DPP-01

Solution

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1. KO_2 is used in oxygen cylinders for space and submarines. Because it absorbs CO_2 and release O_2. $4KO_2 + 2CO_2 \rightarrow 2\ K_2CO_3 + 2O_2$.

2. The molecule is typically paramagnetic if the number of electrons is odd and the electrons are unpaired. The molecule is typically diamagnetic if there are even numbers of electrons and all of them are coupled.

   In KO_2

   $19 + 2 \times 8 = 35$

   There is odd electrons. So paramagnetic.KO_2 has superoxide, which contain one unpaired electron in $\pi^* 2p$ orbital.

   Hence it is paramagnetic.

   The odd electron is paired in $K_2O_2(O_2\ ^{2-})$, thus diamagnetic.

   Na2o2 is a alkali metal oxide, and all alkali metal oxides are diamagnetic hence na2o2 is diamagnetic.

   In RbO_2

   $37 + 2 \times 8 = 43$

   There is odd electrons. So paramagnetic.

3. Lattice energy is defined as the amount of energy required to separate one mole of solid ionic compound into its gaseous ions. Evidently greater the lattice energy, higher is the melting point of the alkali metals halide and lower is its solubility in water.

   For the same halide ion, the melting point of lithium halides are lower than those of the corresponding sodium halides and thereafter they decrease as we move down the group from Na to Cs.

   The low melting point of LiCl (887 K) as compared to NaCl is probably because LiCl is covalent in nature and NaCl is ionic.

   Hence the correct order is $NaCl > KCl > CsCl > LiCl$.

4. Alcohol cannot be used to store sodium metal because the alcohol's parotic nature and sodium's high reactivity will react to produce an alkoxide.

   For example: $CH_3OH + Na \rightarrow CH_3ONa + H_2$

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5. In the given alkali metal halides, the anion is the same (F− ion). Lattice energy depends on the size of the cation. It is inversely proportional to the size of the cation.

Thus, as the size of the cation increases, the lattice energy decreases. Since the smallest size is of Li+ and hence, LiF will have the highest lattice energy.

6. $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Hydration enthalpy depends upon ionic potential (charge/ size). As ionic potential increases hydration enthalpy increases.

Hydration energy is the amount of energy produced when a mole of an ion dissolves in a large volume of water, generating an infinitely dilute solution.

The higher the hydration enthalpy, the smaller the ion. This is because smaller atoms can contain a large number of water molecules and get hydrated. The size of the atom increases and the hydration enthalpy lowers down the group due to the inclusion of extra valence shells.

In the group 2elements of the periodic table, Lithium has the smallest ion hence, it will have the highest hydration enthalpy.

Caesium has the largest size in group 2 and will have minimum hydration energy.

Hence, it is the correct option.

7. The reaction is,

(i) $\underset{A}{Ca(OH)_2} + \underset{B}{Na_2CO_3} \rightarrow NaOH + \underset{\text{calcium carbonate(C)}}{CaCO_3}$

(ii) $\underset{\substack{A \\ \text{calcium hydroxide}}}{Ca(OH)_2} + \underset{B}{CO_2} \rightarrow \underset{\text{calcium carbonate.}}{CaCO_3(C)}$

8. Sodium formate (HCOONa) is produced by absorption of carbon monoxide by sodium hydroxide at 200ºC under pressure.

$CO + NaOH \rightarrow HCOONa$