

CHEMISTRY - MODULE 3

SYLLABUS: GASEOUS STATE & THERMODYNAMICS

Single Correct Answer Type

1.

Sol. $n_{(O_2+O_3)} = \frac{1120}{22400} \text{ mol} = 0.05 \text{ mol.}$

& $n_{O_2} + n_{O_3} = n_{(O_2+O_3)} \Rightarrow n_{O_2} + n_{O_3} = 0.05 \quad \dots\dots (1)$

$32 n_{O_2} + 48 n_{O_3} = 1.76$

$\Rightarrow 2 n_{O_2} + 3 n_{O_3} = 0.11 \quad \dots\dots (2)$

From (1) & (2) $n_{O_2} = 0.04 \text{ mol}$ $n_{O_3} = 0.01 \text{ mol}$

Vol of $O_2 = 22400 \text{ ml} \times 0.04 = 896 \text{ ml}$

4.

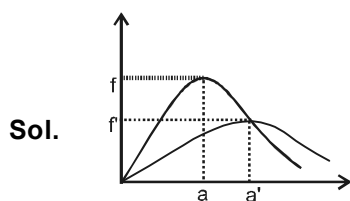
Sol. Using $p_1 V_1 = P_2 V_2$ $1 \times 2.5 = 0.5 \times P_2 = 5 \text{ bar.}$

\therefore % increase in pressure = $\frac{(5-1)\text{bar}}{1\text{bar}} \times 100\% = 400 \%$.

5.

Sol. $\sqrt{\frac{8RT}{\pi M}} = 2 \sqrt{\frac{8 \times R \times 300}{\pi M}} \Rightarrow T = 1200 \text{ K} = 927^\circ\text{C}$

6.

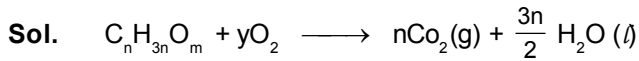


$f' < f$
 $a' > a$

(A)

f = fraction of molecules possessing velocity (V)
 a = most probable velocity.

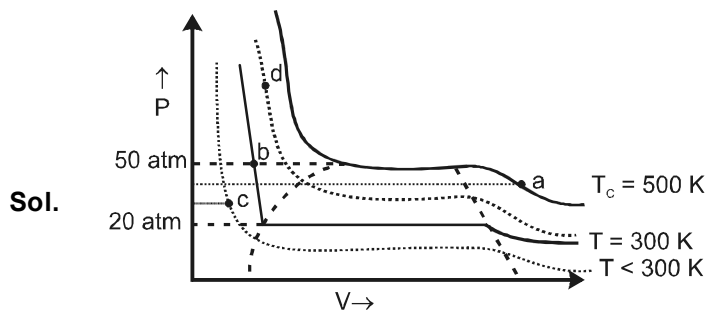
7.



$$\begin{aligned} \text{Contraction in volume} &= \text{Contraction in moles of gas} = 1 + \frac{3n}{4} - \frac{m}{2} \\ &= 1 + \frac{3n}{4} - \frac{m}{2} \end{aligned}$$

$$\Rightarrow \left(2n + \frac{3n}{2} - m\right) \times \frac{1}{2} = y \quad \Rightarrow \quad n + \frac{3n}{4} - \frac{m}{2} = y$$

8.



- (a) at $T = 500\text{ K}$, $P = 40\text{ atm}$ corresponds to 'a' substance - gas
 (b) at $T = 300\text{ K}$, $P = 50\text{ atm}$ corresponds to 'b' substance - liquid
 (c) at $T < 300\text{ K}$, $P > 20\text{ atm}$ corresponds to 'c' substance - liquid
 (d) at $T < 500\text{ K}$, $P > 50\text{ atm}$ corresponds to 'd' substance - liquid
 So, Answer **(D)**

9.

Sol. (A)

For constant pressure $V \propto T$, hence linear dependence with the slope

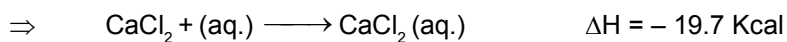
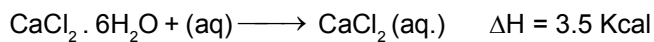
10.

Sol. (A)

Use $\Delta G = \Delta H - T\Delta S$

11.

Sol. (B)



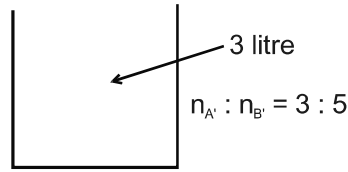
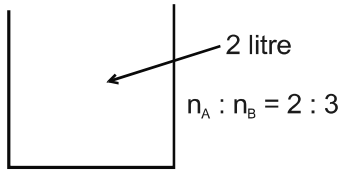
12.

Sol. (C)

$$b = \frac{16}{3} \pi r^3 \times N_a$$

13.

Sol. (A)



$$\frac{n_A}{n_B} = \frac{2}{3}$$

$$n_A = \frac{2}{3} n_B$$

Put the value of n_A , $n_{B'}$, $n_{A'}$ and $n_{B'}$ and get.

$$\text{mean molar mass} = \frac{(n_A + n_{A'})m_A + (n_B + n_{B'})m_B}{(n_A + n_B + n_{A'} + n_{B'})}$$

$$\frac{n_{A'}}{n_{B'}} = \frac{3}{5}$$

$$n_{A'} = \frac{3}{5} n_{B'}$$

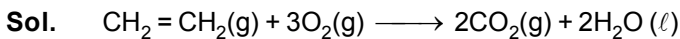
14.

Sol. (B)

$$\Delta G = \Delta H - T\Delta S$$

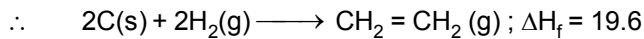
If $T\Delta S$ dominates ΔH at high temperature then $\Delta G < 0$ hence CaCO_3 decomposes at high temperature.

15.



$$\therefore -330 = [2 \times (-94.2) + 2(-61)] - \left[\Delta H_f^\circ \text{C}_2\text{H}_4 \right]$$

$$\therefore \Delta H_f^\circ (\text{C}_2\text{H}_4) = 19.6 \text{ Kcal mol}^{-1}$$



$$\therefore \Delta H_{\text{Reaction}} = \sum \text{B.E.}_{(\text{Reactants})} - \sum \text{B.E.}_{(\text{Products})}$$

on substituting the value in above relation we get $\text{B.E.}_{(\text{C}=\text{C})} = 122 \text{ Kcal / mol}$

16.

Sol. (A)

In process-1 heat supplied = area under AB curve + $n \times c_v \times 100$ (isobaric process)

In process-2 heat supplied = area under AC curve (isothermal process)

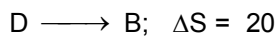
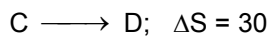
In process-3 heat supplied = 0 (adiabatic process)

In process-4 heat supplied = $n \times c_v (T - 600)$ = negative (isochoric process)

Ans. $Q_1 > Q_2 > Q_3 > Q_4$

17.

Sol. (D)



For $\text{A} \longrightarrow \text{B}; \Delta S = 50 + 30 - 20 = 60$

18.

Sol. (C)

There is some finite value of entropy at $t = 0$. It increases constantly till the temperature of the copper block and surrounding is equal. This will be the equilibrium situation hence further change in entropy is restricted $\Delta S = 0$ at equilibrium.

19.

Sol. (B)

$$\Delta U = \Delta W$$

$$n C_v (T_2 - T_1) = -P \times (V_2 - V_1)$$

$$\frac{3}{2} R (T_2 - T) = -1$$

$$\therefore T_2 = T - \frac{2}{3 \times 0.0821}$$

20. **Sol. (A)**

All product and reactants are in solid state

So $\Delta S^\circ \approx 0$

$\Delta G^\circ = \Delta H - T\Delta S^\circ$

So $\Delta G^\circ \approx \Delta H^\circ$

21.

Sol. (C)

At phase transitions, entropy increases at constant temperature and it is zero at absolute zero.

22.

Sol. (C) Internal energy of a gas = $\frac{f}{2} nRT$

23.

Sol Entropy is extensive property & others are intensive properties.

24.

Sol. (D) $w = -P_{ext} \Delta V = -\Delta n_g RT$ and Δn_g is -ve for I and II
also $\Delta V = -ve$ for IV

25

Ans. 310.4 g escaped.

Sol. $\frac{n_1 T_1}{P_1} = \frac{n_2 T_2}{P_2} \quad \therefore \quad \frac{10 \times 300}{24.6} = \frac{n_2 \times 400}{1}$

$$\therefore n_2 = 0.3$$

$$\therefore \text{Mass of oxygen left} = 0.3 \times 32 = 9.6 \text{ g}$$

$$\therefore \text{Mass of oxygen escaped} = 320 - 9.6 = 310.4 \text{ g}$$

26.

Sol. (C) At const P,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{22.4}{273} = \frac{V_2}{373} \Rightarrow V_2 = 30.6 \text{ litre.}$$

27.

Sol. Various gas laws can be easily derived from kinetic equation obtained as a result of kinetic theory of gases.

CHEMISTRY - MODULE 3

SYLLABUS: GASEOUS STATE & THERMODYNAMICS

Multiple Correct Answer Type

1.
Sol. With increase in temperature, most probable velocity increases & fraction of molecules with velocity equal to M.P. velocity decreases. Total no. of molecules remain same.

3.
Sol. (B) $PV = \text{constant}$ for isothermal process
 $PV^\gamma = \text{constant}$ for adiabatic process so more value of γ , more decrease in pressure as volume increases.

5.
Sol. Fact

6.
Sol. Given $\frac{r_A}{r_B} = \frac{16}{3}$; $\frac{w_A}{w_B} = \frac{2}{3}$

we have $\frac{r_A}{r_B} = \frac{n_A}{n_B} \sqrt{\frac{M_B}{M_A}}$

$$\frac{16}{3} = \frac{w_A}{M_A} \frac{M_B}{w_B} \sqrt{\frac{M_B}{M_A}}$$

$$\frac{16}{3} = \frac{2}{3} \left(\frac{M_B}{M_A} \right)^{3/2} \Rightarrow \left(\frac{M_B}{M_A} \right)^{3/2} = 8 \Rightarrow \frac{M_B}{M_A} = 4$$

$$\therefore \text{mole ratio} = \frac{8}{3}$$

8.

Sol. (B, C)

At const. temperature $V \propto 1/p$

9.

Sol. (A) $\Delta_r H^0 = -100 - (-50) = -50 \text{ kCal / mol}$

(B) for maximum heat Al and Fe_2O_3 should be in 2:1 ratio i.e. 10 mole of Al and 5 mole of Fe_2O_3 hence heat released will be 250 kCal

(C) $\frac{50}{214} = 0.234 \text{ kCal/gm}$

(D) $V = \frac{54}{d_{\text{Al}}} + \frac{160}{d_{\text{Fe}_2\text{O}_3}}$

C.V. = $\frac{50}{V} = 0.714 \text{ kCal / cc]}$

10.

Sol. $r \propto \frac{1}{\sqrt{M}}$

11.

Sol.

$\text{HA} \longrightarrow \text{H}^+ + \text{A}^-; \Delta_r H = 1.4 \text{ kJ/mol}$

$\Delta H_{\text{neutralization}} = \Delta H_{\text{ionization}} + \Delta_r H \text{ of } (\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O})$

$-55.95 = \Delta H_{\text{ionization}} - 57.3$

$\Delta H_{\text{ionization}}$ for 1 M HA = 1.35 kJ/mol

% heat utilized by 1 M acid for ionization

$= \frac{1.35}{1.4} \times 100 = 96.43\%$

So, acid is $100 - 96.43 = 3.57\%$ ionized.

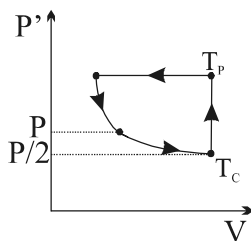
20.

Sol. $\Delta S_{\text{CD}} = 4 \ln 16$

$= nC_v R \ln \frac{T_D}{T_C}$

$\frac{T_D}{T_C} = 16 = \frac{P'}{P/2}$

$P' = 8P$



For AB $\frac{T_B}{T_A} = \left(\frac{P_A}{P_B} \right)^{\frac{1-\gamma}{\gamma}}$

$$\frac{T_B}{300} = (8)^{-1/3} = \frac{1}{2}$$

$$T_B = 150]$$

21.

Sol. Suppose the cylinder will burst at T_2 K

$$T_2 = \frac{P_2 T_1}{P_1} \quad (V_1 = V_2) = \frac{14.9 \times 300}{12} = 372.5 \text{ K}$$

22.

$$\text{Sol. } P_c = \frac{a}{27b^2} \qquad T_c^2 = \frac{64 a^2}{27 \times 27 R^2 b^2}$$

$$V_c = 3b \qquad \frac{T_c^2}{P_c} = \frac{64 a^2}{27 \times 27 R^2 b^2} \times \frac{27 b^2}{a}$$

$$T_c = \frac{8a}{27Rb} \qquad a = \frac{27 R^2 T_c^2}{64 P_c}$$

24.

Sol. (A) At very large molar volume

$$P + \frac{a}{V_m^2} \approx P \quad \text{and} \quad V_m - b = V_m$$

(C) According to van der Waals equation 'a' and 'b' are independent of temp.

25

Sol. The vander waals equation of state is -
(for 1 mole of gas)

$$\left(P + \frac{a}{V_m^2} \right) (V_m - b) = RT$$

When a is negligible, then

$$Z = \frac{pV_m}{RT} = 1 + \frac{b}{RT} P$$

that is Z increases with increaser in p.

when b is negligible, then

$$Z = \frac{pV_m}{RT} = 1 - \frac{a}{VRT}$$

increasing p implies decrease in V, which is turn, implies increase in the value of a/VRT and hence decrease in the value of Z.

The curve IV is applicable provided temperature of the gas is near but larger than it's critical temperature Hence, the choice (a), (b) and (c) are correct.

28.

Sol. (D)

As dew formation is spontaneous process therefore entropy or randomness of the universe will increase. As randomness of the system has decreased but randomness of the surrounding will increase larger so that change is positive.

29.

Sol. (B)

For the reaction

$$\Delta G_r = 2\Delta G_{\text{NH}_3} - (\Delta G_{\text{N}_2} + 3\Delta G_{\text{H}_2})$$

at equilibrium $\Delta G_r = 0$

$$\text{Hence } 2\Delta G_{\text{NH}_3} + \Delta G_{\text{N}_2} + 3\Delta G_{\text{H}_2}$$

30.

Sol. (A,B)

$$\Delta S = nC_v \ln \left(\frac{T_f}{T_i} \right) + nR \ln \left(\frac{V_f}{V_i} \right)$$

$$\Delta H = nC_p \Delta T$$

$$\Delta E = nC_v \Delta T$$

$$\Delta G = \Delta H - \Delta(TS)$$

CHEMISTRY - MODULE 3

SYLLABUS: GASEOUS STATE & THERMODYNAMICS

Paragraph Type Solution

1.
Sol. $P_1 = 70 + 20 = 90$ cm of Hg,
 $P_2 = (70 + 5)$ cm of Hg $\Rightarrow 90 \times 20 = 75 \times (5 + x) \Rightarrow x = 19$ cm.

2.

Sol. $P_1 = 75$ cm of Hg, $V_1 = 24 \times A$
 $P_2 = 75 + 10 + \frac{20.4 \times 10}{13.6} = 100$ cm of Hg
 $\Rightarrow 75 \times 24 = 100 \times x$
 $x = 18$ cm



3.

Sol. At critical point

$$\frac{\partial p}{\partial V_m} = 0 \Rightarrow -\frac{RT_c}{V_m^2} + \frac{2B}{V_m^3} - \frac{3C}{V_m^4} = 0 \Rightarrow -RT_c + \frac{2B}{V_m} - \frac{3C}{V_m^2} = 0 \Rightarrow RT_c V_m^2 - 2BV_m + 3C = 0$$

as equation will have repeated root then $D = 0 \Rightarrow T_c = \frac{B^2}{3RC}$

4.

Sol. P_c , V_c and T_c are given hence 'a' and 'b' should be calculated using P_c and T_c as it is more reliable.

$$P_c = \frac{a}{27b^2}, T_c = \frac{8a}{27Rb}$$

$$\frac{P_c}{T_c} = \frac{R}{8b} \Rightarrow b = \frac{300 \times 1/12}{8 \times 50} = \frac{1}{16}$$

$$4 \times \frac{4}{3} \pi r^3 \cdot N_A = \frac{1}{16} \Rightarrow r = \left(\frac{3}{256 \pi N_A} \right)^{1/3}$$

5.

Sol. $\Delta S = 2.303 \times 2 \times 8.3 \log \left(\frac{50}{5} \right) = 38.23 \text{ J/K}$

6.

Sol. $\Delta S = 2.303 \times 1 \times C_p \log \left(\frac{600}{300} \right) = 23.03 \Rightarrow C_p = \frac{10}{\log 2}$

$$C_v = C_p - R = \frac{10}{\log 2} - 8.3$$

CHEMISTRY - MODULE 3

SYLLABUS: GASEOUS STATE & THERMODYNAMICS

Matrix-Match Type

1. A - p, s ; B - r ; C - p, q ; D - r
2. A - s ; B - q, s ; C - r ; D - p
3. A - p; B - r; C - q, s; D - q, s

1.

- Sol.** (A) For H_2 gas at high pressure $Z > 1$.
(B) For any gas at $P \sim 0$, $Z \sim 1$ i.e. ideal behaviour.
(C) For CO_2 gas at normal pressure and temperature $Z < 1$.
(D) For any gas at very large molar volume i.e. $P \sim 0$, $Z \sim 1$ i.e. ideal behaviour of gas.

2.

- Sol.** (A) $PV = nRT$
At constant temperature
 $PV = K$ ($T = \text{constant}$)
Higher the value of PV , higher the temperature.
So, $T_3 > T_2 > T_1$
Since, $P_1 = P_2 = P_3$
So, $V \propto T \Rightarrow V_3 > V_2 > V_1$
 $d = \frac{PM}{RT}$
Since, $P_1 = P_2 = P_3$
 $d \propto \frac{1}{T} \Rightarrow d_1 > d_2 > d_3$
- (B) From Graph,
 $V_3 > V_2 > V_1$ and $T_1 = T_2 = T_3$
Higher the volume, lesser the pressure because temperature is same for all.
 $P_1 > P_2 > P_3$
 $d = \frac{PM}{RT}$
Since, $T_1 = T_2 = T_3$
So, $d \propto P \Rightarrow d_1 > d_2 > d_3$
- (C) From the graph,
 $P_3 > P_2 > P_1$ and $T_1 = T_2 = T_3$
Higher the pressure, lesser the volume because temperature is same for all.
 $V_1 > V_2 > V_3$
 $d = \frac{PM}{RT}$
Since, $T_1 = T_2 = T_3$
So, $d \propto P \Rightarrow d_3 > d_2 > d_1$
- (D) From the graph,
 $d_3 > d_2 > d_1$ and $P_1 = P_2 = P_3$

$$d = \frac{PM}{RT} \Rightarrow d \propto \frac{1}{T}$$

So, $T_1 > T_2 > T_3$
 $PV = nRT$

Since, $P_1 = P_2 = P_3$
 $V \propto T$

So, $V_1 > V_2 > V_3$

3.

Sol.

(A) For heating ideal gas at constant pressure $\Delta H = nC_{p,m} \Delta T$

(B) $\Delta G = VdP - SdT$

(C) U is a function of temperature only for an ideal gas and $\Delta G = VdP - SdT$

(D) Free expansion is an isothermal process for an ideal gas

CHEMISTRY - MODULE 3

SYLLABUS: GASEOUS STATE & THERMODYNAMICS

Integer Type

1.

Sol. (7)

$$0.42 = a(10)^3 \Rightarrow a = 0.42 \times 10^{-3}$$

$$S_m = \int_0^{10} \frac{C_{p.m.}}{T} dT = \int_0^{10} aT^2 = \frac{a}{3} [10^3 - 0] = \frac{0.42}{3} = 0.14 \text{ J/K - mol}$$

2.

Sol. (4)

Net pressure of gas = P_{gas}

$$P_{\text{gas}} = 650 \text{ mm.}$$

$$\frac{P_1 V_1}{T_1} = \left(\frac{P_2 V_2}{T_2} \right)_{\text{STP}}$$

$$\frac{650 \times 50}{291} = \frac{760 \times V_2}{273}$$

$$V_2 = 40.11 \text{ ml}$$

3.

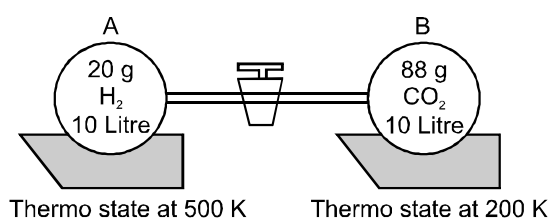
Sol. (5)

$$\Delta n_g = 0 \Rightarrow \Delta H^\circ = \Delta U^\circ$$

For 2 mole $\Delta U^\circ = -370 \text{ kJ}$.

4.

Sol. (3)



$$\text{No. of mole of H}_2 \text{ in flask A} = \frac{20}{2} = 10 \text{ mole}$$

$$\text{No. of mole of CO}_2 \text{ in flask B} = \frac{88}{2} = 2 \text{ mole}$$

Now pressure of Gas in flask A

$$PV = nRT$$

$$P_A \times 10 = 10 \times R \times 500$$

$$P_A = 500 R$$

Now pressure of Gas in flask B

$$P_B \times 10 = 2 \times R \times 200$$

$$P_B = 40R$$

Because flask A is on higher pressure that why H₂ is flow from flask A to flask B.

Let suppose x mole of H₂ move from flask A to B.

So mole of H₂ remain in A = (10 - x) and total mole in B = (2 + x)

Now after opening stop cock pressure of both flak become equal.

$$n_A T_A = n_B T_B$$

$$(10 - x) \times 500 = (2 + x) \times 200$$

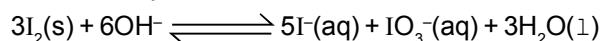
$$x = 6.57$$

$$\text{Composition of H}_2 \text{ in B} = \frac{6.57 \times 2}{101.14} \times 100 = 13\%$$

5.

Ans. 8

Sol. Balanced equation will be



$$\Delta G^\circ = -172.5 \text{ kJmole}^{-1}$$

$$= -\frac{25}{3} \times 300 \times 2.3 \times 10^{-3} \log k$$

$$\log k = 30$$

$$10^{30} = \frac{10^{-5} \times 10^{-1}}{[\text{OH}^-]^6}$$

$$\text{so } [\text{OH}^-] = 10^{-6}$$

6.

Sol. (2)

From first law of Thermodynamics, $\Delta E = q + w \Rightarrow nC_v dT = nCdT - PdV$ (1)

Now according to process, $P = V$ and according to ideal gas equation, $PV = nRT$

We have, $V^2 = nRT$

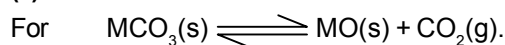
$$\text{On differentiating, } 2VdV = nRdT \quad \text{and} \quad PdV = VdV = \frac{nRdT}{2}$$

$$\text{So from first equation we have, } nC_v dT = nCdT - \frac{nRdT}{2}$$

$$\text{So, } C_v = C - \frac{R}{2} \quad \text{Hence } C = \frac{4R}{2}$$

7.

Sol. (4)



$$K_p = P_{\text{CO}_2} \text{ at } T_1 = 400 \text{ K}$$

$$K_{p1} = 0.14 \text{ bar}$$

$$\text{at } T_2 = 420 \text{ K } (K_p)_2 = 0.35 \text{ bar}$$

$$\log \left(\frac{0.35}{0.14} \right) = \frac{\Delta H_{\text{rxn}}}{2.303R} \left[\frac{1}{400} - \frac{1}{420} \right]$$

$$\log \left(\frac{5}{2} \right) = \frac{\Delta H_{\text{rxn}}}{2.303R} \left[\frac{20}{400 \times 420} \right]$$

$$1 - 2 \log 2 = \frac{\Delta H_{\text{rxn}}}{2.303R} \left[\frac{1}{8400} \right]$$

$$1 - 0.60 = \frac{\Delta H_{\text{rxn}}}{84 \times 230.3R}$$

$$\Delta H_{\text{rxn}} = 64.012 \text{ kJ/mol}$$

8.

Sol. (8)

$$\text{Avg. } C_{V,m} = \frac{n_1 C_{V,m_1} + n_2 C_{V,m_2}}{n_1 + n_2} = \frac{1 \times 3R + 2 \times \frac{3}{2}R}{3} = 2R$$

$$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1} \Rightarrow 320 \times \frac{3}{12}^{-1} = T_2 \times (4)^{3/2-1} \Rightarrow T_2 = 160 \text{ K}$$

$$\Delta U = (n_1 + n_2) C_{V,\text{avg}} \Delta T = 3 \times 2R \times (160 - 320) = -960 R$$

9.

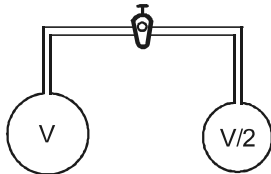
Sol. (5)

Work done by the gas in the cyclic process = Area bounded (ABCA) = $5P_1V_1$

10.

Sol. (2)

Sol.



Let the total number of molecules of the gas be n , of which n_1 are in the larger sphere and n_2 in the smaller sphere after the stopcock is opened

$$n = n_1 + n_2 \text{ and } pV = nRT$$

$$\frac{pV}{RT_1} = \frac{p'V}{RT_1} + \frac{p'V}{2T_2R}$$

$$p' = \frac{2pT_2}{2T_2 + T_1}$$

11.

Sol. (4)

W_{net} = area enclosed

$$V = \frac{nRT}{P}$$

$$V_A = \frac{2R \times 300}{1} = \frac{600R}{1}$$

$$V_B = \frac{2R \times 300}{2} = \frac{300R}{1}; V_C = \frac{2R \times 400}{2} = \frac{400R}{1}$$

$$V_D = \frac{800R}{1}$$

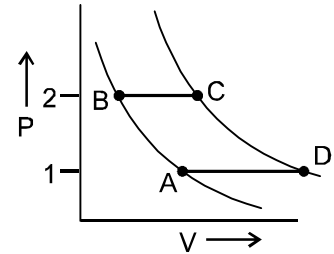
$$W_{AB} = -nRT_A \ln \frac{V_B}{V_A} = -2R(300) \ln \frac{1}{2} = 600 R \ln 2$$

$$W_{BC} = -2(400 - 300) R = -200 R$$

$$W_{CD} = -2 R(400) \ln \frac{V_D}{V_C} = -800 R \ln 2$$

$$W_{AD} = -1(600 R - 800 R) = 200 R$$

$$W_{Total} = W_{AB} + W_{BC} + W_{CD} + W_{AD} = -200 R \ln 2 = -100 R \ln 4$$



12.

Sol. (1)

The volume of the air in the inflated tire is 1 L and the pressure is 8 bar. According to Boyle's law, this air sample occupies a volume 8L at a pressure of 1 bar, the value we take for atmospheric pressure. The capacity or volume of the hand pump is $\pi r^2 \times \text{length} = \pi(1 \text{ cm})^2 \times 25 \text{ cm} \approx 80 \text{ cm}^3 = 0.08 \text{ L}$. This is the volume of air at atmospheric pressure, provided by each pump stroke. Thus the calculated no. of stroke is $8\text{L}/0.08\text{L} = 100$

13.

Sol. (9)

$$\Delta U = \Delta Q + \Delta W$$

for adiabatic process $\Delta Q = 0$

$$\therefore \Delta Q = \Delta W = -P\Delta V = -100 \times 10^5 (-10^{-6}) = 10 \text{ J}$$

$$\Delta H = \Delta U + \Delta(PV)$$

$$\begin{aligned} \therefore \Delta H &= \Delta U + P_2 V_2 - P_1 V_1 \\ &= 10 + 100 \times 10^5 \times 99 \times 10^{-6} - 10 \times 10^5 \times 10 \times 10^{-6} \\ &= 10 + 990 - 100 = 900 \text{ J} \end{aligned}$$

14.

Sol. (5)

$$E_1 = \frac{3}{2} \times \frac{M}{16} RT_1$$

$$E_2 = \frac{3}{2} \times \frac{M}{30} RT_2 \quad \Rightarrow \quad \frac{E_1}{E_2} = \frac{30}{16} \frac{T_1}{T_2}$$

$$\Rightarrow \quad \frac{T_1}{T_2} = \frac{8}{5} \quad \frac{3}{1} = \frac{30}{16} \frac{T_1}{T_2}$$

15.

Sol. (6)

$$\text{Magnitude of work} = A = P_1 V_1 + \frac{1}{2} \times P_1 \times 6 V_1$$

$$= 4 P_1 V_1 = 4 nRT_1$$

$$= 4 \times 1 \times 2 \times 300$$

$$= 2400 \text{ cal} \quad]$$

