CHEMISTRY ONLINE
TUITION

Phone: +442081445350

www.chemistryonlinetuition.com

Email:asherrana@chemistryonlinetuition.com

CHEMISTRY
PHYSICAL CHEMISTRY

Level & Board	CIE (A-LEVEL)
TOPIC:	CHEMICAL BONDING
PAPER TYPE:	SOLUTION - 1
TOTAL QUESTIONS	9
TOTAL MARKS	83

CHEMICAL BONDING

1)

(a) *The relative atomic mass of an element,* A_r *is defined as*

$$A_r = 12 \times \frac{Average\ mass\ of\ one\ atom\ of\ the\ element}{Mass\ of\ one\ atom\ of\ {}^{12}C}$$

(b) $\quad A_r = \frac{80\times2.6+82\times11.6+83\times11.5+84\times56.9+86\times17.4}{100} = 83.9$

(c) Assume ideal gas behavior,

pV = nRT

$$(2.00 \times 10^4)(104 \times 10^{-6}) = n \times 8.31 \times 305$$

$$n = 8.21 \times 10^{-4} mol$$

$$\therefore \quad M = \frac{0.100}{8.21 \times 10^4} = 122\ g\ mol^{-1}$$

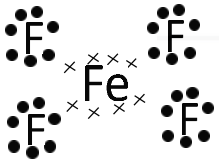
Hence, the relative molecular mass of A is 122.

∴ 122 – 83.9 = 38.1

Thus is equivalent to 2F atoms (2×19).

Hence, A is KrF_2.

(d) (i)



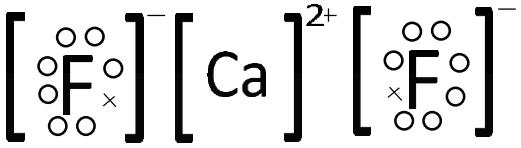
(ii) Square planar.

(iii) To balance O, a = 2

To balance Xe, b =4.

To balance F (or H), c = 24.

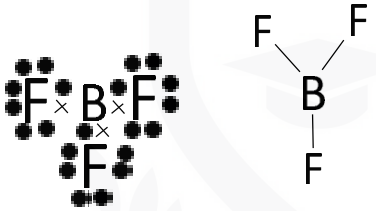
2)



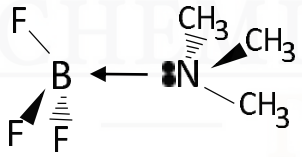
3)

(a) (i) There are 3 region of electron clouds around B (with no Ione pair). To minimize electronic repulsion, they are directed in a trigonal planar manner.

Hence, BF_3 is trigonal planar.



(ii) A dative bond is formed between N and b where n uses its Ione pair of electron, while B has a vacant orbital to accept it.



(b) (i) Relative atomic mass is the ratio of the average mass of an atom to $\frac{1}{2}$

The mass of a ^{12}C isotope.

(ii)

m/e	Ion
45	$^{10}B^{35}Cl^{+}$
46	$^{11}B^{35}Cl^{+}$
47	$^{10}B^{37}Cl^{+}$
48	$^{11}B^{37}Cl^{+}$

(iii) mass = 11.009 + 34.969 = 45.978 (g mol^{-1})

(iv) let x be the fraction of ^{10}**B**

Using peaks at m/e = 45 and 46,

$$\frac{abundance\ of\ m/e\ = 45}{abundance\ of\ m/e\ = 46} = \frac{x}{(1-x)} = \frac{3}{12}$$

$$12x = 3(1-x)$$

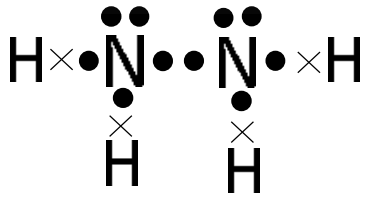
$$X = 0.2 \text{ or } 20\%$$

Relative atomic mass of boron = $0.2 \times 10.013 + 0.8 \times 11.009 = 10.81$

4)

(a) (i) between 117^0 and 120^0

(ii)



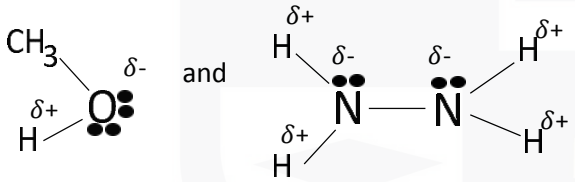
. electron of nitrogen

× electron of hydrogen

(iii) between 107^0 and 109^0

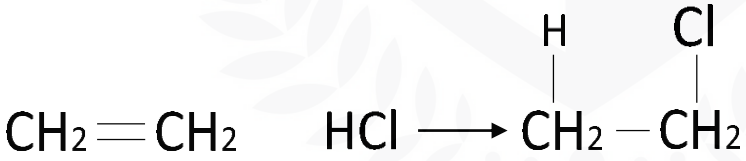
(b) Ethene molecules offer vander wall's forces and hydrazine has hydrogen Bonds among these molecules. Hydrogen bonds are stronger than wander Wall's forces, therefore, melting point and boiling points of hydrazine are Much higher than those of ethene.

(c) Ethanol and hydrazine have dipoles as shown.



Oxygen atom of alcohol and hydrogen of hydrazine bond together.

(d) (i)



(ii) Electrophilic addition

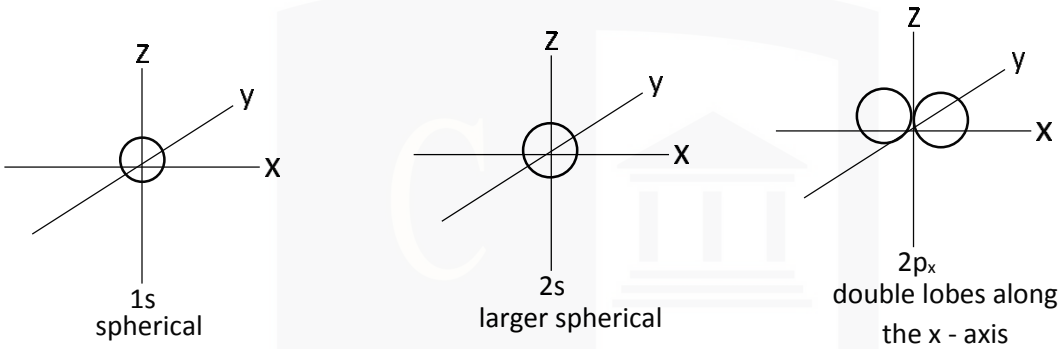
(iii) C2H5Cl molecule is a saturated compound and there is no possibility of Further addition.

(e) (i) acid – base reaction

(ii) Nitrogen atom has a Ione pair of electrons to make Dative bond with H+ Ion.

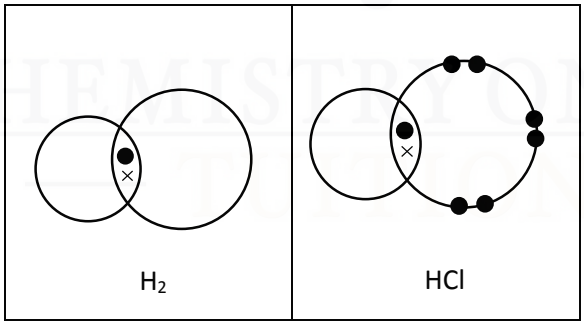
(iii) There are two nitrogen atoms in hydrazine and each nitrogen Atom has a Ione pair of electrons to make a dative bond with H+ Ion.

5)



(b) (i) Electrostatic attraction between bonding electrons and positive nuclei of the atoms.

(ii)



(c) (i) When bonding electrons are unequally shared, the molecule has a dipole Character.

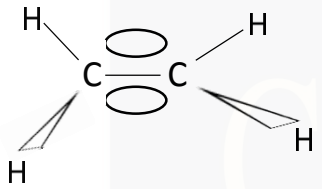
(ii) Chlorine atom being more electronegative

than hydrogen,

Gets a partial negative charge and hydrogen atom gets

Partial positive charge.

(d)



(e) $\Delta H(C_2H_4) = \Delta H_{C(R)} - \Delta H_{C(P)}$

$= [2\Delta_{(c)} + 2\Delta H_C (H_2)] - [\Delta_C(C_2H_4)]$

$= [2(-393.7) + 2(-285.9)] - [-1411.0]$

$= 51.80$

$\therefore H_f^{\theta} = 51.80$ KJ mol^{-1}

I am Sorry !!!!!

6)

(a) (i) 2

(ii) 104.5^0

(b) ethanol : A

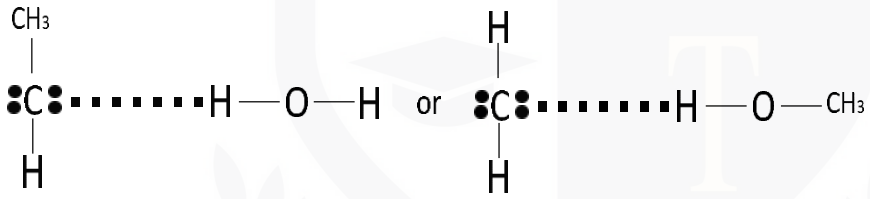
Ethanol : C

methoxymethane : A

2 – methylpropane : B

(c) (i) Hydrogen bonds.

(ii)



(d) Hydrogen bonding exist between H2O molecules.

Hydrogen bonds can not form between C2H5 – O – C2H5 molecules because

Oxygen and hydrogen are not directly bonded.

7)

(a) $HF \rightleftharpoons H^+ + F^-$

$$\Longrightarrow K_a = \frac{[H^+](F^-)}{[HF]}$$

HF behaves as a weak acid I water.

$\therefore$ $[H^+][F^-]$,

$$\Longrightarrow K_a = \frac{[H^+](F^-)}{[HF]} \qquad \Longrightarrow [H^+]^2 = [HF]K_a.$$

$$\Longrightarrow [H^+]^2 = 5.6 \times 10^{-4} \times 0.05$$

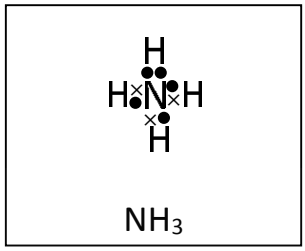
$$\Longrightarrow [H^+] = \sqrt{5.6 \times 10^{-4} \times 0.05} = 0.00529$$

$$pH = -\log_{10}[H^+]$$

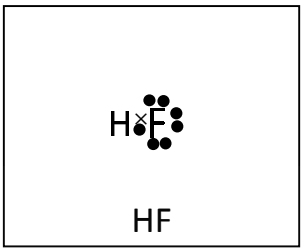
$$= -\log_{10}(0.00529) = 2.277 = 2.3$$

(b) (i) Neutralisation reaction.

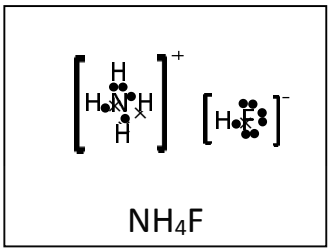
(ii)



NH_3



HF



NH_4F

NH_3 has covalent bonding. HF has covalent bonding. NH_4F has ionic,

Covalent and dative bonding.

(iii) Covalent bonding occurs between N & H.

Dative bonding occurs between N & H.

Ionic bonding occurs between N_4^+ & F^-

(iv) **High temperature:** Increasing the temperature would favour the reverse.

Reaction as it is endothermic.

Low pressure: Lovering the pressure would favour the reverse reaction which

would cause an increase in the number of gaseous molecules

8)

(a) Volatility: $Cl_2 > Br_2 > I_2$

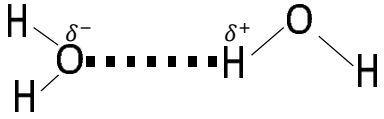
Reason: Down the group the number of electrons increases causing

The van der waal's forces of attraction to increase. Therefore the

Volatility of the halogens decreases down the group.

(b) (i) H_2O has a higher boiling point due to H – bonding in H_2O. However, there is no

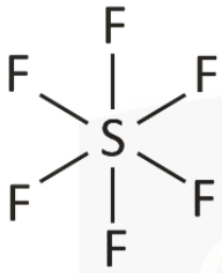
H – bonding in H_2S.



(ii) $CH_3 - O - CH_3$ has a higher boiling point than $CH_3 - CH_2 - CH_3$ since $CH_3 - O - CH_3$ is polar, and $CH_3 - CH_2 - CH_3$ is not.

(c) SF_6 has 6 bonding pairs and no Ione pairs.

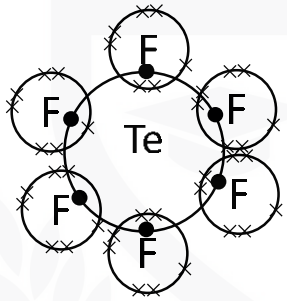
The shape is octahedral.



9)

(a)

(b) (i)



(ii) Octahedral.

(iii) 90^0

number of bond pairs	number of Ion pairs	shape of molecule	formula of a molecule with this shape
3	0	Trigonal planar	BH_3
4	0	Tetrahedral	CH_4
3	1	Trigonal pyramids	NH_3
2	2	Bent / V - sound	H_2O

DR. ASHAR RANA

M.B.B.S / MS. CHEMISTRY

CHEMISTRY ONLINE TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

CONTACT INFORMATION FOR
CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com

Address: 210-Old Brompton Road, London SW5 OBS, UK