1. The first and the second ionisation energies of magnesium are 7.646 eV and 15.035 eV respectively. The amount of energy in kJ needed to convert all the atoms of magnesium into Mg^{2+} ions present in 24 mg of magnesium vapour will be:
(Given $1\ eV = 96.5\ kJmol^{-1}$).

   A. $2.455\ kJ$

   B. $2.188\ kJ$

   C. $1.094\ kJ$

   D. $4.370\ kJ$

   Total energy needed to convert one Mg atom into Mg^{2+} gas ion,
   $= I.E_I + I.E_{II} = 22.681\ eV.$
   $= 2188.71\ kJ\ mol^{-1}$

   24 mg of Mg = 1×10^{-3} mole.
   Total energy = $1 \times 10^{-3} \times 2188.7 = 2.188\ kJ$

2. Among the following species, which has the maximum hydration energy?

   A. OH^-

   B. NH_4^+

   C. F^-

   D. H^+

   Hydration energy is the amount of energy released upon solvation by water.

   Hydration energy depends on the charge of the ion and the ionic radius. Higher the charge and smaller the size, greater the hydration energy. H^+ has the smallest size and hence has the maximum hydration energy among the four.

3. Select the correct statements.

A. The heat of hydration of the dipositive alkaline earth metals ions increases with increase in their ionic size.

✓ B. Hydration of alkali metal ions is less than that of alkaline earth metals.

✓ C. Alkaline earth metal ions, because of their much larger charge to size ratio, exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them.

✓ D. The melting point of sodium halides follow the order $NaF > NaCl > NaBr > NaI$.

a) Down the group, due to the increase in ionic size, the hydration energy of a dipositive ion decreases.

b) The size of the alkali metals is larger than that of the corresponding alkaline earth metals. So, their hydration energy is lower than that of the alkaline earth metals.

c) Alkaline earth metal ions, because of their much larger charge to size ratio, exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them.

d) Ionic radius decreases in the order $I^- > Br^- > Cl^- > F^-$. According to fajan's rule, covalent character decreases as $NaI > NaBr > NaCl > NaF$. So, NaF is the most ionic and hence it has the highest melting point. The melting point order is $NaF > NaCl > NaBr > NaI$

4. For two ionic compounds XY and AB, the data of their lattice energy and hydration energy is given as:

Compound	Lattice energy (kJ/mol)	Hydration energy(kJ/mol)
XY	400	1000
AB	600	2000

What will be the correct order of solubility in water?

- **A.** AB > XY
- **B.** XY > AB
- **C.** XY = AB
- **D.** Can't be predicted

More is the difference in lattice energy (cost) and hydration energy (gain), more will be the solubility of a given compound.
For XY,
Hydration energy - Lattice energy
= 1000 kJ/mol - 400 kJ/mol
=600 kJ/mol
For AB,
Hydration energy - Lattice energy
= 2000 kJ/mol - 600 kJ/mol
= 1400 kJ/mol
So, the difference in lattice energy and hydration energy is more for AB as compared to XY. Hence, AB is more soluble in water.