Nishant Jindal

Haber cycle

$$\Delta H_f = \Delta H_{sb} + I.E + \frac{B.D.E}{2} + \Delta H_{eg} + L.E$$

$$Na_{(s)} + \frac{1}{2}Cl_{2(g)} \xrightarrow{-\Delta H_f} NaCl_{(s)}$$

$Na_{(s)} \xrightarrow{\Delta H_{sb}} Na_{(g)}$

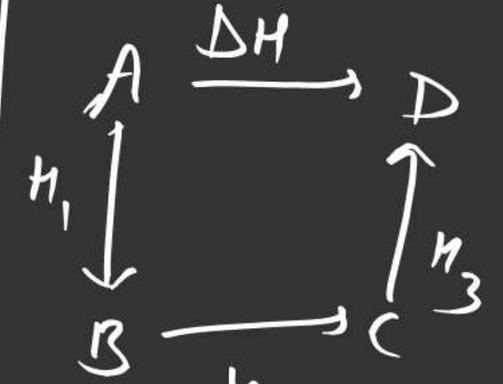
$\frac{1}{2}Cl_{2(g)} \xrightarrow{\frac{B.D.E}{2}} Cl_{(g)}$

$Na_{(g)} \xrightarrow{I.E} Na^{+}_{(g)}$

$Cl_{(g)} \xrightarrow{\Delta H_{eg}} Cl^{\ominus}_{(g)}$

$Na^{+}_{(g)} + Cl^{\ominus}_{(g)} \xrightarrow{L.E(U)} NaCl_{(s)}$

Hess Rule



$$\Delta H = H_1 + H_2 + H_3$$

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$L.E = 108 + 496 + 411 + 122 - 349$

$L.E = -788$

$Na_{(s)} + \frac{1}{2} Cl_{2(g)} \xrightarrow{-411} NaCl_{(s)}$

$Na_{(s)} \xrightarrow{108} Na_{(g)}$

$\frac{1}{2} Cl_{2(g)} \xrightarrow{+122} Cl_{(g)}$

$Na_{(g)} \xrightarrow{496} Na^{+}_{(g)}$

$Cl_{(g)} \xrightarrow{-349} Cl^{\ominus}_{(g)}$

$Na^{+}_{(g)} + Cl^{\ominus}_{(g)} \xrightarrow{U(L.E)} NaCl_{(s)}$

$U(L.E) = -788$

$\Delta H_f = \Delta H_{sb} + I.E + \frac{B.D.E}{2} + \Delta H_{eg} + L.E$

$-411 = 108 + 496 + \frac{122}{2} + (-349) + (L.E)$

Ionic mobility (I.M)

(ϕ) ↓ Charge density = $\frac{\text{Charge}}{\text{Size} \uparrow}$

Li^+	Be^{+2}
Na^+	Mg^{+2}
K^+	Ca^{+2}
Rb^+	Sr^{+2}
Cs^+	Ba^{+2}

Size ↑ charge density ↓

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Hydrated size $\propto$ (charge density) $\propto \frac{1}{\text{I·M}}$

Hydrated size

$Li^+_{(aq.)} > Na^+_{(aq.)} > K^+_{(aq.)} > Rb^+_{(aq.)} > Cs^+_{(aq.)}$

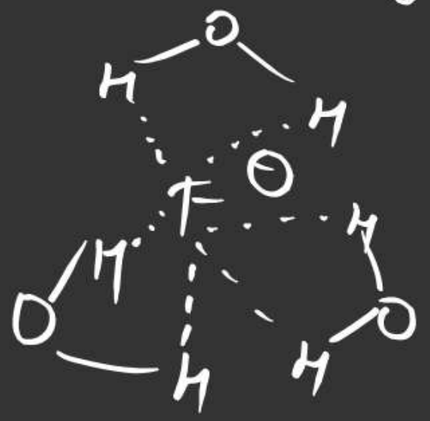
I·M

Hydrated size

$$Be^{+2}_{aq.} > Mg^{+2}_{aq.} > Ca^{+2}_{aq.} > Sr^{+2}_{aq.} > Ba^{+2}_{aq.}$$

$\pm$ M $<$ $<$ $<$ $<$

Hydrated size



$$F^{\ominus}_{(aq.)} > Cl^{\ominus}_{aq.} > Br^{\ominus}_{aq.} > I^{\ominus}_{aq.}$$

$\pm$ M $<$ $<$ $<$

Order of Size

Charge density of Be^{+2} = is 6.4

Be^{+2} and Charge density of Al^{+3} = 6

Al^{+3}

$6.4 = \frac{2}{size}$

$6 = \frac{3}{size}$

$size = 0.32$

$size = 0.50$

Cation size of

$Al^{+3} > Be^{+2}$

Q. Which of the following ion has higher hydration energy

(a) $Na^+_{aq.}$ (b) $Li^+_{(aq.)}$ (c) $K^+_{aq.}$ (d) $Rb^+_{(aq.)}$

$M \longrightarrow M^+ + e^-$ (oxidation)

(R.A)

I.E ↓ Reducing agent ↑

One

Order of Reducing power ←

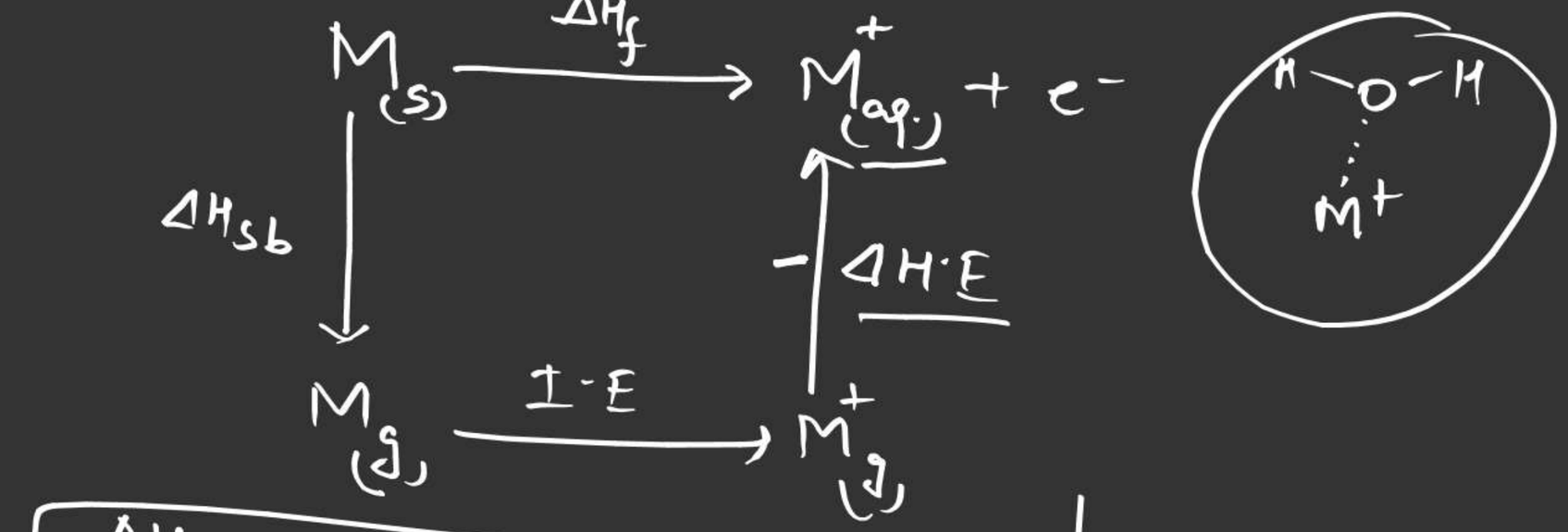
Li Na K Rb Cs

Ans (Li) $Cs > Rb > K > Na$

S.R.A due to high hydration energy

Li
Na
K
Rb
Cs

I.E ↓



$$\Delta H_f = \Delta H_{sb} + I.E - \Delta H.E$$

$L^+_{(aq.)}$

H.W

1. NCERT
2. DPP
3. Book
4. Sheet