

Heat Demonstration Kit

Index




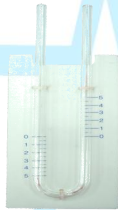









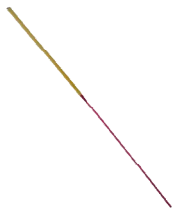
1. Fluid Volume Expansion Experiment	P05
2. Gas Volume Expansion Experiment	P08
3. Production of Liquid Thermometer	P13
4. Saturated Steam Experiment	P16
5. Metal Ball Expansion Experiment	P18
6. Linear Expansion Experiment	P22
7. Solid Thermal Conduction Experiment	P25
8. Solid Specific Heat Experiment	P28
9. Thermal Equilibrium Experiment	P32
10. Fluid Convection Experiment	P34
11. Gas Convection Experiment	P37
12. Thermal Radiation Experiment	P40

Instrument

NO	Accessory	Quantity	NO	Accessory	Quantity
1	Aluminum Base	1	2	Alcohol Burner	1
3	Alcohol Burner Holder	1	4	Water Convection Glass Tube	1
5	Flask	1	6	Thermal Radiation Aluminum Tube Holder	1
7	U-shaped manometer	1	8	Ring-Shaped Heated Seat	1
9	Ceramic Fiber Net	1	10	Linear Expansion Experimental Stick • copper stick /1pc • iron stick /1pc • aluminum stick /1pc	3
11	Linear Expansion Scale	1	12	Removable Stand	1
13	Removable Pedestal	1	14	Iron Bar	1
15	Thermal Radiation Aluminum Tubes • black bottle /1pc • white bottle /1pc • original aluminum bottle /1pc each with rubber plug	3	16	Thermal Conductivity Aluminum Piece	1
17	Solid Thermal Conduction Device	1	18	Ball Expansion Experimental Ball	1
19	Ball Expansion Experimental Ring	1	20	Incense	1
21	Electronic Thermometer	3	22	Calorimeter (including a steel cup)	2
23	Air Convection Box	1	24	Saturated Steam Experimental Device	1
25	Hose (50cm)	1	26	Air Convection Metal Bar	1
27	Forceps	1	28	Three-Prong Clamp	1



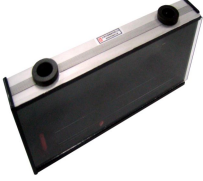


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29	Solid Specific Heat Metal Piece • copper piece /1pc • iron piece /1pc • aluminum piece /1pc	3	30	Candle	1
31	Acrylic Tube	1	32	Dropper	1
33	Bulb Holder	1	34	Bulb	1
35	DC Power Supply (12V)	1			

				
1	2	3	4	5
				
6	7	8	9	10
				
11	12	13	14	15
				
16	17	18	19	20

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21	22	23	24	25

				
26	27	28	29	30
				
31	32	33	34	35

Experiment 1: Fluid Volume Expansion Experiment

Purpose

Observe the changes between the volume and temperature of the liquid.

Instrument

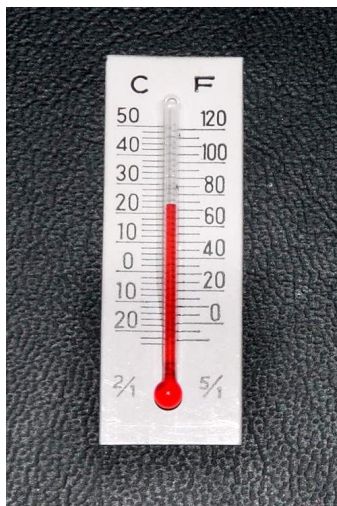
NO	Accessory	Qty	NO	Accessory	Qty
1	Aluminum Base	1	2	Alcohol Burner	1
3	Alcohol Burner Holder	1	5	Flask	1
7	U-shaped Manometer	1	8	Ring-shaped Heated Seat	1
9	Ceramic Fiber Net	1	13	Removable Pedestal	1
14	Iron Bar	1	21	Electronic Thermometer	1
22	Steel cup (in the calorimeter)	1	25	Hose (50cm)	1
28	Three-Prong Clamp	1	31	Acrylic Tube	1

Theory

When a material is heated, the molecules vibrate more due to the internal temperature raise (energy boost), so that the distance between molecules increases to make the material expand. On the contrary, when the temperature decreases, the distance between molecules shortens, and the material contracts. Therefore, most materials expand or contract with the increase or decrease in temperature.

NOTE

1. Use the alcohol burner lampshade to put off the flame, and do not blowing the flame.
2. The temperature of the apparatus is still very high after heating; use the gloves to handle the apparatus. Do not take the apparatus with bare hands.
3. Be careful when using the glassware, in case the glassware breaks and causes slashes.



Procedure

1. Fix the alcohol burner holder and the removable pedestal on the aluminum base. And then add alcohol to the burner and set the burner on the holder. Tighten the iron bar into removable pedestal as shown in Figure 1.
2. Set the ring-shaped heated seat with the iron bar at an appropriate distance. And then cover the burner with the ceramic fiber net, and adjust the burner position so that the ceramic fiber net can be right above the flame as shown in Figure 2.



Figure 1

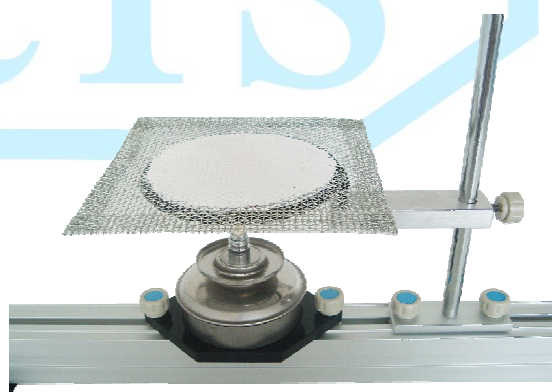


Figure 2

3. Fix the three-prong clamp on the iron bar and then use the three-prong clamp to clip the flask filled with water. Second, plug the rubber plug in and stick the acrylic tube into the flask. Finally, put the steel cup filled with right amount of water on the net as a container for heating water, and then put the flask in the steel cup as shown in Figure 3.

4. Fix the U-shaped manometer on the iron bar and fill in some colored water in it. Then, use the hose to connect the manometer with the acrylic tube as shown in Figure 4.

5. Light alcohol burner to heat up the water, and then measure the temperature using the electronic thermometer. Observe the changes of the water level and write down.

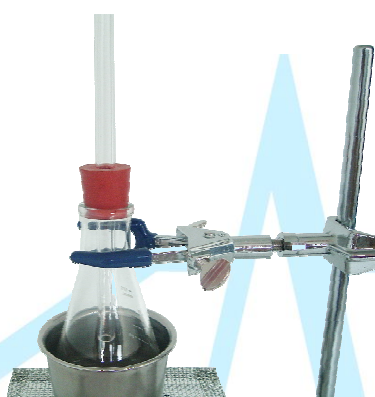


Figure 3

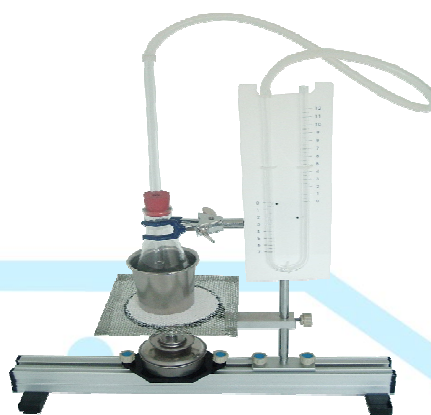


Figure 4

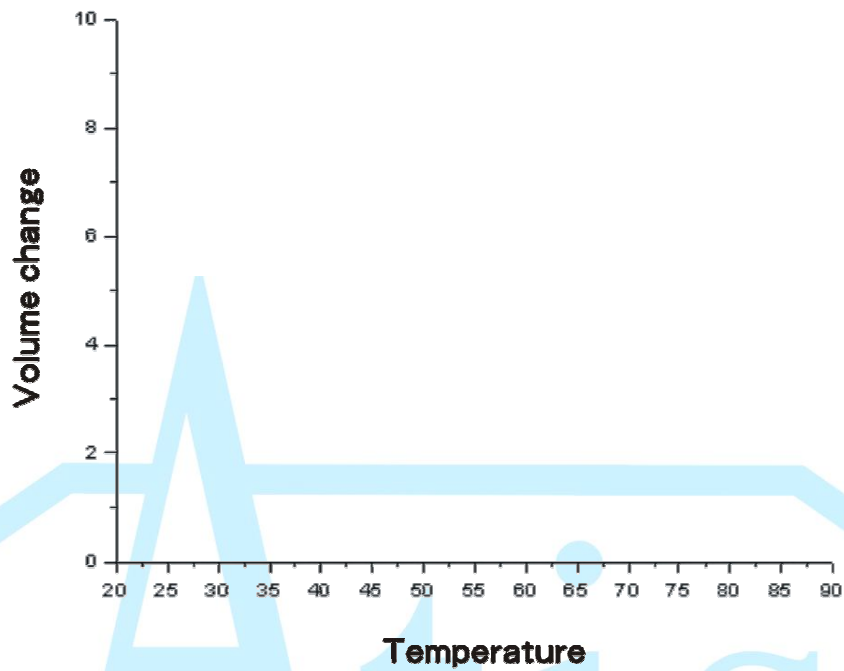
Experimental Record

Relationship between the volume and temperature

Temperature (°C)	25°	30°	35°	40°	45°	50°	55°
Volume change							

Temperature (°C)	60°	65°	70°	75°	80°	85°	90°
Volume change							

2. Draw the diagram between the volume and temperature.



Questions and Discussions

1. Does all liquid expand with temperature? If not, please explain why and give examples.
2. Does a small portion of air in the acrylic tube, hose and U-shaped manometer cause errors in the experiment? Why?

Experiment 2: Gas Volume Expansion Experiment

Purpose

Verify gas thermal expansion and use the characteristic to make a gas thermometer.

Instrument

NO	Accessory	Qty.	NO	Accessory	Qty.
1	Aluminum Base	1	2	Alcohol Burner	1
3	Alcohol Burner Holder	1	5	Alcohol Burner Holder	1
7	Flask	1	8	Ring-Shaped Heated Seat	1
9	U-shaped manometer	1	13	Removable Pedestal	1
14	Iron Bar	1	21	Electronic Thermometer	1
22	Steel cup (in the calorimeter)	1	25	Hose (50cm)	1
28	Three-Prong Clamp	1	31	Acrylic Tube	1

Theory

When a quantitative gas at low density, the temperature increases 1 ° C and the volume stays the same, the pressure increases 1/273.15% when the gas pressure at 0 ° C. Assume the gas pressure at 0 ° C P_0 , and the pressure at t ° C P , so P can be expressed as the following formula:

$$P = P_0 + \frac{1}{273.15} P_0 \Delta T \quad (1)$$

This is called Charles – Louis Gay-Lussac's Law (Joseph-Louis Gay-Lussac, 1778 ~1850). In science, the use of a constant volume of noble gases, such as helium (He), argon (Ar) is to make the standard thermometer. Because the volume expansion of gases is far greater than solid and liquid, when the constant volume of gas in a fixed container, the heated volume expansion on the temperature scale is greater than the expansion of liquid and solid- it's called constant volume gas thermometer. In this experiment, we use the U-shaped manometer to define the temperature scale T_{air} -

$$T_{\text{air}} = \frac{T_f - T_i}{P_f - P_i} \quad (2)$$

In the formula, T_i and T_f individually mean before and after heating temperature, when the temperature is T_i , the pressure will be P_i ; when the temperature is T_f , the pressure will be P_f .

Procedure

1. Fix the alcohol burner holder and the removable pedestal on the aluminum base. And then add alcohol to the burner and set the burner on the holder. Tighten the iron bar into removable pedestal as shown in Figure 1.
2. Set the ring-shaped heated seat with the iron bar at an appropriate distance. And then cover the burner with the ceramic fiber net, and adjust the burner position so that the ceramic fiber net can be right above the flame as shown in Figure 2.

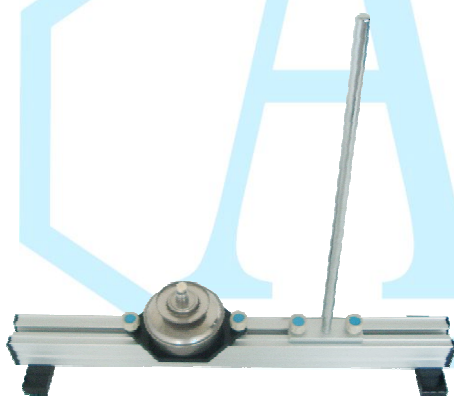


Figure 1

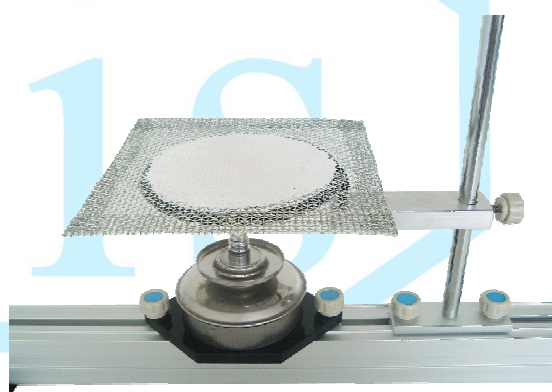


Figure 2

3. Fix the three-prong clamp on the iron bar and then use the three-prong clamp to clip the flask filled with water. Second, plug the rubber plug in and stick the acrylic tube into the flask. Finally, put the steel cup filled with right amount of water on the net as a container for heating water, and then put the flask in the steel cup as shown in Figure 3.