

Answer on Question #43120 – Physics – Molecular Physics | Thermodynamics

Question.

Find the magnitude and ratio of internal energies for 5 moles of mono-atomic gas to the di-atomic gas at temperature 27°C.

Given:

$$\nu = 5 \text{ moles}$$

$$T = 27^\circ\text{C} = 300 \text{ K}$$

Find:

$$U_1 = ? \quad U_2 = ?$$

$$\frac{U_2}{U_1} = ?$$

Solution.

From the thermodynamics it's known that internal energy is:

$$U = \frac{i}{2} \nu RT$$

i is the number of degrees of freedom;

$R = 8.31 \frac{J}{\text{mole}\cdot\text{K}}$ is the gas constant.

For monoatomic gas $i = 3$, for diatomic gas $i = 5$.

So,

$$U_1 = \frac{3}{2} \nu RT; \quad U_2 = \frac{5}{2} \nu RT$$

Calculate:

$$U_1 = \frac{3}{2} 5 \cdot 8.31 \cdot 300 = \frac{3}{2} 12465 = 18697.5 \text{ J}$$

$$U_2 = \frac{5}{2} 5 \cdot 8.31 \cdot 300 = \frac{5}{2} 12465 = 31162.5 \text{ J}$$

And

$$\frac{U_2}{U_1} = \frac{5}{3}$$

Answer.

$$U_1 = \frac{3}{2} \nu RT = 18697.5 J$$

$$U_2 = \frac{5}{2} \nu RT = 31162.5 J$$

$$\frac{U_2}{U_1} = \frac{5}{3}$$

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