Nishant Jindal

THERMODYNAMICS

0-1 21-22

S-I 16-22

J-Adv TD-2

S-I

22

$HCl(g) \longrightarrow H^+(aq) + Cl^-(aq)$

O

$\Delta H_r =$

0-I

22

250ml 4M $\longrightarrow$ 2M

500

$-2.5\ kJ/mol$

16

$CH_2=CH_2 \rightarrow -(CH_2-CH_2)-$

$= BE_{C=C} - BE_{C-C} - BE_{C-C}$

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$$CuSO_4(s) + H_2O(\ell) \longrightarrow Cu^{2+}(aq) + SO_4^{2-}(aq) \qquad -16$$

$$CuSO_4 \cdot 5H_2O(s) + H_2O(\ell) \longrightarrow Cu^{2+}(aq) + SO_4^{2-}(aq) \qquad 3$$

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Enthalpy of neutralisation :→ It is the enthalpy change 1 equivalent acid is mixed with one equivalent base.

In case of acid base reaction

no. of equivalent = no. of moles × (basicity or acidicity)

$HCl \rightarrow 1$

$H_2SO_4 \rightarrow 2$

$H_3PO_4 \rightarrow 3$

$NaOH - 1$

$Ba(OH)_2 - 2$

$NH_4OH - 1$

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$$HA + BOH \longrightarrow BA + H_2O \quad \Delta H_{neut} < 0 \ (exo)$$

Magnitude of ΔH_{neut} depends on

1) Strength of acid and base
2) Concentration of acid and base used

Note: Variation due to 2nd factor is quite small and can be neglected if enthalpy of dilution data are not given

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Case-I If both are strong

$$HCl\,(2M,\ aq) + NaOH\,(3M,\ aq) \xrightarrow{\Delta H_{neut}} NaCl\,(aq) + H_2O(\ell)$$

$$H^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + Cl^-(aq) + H_2O(\ell)$$

$$H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$$

$\Delta H_{neut} = -13.7$ kcal/eq

measured at infinite dilution

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Case-II If one of them is weak :→

$$CH_3COOH(aq) + NaOH(aq) \xrightarrow{\Delta H_{neut}} CH_3COONa(aq) + H_2O(l)$$

$CH_3COOH(aq)$ → $CH_3COO^- + H^+(aq)$: ΔH_{ion}

$NaOH(aq)$ → $Na^+(aq) + OH^-(aq)$: 0

$CH_3COONa(aq)$ → $CH_3COO^-(aq) + Na^+(aq)$: 0

$H_2O(l)$ → $H_2O(l)$: 0

$$H^+(aq) + OH^-(aq) \xrightarrow{-13.7} H_2O(l)$$

$$\Delta H_{neut} = -13.7 + \Delta H_{ion}$$

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Q.1 2 lit 2M HCl(aq) + 2 lit 1M NaOH(aq) $\Delta H_{neut} = -27.4$ kcal

Q.2 100 ml 5M HCl(aq) + 200 ml 0.2M NaOH $\Delta H_{neut} =$

HCl	NaOH
$\frac{100 \times 5}{1000}$	$\frac{200 \times 0.2}{1000}$
0.5	0.04

$= -0.04 \times 13.7 \times 10^3$ cal

$= -4 \times 137$ cal

$= -548$ cal

$= -0.548$ kcal

Q.3 1 lit 1M CH_3COOH(aq) + 2 lit 1M NaOH

$\Rightarrow$ ($\Delta H_{ion} = 2$ kcal/mol)

Q.4 100 ml 0.1M CH_3COOH(aq) + 100 ml 0.1M NaOH (aq)

Q.5 100 ml 0.1M CH_3COOH(aq) + 200 ml 0.1M NH_4OH (aq)

($\Delta H_{ion} = 1$ kcal/mol)

Q.6 1 lit 1M H_2SO_4 + 2 lit 1M NaOH

$\Delta H_{neut} = -13.7 + 2 = -11.7$ kcal

3

4

CH_3COOH	NaOH
10	10 mmol

$-11.7 \times 10 \times 10^{-3}$ kcal

$= -117$ cal

$\Delta H_{neut} = -13.7 \times \frac{10}{1000} + 2 \times \frac{10}{1000}$

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(5) for 1 mol $= -13.7 + 2 + 1$

$= -10.7$

for 10 mmol $-10.7 \times \frac{10}{1000}$ Kcal

$= -107$ cal

(6) -27.4

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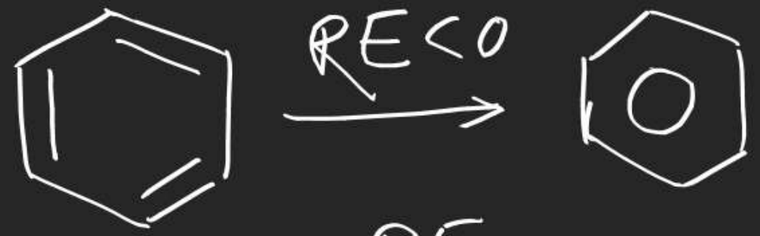
Resonance energy:→ It shows the difference in energy of most stable resonating structure and resonance hybrid.



MS $\xrightarrow{\alpha}$ hybrid

RE

calculation of RE

① By ΔH_f

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$6C(gr) + 3H_2(g) \xrightarrow{\Delta H_f}$  or $C_6H_6(g)$

ΔH_r

$\Delta H_r = 6\,\Delta H_{atom(graphite)} + BE(R) - BE(P_r)$

$\Delta H_r + x = \Delta H_f$

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(11) By heat & hydrogenations

$$C_4H_6(g) + 2H_2 \xrightarrow{\Delta H_{hydrogenation}} C_4H_{10}$$

x ↑ ↑ 0

$$CH_2=CH-CH=CH_2 + 2H_2 \xrightarrow{\Delta H_r} C_4H_{10}$$

$$CH_2=CH-CH=CH_2$$

O-2 23-33

S-2 23-34

T.D-2

J-adv