

Name of the Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

Mark Schemes

Q1.

- (a) The enthalpy change / heat energy change / ΔH for the formation of one mole of (chloride) ions from (chlorine) atoms

Allow enthalpy change for $Cl + e^- \rightarrow Cl^-$ *Do not allow energy change**ionisation energy description is CE=0**Allow enthalpy change for the addition of 1 mol of electrons to Chlorine atoms**penalise Cl_2 and chlorine molecules CE = 0**allow chlorine ions*

1

Atoms and ions in the gaseous state

*Or state symbols in equation**Cannot score M2 unless M1 scored**except allow M2 if energy change rather than enthalpy change**ignore standard conditions*

1

- (b) $Mg^{2+}(g) + 2e^- + 2Cl(g)$ (1)
(M5)

$Mg^{2+}(g) + 2e^- + Cl_2(g)$ (1) (M4)	
	$Mg^{2+}(g) + 2Cl^-(g)$ (1) (M6)
$Mg^+(g) + e^- + Cl_2(g)$ (1) (M3)	
$Mg(g) + Cl_2(g)$ (1) (M2)	
$Mg(s) + Cl_2(g)$ (1) (M1)	
	$MgCl_2(s)$

*Allow e for electrons (i.e. no charge)**State symbols essential**If no electrons allow M5 but not M3,M4**If incorrect 1 / 2 Cl_2 used allow M3 and M4 for correct electrons (scores 2 / 6)*

- (c) $-\Delta H_f(\text{MgCl}_2) + \Delta H_a(\text{Mg}) + 1^{\text{st}} \text{IE}(\text{Mg}) + 2^{\text{nd}} \text{IE}(\text{Mg}) + 2\Delta H_a(\text{Cl}) = -2\text{EA}(\text{Cl}) - \text{LE}(\text{MgCl}_2)$
Allow Enthalpy of Formation = sum of other enthalpy changes (incl lattice formation)

1

$$-2\text{EA}(\text{Cl}) = 642 + 150 + 736 + 1450 + 242 - 2493 = 727$$

1

$$\text{EA}(\text{Cl}) = -364 \text{ (kJ mol}^{-1}\text{)}$$

Allow -363 to -364

Allow M1 and M2 for -727

Allow 1 (1 out of 3) for +364 or +363 but award 2 if due to arithmetic error after correct M2

Also allow 1 for -303

Units not essential but penalise incorrect units

Look for a transcription error and mark as AE-1

1

- (d) (i) Magnesium (ion) is smaller **and** more charged (than the sodium ion)
 OR

magnesium (ion) has higher charge to size ratio / charge density

Do not allow wrong charge on ion if given

Do not allow similar size for M1

Do not allow mass / charge ratio

1

(magnesium ion) attracts water more strongly

Mark independently

Mention of intermolecular forces, (magnesium) atoms or atomic radius

CE = 0

1

- (ii) Enthalpy change = $-\text{LE}(\text{MgCl}_2) + \Sigma(\Delta H_{\text{hyd}}\text{ions})$

$$= 2493 + (-1920 + 2 \times -364)$$

1

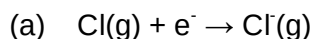
$$= -155 \text{ (kJ mol}^{-1}\text{)}$$

Units not essential but penalise incorrect units

1

[15]

Q2.



State symbols essential

Allow e with no charge

This and all subsequent equations must be balanced

1

(b) There is an attraction between the nucleus / protons and (the added) electron(s)

1

Energy is released (when the electron is gained)

Allow product more stable / product has lower energy

Allow reaction exothermic / heat released

Allow reference to chlorine rather than fluorine

Wrong process eg ionisation, boiling CE = 0

1

(c) (i) Top line: $+\text{e}^- + \text{F(g)}$

Penalise missing / wrong state symbols one mark only

Penalise F1 or Cl one mark only

1

Second line from top : $+\text{e}^- + \frac{1}{2}\text{F}_2(\text{g})$

Mark independently

Allow e with no charge

1

Bottom two lines: $+\frac{1}{2}\text{F}_2(\text{g})$

Penalise each lack of an electron in M1 and M2 each time

1

(ii) $\frac{1}{2}\text{E(F-F)} + 732 + 289 + +203 = 348 + 955$

$\frac{1}{2}\text{E(F-F)} = 79$

1

$\text{E(F-F)} = 158 \text{ (kJ mol}^{-1}\text{)}$

Award one mark (M2) if M1 wrong but answer = $M1 \times 2$

Ignore no units, penalise wrong units but allow kJ mol^-

Any negative answer, CE = 0

1

(d) (i) Experimental lattice enthalpy value allows for / includes covalent interaction / non-spherical ions / distorted ions / polarisation

OR AgF has covalent character

Allow discussion of AgCl instead of AgF

CE = 0 for mention of molecules, atoms, macromolecular, mean bond enthalpy, intermolecular forces (imf), electronegativity

1

Theoretical lattice enthalpy value assumes only ionic interaction / point charges / no covalent / perfect spheres / perfectly ionic

OR AgF is not perfectly ionic

1

- (ii) Chloride ion larger (than fluoride ion) / fluoride ion smaller (than chloride ion)

Penalise chlorine ion once only

Allow Cl^- and F^- instead of names of ions

Allow chloride ion has smaller charge density / smaller charge to size ratio but penalise mass to charge ratio

1

Attraction between Ag^+ and Cl^- weaker / attraction between Ag^+ and F^- stronger

For M2 Cl^- and F^- can be implied from an answer to M1

Mark M1 and M2 independently provided no contradiction

CE = 0 for mention of chlorine not chloride ion, molecules, atoms, macromolecular, mean bond enthalpy, intermolecular forces (imf), electronegativity

1

[12]