

Unit-10 Absolute Zero Experiment

Objective :

Verify absolute zero over the absolute zero ball.

Apparatus :

Absolute zero ball, pressure sensor, temperature sensor, digital device, analog device, digital-analogy adapter, digital thermometer, electric bottle, plastic cylinder, stirring rod

Principle :

From Ideal gas equation, temperature T and gas pressure P can be represented as

$$T = \frac{V}{nR} P \quad (1)$$

Where T is absolute temperature.

Furthermore, $T = t + 273.5$, where t is Celsius degree. Above relation can be rewritten as

$$273.15 + t = \frac{V}{nR} P$$

Intercept of the linear regression line is absolute zero.

Remarks :

1. While water is heated by electric bottle, do not lay the pot near the corner for avoiding accident.
2. Absolute zero ball must be completely submerged in the water, so the ball reached thermal equilibrium with the water.

Procedure :

1. Open the software and set the parameters by instruction book.
2. Fill proper water into plastic cylinder (about 80-90°C, 1000 mL), and mix with a stirring rod, and then measure the water temperature with a digital thermometer if it reached thermal equilibrium.

- Until the water temperature reached thermal equilibrium, sink the absolute zero ball completely in hot water.
- Press start button to start catching data. While observing the 『Pressure - Time』 and 『Temperature - time』 diagram about 10-20 seconds, record the average absolute zero pressure P and temperature T from the ball.
- Change the temperature of hot water (pour cold water with another plastic cylinder), mix with stirring rod, and use digital thermometer to check the water temperature whether it reach thermal equilibrium.

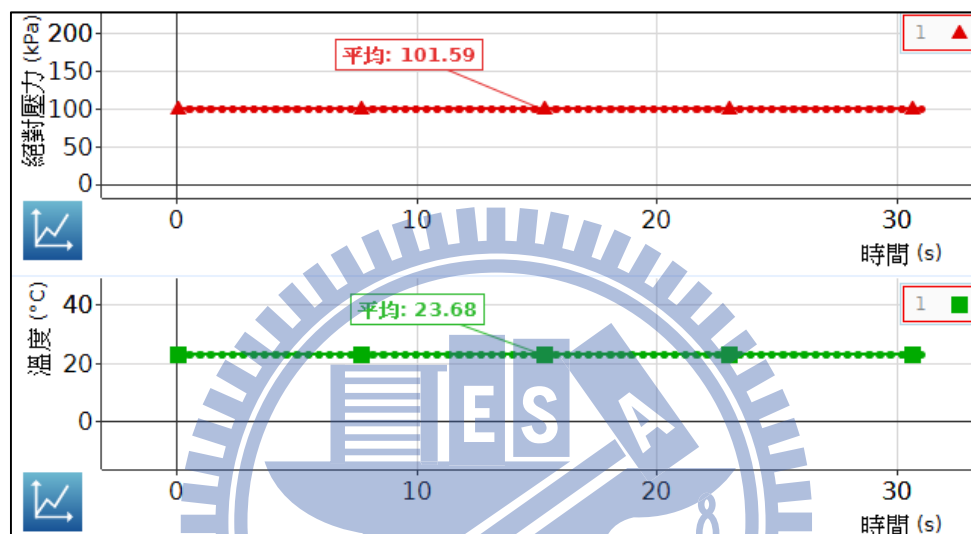
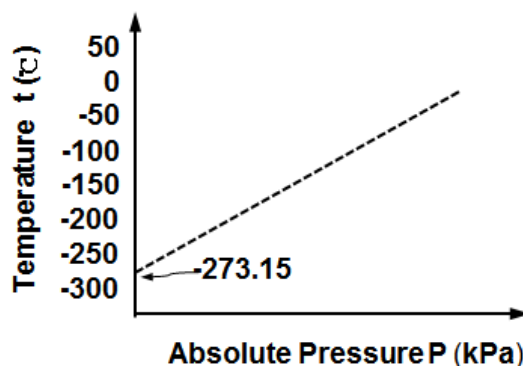


Figure 1. 『Pressure - Time』 and 『Temperature - Time』 diagram

- Repeat above steps, a total of eight groups of experimental data obtained.
[Note] The water temperature is not lower than 30°C .
- Plot $t(^{\circ}\text{C}) - P(\text{kPa})$ diagram. Y-axis intercept of the linear regression line is absolute zero.



Questions :

1. If the absolute ball is not completely submerged in the water, whether it will affect the experiment accuracy? Please explain.
2. The time when the water temperature is below 30°C will affect the experiment accuracy? Please explain.

