

國立中央大學八十四學年度碩士班研究生入學試題卷

所別：大氣物理研究所

組

科目：熱力學

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1. Show that there is a relation (Mayer's relation)

$$C_p = C_v + R$$

between the isobaric and the isovolumic specific heats per mole of an ideal gas.

2. Show that the following relation exists between the adiabatic compressibility

$$K_{ad} = -\frac{1}{v} \left(\frac{\partial v}{\partial p} \right)_{ad} \text{ and the isothermal compressibility } K_T = \frac{1}{v} \left(\frac{\partial v}{\partial p} \right)_T :$$

$$K_{ad} = \frac{C_v}{C_p} K_T$$

where C_v and C_p are the specific heats at constant volume and constant pressure respectively.

3. Prove the following equation by operating a Carnot cycle using gas between two heat reservoirs of temperature T_1 and $T_2 = T_1 + dT$:

$$\left(\frac{\partial P}{\partial T} \right)_v = \frac{1}{T} \left\{ \left(\frac{\partial U}{\partial V} \right)_T + P \right\} ,$$

where U is the internal energy.

4. Show that the internal energy of a material where equation of state has the form $P = f(V)T$ is independent of the volume. Here $f(V)$ is a function of V only.

5. If a system underwent an isothermal and an adiabatic processes, respectively, which one could induce larger pressure change for a given volume change ?