Abbreviations, annotations and conventions used in the Mark Scheme	/	= alternative and acceptable answers for the same marking point
	,	= separates marking points
	NOT	= answers which are not worthy of credit
	( )	= words which are not essential to gain credit
	___	= (underlining) key words which **must** be used to gain credit
	ecf	= error carried forward
	AW	= alternative wording
	ora	= or reverse argument

Question		Expected Answers	Marks
1	(a)	both atomisation steps	1
		1st and 2nd ionisation enthalpies	1
		electron affinity step	1
		lattice enthalpy	1
		enthalpy of formation	1
		all to be chemically correct and correctly labelled; penalise state symbols once only	
	(b)	ΔH_f = (+148) + (2×122) + (738) + (1451) + (2× -349) + (-2526)	1
		ΔH_f = -643 kJ mol^{-1} *(with units, correct answer = 2 marks)*	1
		allow ecf from (a)	
	(c)	$MgCl_2$	1
		Cl^- is the smallest anion *(reject chlorine ion)*	1
		strongest attraction / bonding	1

[Total: 10]

Question	Expected Answers	Marks
3 (a)	*correctly labelled* atomisation of chlorine + atomisation of caesium	1
	1st ionisation energy + 1st electron affinity	1
	formation of CsCl + LE	1
(b)	-443 = + 76 + (+122) + (+376) + (-349) + LE	1
	LE = -668 kJ mol^{-1} (allow ecf here if 1 mistake only in step 1)	1
(c)	Na^+ smaller than Cs^+ (don't accept sodium smaller first time)	1
	Na^+ has a larger charge density	1
	attracts the anion/Cl^- more strongly/ sodium chloride has the stronger bonding	1
(d)	dissolves / no reaction *do not accept "nothing"*	1
	colourless / neutral / pH 7	1
(e)	add aqueous $AgNO_3$	1
	chloride gives a white ppt	1
	iodide gives a yellow ppt	1
	Alternative answer	
	Pass chlorine/use NaOCl & HCl	
	No change with CsCl	
	Iodine displaced/brown solution with CsI	

[Total: 13]

Question	Expected Answers	Marks
4 (a)	$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$	2
	1 mark for correct species, 1 mark for correct balancing including electrons if present	
(b)	amount of $C_2O_4^{2-}$ = (25.0/1000) × 0 0400 = 0 001 mol	1
	amount of MnO_4^- required = 0 001 × (2/5) = 0.0004 mol	1
	vol of MnO_4^- required = 0 0004/0.0200 × 1000 = 20 cm^3 / 0.02 dm^3	1
	(Allow ecf on parts 2 & 3)	

[Total 5]

Question	Expected answers	Marks
1 (a)	Correct oxidation states for **each** atom i.e. Ca = +2, C = +4 and O = -2 (1); Oxidation numbers do not change during the reaction / no electron transfer during reaction (1)	2
(b)	$MgCO_3$ decomposition easier than $CaCO_3$ / higher decomposition temperature with $CaCO_3$ / ora (1); Mg^{2+} higher charge density than Ca^{2+} / both have the same charge but Mg^{2+} has a smaller ionic radius (1); So Mg^{2+} will polarise CO_3^{2-} more than Ca^{2+} can / more distortion of the CO_3^{2-} electron cloud by Mg^{2+} (1)	3
(c)	ΔH = +1207 +(-635) + (-393) / correct energy cycle drawn / ΔH_fproduct – ΔH_f reactants (1); ΔH = +179 (kJ mol^{-1})(1)	2
(d)	Mg^{2+} + O^{2-} → MgO (1); (3916 kJ of) energy is released (1); when one mole of **solid** magnesium oxide is made from its constituent **gaseous** ions (1)	3
(e) (i)	Enthalpy change of atomisation (of oxygen) (1)	1
(ii)	**Any two from** Mg^+ has one more proton than electrons / same number of protons but one fewer electron (1); Electron is lost from a particle that carries an overall positive charge (rather than being neutral) (1); So (outer) electron more firmly attracted to the nucleus (1)	2
(iii)	Correct energy level diagram labelled with correct formulae / correct cycle labelled with correct formulae (1); **Any two from** Correct state symbols (1); Correct energy values shown in the Born-Haber cycle (1) Correct labels for the enthalpy changes (1) **And** Lattice enthalpy = -735 +(-1445) + (-150) + (-878) + 141 + (-247) + (-602) (1)	4
(f)	Furnace lining / aw (1)	1
		Total = 18