

### 三. 证明题.

1. 证明:

已知  $p_0 V = \nu R T_1$ , 内能  $U_1 = \nu \times \frac{5}{2} R T_1 = \frac{5}{2} p_0 V$ ,

已知  $p_0 V = \nu R T_2$ ,  $\nu_2 = \frac{p_0 V}{R T_2}$ ,  $U_2 = \nu_2 \times \frac{5}{2} R T_2 = \frac{p_0 V}{R T_2} \cdot \frac{5}{2} R T_2$

$$= \frac{5}{2} p_0 V = \frac{5}{2} \nu R T_1,$$

得证:

### 四. 计算题.

1. 解: 可得  $p v^2 = a$ , 气体所做功

$$W' = \int_{v_1}^{v_2} p dv = \int_{v_1}^{v_2} \frac{a}{v^2} dv = a \left( \frac{1}{v_1} - \frac{1}{v_2} \right)$$

由  $p v^2 = a$  及  $p v = \nu R T$ , 得

$$v = \frac{a}{\nu R T},$$

即

$$T_1 - T_2 = \frac{a}{\nu R} \left( \frac{1}{v_1} - \frac{1}{v_2} \right)$$

2. 已知

$$\int_0^{V_F} \frac{4\pi A}{N} v^4 dv = 1, \quad \text{得} \quad \frac{4\pi A}{N} \frac{V_F^5}{5} = 1, \quad A = \frac{5N}{4\pi V_F^5},$$

平均动能计算为

$$\int_0^{V_F} \frac{1}{2} m v^2 \cdot \frac{4\pi A}{N} v^4 dv = \frac{4\pi A}{N} \left( \frac{1}{2} m \right) \frac{V_F^5}{5}$$

代入 A 值, 得

$$\bar{\epsilon}_k = \frac{4\pi}{N} \left( \frac{5N}{4\pi V_F^5} \right) \cdot \left( \frac{1}{2} m \right) \frac{V_F^5}{5} = \frac{3}{5} \cdot \frac{1}{2} m V_F^2$$