① Extensive Property (additive) $(V, U, C, \Delta G, \Delta H)$
- depend on size → internal energy, Heat capacity, vol., A, S.

② Intensive property (independent)
- $\propto (size)^0$ (P, T, S) I.P, B.P, η, E°_{cell} $(\Delta H)_m$ $M, X, m, mass\%$

③ Molar लगते हैं intensive

④ $W = -P_{ex} \Delta V$ $\Delta V = V_2 - V_1$

⑤ Exp. in more no of stages leads to greater work done

⑥ $W = -2.303 \, nRT \log \frac{V_F}{V_i}$

⑦ $W = -2.303 \, nRT \log \frac{P_i}{P_F}$

⑧ $x \, L\text{-atm} = x \times 101.3 \, Joule.$

⑨ Reversible expansⁿ (isotherm) } max. work done
Irreversible compressⁿ }

⑩ state expansⁿ in vaccum
↓ $\boxed{dW=0}$ $q=0$ $\Delta U = 0$

⑪ $\boxed{\Delta U = q + W}$ q, w are not state functⁿ

⑫

⑬ $\Delta H = \Delta U + P\Delta V$
$\boxed{\Delta U = q_v}$ $\boxed{\Delta H = q_p}$

⑭ $\boxed{\Delta H = \Delta U + \Delta n_g RT}$

⑮ Heat capacity $= \frac{q}{\Delta T}$

⑯ $\boxed{Cp > Cv}$ $Cv = \partial q_v / \partial T$ $Cp = q_p / \partial T$
$Cv = \partial U / \partial T$ $Cp = \frac{\Delta H}{\partial T} = \frac{output}{\partial T}$

⑰

$\boxed{\Delta U = Cv \Delta T}$ $\boxed{\Delta H = Cp \Delta T}$

⑱ $\boxed{Cp - Cv = R}$ / $\boxed{Cp_m - Cv_m = R}$ (intensive)
⑲ $\boxed{Cp - Cv = nR}$ No. of moles.
$C = ms$ $\boxed{Cp - Cv = \frac{R}{Mw}}$ Always

⑳ $\gamma \, (Cp/Cv)$
- Monoatomic — $1.67 \, (5/3)$
- Diatomic — $1.40 \, (7/5)$
- Polyatomic — $1.33 \, (4/3)$

㉑ Entropy , extensive
state functⁿ $\boxed{\Delta S = \frac{q_{rev}}{T}}$ $\boxed{\Delta S \propto Atomicity}$

㉒ $\boxed{S = \frac{q}{T} = 2.303 \, nR \log \frac{V_F}{V_i}}$

㉓ ΔS for adiabatic reversible process → const. $\Delta S = 0$.

㉔ $\boxed{\Delta S_{sys.} + \Delta S_{surr.} = \Delta S_{Total}}$

$\Delta S_{Total} = +ve$ spontaneous
$\Delta S_T = -ve$ Non-spontaneous
$\Delta S_T = 0$ equilibrium

㉕ Boiling of egg $\Delta S = +ve$
stretching of rubber $\Delta S = -ve$
precipitatⁿ $\Delta S = -ve \, (s \to s)$
formatⁿ of Gas product $\Delta S = +ve \, (l/s \to g)$

㉖
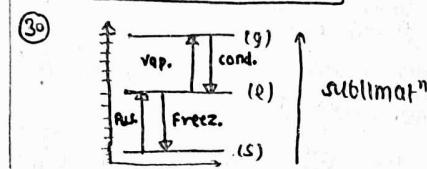
$\Delta S_{sys} = \frac{-q}{T_1}$
$\Delta S_{sys} = +\frac{q}{T_2}$
$\Delta S_T = +ve.$
cooling will be sp. $T_1 > T_2$ Heating will be sp. $T_2 > T_1$

**㉗** $\boxed{\Delta G = \Delta H - T\Delta S}$
$\Delta G = +ve$ Non spontaneous
$\Delta G = -ve$ spontaneous
$\Delta G = 0$ equil.

㉘ $\boxed{\Delta G = 0}$ phase change में

㉙ $\boxed{\Delta_{vap}.H = -\Delta_{cond}.H}$
$\boxed{\Delta_{fus}.H = -\Delta_{freeze}.H}$

㉚

㉛ $\boxed{\Delta H_{sub.} = \Delta_{fus}.H + \Delta_{vap}.H}$

㉜ Enthalpy of formation
- exothermic
- formatⁿ must be from elements in elemental form.

㉝ $\Delta_f H = 0$ in ref. state

㉞ $\boxed{\Delta_r H = \int \Delta_f H_{(P)} - \int \Delta_f H_{(R)}}$

㉟ Enthalpy of combustion
- exothermic $(\Delta H = -ve)$
- element oxidise into its rest o.s.

㊱ $\boxed{\Delta_r H = \int \Delta_{comb}.H_{(P)} - \int \Delta_{comb}.H_{(P)}}$

㊲ Enthalpy of Neutralisation
- Its for 1eq. not for 1mole.

㊳ $S.A + S.B \to \Delta_{Neut}.H = -13.7 \, Kcal/eq$
$\frac{1}{4} \, \frac{1}{4} \, mole \, \left(\frac{-57.7}{4}\right) = -57.3 \, KJ/eq$

㊴ for weak acid $\Delta_{Neut}.H$ is less than $-13.7 \, Kcal$

㊵ $\Delta_{Neut}.H$ of HF is more than $13.7 \, Kcal$
∵ $F^\ominus$ has ↑ value of $\Delta_{hyd}.H$ ∵ of small size.

㊶ Energy released $\propto$ No. of eq. Neutralised

㊷ Temp rise $\propto \frac{No. \, of \, eq \, Neut.}{Vol.}$

㊸ Bond dissociatⁿ enthalpy
A.V B.D.E $= \frac{x + y1 \ldots + z^n}{n}$

㊹ $\boxed{\Delta_r H = \int \Delta_{B.D} H_{(R)} - \Delta_{B.D} H_{(P)}}$

㊺ calorific value
Best fuel $\propto$ C.V $\propto \frac{1}{HOC}$

㊻ Bomb calorimeter
- energy released in Heat of combustⁿ it is $\boxed{\Delta U}$ → in calorimetry.
- $\Delta V = 0.$ $C = ms$
- $\boxed{q = ms\Delta T}$ $s \to$ Heat capacity
$\boxed{\Delta U = q_v = s\Delta T}$ $\boxed{q_p = \Delta H}$

㊼ Readily form होने के लिए
$\Delta S = +ve$, $\Delta G = -ve$, $\Delta H = -ve$
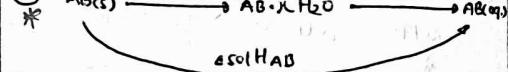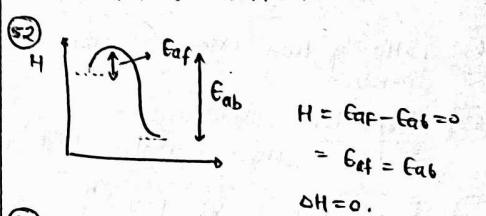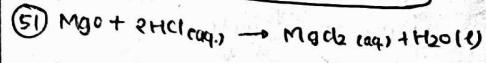
㊽ $\boxed{reversible \, isothermal \, expansion \, \Delta H = 0}$

㊾ Heat of formatⁿ is given for 1mol.

㊿ (anhydrous) $AB_{(s)} \xrightarrow{\Delta_{Hyd}.H_{(s)}} AB.xH_2O \xrightarrow{\Delta_{sol}.H \, AB.xH_2O} AB_{(aq)}$
$\xrightarrow{\Delta_{sol} HAB}$
$\Delta_{sol} H_{AB} = \Delta H_{Hyd.} + \Delta H_{sol} \, AB.xH_2O$

51 $MgO + 2HCl_{(aq.)} \to MgCl_2 (aq.) + H_2O(l)$
$\Delta_{Neut}.H$ is $< -13.7 \, Kcal$

52

$H = E_{af} - E_{ab} = 0$
$= E_{af} = E_{ab}$
$\Delta H = 0.$
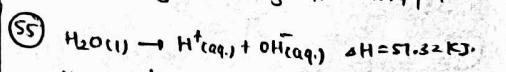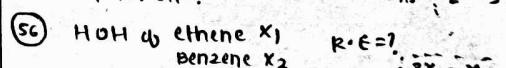
53 Enthalpy of formatⁿ में
1mole $H_2SO_4 \to 2 eq.$
$= 27.4 \, Kcal$
$13.2 \, Kcal/eq.$

54 Maxi. internal energy
$O_2 \to O_3$ तो O_3 की energy ↑

55 $H_2O(l) \to H^+_{(aq.)} + OH^-_{(aq.)}$ $\Delta H = 57.32 \, KJ.$
$H_2(g) + \frac{1}{2}O_2(g) \to H_2O(l)$ $\Delta H = -286.2 \, KJ$
$\Delta_r HF$ for $OH = ?$ Ans $= -28.2 \, KJ$

56 HOH of ethene X_1
Benzene X_2 $R.E = ?$ $3X_1 - X_2$

57 HOC of benzene in Bomb calorimetry is $-870 \, Kcal$. then $\Delta U = ?$

58 ice $\longrightarrow$ water $\Delta S = +ve$ (↑)

59 two ideal mixed.
$\Delta S_{mix} > 0$ $\Delta H_{mix} = 0$.

60 ② $2NO \rightleftharpoons N_2 + O_2$ $K = 25\%$.
$K_p = ?$ $1/36.$

61 diff. of Heat of Rxn at $P \neq \& V \neq$ for
2 mole benzene at $25°c$ in KJ
$C_6H_6 + O_2 \longrightarrow$ $\Delta H = -4120.3 KJ$ $-74.3.$

62 In isothermal expansion
$\Delta U = 0$, $\Delta T = 0$, $W = -q$.

63 For ideal gas expans^s in vaccum.
$\Delta U = 0$. $q = 0$ $w = 0$

64 All sudden expans^n are adiabatic

65 For isothermal process
$$\Delta S_{surr} = - \Delta S_{system} \text{ ※※}$$

66 $Cl_2(g) \longrightarrow 2Cl(g)$ $242.3 KJ/mol$
JEE 2006 $I_2(g) \longrightarrow 2I(g)$ 151 "
$ICl(g) \longrightarrow \frac{1}{2} + Cl(g)$ 211.3 "
$I_2(s) \longrightarrow I_2(g)$ 62.76 ",
ΔH_f ICl ?

Hint:- $\frac{1}{2}I_2(s) + \frac{1}{2}Cl_2(g) \longrightarrow ICl(g)$
$\downarrow \Delta H_1$ $\downarrow \Delta H_2$
$\frac{1}{2}I_2(g)$ $\frac{1}{2}Cl(g)$ $\bigg\rbrace \Delta H_4$
$\downarrow \Delta H_3$
$I(g)$
$\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3 + \Delta H_4$

64 $\Delta T = 0$.
$\Delta H = 0$ $\Delta U = 0$
$\downarrow$
(ΔQ).

65 $\Delta T = 0$ ΔU is tesed by
adding more molecule to it
$U \propto n \frac{f}{2} RT$ $n \uparrow$ $U \uparrow$

66 ratio of two extensive prop. is
intensive.

67 for ideal Gas
$T \Rightarrow *$ $\Delta H = 0$ $\boxed{H = f(T)}$

68 $\boxed{\Delta H = \Delta U + (P_f V_f - P_i V_i)}$
$P \neq *$ vol $\neq *$ Temp $\neq *$ No chemie. rxn

69 cyclic process ($\cdot$ i = f)
$\Delta S = 0$
※ Co state funct^b

70 Isobaric.
$\Delta S = \frac{dq_{rev}}{T} = \frac{\Delta H}{T} = \int \frac{n C_p dT}{T}$
※ $\boxed{\Delta S = 2.303 \, n \, C_p \log \left[T_f / T_i \right]}$

71 $\boxed{(\Delta S)_{irr} > \frac{dq_{irr}}{T}}$

72 $A + B \rightleftharpoons C$
$\boxed{\Delta S = (\Delta S_C) - [\Delta S_B + \Delta S_A]}$

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73 ΔH_f $S(rhombic) = 0$

74 ※ $Ka \propto \frac{1}{H_2I} \propto H \cdot O \cdot N$

75 Acid + Base
10 ml   10 ml $\rightarrow TK \uparrow$
100 ml   100 ml $\rightarrow TK \uparrow$

76 Resonance energy.
$\boxed{R \cdot E = \text{energy of bond} - \text{energy of bond} \atop \text{when not in res} \qquad \text{in res} -}$

77 $8.5L$ of Gas at STP $24 cal$ to rise by $15°c$
$C_p = ?$ at $V \neq$
$n = \frac{8.5}{22.4}$

78 $\boxed{S \propto work}$

79 $2Cl_2(s) \longrightarrow Cl_2(s)$
ΔH, $\Delta S \rightarrow -ve$

80 ※ ΔH_f Given asked ΔH_c.
$\Delta H_c = (\Delta H_f)_P - (\Delta H_f)_R$
ΔH_c Given asked ΔH_f
$\Delta H_f = (\Delta H_c)_R - (\Delta H_c)_P$

81 ※※ $\Delta T = 0$ expans^n.
$\boxed{W = \text{Heat ab. by system}}$

82 $\underset{H_2SO_4}{1 mole} + \underset{NaOH}{2 moles}$
उष्मा $\rightarrow 57$
रही $\rightarrow 2 \times 57$

83 $\boxed{\frac{\Delta V}{V_i} = \frac{\Delta T}{T_i}}$ भाप्य respect में
imp:- ※

84

$T_1 > T_2 > T_3$

85 $\boxed{CO_2 + H_2 \longrightarrow CO + H_2O}$ ΔH
Heat of Rxn

86 $S + 3/2 O_2 \longrightarrow SO_3 + 2x. Kcal$
$SO_2 + 1/2 O_2 \longrightarrow SO_3 + y Kcal.$
HoF of SO_2 गलती $\Delta H = -2x$
$\Delta H = -y$

87

W_{ir} W_r
$W_r > W_{in}$

88

$\Delta S_{isot} > \Delta S_{adia}$
$\Delta S_1 > \Delta S_2$

89 for $\boxed{\substack{R \\ IR}}$ at $\Delta T = 0 \rightarrow \Delta U = 0$

for IR $(\Delta S_{syst} \Delta S_{surr} \neq 0)$

ΔS disorimate b/w $\textcircled{R}$ + $\textcircled{IR}$ but ΔU
does not.