M1.C

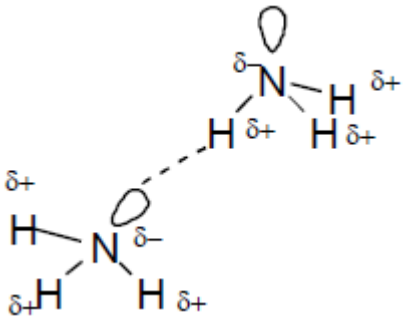
[1]

M2.(a) (i) Hydrogen bonds / H bonds

Not just hydrogen.

1

(ii)



M1 – lone pair on each N.

M2 – correct partial charges must be shown on the N and H of a bond in each molecule.

M3 – for the H bond from lone pair on N to the Hδ⁺ on the other NH_3 molecule.

If not ammonia molecules, CE = 0 / 3.

3

(b) Lone pair / both electrons / 2 electrons / electron pair on N(H_3) is donated to B(Cl_3)

Allow both electrons in the bond come from N(H_3).

1

(c) (i) The power of an atom or nucleus to withdraw or attract electrons or electron density or a pair of electrons (towards itself)

1

in a covalent bond

1

(ii) LiF **OR** Li_2O **OR** LiH

Allow Li_2O_2, allow correct lithium carbide formula.

1

(iii) BH_3 / H_3B

Allow B_2H_6 / H_6B_2

Do not allow lower case letters.

1

[9]

M3. (a) Iodine has more electrons / iodine is bigger (atom or molecule) / iodine has bigger M_r / bigger surface area

1

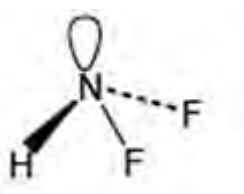
Stronger / more van der Waals forces / vdw / London / temporarily induced dipole / dispersion forces between molecules

1

Stronger VdW intermolecular forces = M2

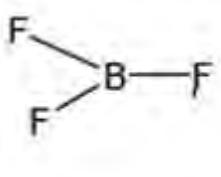
If stated VdW between atoms lose M2

(b) (i)



Mark is for 3 bp and 1 lp attached to N (irrespective of shape)

1



Mark is for 3 bp and 0 lp attached to B (irrespective of shape)

1

NHF_2 shape - pyramidal / trigonal pyramid

Accept tetrahedral / triangular pyramid

1

BF_3 shape - trigonal planar

Not triangular or triangular planar

1

(ii) 107°

Allow 106-108°

1

(c) Hydrogen bonds

Allow H-Bonds

Not just Hydrogen

Apply list principle eg Hydrogen bonding and dipole-dipole = 0

1

(d) Coordinate / dative covalent / dative

If covalent mark on

If ionic / metallic CE = 0

1

Lone pair / both electrons/ 2 electrons on $N(HF_2)$ donated (to BF_3)

Direction of donation needed here

1

[10]

M4.(a) Giant covalent / giant molecular / macromolecular

Not giant alone.

Not covalent alone.

1

(b) Shared pair of electrons / one electron from each C atom

1

(c) No delocalised / free / mobile electrons

Allow all (outer) electrons involved in (covalent) bonds.
Ignore ions.

1

(d) CH

Allow HC
C and H must be capital letters.

1

[4]

M5.(a) Covalent

If not covalent CE = 0/2
If dative covalent CE = 0/2
If blank mark on
Ignore polar
If number of pairs of electrons specified, must be 3

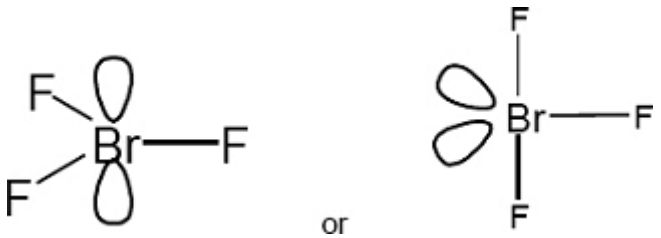
1

Shared <u>pair</u>(s) of electrons / one electron from Br and one electron from F

Not 2 electrons from 1 atom
Not shared pair between ions/molecules

1

(b) (i)



BrF_3 should have 3 bp and 2 lp and correct atoms for the mark
Penalise Fl

1

BrF_3 if trigonal planar shown = 120°

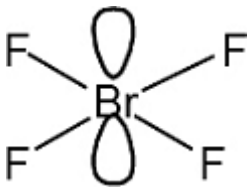
Allow 84 – 90° or 120° and ignore 180°

or if T shape shown 84 – 90°

Irrespective of shape drawn

1

(ii)



BrF_4^- should have 4 bp and 2 lp and all atoms for the mark(ignore sign)

Allow Fl

1

BrF_4^- 90°

Only

Ignore 180°

1

(c) Ionic or (forces of) attraction between ions / bonds between ions

If molecules, IMF, metallic, CE =0

If covalent bonds mentioned, 0/3, unless specified <u>within</u> the BrF_4^- ion and not broken

Ignore atoms

1

Strong (electrostatic) attraction / strong bonds / lots of energy needed to break bonds

1

Between K^+ and BrF_4^- ions/oppositely charged ions / + and – ions

If ions mentioned they must be correct

Strong bonds between + and – ions =3/3

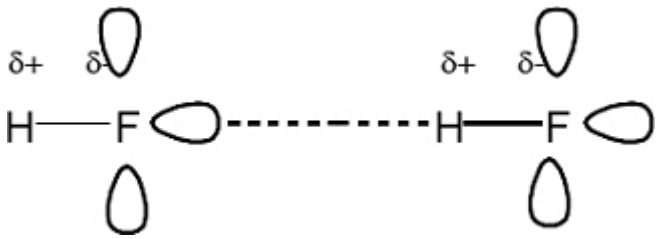
1

(d) (i) Hydrogen bonds/hydrogen bonding/H bonds/H bonding

Not just hydrogen

1

(ii)



One mark for 4 partial charges

One mark for 6 lone pairs

One mark for H bond from the lone pair to the Hδ+

Allow Fl

If more than 2 molecules are shown they must all be correct.Treat any errors as contradictions within each marking point.

CE = 0/3 if incorrect molecules shown.

3

(e) vdw / van der Waals forces between molecules

QoL

Not vdw between HF molecules, CE = 0/2

vdw between atoms, CE = 0/2

If covalent, ionic, metallic, CE=0/2

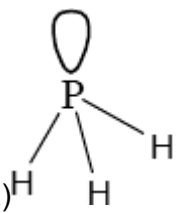
1

IMF are weak / need little energy to break IMF / easy to overcome IMF

1

[15]

M6. (a)



Need to see 3 P–H bonds and one lone pair (ignore shape).

1

(b) Coordinate / dative

If not coordinate / dative then chemical error CE=0 unless blank or covalent then M1 = 0 and mark on.

1

Pair of electrons on P(H_3) donated (to H+)

Do not allow a generic description of a coordinate bond.

1

(c) 109.5° / 109½ / 109° 28□

Allow answers in range between 109° to 109.5°

1

(d) Difference in electronegativity between P and H is too small

Allow P not very electronegative / P not as electronegative as N, O and F / P not electronegative enough / P not one of the 3 most electronegative elements.

Do not allow phosphine is not very electronegative.

1

[5]

M7.(a) $Al + 1.5Cl_2 \rightarrow AlCl_3$

Accept multiples.

Also $2Al + 3Cl_2 \rightarrow Al_2Cl_6$

Ignore state symbols.

1

(b) Coordinate / dative (covalent)

If wrong CE=0/2 if covalent mark on.

1

Electron pair on Cl^- donated to $Al(Cl_3)$

QoL

Lone pair from Cl^- not just Cl

Penalise wrong species.

1

(c) Al_2Cl_6 or $AlBr_3$

Allow Br_3Al or Cl_6Al_2

Upper and lower case letters must be as shown.

Not $2AlCl_3$

1

(d) $SiCl_4$ / silicon tetrachloride

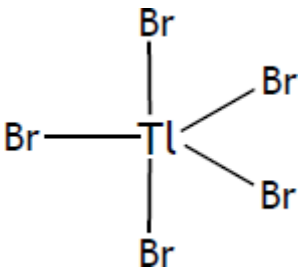
Accept silicon(4) chloride or silicon(IV) chloride.

Upper and lower case letters must be as shown.

Not silicon chloride.

1

(e)



Accept shape containing 5 bonds and no lone pairs from Tl to each of 5 Br atoms.

Ignore charge.

1

Trigonal bipyramid(al)

1

(f) (i) Cl — Tl — Cl

Accept this linear structure only with no lone pair on Tl

1

(ii) (Two) bonds (pairs of electrons) repel equally / (electrons in) the bonds repel to be as far apart as possible

Dependent on linear structure in (f)(i).

Do not allow electrons / electron pairs repel alone.

1

(g) Second

1

[10]