

5. Experimental Contents

- 1) Measure the specific heat capacity ratio of air at constant volume and constant pressure
- 2) Observe thermodynamic process of air
- 3) Learn how to measure gas pressure and temperature using related sensors.

6. Experimental Procedures

- 1) Refer to Figures 1 and 5 to set up the apparatus. **Warning:** ensure to connect the positive (red)/negative(black) poles of the AD590 correctly, as incorrect wiring could damage the sensor.
- 2) Use the multifunctional barometer to measure the atmospheric pressure P_0 and monitor the ambient room temperature T_0 . Turn on the power of the electric unit, preheat for 20 minutes. Zero the voltmeter display of pressure measurement.
- 3) Close valve C_2 and open valve C_1 . Pump some quantity of air into the container bottle using the rubber ball. Watch the change in pressure and temperature on the two meters. Wait for the pressure and temperature in the container bottle to get stabilized (close to ambient temperature), record the voltage values of pressure P_1' and temperature T_1' (the corresponding pressure and temperature are P_1 and T_1 , respectively).
- 4) Quickly open valve C_2 to reduce the air pressure in the bottle to the ambient atmospheric pressure P_0 , then close C_2 immediately. Now, the air temperature in the bottle drops to T_2 .
- 5) The air temperature in the bottle will increase gradually. Wait for the voltage value of the temperature meter to get stabilized at T_1'' (i.e. temperature reaches to the ambient temperature again, so T_1'' should be very close to T_1'). Now, record the voltage values of pressure and temperature as P_2' (corresponding pressure P_2) and T_1'' , respectively.
- 6) Finally, calculate the air specific heat ratio γ per Equation (5).

Notes:

- 1) In Step 4), after opening valve C_2 , when the sound of air release disappears, quickly close the valve. Closing valve C_2 too early or too late will affect the experimental results and introduce larger errors.
- 2) The experiment requires an environment with stable and constant ambient temperature. Do not place the setup close to a window or under the sun light.
- 3) After sealing any leak, wait for the sealant to dry before doing experiment.
- 4) It takes a long time for air in the bottle to return to room temperature after pumping and releasing process during which the room temperature must maintain at a stable value.

7. Example of Data Recording and Processing

Note: the following data are for reference purposes only, not the criteria for apparatus performance.

The sensitivity of the pressure meter is 20 mV/1000 Pa. If pressure and voltage are represented in units of 1×10^5 Pa and mV, respectively; then $P_1 = P_0 + P_1' / 2000$ and $P_2 = P_0 + P_2' / 2000$. By using Equation (5), the specific heat ratio of air was derived with the experimental results shown in the table below:

P_0 (10^5 Pa)	P_1' (mV)	T_1' (mV)	P_2' (mV)	T_1'' (mV)	P_1 (10^5 Pa)	P_2 (10^5 Pa)	γ
1.0171	108.4	1478.5	25.8	1474.8	1.0713	1.0300	1.32
	106.1	1477.8	29.3	1475.2	1.0702	1.0318	1.39
	111.1	1478.2	33.9	1477.9	1.0727	1.0341	1.45
	116.9	1478.9	28.4	1476.1	1.0756	1.0313	1.33

The average value of γ is 1.373, whereas the theoretical value is $\gamma=1.402$, leading to an error of 2.1%.