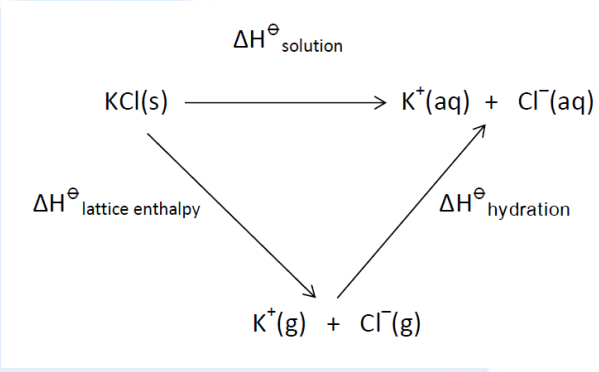
HL Answers to Energy cycle questions

1.(a)

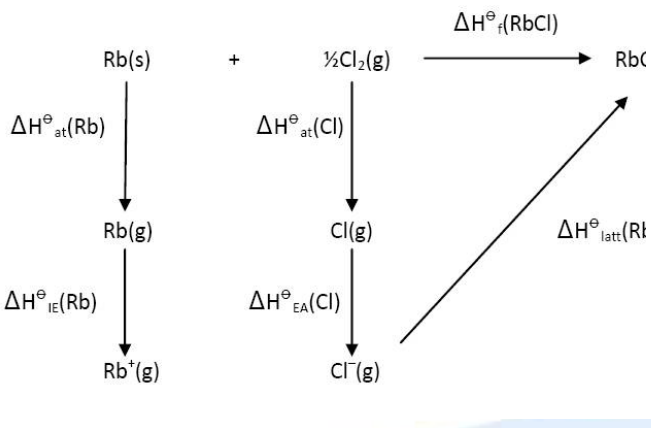


(b) $\Delta H_{solution(KCl)} = \Delta H^{\ominus}_{(lattice\ enthalpy(KCl)} + \Delta H^{\ominus}_{(hydration\ K^+)} + \Delta H^{\ominus}_{(hydration(Cl^-)}$

$= +720 + (-340) + (-359) = +21\ kJ\ mol^{-1}$

This differs by 3.78 kJ mol^{-1} (22%) from the value given in Section 19.

2. (a)



(b) $\Delta H^{\ominus}_f(RbCl) = \Delta H^{\ominus}_{at}(Rb) + \Delta H^{\ominus}_{at}(Cl) + \Delta H^{\ominus}_{IE}(Rb) + \Delta H^{\ominus}_{EA}(Cl) + \Delta H^{\ominus}_{latt}(RbCl)$

$-431 = +85.8 + 121 + 403 + (-349) + \Delta^{\ominus}_{latt}(RbCl)$

$\Delta^{\ominus}_{latt}(RbCl) = -692\ kJ\ mol^{-1}$

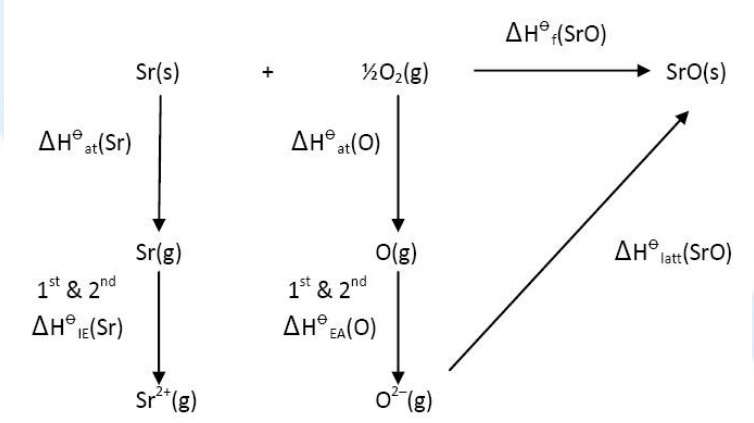
(c) The difference between the experimental value and the theoretical value is 12 kJ mol^{-1} or 1.7%. Since there is very little difference, the bonding in rubidium chloride is close to being 100% ionic.

3. (a) The ionic radius of the Mg^{2+} ion is smaller than the ionic radius of the Ca^{2+} ion so the charge density on the magnesium ion is greater so there is greater attraction to the negative oxide ion.

(b) The ionic radius of the Mg^{2+} ion is smaller than the ionic radius of the Na^{+} ion and the charge is twice as large so the charge density on the magnesium ion is much greater so there is greater attraction to the negative chloride ions.

(c) The ionic radius of the F^{-} ion is smaller than the ionic radius of the Cl^{-} ion so the charge density on the fluoride ion is greater so there is greater attraction to the positive sodium ion.

4. (a)



(b) X represents the sum of the 1st and 2nd electron affinities of oxygen.
Y represents the sum of the 1st and 2nd ionization energies of strontium.

(c) $\Delta H^{\ominus}_f(SrO) = + 164 + 249 + 1608 + 657 + (-3223) = -545$ kJ mol^{-1}