M1. (a) (i) Electronegativity (difference) or suitable description **(1)**

Accept F and Cl are highly electronegative
Not both atoms are highly electronegative

(ii) HF = hydrogen bonding **(1)**
HCl = (permanent) dipole-dipole bonding **or** even van de Waals' **(1)**
Hydrogen bonding stronger / is the strongest IMF **(1)**

Accept a statement that HF must have the stronger IMF, even if no IMFs identified

*The explanation **must** be based on **intermolecular** forces/attractions*

Note: if the explanation is clearly intramolecular = CE

4

(b) Electron pair **or** lone pair donated **(1)**

Do not accept 'donation of electrons'

From chloride ion to Al **or** $AlCl_3$ **(1)**

M1 can be earned by a general explanation of coordinate bonding, even if the electron pair is said to come from Al. The second mark, M2, is for this specific bond

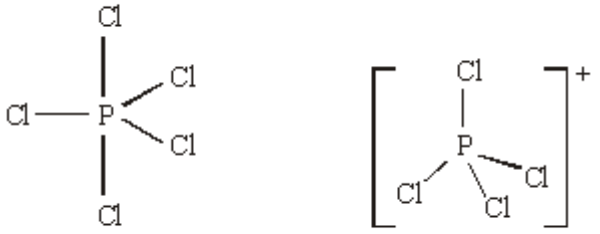
Ignore missing charge

2

(c)

4

PCl_5 PCl_4^+



(1) **(1)**

PCl_5 shown as trigonal bipyramid
[Look for: ONE solid linear Cl-P-Cl bond]

Bond Angle(s) 90° and 120° **(1)**

PCl_4^+ shown as tetrahedral
NO solid linear Cl-P-Cl bonds]

Bond angle(s) 109 or 109.5° **(1)**

[10]

M2.A

[1]

M3.B

[1]

M4. (a) *Force 1:* Van der Waals' **(1)**

Force 2: dipole - dipole **(1)**

Force 3: hydrogen bonding **(1)**
OR London, Dispersion, temporary dipole

3

(b) (i) covalent between atoms **(1)**
OR within molecule

Van der Waals' between molecules **(1)**

(ii) molecular **(1)**

(iii) Bonds (or forces) between molecules must be broken or loosened **(1)**
OR V.dW forces
OR intermolecular forces
Mention of ions CE=0

4

(c) (i) H-Bonding in HF **(1)**

(dipole-) dipole in HCl **(1)**
OR V.dW

H-bonding is stronger than dipole-dipole or V.dW **(1)**

OR H-bonding is a strongest intermolecular force for 3rd mark

(ii) HI bigger molecule than HCl **(1)**

OR Heavier, more e⁻s, more electron shells, bigger M_r, more polarisable

Therefore the forces between HI molecules are stronger **(1)**

QL mark (Look for unambiguous statements using correct terminology)

5

(d) (i) ionic **(1)**

Strong forces between ions **(1)**

OR lots of energy required to break bonds

(ii) All bonds must be broken **(1)**

mention of molecules etc CE=0

3

(e) macromolecular **(1)**

OR giant molecule / lattice or correct diagram

Strong covalent bonds **(1)**

OR lots of energy required to break bonds

2

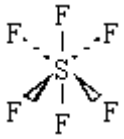
[17]

M5. (a) SF_6 shown as octahedral / square based bipyramid **(1)**

Bond angle: 90° **or** 180° and 90° **(1)**

Shape = octahedral **(1)**

If lone pair shown then C.E. = 0 / 4

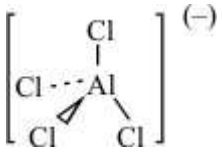


Wrong symbols - no diagram mark

Equal repulsion between 6 bonding **or** shared electron pairs **QoL (1)**

$AlCl_4^-$ shape shown as tetrahedral **(1)**
Bond angle = 109° to 109.5° **(1)**
Shape = tetrahedral **(1)**

If lone pair shown then C.E = 0/4



(Equal repulsion between) 4 bonding pairs **or** shared electron pairs **(1)**

QoL may be awarded here also
Mark all points independently

8

(b) Solvent has low bp or weak intermolecular forces **or** evaporates quickly **(1)**

(Solvent) needs energy to evaporate **(to overcome intermolecular forces) or** valid reference to latent heat of vaporisation **(or evaporation is endothermic) (1)**

OR higher energy or faster molecules more likely to escape so mean energy (and hence temperature) falls

Energy taken from the skin (and so it cools) **(1)**

Fragrance or perfume (molecules) slowly spreads (through the room) **(1)**

By random movement **or** diffusion (of the perfume / fragrance) **(1)**

4

[12]

M6.C

[1]