4 **(a)** Define enthalpy change of atomisation, ΔH_{at}.

.....

..... [1]

(b) Define first electron affinity, EA.

.....

..... [1]

(c) Explain why the first electron affinity of chlorine is more exothermic than the first electron affinity of iodine.

.....

.....

.....

..... [2]

(d) The enthalpy change for the reaction $Cl_2(g) + 2e^- \rightarrow 2Cl^-(g)$ is $-486\,kJ\,mol^{-1}$.

The first electron affinity of chlorine is $-364\,kJ\,mol^{-1}$.

Calculate the enthalpy change of atomisation of chlorine.

ΔH_{at} of chlorine = ... $kJ\,mol^{-1}$ [2]

[Total: 6]

2 **(a)** The Group 2 sulfates and the Group 2 chromates show similar trends in solubility.

Suggest the trend in the solubility of the Group 2 chromates down the group.

Explain your answer.

.....

.....

.....

.....

.....

..... [4]

(b) Silver(I) chromate, Ag_2CrO_4, is sparingly soluble in water.

(i) Write an ionic equation to show the equilibrium between solid Ag_2CrO_4 and its aqueous solution.

Include state symbols.

..... [1]

(ii) The value of the solubility product, K_{sp}, of Ag_2CrO_4 is 1.12×10^{-12} at 298 K.

Calculate the equilibrium concentration of Ag^+, in $mol\,dm^{-3}$, in a saturated solution of Ag_2CrO_4 at 298 K.

equilibrium concentration of Ag^+ = ... $mol\,dm^{-3}$ [3]

(c) The hydrogenchromate ion, $HCrO_4^-$, is a weak acid. The pK_a of $HCrO_4^-$ is 6.49.

(i) Calculate the pH of a 0.0250 mol dm^{-3} $HCrO_4^-$ solution.

pH = ... [2]

(ii) $HCrO_4^-$ can show amphoteric behaviour.

State the formula of:

- the conjugate acid of $HCrO_4^-$ .....
- the conjugate base of $HCrO_4^-$. .....

[1]

(d) Table 2.1 shows some energy changes.

Table 2.1

energy change	value / kJ mol^{-1}
first ionisation energy of silver	+731
second ionisation energy of silver	+2074
first ionisation energy of sulfur	+1000
second ionisation energy of sulfur	+2251
first electron affinity of sulfur	–200
second electron affinity of sulfur	+532
enthalpy change of atomisation of sulfur	+279
enthalpy change of formation of silver(I) sulfide, $Ag_2S(s)$	–33
lattice energy of silver(I) sulfide, $Ag_2S(s)$	–2677

(i) Define the term first electron affinity.

.....

.....

..... [1]

(ii) Explain why the value for the second electron affinity of sulfur is positive.

.....

.....

..... [1]

(iii) Construct an equation for the lattice energy of Ag_2S.

Include state symbols.

..... [1]

(iv) Calculate the enthalpy change of atomisation, ΔH_{at}, in kJ mol^{-1}, of silver using relevant data from Table 2.1.

It may be helpful to draw a labelled Born–Haber cycle.

Show your working.

ΔH_{at} of silver = ... kJ mol^{-1} [3]

(e) Suggest how the magnitude for the lattice energy of $Ag_2S(s)$ differs from the lattice energy of $Cu_2S(s)$.

Explain your answer.

.....

.....

..... [1]

[Total: 18]