Question Number	Correct Answer	Reject	Mark
1 (a)(i)	Hydrogen bonding Hydrogen bond(s) H bonding H bond(s) **Notes** Accept phonetic/incorrect spelling as long as the word is recognisable	Not "hydrogen" on its own Dipole-dipole bond Permanent dipole-dipole bond Covalent bond van der Waals' (forces) Temporary dipole-dipole Induced dipole-dipole London forces Any correct answer in conjunction with an incorrect response, eg hydrogen dipole-dipole bond.	**1**

Question Number	Correct Answer	Reject	Mark
1 (a)(ii)	(Fluorine atom) is more electronegative **(1)** Because it has less shielding / (bonding) electrons closer to the nucleus/ smaller /has less shells (so greater pull from nucleus on bonding electrons) **(1)** so HF has a (greater) dipole moment/$H^{\delta+}$ on HF (greater than on HBr)/HF is (more) polar **(1)**		**3**

Question Number	Correct Answer	Reject	Mark
1 (a)(iii)	Between 150 – 180 (K) Accept a range within the range e.g. '150-170'	°C	**1**

Question Number	Correct Answer	Reject	Mark
1 (b)(i)	Because propanone has both polar and non polar characteristics/can form both London forces and H bonds/can form London forces and dipole-dipole forces OWTTE **(1)** London forces can be described as Van der Waals VDW Temporary dipole-dipole Instantaneous dipole-induced dipole		**1**

Question Number	Correct Answer	Reject	Mark
1 (b)(ii)	**Water**: Hydrogen bonds with the (oxygen of the) carbonyl group/H bonds to the oxygen **(1)** **Octane:** London forces with methyl groups/carbon chain/CH groups/ H atoms **(1)** Both forces given allow **(1)**	Carbon atoms	**2**

Question Number	Acceptable Answers	Reject	Mark
2(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**

Question Number	Acceptable Answers	Reject	Mark
2(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**

Question Number	Acceptable Answers	Reject	Mark
2(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**

Question Number	Acceptable Answers	Reject	Mark
3 (a) (i)	Each mark is independent Diagram of separating funnel with tap. Sides can be straight or bulbous. Top can be stoppered or unstoppered, but not sealed (eg inverted test-tube with tap at bottom). **(1)** Allow straight sides with an open top Two layers. Upper layer is hydrocarbon layer **(1)** Colour – pink/purple/mauve. Allow violet **(1)**	 Filter funnel with tap Three layers Mention of any other colours on their own (e.g. grey, brown, red) or in combination with those accepted.	**3**

Question Number	Acceptable Answers	Reject	Mark
3 (a) (ii)	$2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$ Ignore state symbols Allow multiples/half amounts shown Accept answers involving I_3^-	Formation of Fe^+	**1**

Question Number	Acceptable Answers	Reject	Mark
3 (b)(i)	Answers must refer to oxidation/reduction Sulfuric acid oxidizes (hydrogen/potassium) iodide (to iodine) OR (hydrogen) iodide reduces sulfuric acid OR Phosphoric((V)) acid does not oxidize (hydrogen) iodide (to iodine) (as well as sulfuric acid does) Allow sulfuric acid is a strong(er)/good oxidizing agent/phosphoric(V) acid is a weaker oxidizing agent	 Sulfuric acid oxidizes iodine/oxidizes iodide to iodide Phosphoric acid is a better reducing agent Comments about hazards or strength of sulfuric acid alone Stability of phosphoric(V) acid alone	**1**

Question Number	Acceptable Answers	Reject	Mark
3 (b) (ii)	Water rises in the test tube Allow the gas /HI is soluble / dissolves	Steamy fumes Any coloured solutions forming even if with the acceptable/allowed answer Water would displace the gas	**1**

Question Number	Acceptable Answers	Reject	Mark
3 (b) (iii)	$NH_3(g)/(aq) + HI(g) \rightarrow NH_4I(s)$ Species and balanced equation **(1)** Allow $NH_4^+ + I^-$ for product All state symbols present (dependent on the entities above) **(1)**	NH_3I NH_3HI NIH_4	**2**

Question Number	Acceptable Answers	Reject	Mark
3 (c) (i)	$PI_3 + 3C_4H_9OH \rightarrow 3C_4H_9I + H_3PO_3$ Accept multiples Allow $P(OH)_3$, PH_3O_3, $H_2O + HPO_2$, as product/s		**1**

Question Number	Acceptable Answers	Reject	Mark
3 (c) (ii)	**Both points required** Van der Waals'/ London / dispersion / induced dipole / temporary dipole (forces) in 1-iodobutane Allow recognisable spelling of van der Waals' **and** (permanent) dipole dipole/permanent dipole (forces) Allow dipolar-dipolar	Any mention of hydrogen bonding (0)	**1**

Question Number	Acceptable Answers	Reject	Mark
3 (c) (iii)	Yellow precipitate /ppt /ppte / solid The answer may appear with additional words and phrases: e.g. two clear colourless solutions form a yellow precipitate which is insoluble in concentrated ammonia solution Allow bright yellow, sunshine yellow Allow recognisable spelling eg yello percipitate	Off-white Cream Any other colours and combinations of yellow with any other colours Any other qualifications of yellow eg pale/light Any answers which include bubbles, fizzing, effervescence	**1**

Question Number	Acceptable Answers	Reject	Mark
3 (c) (iv)	$CH_3CH_2CH_2CH_2NH_2$ /$CH_3(CH_2)_3NH_2$ /$CH_2(NH_2)CH_2CH_2CH_3$ / $NH_2CH_2CH_2CH_2CH_3$ / $H_2NCH_2CH_2CH_2CH_3$ /$(CH_3CH_2CH_2CH_2)_2NH$ /$(CH_3CH_2CH_2CH_2)_3N$ Allow displayed and skeletal formulae, $C_4H_9NH_2$ Salts of amines which must include a positively charged ion and I^-	NH_4I NH_3 instead of NH_2 Three carbon chains Missing hydrogens $C_4H_{11}N$	**1**