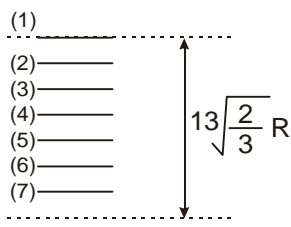


## CHEMISTRY

- Can be seen by drawing isochore lines in the PV graph, greater the volume in isochoric process smaller will be the slope of that isochoric line. Hence the result can be obtained.
- $w = -nR\Delta T$  when ( $p_{\text{gas}}$  is constant  $\approx p_{\text{ex}}$ )  
 $w = -p_{\text{ex}} \Delta V$   
 $= -p_{\text{gas}} \Delta V$   
 $= -nR\Delta T$  ; Hence in isobaric system only, this is possible.
- 85 K is equilibrium temperature. ;  $\Delta H_f = -75 - 392 + 484$   
 $= 17 \text{ KJ/mol}$   
 $\Delta G = 0$   
 $17000 - 85 \times \Delta S = 0 \Rightarrow \Delta S = \frac{17000}{85} = 200 \text{ J/mol-K}$
- If the process was reversible adiabatic  
 then  $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$   
 $1200 \times (1)^{2/3} = T_2 \times (8)^{2/3} \Rightarrow 1200 \times \left(\frac{1}{8}\right)^{2/3} = T_2 \Rightarrow \frac{1200}{4} = T_2 = 300 \text{ K}$   
 We know that for a system of ideal gas, during adiabatic expansion, temperature become least for reversible process. But here it is stated that temperature is 280 K. This is not possible for ideal gas.  
 This can also be concluded by  $\Delta S$  calculation for the change.
- $\Delta_f H^\circ$  of  $\text{H}_3\text{C}-\text{CH}_3$  is  $-84 \text{ kJ/mol}$   
 $\Delta_f H^\circ$  of  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$  is  $-105 \text{ kJ/mol}$  ;  $\Delta_f H^\circ$  per  $\text{CH}_2 = -105 + 84 = -21 \text{ kJ/mol}$   
 for pentane  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$ , the ; Value is  $3 \times (-21) + (-84) = -147 \text{ kJ/mol}$ .
- Volume of unit cell in ccp =  $\left(\frac{4a}{\sqrt{2}}\right)^3$  ; so volume per spheric/atom =  $\frac{1}{4} \times \frac{64a^3}{2\sqrt{2}} = 5.66a^3$ .
- Parallel layer are at a distance of  $2\sqrt{\frac{2}{3}} R$



- $a = 200 \text{ pm} = 200 \times 10^{-10} \text{ cm} = 2 \times 10^{-8} \text{ cm}$   
 $\text{volume} = (2 \times 10^{-8})^3$   
 $\text{No. of atoms} = \frac{Z \times A}{d \times a^3} = \frac{4 \times 100}{10 \times (2 \times 10^{-8})^3} = 5 \times 10^{24}$

9.  $B^+A^-$ , salt is be SAWB type for which  $pH = \frac{1}{2}pK_w - \frac{1}{2}pK_b - \frac{1}{2}\log 'c'$ .

$$\therefore 6.00 = 7.0 - \frac{5}{2} - \frac{1}{2}\log 'c' = 5 - \frac{1}{2}\log 'c'.$$

$$\text{or } \frac{1}{2}\log 'c' = -1 \text{ or } \log c = -2 = \log 10^{-2} \quad \therefore c = 10^{-2}$$

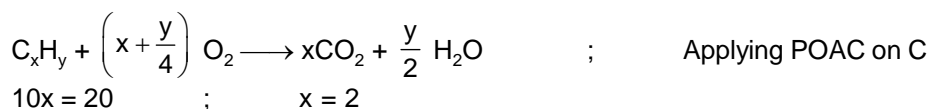
$$\Rightarrow \text{moles} = 10^{-2} \times 1 = 10^{-2} \quad \therefore \frac{1.32}{MM} = \frac{1}{100}$$

$$\text{or mol. wt. of salt} = 132 \quad ; \quad \text{Now } d = \frac{Z}{N_A} \left( \frac{M}{a^3} \right) \quad ; \quad \text{for rock salt } 600 \sqrt{2} = \sqrt{2} a$$

$$\therefore a = 600 \text{ pm} = 600 \times 10^{-10} \text{ cm.} \quad ; \quad d = \frac{4}{6.022 \times 10^{23}} \left[ \frac{132}{(600)^3 \times 10^{-30}} \right] = 4.06 \text{ gm/cc.}$$

10. The graph represents liquefaction of gas. Hence  $Z < 1$   
The gas is below critical temperature.

11. Volume of oxygen used =  $100 - 75 = 25 \text{ ml}$  ; Volume of  $CO_2$  produced =  $20 \text{ ml}$



$$\text{Also, ratio of } O_2 \text{ to hydrocarbon} \quad ; \quad \frac{25}{10} = x + \frac{y}{4}$$

$$\Rightarrow 2.5 = 2 + \frac{y}{4} \quad \Rightarrow 0.5 = \frac{y}{4} \quad \Rightarrow y = 2 \quad \Rightarrow C_2H_2$$

12.  $r_{SO_2} \propto \frac{1}{\sqrt{273 \times 64}} \quad ; \quad r_{He} \propto \frac{1}{4 \times \sqrt{546 \times 4}}$

$$\Rightarrow \frac{r_{SO_2}}{r_{He}} = \frac{n}{?}$$

$$\Rightarrow \frac{r_{He}}{n} = \frac{1}{4 \times \sqrt{546 \times 4}} \times \frac{\sqrt{273 \times 64}}{1} = \frac{1}{\sqrt{2}}$$

13.  $\Delta H = -20 \text{ kJ/mol}$  ;  $\Delta S = -70 \text{ J/mol K}$  ;  $\Delta G = \Delta H - T\Delta S < 0$   
 $\Rightarrow -20000 + T \times 70 < 0$

$$T \times 70 < 20000 \quad ; \quad T < \frac{20000}{7} \quad ; \quad < 285.7$$

14.  $\frac{x}{m} = k (P)^{1/n}$   
 $0.2 = k (4)^{1/n} \quad \dots(1) \quad ; \quad 0.5 = k (25)^{1/n} \quad \dots(2)$

$$\Rightarrow \frac{2}{5} = \left(\frac{4}{25}\right)^{1/n} \quad ; \quad \left(\frac{2}{5}\right)^1 = \left(\frac{2}{5}\right)^{2/n}$$

$$\Rightarrow \frac{2}{n} = 1 \quad \Rightarrow n = \frac{1}{2} \quad \Rightarrow 0.2 = k (4)^{1/2} \quad \Rightarrow 0.2 = 2k$$

$$\Rightarrow k = 0.1 \quad \Rightarrow \text{At } 70 \text{ k and } 36 \text{ bar} \quad ; \quad \frac{x}{m} = 0.1 \times (36)^{1/2} \quad ; \quad \frac{x}{m} = 0.6$$

Hence mass of  $N_2$  adsorbed by  $5 \text{ g}$  of  $Fe = 5 \times 0.6 = 3 \text{ g}$

15. Facts 16. Factual Question 17. Facts to remember.

18. It look as if process is reversible as it is carried out in small steps. But  $P_{ex} = 0$ , so  $w = 0$

The wall is diathermic, so process is isothermal.

$$\text{Hence, } T_1 = T_2 \quad ; \quad \text{So, } \Delta U = 0 \quad ; \quad \text{So, } U_2 = U_1$$

As gas has expanded without change in temperature, so pressure has decreased.

$$\Delta U = q + w \quad ; \quad \text{So, } q = 0$$



19. (A) Gaseous moles increases, enthalpy increases (B) In isolated system,  $\Delta U = 0$   
 (C) It can be negative or positive also, as in isothermal expansion of ideal gas in a closed system.  
 (D)  $\Delta G^\circ$  is a constant.
20. (A)  $\frac{PV}{RT} \neq 0$  at any point in the graph ; So,  $\frac{V}{V-b} \neq \frac{a}{VRT}$   
 (B) At 80 atm ;  $\frac{PV}{RT} = 1 \Rightarrow \frac{V}{V-b} = 1 + \frac{a}{VRT}$   
 (C) At  $P > 80$  atm ;  $\frac{PV}{RT} > 1 \Rightarrow \frac{V}{V-b} > 1 + \frac{a}{VRT}$   
 (D) Similar explanation as in C
21. Statement-1 and statement-2 are true and statement-2 is correct explanation of 1.
23.  $S^{2-}$  ion : number of tetrahedral void  
 1 : 2
25. If two gases have identical Maxwellian plot then their all the speeds will also be identical.  
 Hence  $\frac{T_A}{M_A} = \frac{T_B}{M_B}$ . Since all the speeds are proportional to  $\sqrt{\frac{T}{M}}$
26.  $\Delta G = G$  for 2 moles of  $NO_2$  –  $G$  for 1 mole of  $N_2O_4$ . = 5.40 kJ  
 Hence, (A) is the correct answer.
27. The lowest point of the plot represents equilibrium mixture. When 1 mole of  $N_2O_4$  changes into equilibrium mixture, free energy is lowered by 0.84 kJ,  $\Delta G = -0.84$  kJ.  
 Hence, (B) is the correct answer.
28. When 2 moles of  $NO_2$  change into equilibrium mixture, free energy is lowered by  $(5.40 + 0.84)$  kJ = 6.24  
 $\Delta G = -6.24$  kJ  
 Hence, (C) is the correct answer.
29. More is the zeta potential, more is the repulsion between charged colloidal particles.
30. At isoelectric point, charged colloidal species do not exist.  
 Hence, zeta potential tends to zero.
31. Clear from comprehension that  $A^{2+}$  occupy tetrahedral void in normal spinel.
32.  $x + 2y = 2 \Rightarrow 2y = 2 - x$  ;  $y = 1 - \frac{x}{2}$
33.  $\frac{d_A}{d_B} = \frac{2}{1} = \frac{P_A M_A}{P_B M_B} = \frac{P_A M_A}{P_B \times 3 \times M_A}$  ;  $\frac{P_A}{P_B} = \frac{6}{1}$
34.  $a_{KCl} = 2 a_{CsF}$  ;  $2M_{KCl} = M_{CsF}$   
 $\rho_{KCl} = \frac{4M_{KCl}}{N_A a_{KCl}^3}$  ;  $\rho_{CsF} = \frac{1M_{CsF}}{N_A a_{CsF}^3}$  ;  $\frac{\rho_{CsF}}{\rho_{KCl}} = \frac{M_{CsF}}{a_{CsF}^3} \cdot \frac{a_{KCl}^3}{4M_{KCl}} = \frac{2}{4} \times \left(\frac{2}{1}\right)^3 = 4$   
 $\frac{\rho_{CsF}}{\rho_{KCl}} = 4$
35. The process denoted by solid line is not isothermal as  $1024 \times \frac{1}{8} \neq 32 \times 1 \neq 8 \times 1$   
 $\gamma = \frac{5}{3}$  ;  $1024 \times \left(\frac{1}{8}\right)^{5/3} = 1024 \times \frac{1}{2^5} = 32$  ;  $32 \times (1)^{5/3} = 32$  ;  $1 \times (8)^{5/3} = 32$   
 i.e.  $PV^\gamma = \text{constant}$  ; Hence, process denoted by solid line is reversible adiabatic.

$$\text{So, } w_{\text{adiabatic reversible}} = \frac{8 \times 1 - \frac{1}{8} \times 1024}{\frac{5}{3} - 1} = \frac{8 - 128}{\frac{2}{3}} = -\frac{120}{2} \times 3 = -180 \text{ L atm}$$

$$\text{and } w_{\text{B along dotted line}} = 32 \times \left(1 - \frac{1}{8}\right) + 1(8 - 1) = 32 \times \frac{7}{8} + 7 = 28 + 7 = 35 \text{ atm}$$

$$\Rightarrow \frac{w_A}{w_B} = \frac{180}{35} = \frac{36}{7} = 5.11 \approx 5$$

36. C.N. of  $A^{x+} = 12$

C.N. of  $B^{y-} = 4$

$\Rightarrow$  difference = 8 = p

$C_4$  axis passes through centre of opposite faces. Hence B atoms are removed. Formula becomes  $AB_2$ . So q

$$= 1, r = 2. \quad ; \quad \frac{8 \times 1}{2} = 4.$$

37. 100 ml of 0.5  $CH_3COOH$  contains = 0.05 mole ; after adsorption,  $CH_3COOH$  present = 0.049 mole  
 acetic acid adsorbed by 1 gm charcoal =  $0.05 - 0.049 = 0.001 \text{ mole} = 6.023 \times 10^{20} \text{ molecule}$   
 surface area of 1 gm charcoal =  $3.01 \times 10^2$   
 surface area of charcoal adsorbed by each molecule =  $3.01 \times 10^2 / 6.023 \times 10^{20} = 5 \times 10^{-19} \text{ m}^2$ .

$$38. 5.75 = \frac{(56x + 16) 4}{(4.31 \times 10^{-8})^3 \times 6.02 \times 10^{23}} \Rightarrow x = 0.95$$

For each O, there should be one Fe in normal FeO. But here we have only 0.95 Fe per O. This means that 95% of sites are occupied by Fe.

$$39. \text{ We know that, Compressibility factor, } Z = \frac{PV}{RT} \Rightarrow 0.5 = \frac{100 \times V}{0.082 \times 1000} \therefore V = 0.41 \text{ L}$$

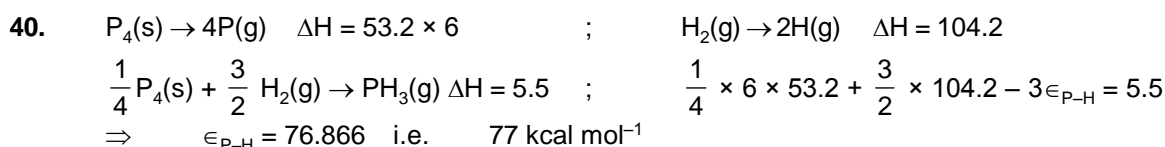
Further when volume of a gas molecule is negligible, van der Waal's equation becomes  $\left(P + \frac{a}{V^2}\right)(V - 0) = RT$

$$\text{or } PV = RT - \frac{a}{V} \quad \text{or } a = RTV - PV^2$$

Substituting the values

$$a = (0.082 \times 0.41 \times 1000) - (100 \times 0.41 \times 0.41) = 33.62 - 16.81 = 16.81 \text{ atm L}^2\text{mol}^{-2}.$$

**Ans. 17**



$$41. \Delta H - \Delta E = -4.5 \times 8.315 \times 298 \text{ J} = -11.15 \text{ kJ}$$

42. (A) It is formation of H.

$H_2(g)$  and  $H(g)$  are both gases, so in same phase,  $H(g)$  is not allotrope of  $H_2$  and  $\epsilon_{H-H} = 2\Delta H_f$ .

(B) It is formation of diamond. It is allotropic change. They are allotropes and also two different solid phases. Bond energy cannot be calculated from only  $\Delta H$  of given reaction.

(C) It is formation of sulphur (g).

They are not allotropes. They are two different phases as S(rhombic) is solid. The  $\Delta H_f$  can't be used to calculate bond energy in X due to vanderwaal's forces.

(D) It is not formation. They are allotropes. They both are gases, so same phase. Bond energy can't be calculated from  $\Delta_f H$ .

43. Refer Notes

44. Fact based

