Specific and Molar heat capacity of Gases.

(1) **Specific heat (or specific heat capacity)** of a substance is the quantity of heat (in calories, joules, kcal, or kilo joules) required to raise the temperature of 1g of that substance through $1^o C$. It can be measured at constant pressure (c_p) and at constant volume (c_v).

(2) **Molar heat capacity** of a substance is the quantity of heat required to raise the temperature of 1 mole of the substance by $1^o C$.

$\therefore$ Molar heat capacity = Specific heat capacity × Molecular weight, i.e.,

$$C_v = c_v \times M \text{ and } C_p = c_p \times M.$$

(3) Since gases upon heating show considerable tendency towards expansion if heated under constant pressure conditions, an additional energy has to be supplied for raising its temperature by $1^o C$ relative to that required under constant volume conditions, i.e.,

$$C_p > C_v \text{ or } C_p = C_v + \text{Work done on expanson, } P\Delta V (= R)$$

Where, C_p = molar heat capacity at constant pressure; C_v = molar heat capacity at constant volume.

Note: C_p and C_v for solids and liquids are practically equal. However, they differ considerable in case of gas because appreciable change in volume takes place with temperature.

(4) **Some useful relations of C_p and C_v**

(i) $C_p - C_v = R = 2\,calories = 8.314\,J$

(ii) $C_v = \frac{3}{2}R$ (For monoatomic gas) and $C_v = \frac{3}{2} + x$ (for di and polyatomic gas), where x varies from gas to gas.

(iii) $\frac{C_p}{C_v} = \gamma$ (Ratio of molar capacities)

(iv) For monoatomic gas $C_v = 3\,calories$ whereas, $C_p = C_v + R = 5\,calories$

(v) For monoatomic gas, $(\gamma) = \dfrac{C_p}{C_v} = \dfrac{\frac{5}{2}R}{\frac{3}{2}R} = 1.66$.

(vi) For diatomic gas $(\gamma) = \dfrac{C_p}{C_v} = \dfrac{\frac{7}{2}R}{\frac{5}{2}R} = 1.40$

(vii) For triatomic gas $(\gamma) = \dfrac{C_p}{C_v} = \dfrac{8R}{6R} = 1.33$

Values of Molar heat capacities of some gases,

Gas	C_p	C_v	$C_p - C_v$	$C_p/C_v = \gamma$	Atomicity
He	5	3.01	1.99	1.661	1
N_2	6.95	4.96	1.99	1.4	2
O_2	6.82	4.83	1.99	1.4	2
CO_2	8.75	6.71	2.04	1.30	3
H_2S	8.62	6.53	2.09	1.32	3