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General Physics-II, Quiz 6-Sol
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St. ID:__________________ Name:________________

Solutions:

1. (a) Write down the first law of thermodynamics (Equation). [10+20 = 30]

Solution:

(a) $dE_{Int.} = dQ - dW$ (If the work is done by system)

or $dE_{int.} = dQ + dW$ (If the work is done on the system by external source)

Where, E_{int} = Internal energy of a system
Q = Heat
W = Total work

(b) Mark (√) the right condition for the thermodynamical processes bellow:

Adiabatic process	√Q = 0/ W = 0/ $\Delta E_{int} = 0$?
Constant Volume process	Q = 0/ √W = 0/ $\Delta E_{int} = 0$?
Closed Cycle process	Q = 0/ W = 0/ √$\Delta E_{int} = 0$?
Free Expansion process	√Q = W = 0 / $\Delta E_{int} = 0$?

2. For an isobaric expansion of an ideal gas at 300 K and 5.50 kPa, if the volume is increased from 1 m^3 to 5 m^3 and 12.5 kJ energy is transferred to the gas by heat. Find out (a) the change in its internal energy and (b) its final temperature ? [30]

Solution:

(a) We use the energy version of the non-isolated system model.

$$\Delta E_{int} = Q + W$$

Where, $W = -P\Delta V$ for a constant-pressure process so that

$$\Delta E_{int} = Q - P\Delta V$$

$$= 12.5 \text{ kJ} - 5.50 \text{ k Pa} (5 \text{ m}^3 - 1 \text{ m}^3) = 28 \text{ kJ}$$

(b) Since pressure and quantity of gas are constant, we know the equation of state is

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2}{V_1} T_1 = \left(\frac{5\,\text{m}^3}{1\text{m}^3} \right) (300\,\text{K}) = 1500K$$

3. (a) Write down the formula of total kinetic energy of an ideal gas interms of temperature (T). (b) If a 10-L of oxygen-cyllinder contains O_2 gas at 22.0°C and 5 atm., find out the total translational kinetic energy of the gas molecules. (1 atm = 1.013×10^5 Pa) [10+30 = 40]

Solution :

(a) Total kinetic energy, $K_{total} = \frac{3}{2}\text{nRT}$

Where , n = N/N_A for the number of moles of gas

R= Universal gas constant (8.31 J/mol. K)

T = temperature

(b) From the ideal gas law,

$$PV = nRT = \frac{2N}{3}(\frac{1}{2}m_0\upsilon^2) = \frac{N}{3}(m_0\upsilon^2)$$

The total translational kinetic energy is $E_{\text{trans}} = N(\frac{1}{2}m_0\upsilon^2)$

$$E_{\text{trans}} = \frac{3}{2}PV = \frac{3}{2}\left(5 \times 1.013 \times 10^5\,\text{Pa}\right)\left(10 \times 10^{-3}\,\text{m}^3\right)$$

$$\therefore E_{\text{trans}} = 7.59kJ$$