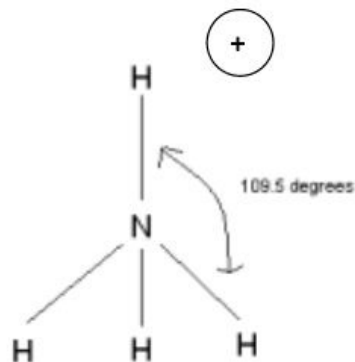
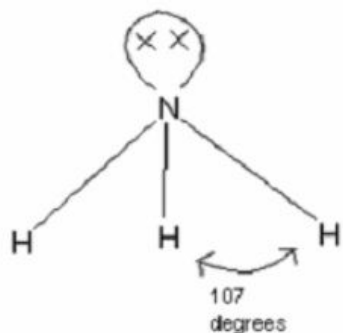


Q1.

(d)

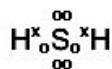


1 mark for each diagram, 1 mark for each correct bond angle
 If not 3-dimensional diagram – 1 penalty.

[4]

Q2.

(c) (i)



(1)

(ii) non-linear/bent/V-shaped

(1)

(iii) H₂O has hydrogen bonds/H₂S does not or
 H₂S has van der Waals' forces only

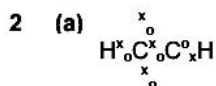
(1)

hydrogen bonds are stronger
 than van der Waals' forces or
 H₂S has weaker intermolecular bonds
 than H₂O

(1)

[4]


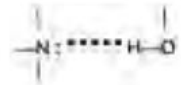
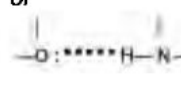
Q3.



(1)

[1]

Q4.

- 1 (a) (i) between 117° and 120° [1]
- (ii)  [1]
 14 electrons must be shown [1]
 single N-N bond [1]
 lone pair on each N atom [1]
- (iii) between 107° and 109° [1] [4]
- (b) ethene – van der Waals' forces [1]
 hydrazine – hydrogen bonds [1]
 hydrogen bonds are stronger [1] [3]
 or van der Waals' forces are weaker
- (c) correct dipole on O—H and N—H bonds [1]
 labelled hydrogen bond shown [1]
 between an O atom of H_2O and a H atom of N_2H_4
 or between an N atom of N_2H_4 and a H atom of H_2O
 lone pair on O atom or on N atom *in the H bond*
 i.e. 
 or  [1] [3]
- (e) (i) acid – base/neutralization [1]
 (ii) N atom has a lone pair of electrons [1]
 or N atom can behave as a base
 or N atom can form dative bond [1]
 (iii) each N atom has a lone pair [1] [3]
 or each nitrogen atom can behave as a base
 or each nitrogen atom can form a dative bond

Q5.

1 (a) (i) 2 (1)

(ii) between 104° and 105° (1) [2]

(b) ethanal CH_3CHO A (1)

ethanol $\text{CH}_3\text{CH}_2\text{OH}$ C (1)

methoxymethane CH_3OCH_3 A (1)

2-methylpropane $(\text{CH}_3)_2\text{CHCH}_3$ B (1) [4]

(c) (i) hydrogen bonds (1)

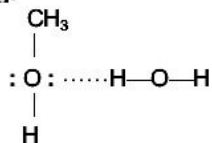
(c) (i) hydrogen bonds (1)

(ii) correct dipole on an -O—H bond (1)

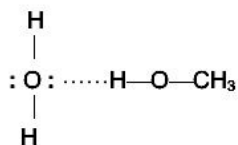
hydrogen bond shown between the lone pair of an O and a H atom in an -OH group (1)

lone pair on O atom of CH_3OH or H_2O clearly shown **in the hydrogen bond** (1)

e.g.



or



[4]

(d) hydrogen bonds exist between H_2O molecules (1)

hydrogen bonds cannot form between $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ molecules (1)

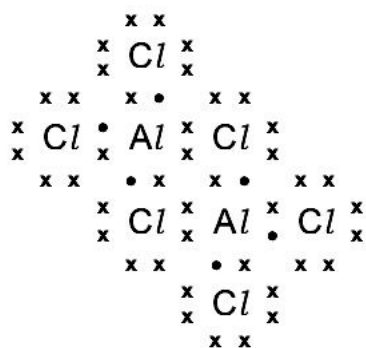
[2]

[Total: 12]

Q6.

- 1 (a) Al $1s^2 2s^2 2p^6 3s^2 3p^1$ (1)
- Ti $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$ or
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$ penalise any error (1) [2]
- (b) (i) pass chlorine gas (1)
over heated aluminium (1)
- (ii) aluminium glows (1)
white/yellow solid formed (1)
chlorine colour disappears/fades (1) (any 2)

(iii)



correct numbers of electrons, i.e.

3 • per Al atom and 7x per Cl atom

i.e. 6 • and 42 x in total

dative bond Cl to Al clearly shown by \times

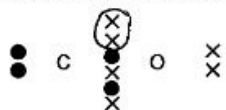
- (c) chlorine is a strong/powerful oxidising agent (1) [1]

- (d) (i) $n(\text{Ti}) = \frac{0.72}{47.9} = 0.015$ (1)
- (ii) $n(\text{Cl}) = \frac{(2.85 - 0.72)}{35.5} = 0.06$ (1)
- (iii) $0.015 : 0.06 = 1:4$
empirical formula of **A** is TiCl_4
Allow ecf on answers to (i) and/or (ii). (1)
- (iv) $\text{Ti} + 2\text{Cl}_2 \rightarrow \text{TiCl}_4$ (1)
Allow ecf on answers to (iii). [4]
- (e) covalent/not ionic (1)
simple molecular **or**
mention of weak intermolecular forces **or**
weak van der Waals's forces between molecules (1) [2]
- [Total: 14 max]

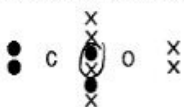
Q7.

- 1 (a) fewer electrons in Cl_2 than in Br_2 (1)
smaller van der Waals' forces in Cl_2 **or** stronger van der Waals' forces in Br_2 (1) [2]
- (b) CO has a permanent dipole **or** N_2 does not (1)
permanent dipole-permanent dipole interactions are stronger than those from induced dipoles (1) [2]

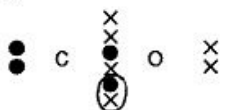
(c) (i) a co-ordinate bond (1)



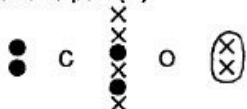
(ii) a covalent bond (1)



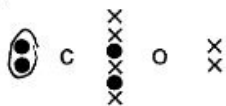
or



(iii) a lone pair (1)



or



penalise any groups of 3 or 4 electrons that are circled

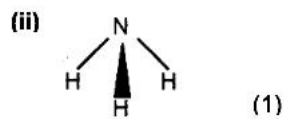
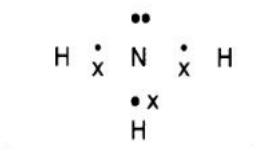
[3]

(d) CO and HCN both have a dipole or N₂ does not have a dipole (1)

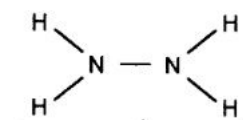
[1]

Q8.

(c) (i) 'dot-and-cross' diagram (1)



(iii) minimum is



allow bond angle around N atom between 109° and 104° (1)

[4]

(d) -2 (1)

[1]

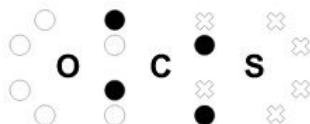
Q9.

(f) (i) both have very similar/same van der Waals' forces (1)

(ii) CH_3F has permanent dipole (1) [2]

Q10.

(f) (i)



(1)

(ii) 180°

(1) [2]

Q11.

(c) (i) around the N atom there is only one lone pair
 around the S atom there are two lone pairs

both (1)

(ii) angle (a) or sulfur – **no mark for this**

because two lone pairs repel more than one lone pair or
 lone pair-lone pair repulsions are stronger
 than lone pair-bond pair repulsions

(1) [2]

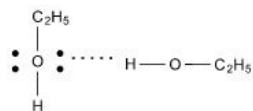
Q12.

(d) (i) hydrogen bonds (1)

(ii) lone pair on O atom of C₂H₅OH (1)

correct dipole O^{δ-}—H^{δ+} on bond in one molecule of ethanol (1)

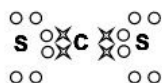
hydrogen bond shown between lone pair of an O atom and a hydrogen atom, i.e.



(1) [4]

Q13.

1 (a) (i)

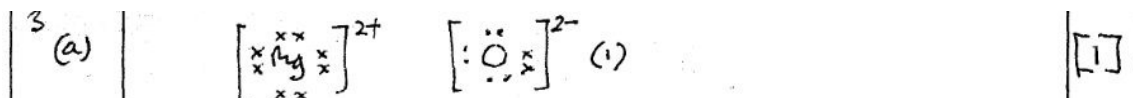


S atom has 6 **and** C atom has 4 electrons (1)

S=C double bonds (4 electrons) clearly shown (1)

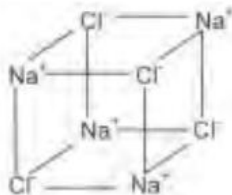
(ii) linear **and** 180° (1) [3]

Q14.



Q15.

- 1 (a) ionic⁻ (1)
 Na^+ and Cl^- (1)
 arranged in cubic lattice (diagram required)

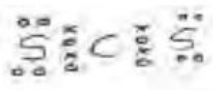


each Na^+ ion surrounded by six Cl^- ions
 or each Cl^- ion surrounded by six Na^+ ions
 may be in diagram or stated in words (1) [4]

- (b) in the solid, the ions cannot move (1)
 in the melt, the ions move
 or carry the charge/current (1) [2]

Q16.

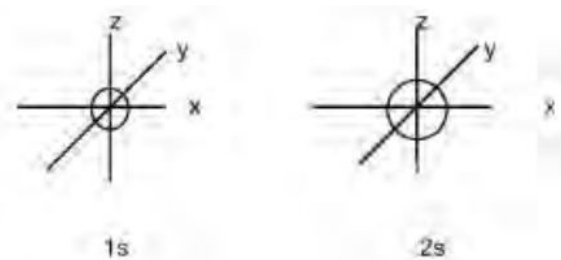
(a)



- sulphur atom has 6 /carbon atom has 4 electrons (1)
 $\text{S}=\text{C}$ double bonds (4 electrons) clearly shown (1) [2]
- (b) linear (1)
 180° (1) [2]

Q17.

1 (a)

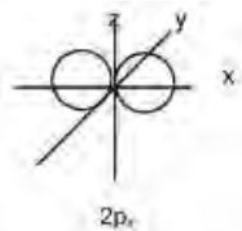


1s

spherical (1)

2s

larger spherical (1)

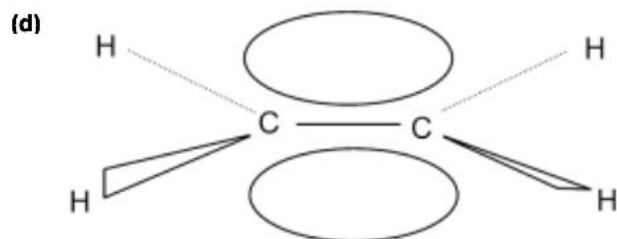


2p_x

double lobes along the x-axis (1)

[3]

- (b) (i) attraction between bonding electrons and nuclei (1)
 attraction is electrostatic (1)
- (ii) H₂ s-s **overlap** clearly shown
 must **not** be normal dot/cross diagram (1)
- HC_l s-p **overlap** clearly shown
 overlap must involve s and p orbitals (1) [4]
- (c) (i) bonding electrons are unequally shared **or**
 the molecule has a dipole/ δ^+ and δ^- ends to molecule (1)
- (ii) the H and Cl atoms have different electronegativities
or chlorine is more electronegative than hydrogen (1) [2]



allow two 'sausages' above and below the C-C axis

or two p orbitals **overlapping** sideways
to form one (localised) π bond over two carbon atoms

(1) [1]

(e) $\Delta H_f^\circ = 2(-393.7) + 2(-285.9) - (-1411)$

$= + 51.8 \text{ kJ mol}^{-1}$ (units given in qu.)

(3)

penalise errors: no 2 for -393.7
no 2 for -285.9
wrong sign for -(-1411)

[3]

[Total: 13]

Q18.

(b) (i) giant ionic lattice (may be in diag.)

(1)

strong ionic bonds

(1)

(ii) simple molecular or discrete molecules

(may be shown in a diagram)

(1)

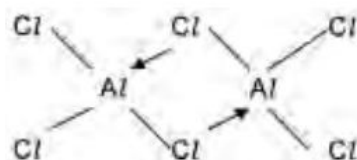
with **weak** intermolecular forces or

weak van der Waals' forces

between them

(1) [4]

- (e) (i) 460 K Al_2Cl_6 (1)
 1150 K $AlCl_3$ (1)
- (ii) correct **dot-and-cross** diagram for $AlCl_3$ (1)
- (iii) correct displayed structure for Al_2Cl_6 (1)
 two correct co-ordinate bonds (1)



[5]

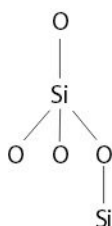
Q19.

- 2 (a) (i) H-C-H 117 to 120° (1)
 C=C=O 180° (1)
- (ii) molecule contains **both** ketone **and** alkene (1) [3]
- (b) (i) $C_2H_2O + 2O_2 \rightarrow 2CO_2 + H_2O$ (1)
- (ii) from eqn., $42 \text{ g } C_2H_2O \rightarrow 48 \text{ dm}^3 \text{ of } CO_2$ (1)
 whence $3.5 \text{ g } C_2H_2O \rightarrow \frac{48 \times 3.5}{42} \text{ dm}^3 \text{ of } CO_2$ (1)
 = $4.0 \text{ dm}^3 \text{ of } CO_2$ (1)
- or $n(C_2H_2O) = \frac{42}{3.5} = 0.0833$ (1)
 $n(CO_2) = 2 \times 0.0833 = 0.0166$ (1)
 vol. of $CO_2 = 0.0166 \times 24 = 4.0 \text{ dm}^3$ (1)
 allow e.c.f. on wrong eqn. in (b)(i)
 penalise significant figure error [4]

Q20.

- 1 (a) CO₂ is simple molecular/simple covalent/has discrete molecules (1)
 CO₂ has induced dipole – induced dipole interactions/
 van der Waals' forces/weak intermolecular forces (1)
 SiO₂ is giant molecular/giant covalent/macromolecular (1)
 SiO₂ has strong covalent bonds (1) [any 3]

- (b) minimum is 4-valent Si-O (1)
 and at least one Si-O-Si (1)
 i.e.



[2]

- (c) (i) for an ideal gas, **any four** from the following (1)
 the molecules behave as rigid spheres (1)
 there are no/negligible intermolecular forces (1)
 between the molecules (1)
 collisions between the molecules are perfectly elastic (1)
 the molecules have no/negligible volume (1)
 the molecules move in random motion (1)
 the molecules move in straight lines (1)
 the kinetic energy of the molecules is (1)
 directly proportional to the temperature (1)
 the pressure exerted by the gas is due to the collisions (1)
 between the gas molecules and the walls of the container (1)
not an ideal gas obeys $pV = nRT$ (1)
 (max 4)
- (ii) there are intermolecular forces between CO₂ molecules/
 CO₂ molecules have volume (1) [5]
- (d) graphite has delocalised electrons (1) [1]
- (e) (i) SiO₂ + 2C → SiC + CO₂ or (1)
 SiO₂ + 3C → SiC + 2CO (1)
- (ii) diamond **because** SiC is hard (1) [2]

[Total: 13]

Q21.

- (b) (i) giant lattice (may be in diagram) (1)
with strong ionic bonding (1)
- (ii) ionic (1)
- (iii) -1 (1)
- (iv) $\begin{array}{c} \cdot\cdot \\ \cdot\cdot \end{array} \overset{+}{\text{Na}} : \quad \overset{-}{\text{H}} \cdot$
- correct numbers of electrons (1)
correct charges (1)

(v)

compound	MgH ₂	AlH ₃	PH ₃	H ₂ S
oxidation number of element in the hydride	+2	+3	-3	-2

- correct oxidation nos. for MgH₂ and AlH₃ (1)
correct oxidation nos. for PH₃ and H₂S (1)

[8]

Q22.

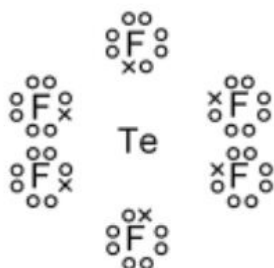
1 (a)

number of bond pairs	number of lone pairs	shape of molecule	formula of a molecule with this shape
3	0	trigonal planar	BH ₃
4	0	tetrahedral	CH ₄ allow other Group IV hydrides
3	1	pyramidal or trigonal pyramidal	NH ₃ allow other Group V hydrides
2	2	non-linear or bent or V-shaped	H ₂ O allow other Group VI hydrides

1 mark for each correct row

(3 × 1) [3]

(b) (i)



(1)

(ii) octahedral or square-based bipyramid

(1)

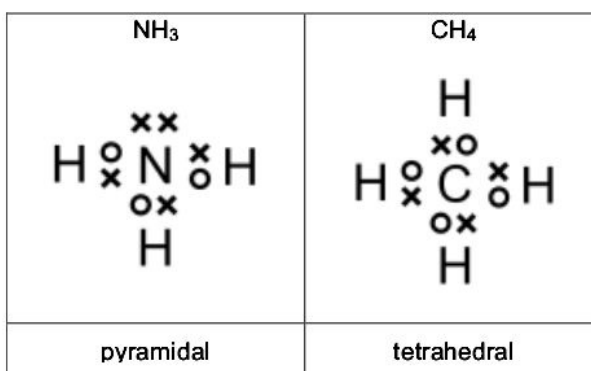
(iii) 90°

(1) [3]

[Total: 6]

Q23.

1 (a)



both 'dot-and-cross' diagrams correct
 NH₃ is pyramidal or trigonal pyramidal
 CH₄ is tetrahedral

(1)

(1)

(1) [3]

(b) (i) nitrogen and hydrogen have different electronegativities

(1)

N–H bond has a dipole or

$N^{\delta-}-H^{\delta+}$ or

bonding pair is unequally shared

(1)

(ii) molecule is not symmetrical or

dipoles do not cancel out

(1)

- (iii) NH_3 has higher boiling point than expected from M_r value **or**
has higher boiling point than methane
or NH_3 is soluble in water (1) [4]
- (c) three covalent N–H bonds (1)
one co-ordinate (dative covalent) N–H bond (1)
one ionic bond between NH_4^+ and Cl^- (1) [3]

[Total: 10]

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www.youtube.com/megalecture
www.megalecture.com