

Heat Capacity

C_v = heat capacity at constant volume

$$\left[\frac{\text{J}}{\text{mol} \cdot \text{K}} \right]$$

c_v = specific heat capacity at constant volume

$$\left[\frac{\text{J}}{\text{kg} \cdot \text{K}} \right]$$

$$= \frac{C_v}{M} \quad \text{molar mass}$$

C_p = heat capacity at constant pressure

$$\left[\frac{\text{J}}{\text{mol} \cdot \text{K}} \right]$$

$$= C_v + R \quad (\text{Mayer's relation})$$

c_p = specific heat capacity at constant pressure

$$\left[\frac{\text{J}}{\text{kg} \cdot \text{K}} \right]$$

$$= \frac{C_p}{M} \quad \text{molar mass}$$

$$= c_v + R_s$$

Heat Capacity Ratio

$$\gamma = \frac{C_p}{C_v} = \frac{c_p}{c_v} = 1 + \frac{R_s}{C_v} = \frac{c_p}{c_p - R_s}$$

and further

$$C_v = \frac{R_s}{\gamma - 1}$$

$$C_p = \frac{\gamma R_s}{\gamma - 1}$$

Heat Capacity Ratio and Degrees of Freedom

$$\boxed{\gamma = 1 + \frac{2}{f}} \quad (\text{from adiabatic derivation})$$

where

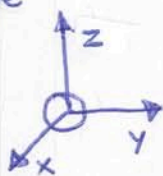
f = degrees of freedom of the gas molecule

for monatomic gas

$$f = 3$$

= 3 translational degrees of freedom

example



* can move in x, y or z

* rotation does not matter as it is a sphere.

so

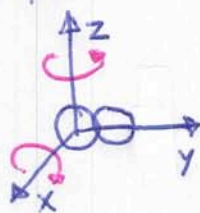
$$\boxed{\gamma = 1 + \frac{2}{3} = \frac{5}{3} = 1.\bar{6}}$$

for diatomic gas

$$f = 5$$

= 3 translational + 2 rotational degrees of freedom

example



* can move in x, y or z

* rotation around x or z axis

* rotation around y axis does not matter
(axis symmetric)

so

$$\boxed{\gamma = 1 + \frac{2}{5} = \frac{7}{5} = 1.4}$$