[PHYSICS]

1. $\dfrac{C_{H_2}}{C_{O_2}} = \sqrt{\dfrac{32}{2}} = 4$

   or $C_{H_2} = 4 \times C_{O_2} = 4 \times 400\ \text{ms}^{-1} = 1600\ \text{ms}^{-1}$

2. The kinetic energy of gas w.r.t. centre of mass of the system $\text{K.E.} = \dfrac{5}{2}nRT$

   Kinetic energy of gas w.r.t. ground = Kinetic energy of centre of mass w.r.t. ground + Kinetic energy of gas w.r.t. centre of mass.

   $\text{K.E.} = \dfrac{1}{2}MV^2 + \dfrac{5}{2}nRT$

3. Ideal gas equation $PV = \mu RT = \left(\dfrac{N}{N_A}\right)RT$ where N

   = Number of molecule, N_A = Avogadro number

   $\therefore \dfrac{N_1}{N_2} = \left(\dfrac{P_1}{P_2}\right)\left(\dfrac{V_1}{V_2}\right)\left(\dfrac{T_2}{T_1}\right) = \left(\dfrac{P}{2P}\right)\left(\dfrac{V}{V/4}\right)\left(\dfrac{2T}{T}\right) = \dfrac{4}{1}.$

4. $C = \sqrt{\dfrac{3RT}{M}}$ or $T \propto M$

   $\therefore \quad \dfrac{T'}{T} = \dfrac{4}{2} = 2$ or $T' = 2T$

   or $T = 2 \times 273\ \text{K} = 546\ \text{K}$

5. or $m \propto (1/P)$ or, $m_2 > m_1 \therefore P_2 < P_1$

6. Since the graph is a straight line,

   so, $V = mT$ where m is the slope.

   $= (nRT)/P$ [From equation of state]

7. Given:

    Initial volume $V_1 = 3V$

    Initial pressure $P_1 = 2$ atmosphere.

    Final pressure

    $P_2 = 2P_1 = 2 \times 2 = 4$ atmosphere

    According to the Boyle's law we have

    $P_1 V_1 = P_2 V_2$ (where V_2 is the final volume of gas)

    or $2 \times 3V = 4 \times V_2$ or $V_2 = 1.5\,V$

8. For a given pressure, V is small for T_1. Since $V \propto T$, therefore, $T_1 < T_2$.

9. When, the container stops, its total kinetic energy is transferred to gas molecules in the form of translational kinetic energy, thereby increasing the absolute temperature.

    Assuming n = number of moles.

    Given, m = molar mass of the gas.

    If ΔT = change in absolute temperature.

    Then, kinetic energy of molecules due to velocity v_0,

    $$\Delta K_{motion} = \frac{1}{2}(mn)v_0^2 \qquad (i)$$

    Increase in translational kinetic energy

    $$\Delta K_{translation} = n\frac{3}{2}R(\Delta T) \qquad (ii)$$

    According to kinetic theory Eqs. (i) and (ii) are equal

    $$\Rightarrow \quad \frac{1}{2}(mn)v_0^2 = n\frac{3}{2}R(\Delta T)$$

    $$(mn)v_0^2 = n3R(\Delta T)$$

    $$\Rightarrow \quad \Delta T = \frac{(mn)v_0^2}{3nR} = \frac{mv_0^2}{3R}$$

10. $$\frac{C_t}{C_0} = \sqrt{\frac{273 + t}{273}}$$

    or $4 \times 273 - 273 = t$

    or $t = 3 \times 273 = 819°C$

11. 3 moles of H_2 are given.

12. $PV = \mu RT$, $PV = \dfrac{n}{N} \times hNT$ or $n = \dfrac{PV}{kT}$

13. For a constant value of density, pressure is more at T_1.

    $\therefore \quad T_1 > T_2 \qquad\qquad [\because P \propto T]$

14.

15. Initial volume of gas = V_1

    Final volume of gas = V_2

    Initial temperature of gas T_1 = 27°C = **300 K**

    Final temperature of gas T_2 = 54°C = **327 K**

    Now from the Charles's law at constant pressure

    $$\frac{V_1}{V_2} = \frac{T_1}{T_2} = \frac{300}{327} = \frac{100}{109}$$

16.

17. The given statement is zeroth law of thermodynamics. It was formulated by R. H. Fowler in 1931

18. The internal energy of ideal gas depends only upon temperature of gas not on other factors.

19. For monoatomic gas, $\dfrac{\Delta U}{Q} = \dfrac{1}{3}$ or, $\Delta U = \dfrac{Q}{3}$

    From the first law of thermodynamics,

    $$Q = \Delta U + W \quad \therefore \quad W = (2/3)Q$$

20. $\Delta U = nC_V \Delta T = n(5/2)R\Delta T$

    $\Delta Q = nC_P \Delta T = n(7/2)R\Delta T$

    $W = \Delta Q - \Delta U = \dfrac{n7}{2}R\Delta T - \dfrac{n5}{2}R\Delta T = nR\Delta T$

    $\dfrac{W}{\Delta U} = \dfrac{2}{7}$