18 - Lattice Energy

Q-1) What is the enthalpy change of formation?

> It's the enthalpy change when 1 mol of a compound is formed from its elements under standard conditions.

* The reactants and products must be in their standard states ↓ exothermic.

Q-2) What is standard enthalpy change of atomisation?

> It's the enthalpy change when 1 mol of gaseous atoms are formed from its elements under standard conditions.

↑ endothermic

Q-3) What is ionisation energy 1/2?

> It's the energy needed to remove one e^- from each atom/+1 ion in one mole of atoms/+1 ions in the gaseous state to form one mole of +1/+2 ions.

↑ endothermic.

Q-4) What is electron affinity 1/2?

> It's the enthalpy change when 1 mol of e^- is added to 1 mol of gaseous atoms/-1 ions to form 1 mol of gaseous -1/-2 ions under standard conditions.

EA1 = ↓ exothermic

EA2+ = ↑ endothermic.

Q-5) What is bond energy?

> It's the energy needed to break 1 mol of a particular bond in 1 mol of gaseous molecules
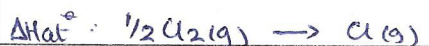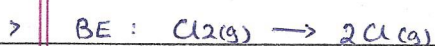
↑ endothermic

Q-6) What is lattice energy?

> It's the enthalpy change when 1 mol of an ionic compound is formed from its gaseous ions under standard conditions.
>
> ↓ exothermic

Q-7) Relationship between bond energy and ΔH_{at}°.

> BE : $Cl_{2(g)} \longrightarrow 2Cl_{(g)}$
>
> ΔH_{at}° : $\frac{1}{2}Cl_{2(g)} \longrightarrow Cl_{(g)}$
>
> $\therefore \Delta H_{at}^{\circ} = \frac{1}{2}BE$

Q-8) Factors affecting lattice energy.

> Size of ions:
>
>   - as size increases, ΔH_{latt} becomes less exothermic (less -ve) as there are less forces of attraction.
>
> Charge on ions:
>
>   - as charge increases, ΔH_{latt} becomes more exothermic (more -ve) as there are more forces of attraction.

ΔH_{latt} more exothermic (more -ve) when:

     - Small size of ion

     - high charge on ion.

Q-9) Thermal stability of group 2 carbonates and nitrates.

> $X(CO_3) \longrightarrow XO + CO_2$
>
> $2X(NO_3)_2 \longrightarrow 2XO + 4NO_2 + O_2$
>
>   ↓
>
>   brown fumes

Ion polarisation is when the high charge density cation pulls the e^- cloud of large anion towards itself.

Down the group 2
- cation size increases.
- charge density decreases
- ion polarisation decreases.
∴ → thermal stability increases
→ decomposition temperature increases.

Q-10) What is standard enthalpy change of solution?
> It's the enthalpy change when 1mol of an ionic solid dissolves completely in a solvent to give an infinitely ~~dilute~~ dilute solution
→ exothermic or endothermic.

Q-11) What is standard enthalpy change of hydration?
> It's the enthalpy change when 1mol of a gaseous ion dissolves in a solvent to form an infinitely dilute solution.
↓ exothermic.

Q-12) Solubility of group 2 sulphates and hydroxides.
> A compound is soluble in water when:

$$\Delta H_{hyd} > \Delta H_{latt}.$$ — ° since $\Delta H_{sol} = \Delta H_{hyd} - \Delta H_{latt}$

Down the group 2: SULPHATES.
- ΔH_{hyd} and ΔH_{latt} decreases.
- BUT ΔH_{hyd} decreases more rapidly
∴ $\Delta H_{hyd} < \Delta H_{latt}$.
∴ Solubility decreases. (ΔH_{sol} becomes more endothermic)

HYDROXIDES:
- BUT ΔH_{latt} decreases more rapidly
∴ $\Delta H_{hyd} > \Delta H_{latt}$
∴ solubility increases (ΔH_{sol} becomes more exothermic.)

Q-13) What is entropy?

> Entropy is the measure of the disorder of a system.
The lower the entropy, the more ordered a compound.

unit : $kJ\,mol^{-1}\,K^{-1}$

$$\Delta S^{\ominus} = \Delta S^{\ominus}_{products} - \Delta S^{\ominus}_{reactants}$$

* (s) → (ℓ) → (g) ⇝ (aq).

   entropy increases →

* As temperature increases, entropy increases.

* As no. of (g) molecules increases, entropy increases.

Q-14) What is standard Gibbs free energy change?

$\Delta H^{\ominus}$ = enthalpy change

$$\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$$

$kJ\,mol^{-1}$ $kJ\,mol^{-1}$ $kJ\,mol^{-1}\,K^{-1}$

T = temperature

$\Delta S^{\ominus}$ = entropy

* If ΔS is -ve; reaction is spontaneous.
* If ΔS is +ve; reaction is non-spontaneous.

$$\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$$

if:			then $\Delta G^{\ominus}$:
1	−	+	-ve
2	+	−	+ve
3	+	+	+ve at low temp
			-ve at high temp
4	−	−	-ve at low temp
			+ve at high temp.