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THERMODYNAMICS

3

$$\frac{3 \times M/N_A}{V} = d$$

4

Ti	O
2	4

TiO_2

7

$a/2 = X$

$a/\sqrt{2} = Y$

9

$$2r\sqrt{2/3} = 10\cancel{\sqrt{2/3}}$$

$$\frac{r_+}{r_-} = 0.414$$

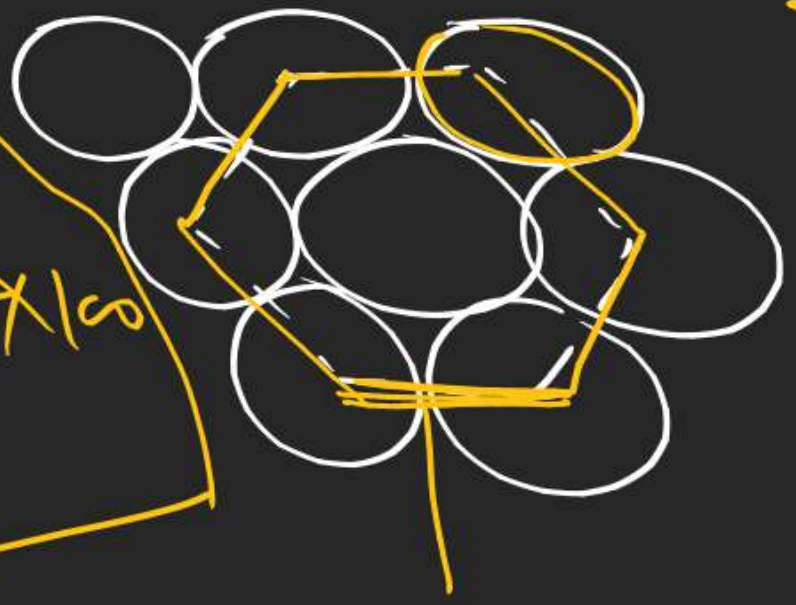
$r_- = 5 \text{ pm}$

THERMODYNAMICS

10

A A A A A

$$\frac{3 \times \frac{4}{3}\pi r^3}{V} \times 100$$



2r

$\text{height} = 2r \qquad a = 2r$

$$\text{Volume of box} = \frac{\sqrt{3}a^2}{4} \times 6 \times 2r$$

$$2 \times \frac{1}{2} + \frac{1}{6} \times 12$$

$$1 + 2 = 3$$

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THERMODYNAMICS

$$5.561 = \frac{Z \times 58.5/N_A}{a^3}$$

$Z = 4$

14

$$\frac{a_{NaCl}}{2} = r_{Na^+} + r_{Cl^-}$$

$$\text{\% Sites occupied} = \frac{Z}{4} \times 100$$

$$\frac{a_{KCl}}{2} = r_{K^+} + r_{Cl^-}$$

$$\frac{r_{K^+}}{r_{Cl^-}} = \frac{0.5}{0.7}$$

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THERMODYNAMICS

15. CaF_2

Ca^{2+} will never touch each other

F^- can touch each other

$$\frac{\sqrt{3}a}{4} = r_+ + r_-$$

$$\boxed{\frac{r_+}{r_-} = 0.732}$$

$$P.F = \frac{4 \times \frac{4}{3}\pi \left(r^3_{Ca^{2+}} + 2 r^3_{F^-} \right)}{a^3}$$

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THERMODYNAMICS

$$\Rightarrow V_1 d_1 + V_2 d_2 = (V_1 + V_2) d_3$$

$$\Rightarrow \frac{W_1}{d_1} + \frac{W_2}{d_2} = \frac{W_1 + W_2}{d_3}$$

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THERMODYNAMICS

$\Delta U = q_v$ = heat transfer at constant 'V'

$\Delta H = q_p$ = " " " Const 'p'

Relationship betn ΔH & ΔU

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$$H = U + PV$$

for a change

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

$$\boxed{\Delta H = \Delta U + (P_2V_2 - P_1V_1)}$$

Always applicable

Case-I for a substance not undergoing any chemical & phase change

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

(a) for ideal gas

$$nC_p\Delta T = nC_v\Delta T + \Delta(nRT)$$

$$\cancel{n}C_p\cancel{\Delta T} = \cancel{n}C_v\cancel{\Delta T} + \cancel{n}R\cancel{\Delta T}$$

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

$$= \Delta U + \Delta(nRT)$$

$$\boxed{\Delta H = \Delta U + nR\Delta T}$$

$$\cancel{n} C_p \cancel{\Delta T} = \cancel{n} C_v \cancel{\Delta T} + \cancel{n} R \cancel{\Delta T}$$

$$C_p = C_v + R$$

ΔU

$P_1 \quad V_1 \quad T_1$

$P_2 \quad V_2 \quad T_2$

n

$\Delta H = ?$

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(b) for solid/liq

18ml

224ml

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

$$\Delta H = \Delta U + (P_2V_2 - P_1V_1)$$

$$\boxed{\Delta H \simeq \Delta U} + 0$$

$$\Delta(PV) \simeq 0$$

$$C_p \simeq C_v$$

Case-II for chemical & phase change

T = Constant

(a) Rxns involving only gases

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

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

$$\Delta H = \Delta U + (\Delta n)RT$$

(b) Rxn involving solid & liq also

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

$$= \Delta U + \Delta(nRT)$$

$$\boxed{\Delta H = \Delta U + \Delta n_g RT}$$

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THERMODYNAMICS

$$\Delta H = \Delta U + (P_2V_2 - P_1V_1)$$

$$\Delta H = \Delta U + nR\Delta T$$

$$\Delta H = \Delta U + \Delta n_g RT$$

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$$4C_{(g)} + 2A_{(g)} \longrightarrow 3B_{(g)} + 5D_{(g)} \quad \Delta H_r = 50\ kJ/mol$$ endo

$$\Delta n_g = 2$$

mol — Per mol of Rxn = no. of moles equal to the stoichiometric coefficient

$$\underline{8C} + \underline{4A} \longrightarrow \underline{6B} + \underline{10D} \quad \Delta H_r = 100\ kJ/mol$$

$$\Delta n_g = 4$$

$$2NH_3 \longrightarrow N_2 + 3H_2 \quad \Delta H = 100\ kJ/mol$$

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100 k cal heat is absorbed when 2 mol $H_2O(l)$ is vapourised at 1 atm, 300 K. find ΔH & ΔU for this change.

$$\boxed{\Delta H_r = 100\,\text{kcal}}$$

$$2H_2O(l) \longrightarrow 2H_2O(g) \quad \Delta H_r = 100\,\text{kcal/mol}$$

$$\Delta n_g = 2 - 0$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$100\,\text{kcal} = \Delta U + \frac{2 \times 2 \times 300}{1000}$$

$$\Delta U = 98.8\,\text{kcal}$$

$$R = 8.314\ \text{J/mol/K}$$

$$= \frac{8.314}{4.18}\ \text{cal/mol/K}$$

$$\simeq 2\ \text{cal/mol/K}$$

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100 kcal heat is evolved when 2 mol $C_3H_8(l)$ is burnt at 300K in a closed rigid container find ΔH & ΔU for this change

$$\Delta U = -100\ kcal$$

$$C_3H_8(l) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

for 1 mol $C_3H_8(l) = -2$

2 mol " $= -4$

$$\Delta H = -100 + \frac{(-4) \times 2 \times 300}{1000} = -100 - 2.4$$

$$= -102.4\ kcal$$

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T.D

O-I	1-23
S-I	1-18