

## Experiment 1: Basic Laboratory Operations (عمليات المختبر الأساسية)

### OBJECTIVES:

Students 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.

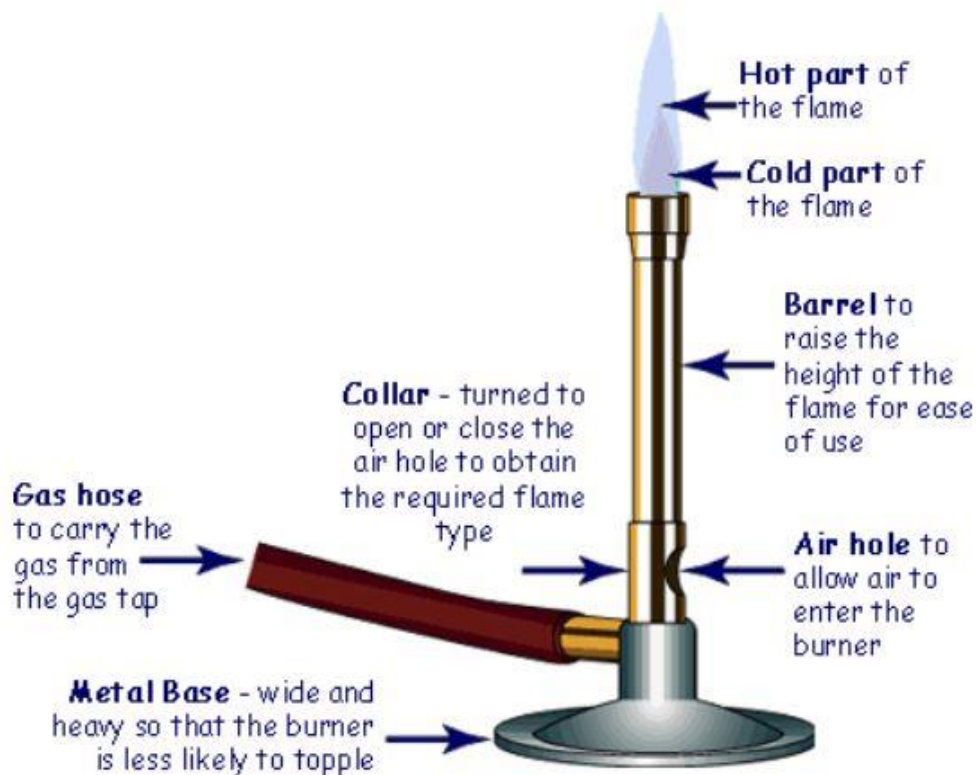
**Bunsen Burner (موقد بنسن), 1853.**

An important piece of equipment used for heating in the lab

Can be very dangerous if care is not taken.

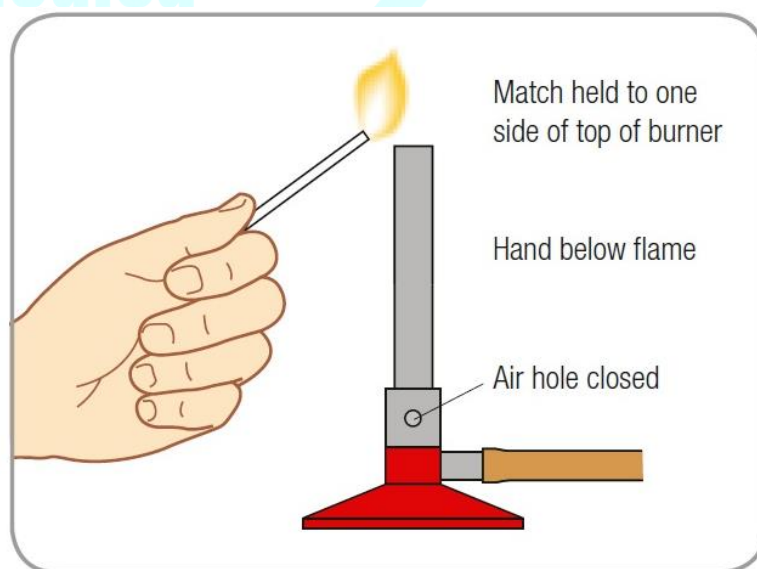


## Parts of the Bunsen Burner

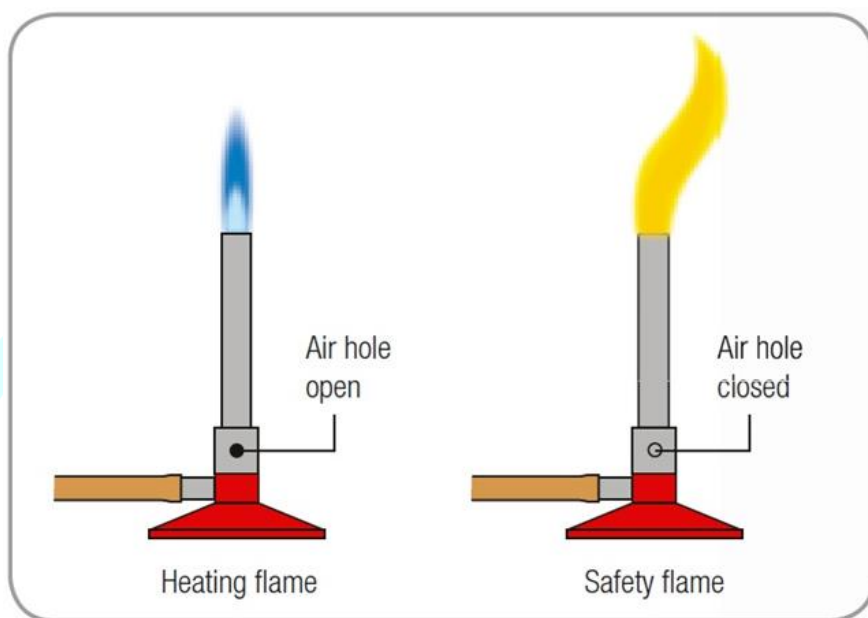


## How to light a Bunsen Burner

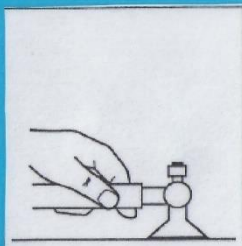
1. Connect hose to gas tap.
2. Make sure the air hole is closed.
3. LIGHT THE MATCH and place near the top of the Bunsen burner.
4. Turn on gas LAST.



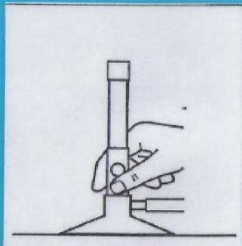
## Different Flames



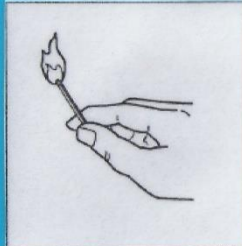
## How to light a Bunsen Burner



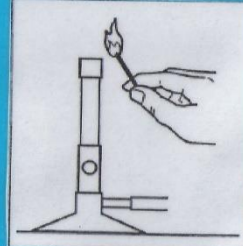
Attach the rubber hose of the Bunsen burner to the gas tap.



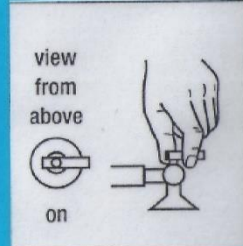
Close the air hole.



Light a match.



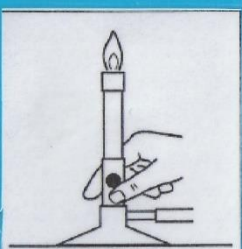
Place the flame of the match near the top of the Bunsen burner.



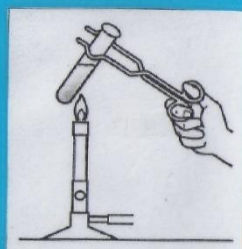
Turn on the gas at the gas tap.



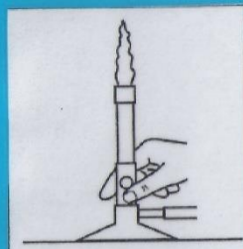
Blow out the match.



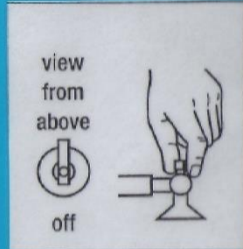
Open the air hole.



Hold the test tube above the Bunsen burner.



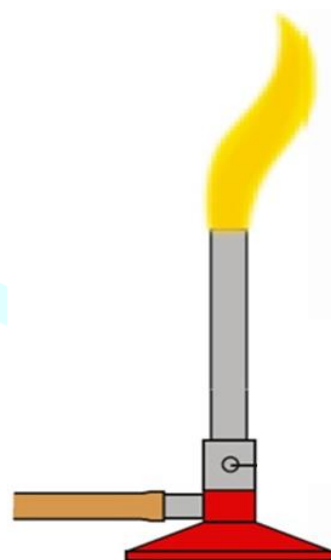
Close the air hole again.



Turn off the gas tap.

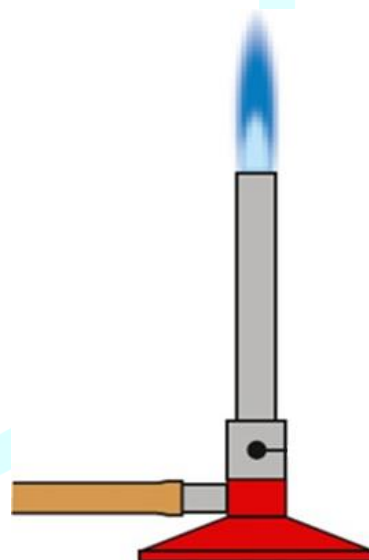
## Characteristics of the **Yellow Flame**

- 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.



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## Complete combustion and Incomplete combustion

### Fuel/oxidant mixture: natural gas/air

#### with sufficient oxygen supply: 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<sub>4</sub>) and produce carbon dioxide and water.

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

This example is for methane fuel:  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) + \text{Energy}$ .

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

#### with insufficient oxygen supply: incomplete combustion

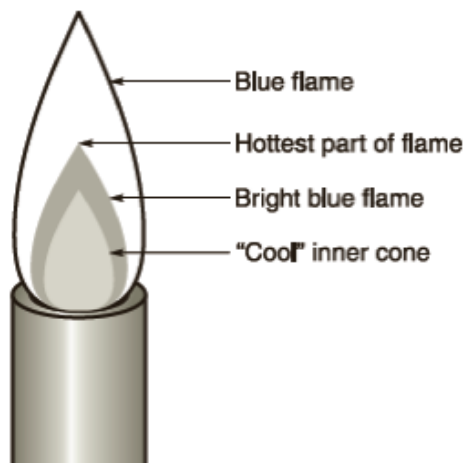
If you see a **yellow** flame you know **incomplete combustion** is occurring and there is **insufficient oxygen** gas present to burn the fuel

▶  $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{CO}(\text{g, toxic,}) + \text{C}(\text{carbon particles, smoke}) + \text{H}_2\text{O}(\text{g})$

**Flame characteristics:** Yellow, luminous Flame.

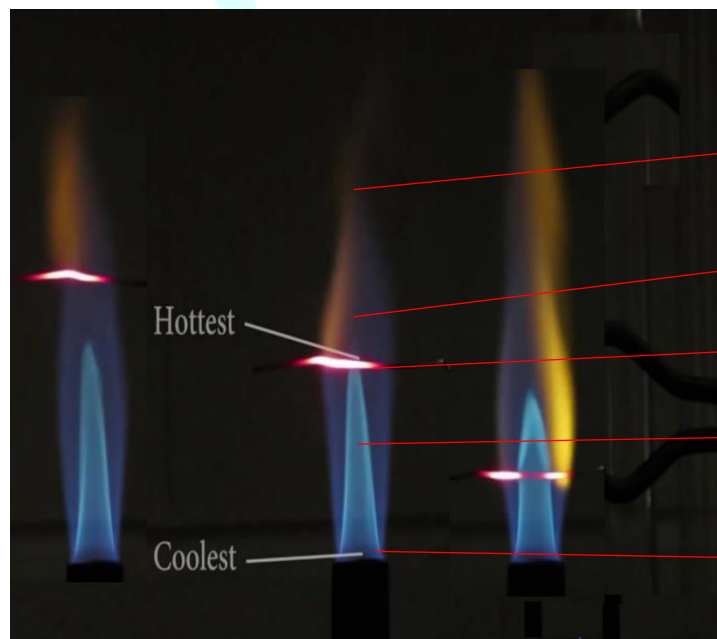
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A properly adjusted Bunsen flame has 3 distinct cones (zones): outer cone, inner - cone (the hottest part of the flame, about 1600°C) and base cone.



**Figure 1.3** Flame of a properly adjusted Bunsen burner.

Parts of a flame



Top of the flame (~1000 °C)

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

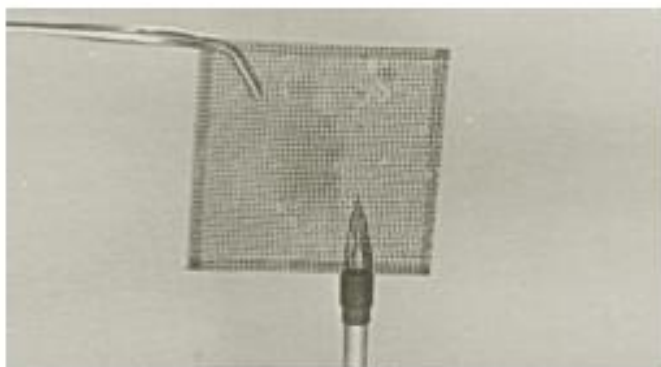
Top of inner core (~1650 °C)

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°C), Cu (m.p: 1083°C), and Al (m.p: 660°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:  $\pm 0.01$  g, not in use currently

✓ **Electronic balances:**

a) **Top-loading balances**, sensitivity:  $\pm 0.01$  or  $\pm 0.001$  g, used in general chemistry labs.

B) **Analytical balances**, sensitivity:  $\pm 0.0001$  or  $\pm 0.00001$  g, widely used in analytical chemistry lab.

### **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.



### **Top-Loading Balances**

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



### **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?

$$D = \frac{\text{Mass}}{\text{Volume}}$$

SI system ,(g/mL, Kg/L)

lb/gal in English system

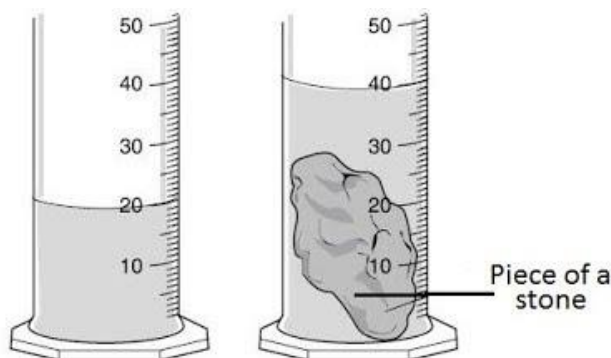
Review physical and chemical properties of substances, as well as intensive and extensive properties.

### 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 Roll (المخبر المدرج) 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.



## How to calculate the volume of an irregular shaped solid object (a stone)

### 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.

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