1)

Correct Answer	Mark
D	**1**

2)

Correct Answer	Mark
D	**1**

3)

Correct Answer	Mark
A	**1**

4)

Correct Answer	Reject	Mark
A		**1**

5)

Correct Answer	Reject	Mark
B		**1**

6)

Correct Answer	Reject	Mark
D		**1**

7)

Correct Answer	Reject	Mark
C		**1**

8)

Correct Answer	Reject	Mark
A		**1**

9)

Correct Answer	Reject	Mark
A		**1**

10)

Correct Answer	Reject	Mark
C		**1**

11)

(a)	**First mark:** Mass of **an atom**/mass of **an isotope** (of an element) **(1)** IGNORE any references to average or (weighted) mean **Second mark:** relative to 1/12th the mass of a ^{12}C atom **(1)** NOTE: The second mark is awarded for **any mention of ^{12}C** IGNORE throughout the candidate's answer any references to 'moles' or '1 mol' or '12 g' Mark the two points independently	Mass of (all the) isotope**s** /atom**s** 'Mass of an element'	**2**

estion mber	Acceptable Answers	Reject	Mark
(b)(i)	{(35 x 75.53) + (37 x 24.47)} ÷ 100 **(1)** = 35.4894 = 35.49 **(1)** **Answer to 4 s.f. only.** Correct answer no working **(2)** IGNORE units of any kind (e.g. 'g' 'g mol^{-1}' 'amu', etc.)		**2**

umber			
1(b)(ii)	$^{35}Cl_2^+/(^{35}Cl-{}^{35}Cl)^+$ **(1)** $^{37}Cl_2^+/(^{37}Cl-{}^{37}Cl)^+$ **(1)** ALLOW $(^{35}Cl + {}^{35}Cl)^+$ and/or $(^{37}Cl + {}^{37}Cl)^+$ OR $(^{35}Cl^{35}Cl)^+$ and/or $(^{37}Cl^{37}Cl)^+$ OR $(^{35}Cl$ and $^{35}Cl)^+$ and/or $(^{37}Cl$ and $^{37}Cl)^+$ If the 'formal' charge is omitted on either ion (or both the ions), then award **(1)** mark only. NOTE: $^{35}Cl^+$ $^{35}Cl^+$ and $^{37}Cl^+$ $^{37}Cl^+$ scores **(1)** as each ion has an extra + charge. $2^{35}Cl^+$ and $2^{37}Cl^+$ scores **(1)** Accept mass number written as superscript to right of symbol.	$^{70}Cl_2^+$ $^{74}Cl_2^+$ $2^{35}Cl$ and/or $2^{37}Cl$ scores **(0)**	**2**

uestion umber	Acceptable Answers	Reject	Mark
l(b)(iii)	**72** **(1)** ^{35}Cl — $^{37}Cl^{(+)}$ **(1)** ALLOW $(^{35}Cl + ^{37}Cl)^{(+)}$ and/or $(^{37}Cl + ^{35}Cl)^{(+)}$ OR $(^{37}Cl^{35}Cl)^{(+)}$ and/or $(^{37}Cl^{35}Cl)^{(+)}$ OR $(^{35}Cl$ and $^{37}Cl)^{(+)}$ and/or $(^{37}Cl$ and $^{35}Cl)^{(+)}$ NOTE: The + charge is not needed on **this ion** IGNORE extra + charges, so ALLOW $^{35}Cl^{+}$ $^{37}Cl^{+}$ and/or $^{37}Cl^{+}$ $^{35}Cl^{+}$		**2**

12)

umber			
.(a)(i)	$Ba(s) + 2H_2O(l) \rightarrow Ba(OH)_2(aq) + H_2(g)$ OR $Ba(s) + 2H_2O(l) \rightarrow Ba^{2+}(aq) + 2OH^{-}(aq) + H_2(g)$ Correct products **(1)** State symbols and balancing **(1)**	Ba_2 $H_2O(aq)$ BaO_2	**2**

uestion umber	Acceptable Answers	Reject	Mark
.(a)(ii)	Ba(increases in ON) from 0 to +2 **(1)** H (decreases in ON) from +1 to 0 **(1)** TE from (a)(i) Stand-alone marks	Inclusion of oxygen changes will lose 1 mark	**2**

uestion umber	Acceptable Answers	Reject	Mark
.(b)	$Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$ IGNORE state symbols even if incorrect ALLOW $H^{+} + OH^{-} \rightarrow H_2O$ TE from (a)(i): $BaO + 2HCl \rightarrow BaCl_2 + H_2O$		**1**

uestion umber	Acceptable Answers	Reject	Mark
.(c)	**White** precipitate / **white** solid / **white** crystals (rather than colourless solution) **(1)** Barium sulfate is insoluble (whereas barium chloride is soluble) **(1)** Stand-alone marks	'Cloudy' alone	**2**

(d)(i)	**If flame test is described in (d)(i) then award appropriate marks for (d)(ii).** **A correct decomposition equation given in (d)(i) would score 1 mark.** **Allow valid discussion of thermal stability appearing in (d)(ii) for mark in (d)(i)** Barium carbonate is more thermally stable (than magnesium carbonate) / requires more heating / needs a higher temperature / decomposes more slowly / produces carbon dioxide more slowly OR Reverse argument ($MgCO_3$ decomposes faster) ALLOW $BaCO_3$ doesn't decompose on heating but $MgCO_3$ does **(1)** $MCO_3 \rightarrow MO + CO_2$ Where M stands for Mg or Ba **(1)** IGNORE state symbols even if incorrect	Just 'barium' Just 'produces more carbon dioxide' Just 'magnesium'	**2**

estion mber	Acceptable Answers	Reject	Mark
(d)(ii)	Flame test or description of: Mg does not colour flame **(1)** ALLOW colourless / clear Ba: (pale / apple) green flame **(1)** Stand-alone marks	Magnesium gives white / bright flame 'blue-green' Instrument analysis	2

13)

a)	London (forces) / van der Waals (forces) / temporary dipole-induced dipole (attractions) / dispersion forces / instantaneous dipole-dipole	Dipole-dipole Permanent dipole-dipole Just abbreviations, eg ID-ID, VdW	**1**

estion nber	Acceptable Answers	Reject	Mark
b)	18 /eighteen		**1**

estion nber	Acceptable Answers	Reject	Mark
c)	(Permanent) dipole-dipole attractions (also) present	Hydrogen bonds Reference to CH_3F having more electrons than F_2	**1**

nber			
d)	Hydrogen bonds (also) present **(1)** Which are stronger / which require more energy to break than dipole-dipole / London forces / van der Waals' forces / Or strongest intermolecular force **(1)**		**2**

estion nber	Acceptable Answers	Reject	Mark
e)	HCl does not have hydrogen bonds (between molecules) IGNORE references to electronegativity	Just 'chlorine does not have hydrogen bonds'	US035563

14)

3(a)	London/dispersion forces greater (ALLOW 'more') (in HI) ALLOW van der Waals forces/ temporary dipole (forces)/induced dipole (forces) Just 'Intermolecular (forces)' does not score this mark Stand alone mark **(1)** **Any two from** Because (Iodine/HI) has more electrons/iodine has more electron shells ALLOW bigger surface area **(1)** (So) more energy needed (ALLOW 'harder') to separate molecules / break the (London) forces ALLOW more energy needed to boil compound ALLOW intermolecular (forces) here **(1)** Permanent dipole in HI is weaker than the permanent dipole in HBr **(1)** The increase in London forces (from HCl to HI) outweighs the decrease in permanent dipole **(1)**	Iodide/bromide More electrons in the bond HI has more electron shells Just 'easier to boil compound'	**3**

3(b)	HF has hydrogen bonding (and HCl does not) Stand alone mark **(1)** **Any two from** Fluorine very electronegative/more electronegative than chlorine **(1)** Hydrogen bonding is (much) stronger (than other/named intermolecular forces) ALLOW Hydrogen bonding is (very) strong **(1)** So more energy needed (ALLOW 'harder') to separate molecules/ break the hydrogen bonds ALLOW more energy needed to boil compound **(1)** HCl has London/dispersion (and (weak) dipole-dipole) forces ALLOW (weak) dipole-dipole forces ALLOW 'Only London/dispersion forces' **(1)** ALLOW van der Waals forces/ temporary or induced dipole forces for London/dispersion	Just 'HF has stronger intermolecular forces (than HCl)' HF/F for fluorine Just 'easier to boil compound'	**3**

ion er	Acceptable Answers	Reject	Mark
3(c)	Water forms (up to) two hydrogen bonds (per molecule but HF only one). IGNORE references to numbers of lone pairs.	More/stronger/ greater than two	**1**

15)

nber			
(a)(i)	**Time** for the first (permanent) cloudiness to appear in the limewater ALLOW **Time** for the limewater to turn milky/cloudy ALLOW **Time** for the limewater to turn milky/cloudy and (ppt) to dissolve ALLOW how long for time IGNORE references to volume of CO_2	How fast/how quickly	**1**

(a)(ii)	**Any three from** Constant Bunsen flame/electrical heater setting Fixed height of test tube above the flame Fixed moles/(ALLOW mass/amount) of carbonate Fixed volume/amount/mass of limewater Penalise use of quantity once only Same surface area/particle size (of solid) Standardise cloudiness of limewater using the disappearance of a cross (or similar) IGNORE repeats & use same measuring instruments /same person	 Constant temp/ heat Water bath Fixed angle Volume/quantity Concentration / quantity	**3**
(b)(i)	More stable/(thermal stability) increases (as the group is descended)		**1**

stion nber	Acceptable Answers	Reject	Mark
(b)(ii)	Ignore an incorrect answer to 19b(i) and mark statements given independently Cation/positive (ALLOW metal) ion becomes larger (charge unchanged) OR cation charge density reduced **(1)** IGNORE references to shielding Polarisation/distortion reduced **(1)** (ALLOW polarising power reduced) of carbonate electron cloud/ carbonate ion/C-O bonds /anion **(1)** OR reverse argument for stability *decreasing* as group *ascended*	 Atomic/metal radius/charge density of **atom**/ molecule	**3**