Question	Answer	Marks
1(a)(i)	**M1** movement of electron(s) from potassium to iodine; **M2** one electron transferred;	**2** 1 1
(a)(ii)	**M1** regular arrangement / (giant) lattice of alternating; **M2** positive potassium ions / K⁺ **and** negative iodide ions / I ;	**2** 1 1
(a)(iii)	**M1** strong (forces of) attraction (between oppositely charged ions) / ionic bonds are strong; **M2** which require lots of energy to overcome / break;	**2** 1 1
(b)(i)	**M1** dissolve solids (in water) and mix / combine / add; **M2** filter; **M3** wash the residue (with water); **M4** leave to dry / place in oven / dry between filter papers;	**4** 1 1 1 1
(b)(ii)	$Pb^{2+} + 2I \rightarrow PbI_2$ formulae of ions correct; rest correct;	**2**
(c)(i)	start colour: colourless; end colour: brown;	**2** 1 1
(c)(ii)	**M1** iodide / I ; **M2** it is oxidised **OR** it loses electrons / it increases oxidation number / it reduces the chlorine;	**2** 1 1

Question	Answer	Marks	Guidance
2(a)	both correct charges of ions (calcium 2+ and nitrogen 3–); M2 8 electrons around nitrogen (can be 3 dots and 5 crosses **or** 5 crosses and 3 dots **or** all dots **or** all crosses, but reject any other combinations of dots and crosses); M3 Two electrons on the inner shell on any nitride ions/nitrogen atom: allow 2x or 2o once;	**3**	Charges can be shown anywhere **I** missing symbols for nitrogen **R** wrong symbol of nitrogen **anywhere** **A** if electron configuration of nitride is given as 2,8 or N is given as 2,5 **I** any missing inner shells as long as one is present *General guidance:* **I** electron configuration / symbol of calcium ion **I** formulae / stoichiometry Covalent can score **only** M3
(b)(i)	/ repeated / pattern / framework / periodic / ordered / alternating / organised; (of) particles / atoms / molecules / ions / cations / anions;	**2**	**I** layers **A** ionic / molecular / atomic **I** arrangement / bonding / properties
(b)(ii)	(so that ionic) charges balance or cancel / charge = 0 / no charge / number of positive = number of negative charges / charge is neutral or neutralised; M2 3(–) × 2 = 2(+) × 3 ;	**2**	**A** 6(+) = 6(–) **I** statements about electron transfer / valency / ox state unless valency is referring to ionic charges e.g. valencies 3+ and 2– can get credit if used properly Ratio of ions is 3:2 therefore ratio of charges is 2:3 scores 2

Question	Answer	Marks	Guidance
2(c)	it (refers to Ca) / Calcium / Ca (atom) loses / gives / donates electrons / e / e ;		**A** half-equation with electrons on right-hand side **R** calcium ion / Ca^{2+}
	(these are) gained by nitrogen / N / N_2 ;		**A** half-equation with electrons on left-hand side **R** nitride ion / N^3 **I** numbers of electrons / charges on ions / oxidation state / valency if mentioned **R** reference to oxygen / hydrogen if there is a suggestion that oxygen / hydrogen are involved in the reaction **I** reference to oxygen / hydrogen if in general statement e.g. oxidation is gain of oxygen
	nitrogen / N / N_2 is reduced so calcium / Ca is the reducing agent (these two statements could be split i.e. not in same sentence) **OR** reducing agents are electron donors / give / lose electrons **OR** calcium / Ca is oxidised (by electron loss) therefore calcium is the reducing agent (these two statements could be split i.e. not in same sentence);	3	Electrons / e / e move from calcium to nitrogen get marks 1 and 2 **A** calcium / Ca / it is a reductant or calcium / Ca / it reduces

3   **(a)** **(i)** rate of reaction decreases / gradient decreases   [1]
                because <u>concentration</u> of bromine decreases   [1]
                reaction stops because all bromine is used up   [1]

        (ii) initial rate greater / gradient greater   [1]
                because bigger surface area / more particles of iron exposed   [1]
                or:
                final mass the same   [1]
                because mass of bromine is the same so the same mass of iron is used   [1]

        (iii) increase / decrease / change rate of stirring / not stirred   [1]
                measure new rate / compare results   [1]

    (b) **(i)** Fe to Fe^{2+} [1]
                because oxidation is electron loss / increase in oxidation number   [1]

        (ii) Fe   [1]

    (c) add sodium hydroxide solution / ammonia(aq)   [1]
            Fe^{2+} <u>green</u> precipitate   [1]
            Fe^{3+} <u>brown</u> precipitate   [1]

4   **(i)**   Cu and Pd   [2]

         (ii)   Ba and La   [2]

         (iii) +2 **or** 2+ **or** Ba^{2+} [1]

         (iv) Ba **or** La   [1]

         (v)   it is a transition metal **or** a d block element   [1]

                                                                                                          [Total: 7]

5 **(a)** from methane **[1]**
and water **[1]**

OR electrolysis **[1]**
suitable electrolyte **[1]**

OR alkane **[1]**
cracking **[1]**   **[2]**

(b)(i) iron   **[1]**

   (ii) lower temperature moves equilibrium to right   **[1]**
because forward reaction is exothermic   **[1]**

(c)(i) H—H   **[1]**
endothermic   **[1]**
endothermic   **[1]**
exothermic

   (ii) More heat given out than taken in **[1]**
–2328 + 945 + 1308 = –75(kJ) **[1]**

OR More heat given out bond forming than taken in bond breaking **[2]**
Must mention bond breaking and forming   **[2]**

TOTAL = 10