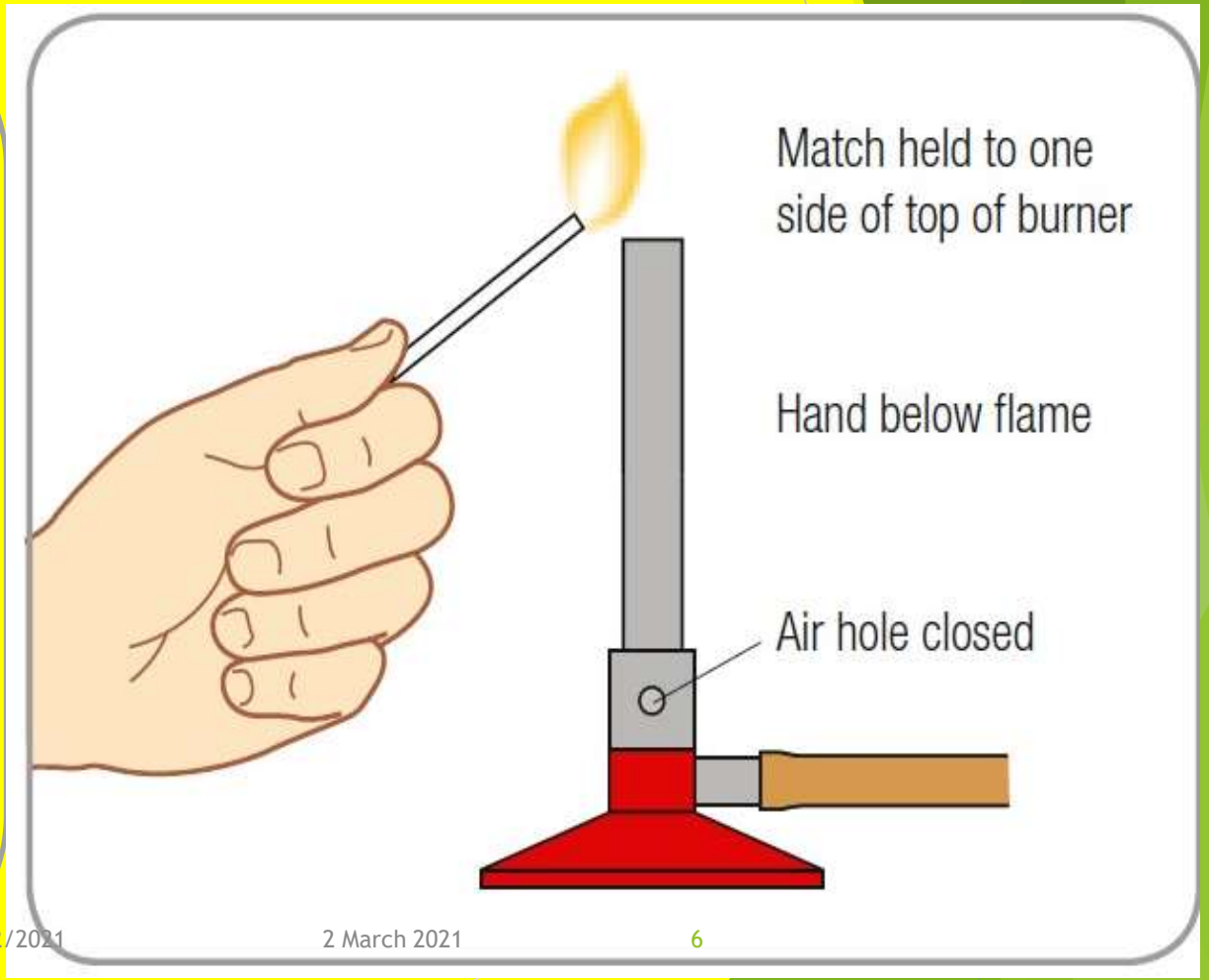


How to light a Bunsen Burner

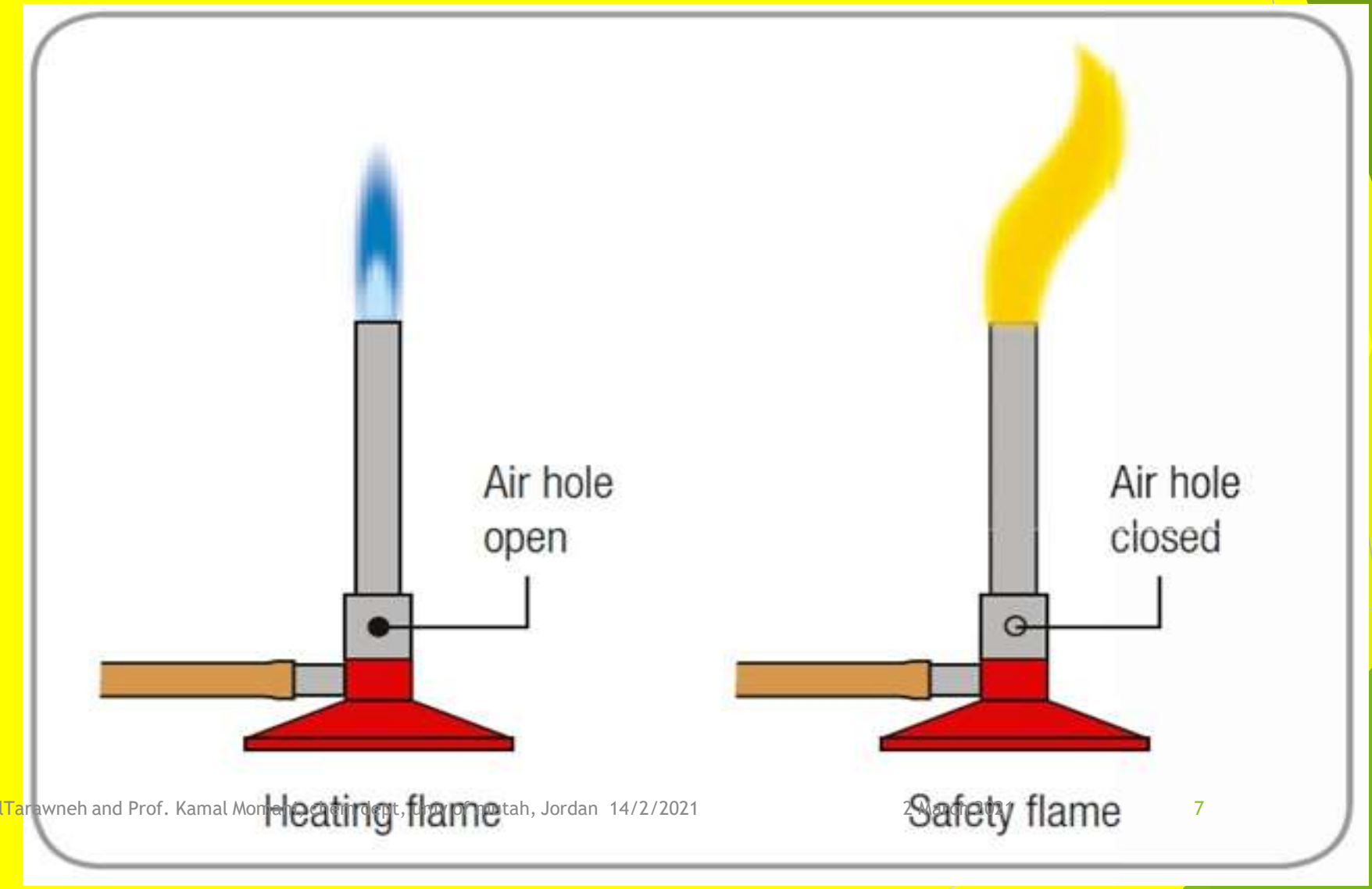
1. Connect hose to gas tap
2. Make sure the air hole is closed

3. LIGHT THE MATCH and place near the top of the Bunsen burner

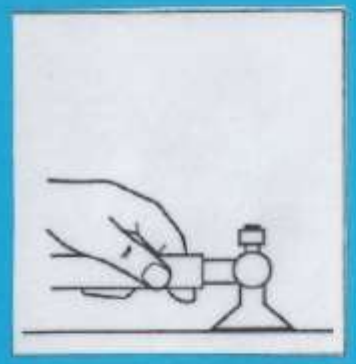
4. Turn on gas LAST



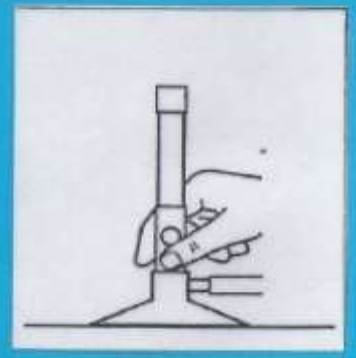
Different Flames



How to light a Bunsen Burner



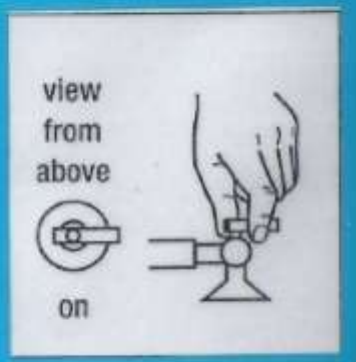
Attach the rubber hose of the Bunsen burner to the gas tap.



Close the air hole.

Light a match.

Place the flame of the match near the top of the Bunsen burner.



Turn on the gas at the gas tap.

Blow out the match.

Open the air hole.

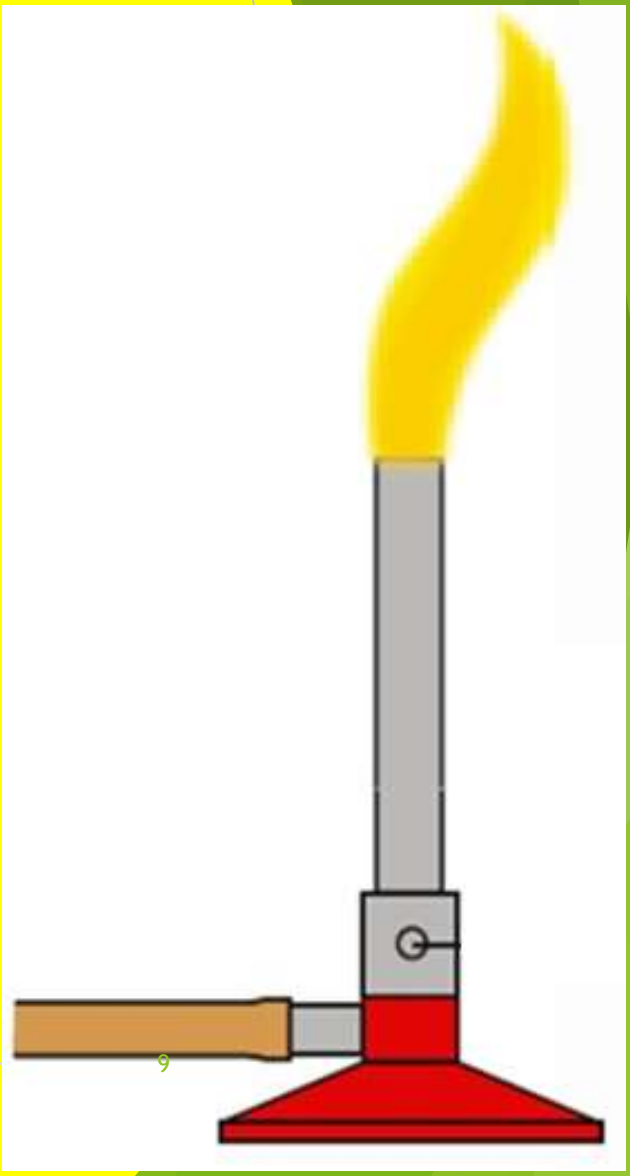
Hold the test tube above the Bunsen burner.

Close the air hole again.

Turn off the gas tap.

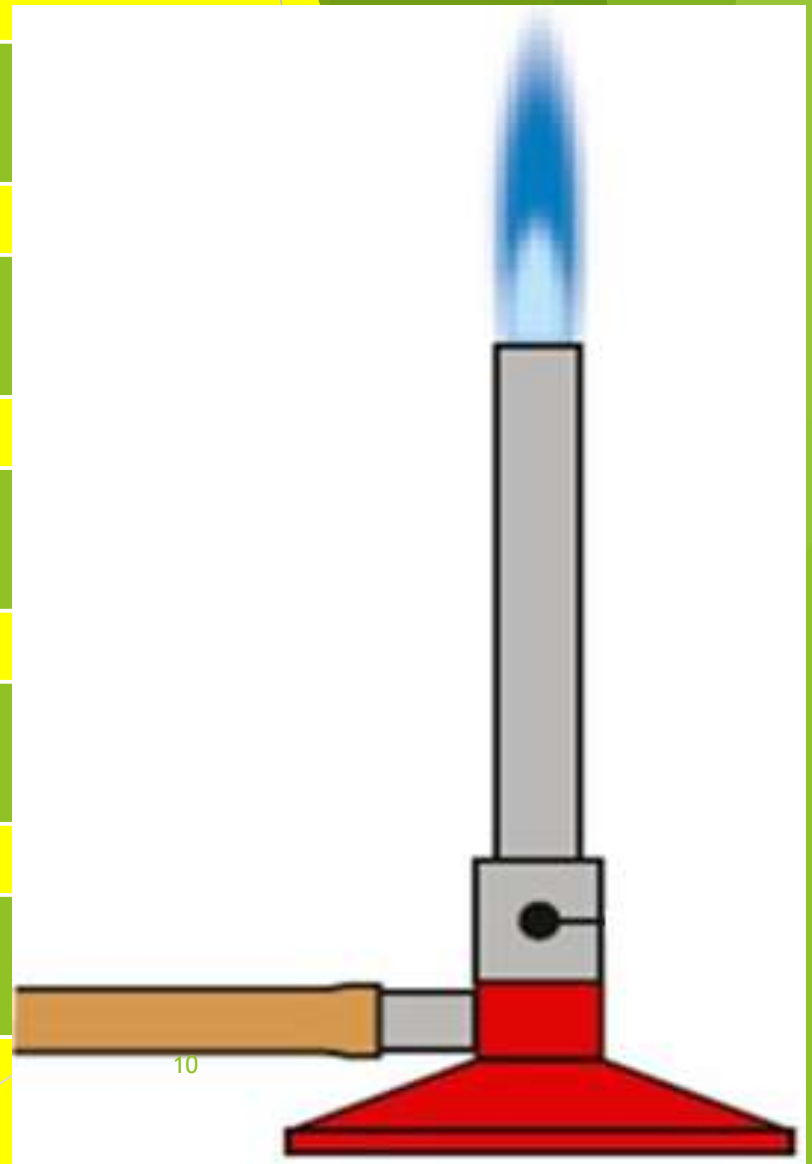
Characteristics of the Yellow Flame

- Air hole closed
- Safety Flame
- Relatively Cool
- Highly Visible
- Dirty Flame



Characteristics of the Blue Flame

- Air hole open
- Heating Flame
- Relatively Hot
- Difficult to see
- Clean Flame



Complete combustion and Incomplete combustion

Fuel/ oxidant mixture: natural gas/air

- **-<u>with sufficient oxygen supply</u>: complete combustion**

If you see a **blue** flame you know **complete combustion** is occurring and there is **sufficient oxygen** gas present to safely burn the fuel (natural gas OR CH_4) and produce carbon dioxide and water.

Complete Combustion: Fuel + Oxygen → Carbon dioxide + Water + Energy

This example is for methane fuel: $\mathbf{CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)} + Energy}$

Flame characteristics: Blue, Hot flame, non-luminous (اللهب الأزرق الساخن ، غير مضيئ)

- **<u>with insufficient oxygen supply</u>: incomplete combustion**

If you see a **yellow** flame you know **incomplete combustion** is occurring and there is **insufficient oxygen** gas present to burn the fuel

- $\mathbf{CH_{4(g)} + O_{2(g)} \rightarrow CO_{2(g)} + CO_{(g, toxic,)} + C_{(carbon\ particles,\ smoke)} + H_2O_{(g)}}$, Yellow, luminous Flame

- A properly adjusted Bunsen flame has 3 distinct cones (zones): outer cone, inner cone (the hottest part of the flame, about 1600^{o}C) and base cone

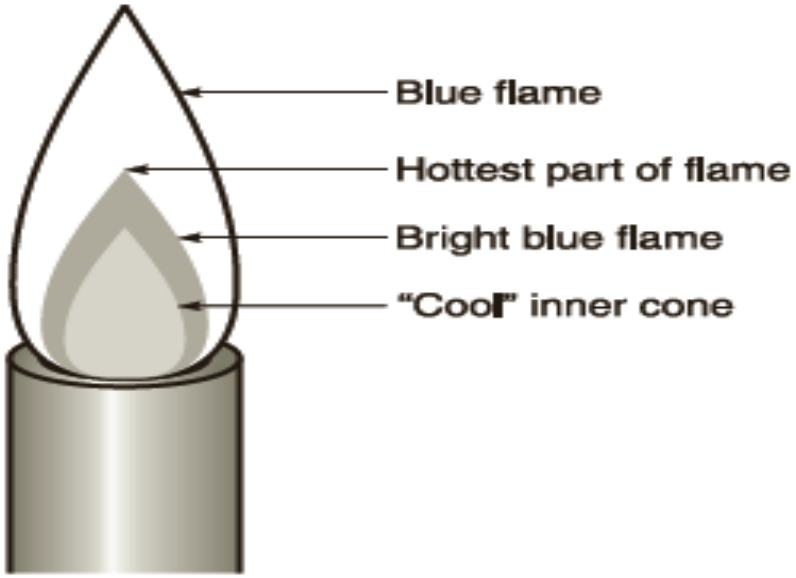
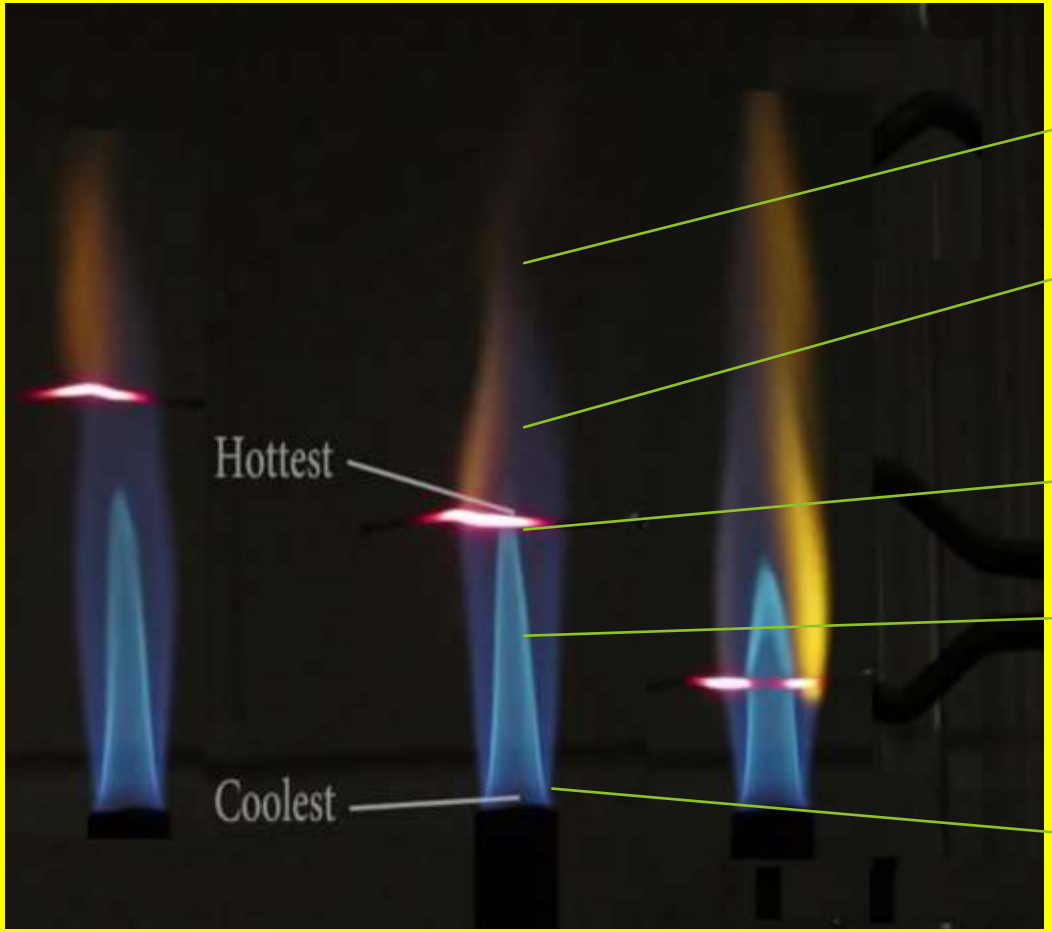


Figure 1.3 Flame of a properly adjusted Bunsen burner.

-Flame temperatures is observed using a wire gauze (شبكة سلكية).
Metal wires of Fe (m.p: 1535^{o}C), Cu (m.p: 1083^{o}C), and Al (m.p: 660^{o}C).

Parts of a flame



Top of the flame (~1000 °C)

Between top of the flame and inner core (~1500 °C)

Top of inner core (~1650 °C)

Region of intense combustion

Within the inner core (~400 °C) (Unburnt gas and air)

-Flame temperatures is observed using a wire gauze (شبكة سلكية).
Metal wires of Fe (m.p: 1535^{o}C), Cu (m.p: 1083^{o}C), and Al (m.p: 660^{o}C).

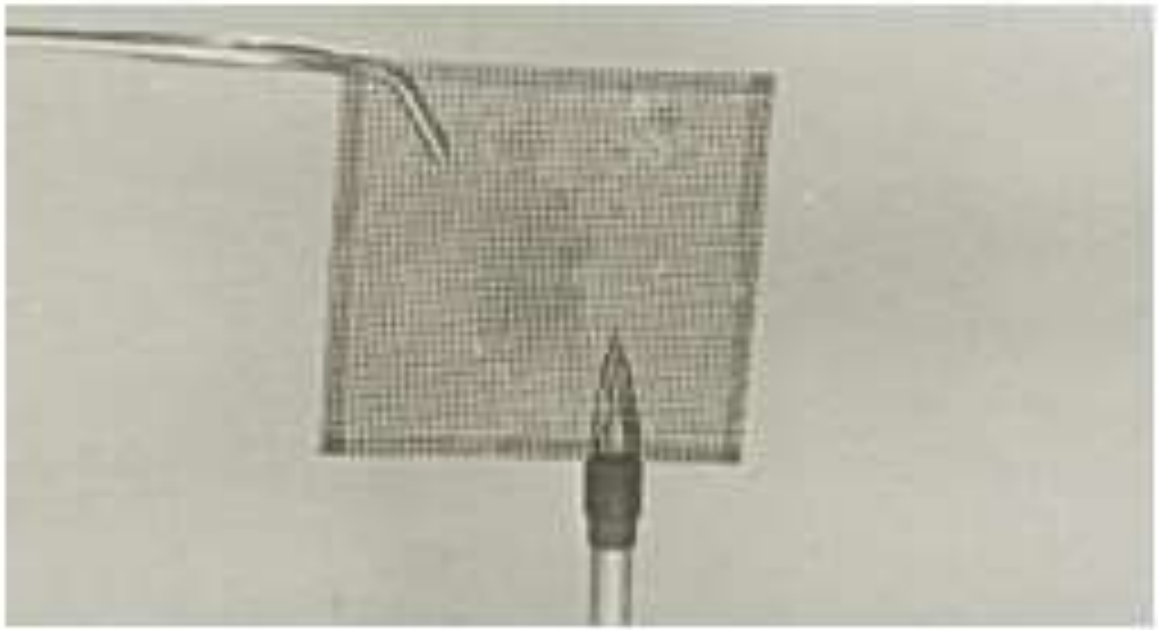


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Figure 1.4 Hold the wire gauze parallel to the burner barrel.

Lab Balances

- Solid and liquid masses are measured using balances.

–Three types of balances:

- ✓ Triple-beam: manual, sensitivity: ± 0.01 g, not in use currently.
- ✓ Electronic balances:

a) Top-loading balances, sensitivity: ±0.01 or ±0.001 g, used in general chemistry labs

b) Analytical balances, sensitivity: ±0.0001 or ±0.00001 g, widely used in analytical chemistry labs

Top-Loading Balances

- Top-loading balances are used for rapid determination of masses to the nearest 0.1-0.001 grams.

Triple-Beam Balance

- A triple-beam balance has three beams with sliding masses, have about a 610 grams capacity and are used to weigh to the nearest 0.01 gram.

Analytical Balance

- Analytical balances are used for very accurate, quantitative mass measurements to the nearest 0.0001 g. They are much more delicate than either top-loading or triple-beam balances. The General Rules must be followed to avoid damaging the balance.

Density

What is density?

-Density is a specific property of matter that is related to the mass divided by the volume

-**Density is an *Intensive property (خاصية غير كمية): property independent of sample size***

-What is the formula for density?

- $D = \frac{\text{Mass}}{\text{Volume}}$ (g/mL, Kg/L), SI system,
- lb/gal in English system

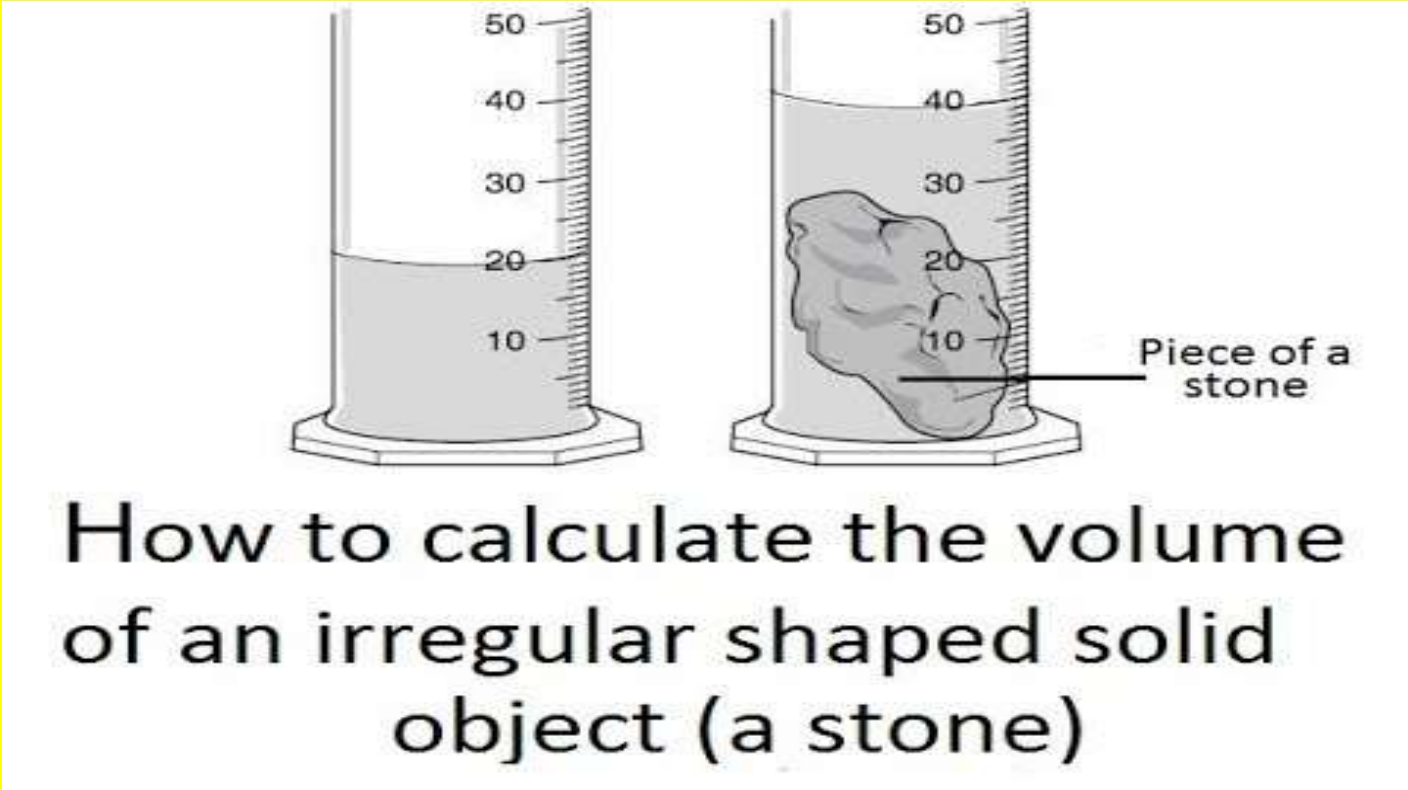
Review physical and chemical properties of substances, as well as intensive and extensive properties

How Do We Calculate Density water-insoluble solid?

-Step 1. weigh the mass of your object (solid) using the top-loading

-Step 2. Gently slide the known mass of solid into the 10.00 mL graduated cylinder (مخبار مدرج). Roll the solid around in the cylinder, removing any air bubbles that are trapped or that adhere to the solid. Record the new water level (see the following Figure). The volume of the solid is the difference between the two water levels.

Step 3. calculate the density of the solid in g/mL



Apparatus for measuring the density of a water-insoluble solid

QUESTIONS

- What were your objectives and were they met?
- What did you learn from this experiment?
- Which gives a hotter flame- vents open or closed? Explain your reasoning.
- Which part of Bunsen burner Flame should be used when performing experiments and why?
- List Any Errors that effected your results?

Experiment 1 *Prelaboratory Assignment*

Basic Laboratory Operations

Date _____ Lab Sec. _____ Name _____ Desk No. _____

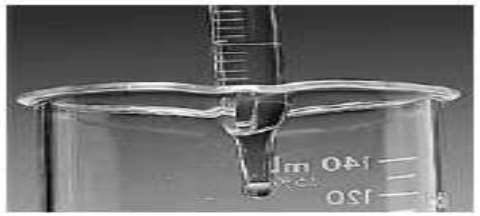
1. a. What is the dominant color of a nonluminous flame from a Bunsen burner? Explain.

   b. Is the temperature of a luminous flame greater or less than that of a nonluminous flame? Explain.

2. Diagram the cross section of a graduated cylinder, illustrating *how* to read the meniscus.

3. Experimental Procedure, Part B. What is the sensitivity of the *least* sensitive balance most likely to be in your laboratory?

5. Refer to Technique 16B.



a. Remove the drop suspended from a pipet tip by . . .

b. The finger used to control the delivery of liquid from a pipet is the . . .

c. A pipet is filled with the aid of a . . .

d. Most pipets are calibrated as "TD 20°C". Define "TD" and what is its meaning regarding the volume of liquid a pipet delivers?

6. Experimental Procedure, Part C.1. The density of aluminum is 2.70 g/cm^3 and the density of chromium is 7.19 g/cm^3. If equal masses of aluminum and chromium are transferred to equal volumes of water in separate graduated cylinders, which graduated cylinder would have the greatest volume change? Explain.

7. Experimental Procedure, Part C.3. The mass of a beaker is 5.333 g. After 5.00 mL of spearmint oil is pipetted into the beaker, the combined mass of the beaker and the spearmint oil sample is 9.962 g. From the data, what is the measured density of spearmint oil?

Laboratory Questions

Circle the questions that have been assigned.

1. The density of Solid A is 2.70 g/cm^3 and that of Solid B is 3.87 g/cm^3. A 1.00-g sample of each solid is transferred to a graduated cylinder containing 5.00 mL of water. Which solid displaces the larger volume of water? By how many milliliters?
2. The density of lead metal is 11.35 g/cm^3. If 16.44 g of lead is added to a 10-mL graduated cylinder that contains 4.2 mL of water, what will be the final volume reading of the water in the cylinder?
3. Suppose that in Part C.1 an air bubble adheres to the surface of the metal when it is submerged in the water. Explain how this phenomenon affects the reported density of the metal.
4. In Part C.3, suppose that several drops of the unknown liquid cling to the inner wall of the pipet (because the pipet is dirty) after delivery. Is the actual volume of liquid delivered greater or less than the 2 mL recorded by the pipet? Explain.