Unit 2

(1) **1984 A/L**

b) Complete the following table.

Compound	Shape of the Molecule	Pair of lone electrons
$BeCl_2$		
BCl_3		
NH_3		
CCl_4		
H_2O		

(2) **1986 A/L**

c) ii) Considering the valence electrons in the central atom of the species NH_4^+, PBr_3 and BF_3, deduce the shapes of the species.

(3) **1987 A/L**

c) $BeCl_2$ molecule is linear while F_2O is conical. Explain why do these two shapes differ.

(4) **1988 A/L**

c) i) Draw the dot – n – cross diagram (Lewis structure) for the CO_2 molecule.

ii) Imagine you have found the phosphorous hydride with the molecular formula P_2H_4. Draw the structured formula of the molecule you suggest.

d) Although the RMM of both Br_2 and ICl molecules are approximately equal, the boiling point of Br_2 is 58°C and the boiling point of ICl is 97°C. Explain this observation as completely as possible.

.....

.....

.....

.....

.....

(5) **1989 A/L**

b) Draw the dot – n – cross diagram for the HNO_2 (nitrous acid) molecule.

c) Derive the shape of the anionic species CH_3^-, considering the valence electrons around the central atom.

(6) **1990 A/L**

b) Draw two structural formula of two triatomic molecules which have similar shapes to the shape of NH_2^- ion. N.B. The shape of the molecules should be stated clearly when the shapes of the structural formulae are drawn.
Only existing molecules are accepted. Hypothetical molecules are not accepted.

(7) **1991 A/L**

b) i) What is the **highest oxidation number of the element with the atomic number 31?**

.....

ii) What is the **lowest oxidation number of the element with the atomic number** 31?

.....

c) The arrangement of atoms **of the** molecule **C_2N_2 is of NCCN way. Draw the dot –** n – cross diagram for this **molecule.**

d) Although the Relative Molecular Mass of H_2S is of twice greater than the Relative Molecular Mass of H_2O, the boiling point of H_2O is much greater than the boiling point of H_2S. Explain this statement as much as possible.

.....

.....

.....

.....

.....

.....

.....

(8) **1992 A/L**

b) The element named *Y* produce a compound with the molecular formula $H_4Y_2O_7$. The two *Y* atoms are identical in this compound. Suggest a structural formula for $H_4Y_2O_7$.

(9) **1993 A/L**

b) Draw the dot – n – cross diagram for the molecule N_2F_2 which has two identical *N* atoms.

N.B.

i) All the electrons in the valence shells should be stated.

ii) If a bonding electron pair is denoted by a line, no marks are awarded.

c) **Give two observations to prove that electrons contribute in forming chemical bonds.**

.....

.....

.....

.....

(10) **1994 A/L**

c) What is the shape of the cationic species BF_2^+? .....

(11) **1995 A/L**

b) Indicate the electron arrangement of valence shell of the molecule $COCl_2$ as a dot – n – cross diagram.

(12) **1996 A/L**

b) The compound of molecular formula $H_2S_2O_7$, gives a white precipitate with aqueous $BaCl_2$. In this reaction, a considerable amount of heat is also liberated. The two sulphur atoms of $H_2S_2O_7$ are identical, while four of the oxygen atoms are also identical. Suggest a structural formula for $H_2S_2O_7$.

(13) **1997 A/L**

c) Explain the nature of the three physical states of matter based on the movement and arrangement of particles.
(N.B. For each state, considering two qualitative properties are sufficient.)

(14) **1997 A/L**

b) Consider the C_2H_4 molecule

i) Name specifically the orbitals that are being used by the carbon atoms for bond formation in this molecule.

.....

ii) Indicate in a diagram the orbitals that are being used by a carbon atom for bond formation in this molecules. Indicate clearly in your diagram the angles between the directions of orientation of the above orbitals.

iii) Describe clearly the nature of the double bond between the two carbon atom in the C_2H_4 molecular

.....

.....

.....

.....

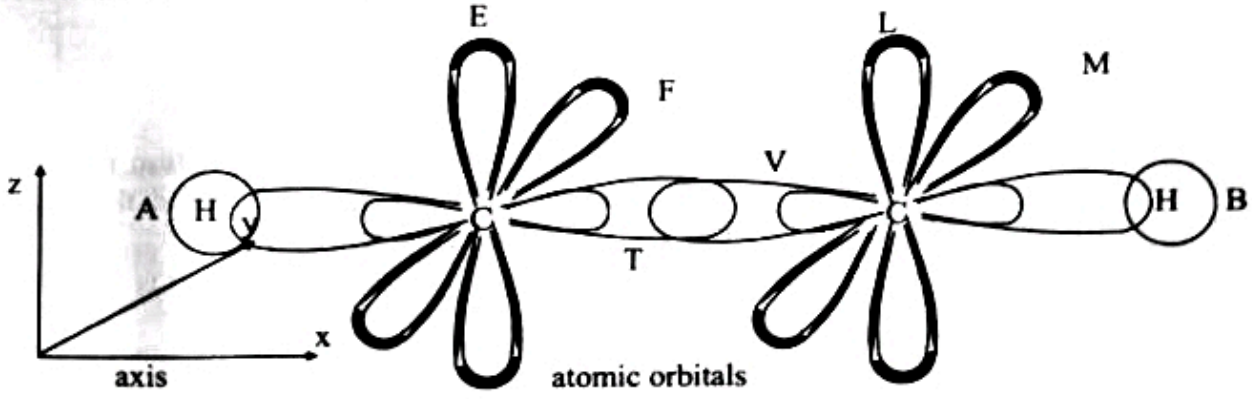
.....

.....

.....

(15) **1998 A/L**

b) **Consider the diagram shown below, pertaining to the formation of chemical bonds in C_2H_2 molecule. In this diagram the various atomic orbitals relevant to the C_2H_2 molecule are drawn approximately.**



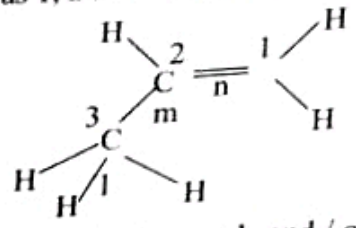
Examine the diagram **given above, and fill in the blanks in the following sentences.**

N.B. You should pay **attention to the axes. In naming the various atomic orbitals specifically, follow the method usually accepted for that purpose.**

i) A is ..... orbital.
ii) T is ..... orbital.
iii) L is ..... orbital.
iv) M ..... orbital.
v) Between T and V ..... takes place
vi) Between F and M ..... takes place

(16) **1999 A/L**

b) Consider the structure shown below. The three carbon atoms of the structure are labelled as 1, 2 and 3. Three of its bonds are labelled as l, *m* and *n*.

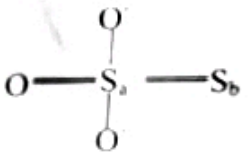


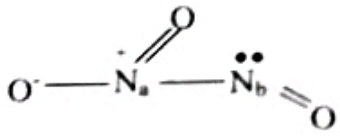
Now, write clearly the words and / or symbols appropriate for the vacant spaces at the relevant places in the description presented below.

Description:
"The C - H σ – bond designated as l is formed by the (1)..... (2)..... of the (3)..... orbital of the relevant *H* atom with an (4)..... (5)..... orbital of the relevant *C* atom."
"The C – C bond designated as m is formed by the (6)..... (7)..... of an (8)..... (9)..... orbital of the C atom labelled as 3, with an (10)..... (11)..... orbital of the C atom labelled as 2."
In the formation of the π – bond of C = C designated as n, the (12)..... (13)..... of the C atom labelled as 2, containing one unpaired (14)..... (15)..... (16)..... with the (17)..... (18)..... of the C atom labelled as l, containing one (19)..... (20).....

(17) **2000 A/L**

c) Write down separately in the relevant box below, the oxidation number and the valency of each of the two *S* atoms (labelled S_a and S_b) and the two *N* atoms (labelled N_a and N_b) in the structures indicated below.





atom	oxidation number	valency
S_a		
S_b		

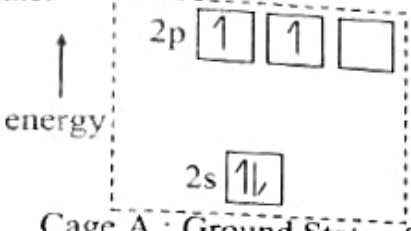
atom	oxidation number	valency
N_a		
N_b		

(18) **2000 A/L**

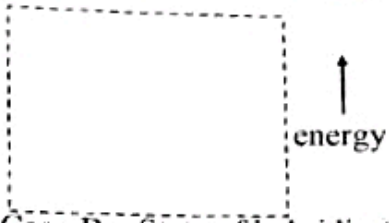
b) Consider the state of hybridisation of the carbon atoms in the ethene molecule, C_2H_4

Given below in Cage *A* is the schematic representation of the electron distribution in the outer shell of the ground state carbon atom, where each box represents an orbital.

N.B. The vertical position of the boxes represents the relative energy levels of the orbitals.



Cage A : Ground State of carbon atom.



Cage B : State of hybridisation of a carbon atom in C_2H_4

i) Using boxes similar to those in **Cage *A*, draw in Cage *B***, the outer orbitals of a hybridised carbon atom in ethene.
Label the boxes to indicate the types of orbitals represented by them.
Indicate, as in Cage *A*, the electron distribution in the boxes in **Cage *B*.**
N.B. In drawing these boxes in **Cabe *B***, pay attention to their vertical position with respect to the boxes in **Cage *A*.**

ii) Complete the following sentences by filling in the blanks.

I) The electron in the ..... orbital of carbon is involved in the formation of the π bonds in C_2H_4.

II) The electrons in the ..... orbitals of carbon are involved in the formation of C – H bonds in C_2H_4.

(19) **2001 A/L**

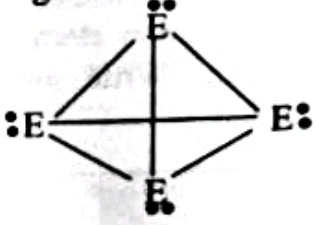
b) **Draw in the relevant boxes below the dot and cross diagrams of the molecules N_2O_4 and O_3 indicating valence electrons of all atoms.**

i) N_2O_4

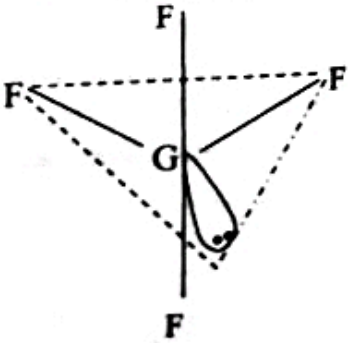
ii) O_3

(20) **2002 A/L**

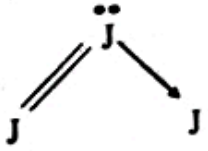
c) **Identify the element *E*, *G* and *J* in the structures for molecules E_4, GF_4 and J_3 given below.**



E : .....

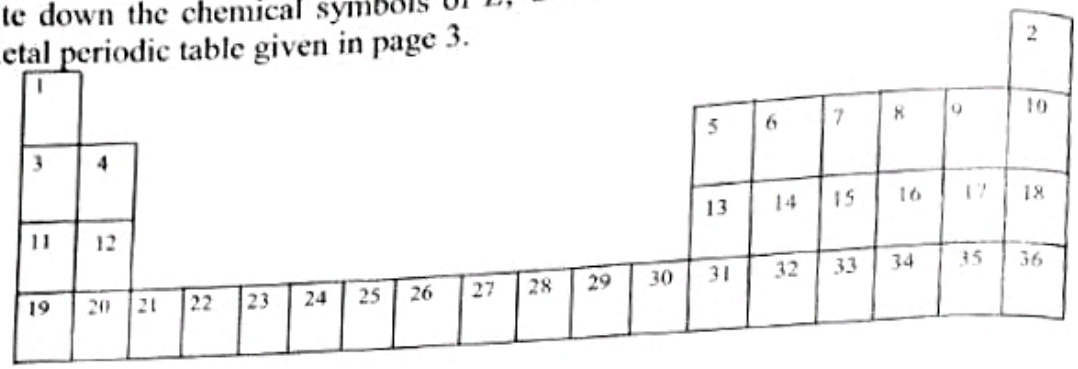


G : .....



I : .....

Write down the chemical symbols of *E*, *G* and *J* in the appropriate cage in the skeletal periodic table given in page 3.



(21) 2004 A/L

c) The molecules of a gaseous compound *L* are triatomic and angular. When *L* is oxidised *M* is formed as the only product. *L* and *M* are both gases at room temperature. Molecules of *M* are trigonal planar. *M* reacts with water forming the acid *N*. *N* forms a tetrahedral anion. Write the molecular formulae of *L*, *M* and *N*.

L : ..... M : ..... N : .....

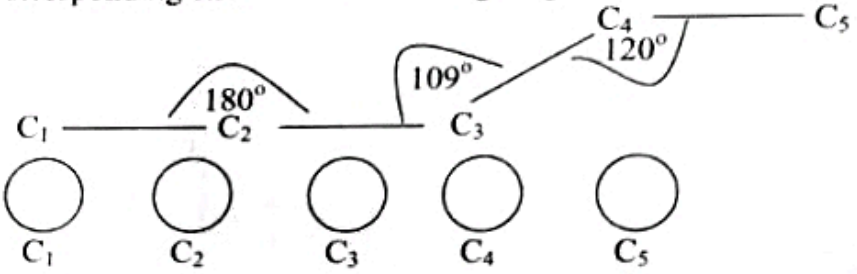
(22) 2004 A/L

b) A molecule of the acyclic hydrocarbon *X*, contains 5 carbon atoms connected to each other as follows.

C_1- C_2- C_3- C_4- C_5

The bond angles $C_1\widehat{C_2}C_3$, $C_2\widehat{C_3}C_4$ and $C_3\widehat{C_4}C_5$ are 180°, 109° and 120° respectively.

i) Write down the hybridization of each carbon atom of *X*, inside the corresponding circle in the following diagram.



ii) Write the molecular formula of *X*.

.....

(23) 2005 A/L

a) ***A*** and ***B*** are isomeric hydrocarbons each having **two** sp^3 hybridized carbon atoms **two** sp^2 hybridized carbon atoms **and two** sp-hybridized carbon atoms. ***A*** shows optical isomerism while ***B*** shows geometric isomerism. Write **one** possible structure each for ***A*** and ***B*** in the cages below.

A

B

(25) **2006 A/L**

c) i) Write the resonance structures of the N_3^- (azide) ion.

Give one application you have read or heard about of sodium azide.

.....

ii) Three sketches that can be used to show the arrangements of repulsion units (bonds and lone pairs) in molecules are given below. Indicate the arrangement of the repulsion units around the central atom in the molecules.

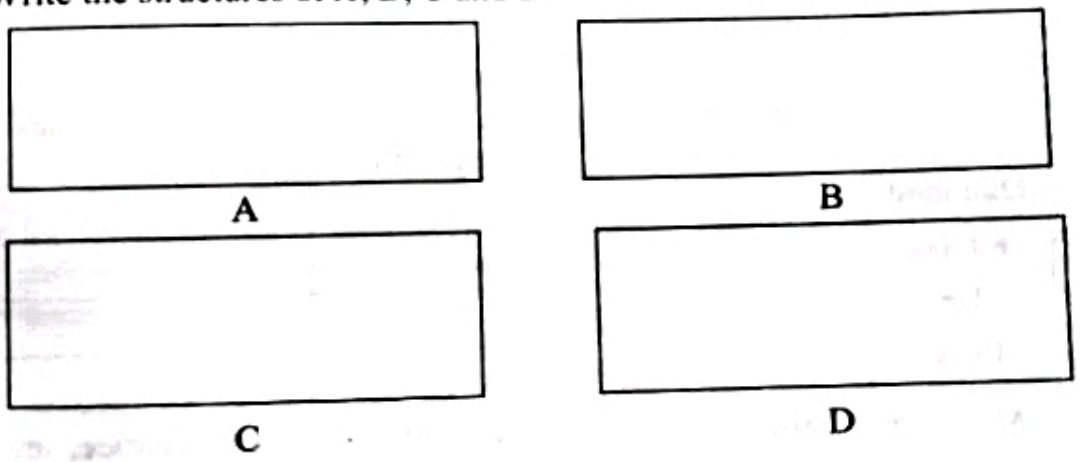
SiF_4, XeF_4 and SF_4

by choosing the appropriate sketch. For this purpose indicate the central atom inside the circle, bonds by solid lines (–) and lone pairs by

(25) **2006 A/L**

a) ***A*** and ***B*** are isomeric hydrocarbons each having two sp-hybridised carbon atoms and two sp^3 hybridised carbon atoms. Substitution of one of the hydrogen atoms in ***B*** by a chlorine atom gives ***C*** which shows optical isomerism. ***A*** and ***B*** separately react with a mixture of water, mineral acid and catalyst ***Y*** to give compound ***D***. ***D*** has three sp^3 hybridised carbon atoms. **One** sp^2 hybridised carbon atom and one oxygen atom.

i) **Write the structures of *A*, *B*, *C* and *D*.**



ii) **What is catalyst *Y*** Y = ...

iii) **How would you distinguish between *A* and *B* using a chemical test?**

.....

.....

.....

(26) **2007 A/L**

c) ***Y*** and ***Z*** are two non – transition elements belonging to the same group of the periodic table. They form the compounds YZ_2 and YZ_3.

i) Identify the elements ***Y*** and ***Z***.

Y = ... Z = ...

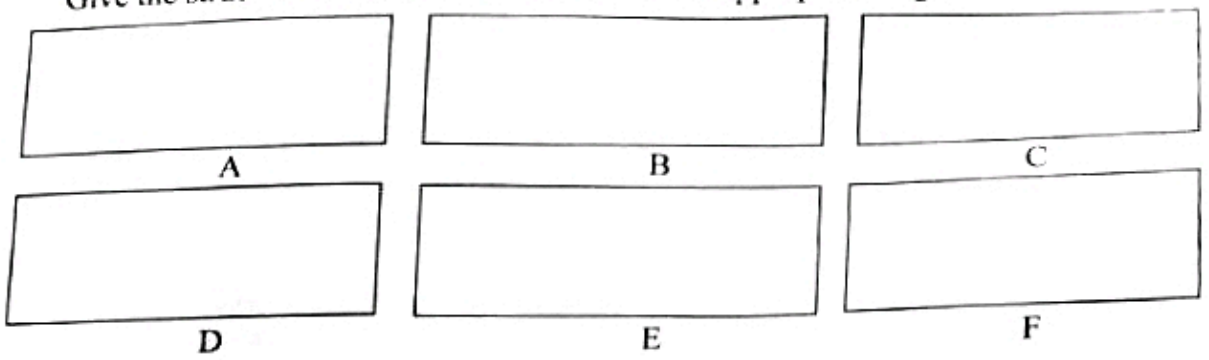
ii) Name the shapes of the molecules YZ_2 and YZ_3. (diagrams are not acceptable)

YZ_2 ..... YZ_3 .....

(27) **2007 A/L**

a) *A*, *B* and *C* are three isomeric hydrocarbons each having two sp^3, hybridized carbon atoms and two sp^2 hybridized carbon atoms only. *A* shows stereoisomerism. On bromination followed by dehydrobromination. *A*, *B* and *C* form *D*, *E* and *F* respectively. *D* and *E* are isomers but F is not an isomer of either *D* or *E*.

Give the structures of *A*, *B*, *C*, *D*, *E* and *F* in the appropriate cages.



(28) **2008 A/L**

b) Fill in the blanks in the following table selecting the most appropriate words / phrases from only those given below in the table under categories *A*, *B*, *C* and *D* for the respective coloums.

Material	A Type of material	B Particles occupying lattice positions	C Interactions between particles	D Electrical properties
Diamond				
KF (s)				
Ice				
Li (s)				

A : Ionic lattice, giant covalent lattice, metallic lattice, molecular lattice, amorphous material.

B : Atoms, positive ions, negative ions, positive ions and negative ions, molecules electrons.

C : covalent bonds, van der waals interactions, hydrogen bonds, metallic bonds, electrostatic interactions.

D : Conductor, non conductor, electrolyte.

(29) **2009 A/L**

a) The element A forms the anions AF_2^- and AF_4^-. AF_2^- is linear and AF_4^- is square planner in shape.

i) Sketch the shapes of AF_2^- and AF_4^- indicating the arrangement of lone pairs if any, on the central atom.

ii) State the group in the periodic table to which A belongs.

.....

(30) **2009 A/L**

b) i) What is the main type of intermolecular force present in each of ethanol ($M_r = 46$) methanoic acid ($M_r = 46$) and propane ($M_r = 44$)?

In ethanol

.....

In methanoic acid

.....

In propane

.....

ii) Arrange ethanol, methanoic acid and propane in the increasing order of their boiling points.

.....

iii) Explain your answer in ii) above.

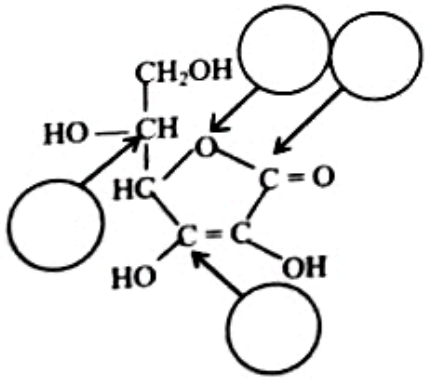
.....

.....

.....

.....

c) The molecular structure of vitamin *C* is given below. Write the hybridisation of the carbon and oxygen atoms indicated by arrows as sp, sp^2 or sp^3 in the appropriate circle.



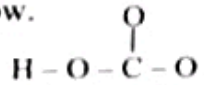
(31) **2010 A/L**

c) Write the type of bond if any, and the type of intermolecular force if any (from those given in the table), present in each of the substances indicated in the table below.

	substance	Type of bond (ionic, polar covalent, nonpolar covalent)	Type of intermolecular force (dipole – dipole, hydrogen bonding, London forces)
i)	Iodine (solid)		
ii)	Carbon tetrachloride		
iii)	Argon (liquid)		
iv)	Sodium hydride (solid)		
v)	Sulphur dioxide (gas)		

(32) **2011 A/L (New)**

b) The following parts i) – vi) are based on the bicarbonate ion, HCO_3^-. The skeleton of HCO_3^- is given below.



i) Draw the most acceptable Lewis structure for this ion.

ii) Draw resonance structures for this ion and comment on their relative stabilities.

iii) **Deduce** the shapes around the following atoms using the VSEPR theory.

I) O attached to H

.....

.....

.....

.....

.....

.....

II) C

.....

.....

.....

.....

.....

.....

.....

.....

iv) Indicate the electron pair geometry of the following atoms.

1) C .....

2) O attached to H .....

v) Indicate the hybridization of the following atoms.

1) C .....

2) O attached H .....

vi) Identify the atomic orbitals / hybrid orbitals involved in the formation of the following σ bonds present in the Lewis structure drawn in i) above.

1) Between *C* and *O* attached to *H*

.....

2) Between *O* and *H*

.....

c) The following table gives the approximate values of melting points and electrical conduction (in relative terms excellent, good, poor, very poor or nil) of five substances, Mg, CO_2, SiO_2, NaCl and MgO. Complete the table by writing the formula of the appropriate substance in the column provided under the heading "Substance."

	Substance	melting points K	Electrical conduction in the solid state	Electrical conduction in the molten / liquid state
1)		3200	poor	good
2)		1100	poor	good
3)		920	excellent	excellent
4)		200	very poor/nil	very poor/nil
5)		1900	very poor/nil	very poor/nil

(33) **2012 A/L**

b) Peroxonitrous acid (HOONO) is formed as an intermediate during the oxidation of acidified aqueous solutions of nitrites to nitrates using H_2O_2. Answer the parts i) to vii) which are based on the peroxinitrite ion, $[OONO]^-$. Its skeleton is given below.

O – O – N – O

i) **Draw the most acceptable Lewis structure for this ion.**

ii) **Draw resonance structures for this ion. Giving reason/s comment on their relative stabilities.**

.....

.....

.....

.....

iii) Deduce the shapes around the following atoms using the VSEPR theory.

I. N

.....

.....

.....

.....

.....

II. O attached to both N and O

.....

.....

.....

.....

.....

iv) State the following.

I. electron pair geometry (arrangement of electron pairs around the atoms)

II. hybridization of the atoms.

given in the table below.

		N	O attached to both N and O
I.	electron pair geometry		
II.	hybridization		

v) Sketch the shape of the Lewis structure drawn in part i) above showing approximate bond angles.

vi) Identify the atomic / hybrid orbitals involved in the formation of the following bonds in the Lewis structure drawn in part i) above. Oxygen atoms are labelled 1, 2 and 3 as given below.

$$\overset{1}{O}-\overset{2}{O}-N-\overset{3}{O}$$

1) $\overset{1}{O}$ and $\overset{2}{O}$ .....

2) $\overset{2}{O}$ and N .....

vii) Give an isomer of peroxonitrous acid.

.....

c) i) Select two polar species from the list given below.

H_2CO (formaldehyde)" SF_6, COS, ICl_4^-, $SiCl_4$

..... and .....

ii) State the type(s) of intermolecular forces that exist between the molecules in each of the following pairs.

I. HBr(g) and H_2S(g).....

II. Cl_2(g) and CCl_4(g).....

III. $CH_3OH(l)$ and $H_2O(l)$.....

(34) **2013 A/L**

a) Arrange the following in the increasing order of the property indicated in parenthesis. Reasons are not required.

i) CO, CO_2, CO_3^{2-} (C – O bond distance)

..... < ..... < .....

ii) NO_2^+, NO_3^-, NH_3 (electro negativity of N atom)

..... < ..... < .....

iii) $BeSO_4$, $MgSO_4$, $CaSO_4$ (decomposition temperature, $MSO_4 \rightarrow MO + SO_3$, M = metal)

..... < ..... < .....

iv) Ne, Ar, Kr (boiling point)

..... < ..... < .....

v) S, F, Si, Cl (atomic radius)

..... < ..... < ..... < .....

b) Nitramide ($H_2N - NO_2$) is a weak acid. It decomposes to N_2O and H_2O in the presence of a base. Answer the parts i) to v) which are based on nitramide. Its skeleton is given below.

i) Draw the most acceptable Lewis structure for this molecule.

ii) Draw the resonance structures for this molecule. Giving reasons, comment on their stabilities.

.....

iii) State the following

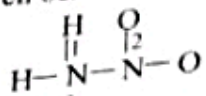
I. electron pair geometry (arrangement of electron pairs) around the atoms.
II. shape around the atoms.
III. hybridization of the atoms.

given in the table below.

	The N attached to two H atoms.	The N attached to two O atoms.
I. electron pair geometry		
II. shape		
III. hybridization		

iv) Is this molecule polar or non – polar? .....

v) Identify the atomic / hybrid orbitals involved in the formation of the following bonds in the Lewis structure drawn in part i) above. N atoms are labelled 1 and 2 as given below.



I. N^1 and N^2 .....

II. N^1 and H .....

c) Xe, CH_3Cl, HF
Of the substances given above, which one / ones will have the forces given below?

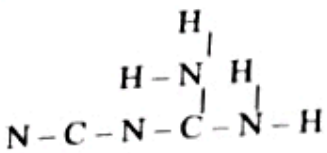
i) dipole – dipole forces .....

ii) hydrogen bonding forces.....

iii) London dispersion forces.....

(35) **2014 A/L**

b) 2 – Cyanoguanidine ($C_2H_4N_4$) is a widely used chemical in agriculture. The following questions i) to v) are based on 2 – Cyanoguanidine. Its skeleton is given below.



i) Draw the most acceptable Lewis structure for this molecule.

ii) Draw four resonance structures (excluding the structure drawn in i) above) for this molecule.

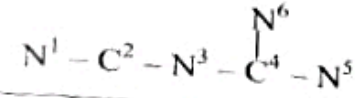
iii) State the following regarding the *C* and *N* atoms given in the table below.

I. Electron pair geometry (arrangement of electron pairs) around the atom.

II. Shape around the atom.

III. Hybridization of the atom.

The carbon and nitrogen atoms of 2 – Cyano guanidine are labelled as follows.



		C^2	N^3	C^4	N^5 or N^6
I.	electron pair geometry				
II.	shape				
III.	hybridization				

iv) Sketch the shape of the Lewis structure drawn in part i) above indicating approximate values of the bond angles (show all bond angles other than those involving N – H bonds).

v) Identify the atomic / hybrid orbitals involved in the formation of the following σ - bonds in the Lewis structure drawn in part i) above (numbering of atoms as in part iii).

I. $N^1 - C^2$ N^1..... C^2 .....

II. $C^2 - N^3$ C^2..... N^3 .....

III. $N^3 - C^4$ N^3..... C^4 .....

c) Consider the two chemical substances CH_3Cl (boiling point 249 K) and CH_3I (boiling point 316 K).

i) Which substance has the larger dipole moment?

.....

ii) Which substance has the stronger London dispersion forces?

.....

iii) Which substance has the stronger total intermolecular attractive forces?

.....

iv) Which type of intermolecular force is dominant in comparing these two substances?

.....

(electronegativity : H = 2.1, C = 2.5, I = 2.5, Cl = 3.0)

(36) **2015 A/L**

a) Consider the following chemical species.

XeF_2, NO_3^-, SF_5^-, Na_2SO_4, SO_3, HF

Which one of the above species.

i) Has both ionic bonds and covalent bonds? .....

ii) Is isoclectronic with BF_3? .....

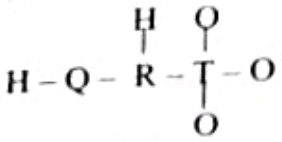
iii) Has a square pyramidal shape? .....

iv) has an equal number of bonding and non bonding electrons in its most stable structure .....

v) Has a σ – bond as a result of overlap of a 1*s* atomic orbital and a 2*p* atomic orbital? .....

vi) Contains a bond angel of 180°? .....

b) The compound, H_3O_3 **QRT** shows acidic properties. It loses H^+ to form the anion $[H_2O_3QRT]^-$ when dissolved in water. In the most acceptable Lewis structure for this anion, the negative charge is on an oxygen atom. There are no charges on the other atoms. The elements ***Q***, ***R*** and ***T*** are non – metals with electronegativities greater than 2 (Pauling scale.) The elements ***Q*** and ***R*** belong to the second period. Whereas ***T*** belongs to the third period of the periodic thable.
The following questions i) to v) are based on the anion $[H_2O_3QRT]^-$ Its skeleton is given below



i) Identify the elements ***Q***, ***R*** and ***T***.

Q =..... , **R** = ... , **T** = ...

ii) Draw the **most acceptable** Lewis structure for this anion

iii) Draw **six** resonance structure for this anion.

iv) State the following regarding ***Q***, ***R*** and ***T*** atom in the table given below

I. Electron pair geometry (arrangement of electron pairs) around the atom.

II. Shape around the atom.

III. Hybridization of the atom.

IV. Approximate bond angel around the atom.

	Q	R	T
I. Electron pair geometry			
II. Shape			
III. Hybridization			
Iv. Bond angel			

v) Identify the atomic / hybrid orbitals involved in the formation of the following σ – bonds in Lewis structure drawn in part ii) above

I. **Q – R Q** ..... , **R** .....

II. **R – T R** ..... , **T** .....

III. **T– O^- T** ..... , O^- .....

vi) I. State what information is directly provided by a Lewis structure of a covalent compound / ion

1) ..... 2).....

II. State what information is not directly provided by a Lewis structure of a covelent compound / ion

1) ..... 2) .....

c) State whether the following statements are true or false. Give reasons for your choice.

i) The decreasing order of electronegativity of nitrogen in NH_3, NO_2F and NO_4^{3-} is $NO_2F > NO_4^{3-} > NH_3$.

.....

.....

.....

.....

.....

.....

.....

.....

ii) The increasing order of melting points of lithium halides is
LiF < LiCl < LiBr < LiI

.....

.....

.....

.....

.....

.....

.....

(37) **2016 A/L**

a) You are provided with the following list of some *p*-block elements in the Periodic Table.

B	C	N	O	F	Ne
Al	Si	P	S	Cl	Ar

From the list,

i) Identify the non-metallic element that forms a homoatomic covalent lattice of high hardness. .....

ii) Identify the element that exhibits the widest range of oxidation states. .....

iii) Identify the element that has the highest first ionization energy. .....

iv) Identify the element that exhibits amphoteric properties. .....

v) Identify the element that has two gaseous allotropes. .....

vi) Identify the element that is considered to be the strongest oxidizing agent. .....

b) The following parts i) to v) are based on the molecule CN_4. It has the following skeleton

N– C – N – N – N

i) Assuming that N – N bond lengths are approximately equal, draw the most acceptable Lewis structure for this molecule.

ii) Draw three resonance structures for this molecule (excluding the structure drawn in part i) above).

iii) Based on the Lewis structure drawn in i) above, state the following regarding the C and N atoms given in the table below.

I. VSEPR pairs around the below. II. Electron pair geometry around the atom.

III. Shape around the atom. IV. Hybridization of the atom.

The nitrogen atoms of CN_4 are numbered as follows:

$N^1 - C - N^2 - N^3 - N^4$

		C	N^2	N^3
I.	VSEPR pairs			
II.	Electron pair geometry			
III.	Shape			
IV.	Hybridization			

iv) In the Lewis structure drawn in part i) above, indicate whether N^2 or N^3 has the higher electro negativity. Give reasons for your choice. [Numbering of atoms is as in part iii).]

.....

.....

.....

.....

v) Identify the atomic/ hybrid orbitals involved in the following σ bonds in the Lewis structure drawn in part i) above. [Numbering of atoms is as in part iii).]

I. $N^1 - C$ N^1 ..... C .....

II. $C - N^2$ C ..... N^2 .....

III. $N^2 - N^3$ N^2 ..... N^3 .....

IV. $N^3 - N^4$ N^3 ..... N^4 .....

c) State whether the following statements are **true** or **false**. (Reasons are **not** required.)

i) SF_6 and OF_6 are both stable molecules. .....

ii) Although the electron pair geometry if $SiCl_4$, NCl_3 and SCl_2 is tetrahedral, their bond angles are different. .....

iii) The boiling point of Kr is greater than that of Xe. .....

iv) The solubility of group II sulphates decreases down the group primarily due to decrease in hydration enthalpy of the cations. .....

(38) **2017 A/L**

a) i) I) Complete the expression given below to determine the charge (Q) of an atom in a Lewis structure by inserting the terms N_A, N_{LP} and N_{BP} in the appropriate boxes. Where,

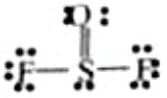
N_A = number of valence electrons in the atom.

N_{LP} = number of electrons in lone pairs.

N_{BP} = number of electrons in bonding pairs around the atom.

$$Q = \square - \square - \frac{1}{2}\square$$

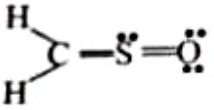
II) Fill in the values for N_A, N_{LP} and N_{BP} in the appropriate boxes and calulate the charge on S. Q(sulfur), in the structure SOF_2 given below.



$$Q(\text{sulfur}) = \square - \square - \frac{1}{2}\square = \ldots\ldots\ldots\ldots$$

ii) Draw the most acceptable Lewis structure for the ion, $ClO_2F_2^+$

iii) The most stable Lewis structure for the molecular CH_2SO(sulfine) is show below. Draw another two Lewis structure (resonance structures) for this molecular.



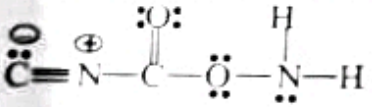
iv) Based on the hypothetical Lewis structure given below, state the following regarding the C, N and O atoms gives in the table below.

I) VSEPR pairs around the atom.

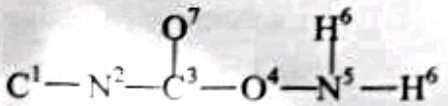
II) Electron pair geometry around the atom.

III) Shape around the atom

IV) Hybridization of the atom.



The atoms are numbered as follows;



		N^2	C^3	O^4	N^5
I)	VSEPR pairs				
II)	Electron pair geometry				
III)	Shape				
IV)	Hybridization				

v) Identify the atomic / hybrid orbitals involved in the formation of the following σ bonds in the Lewis structure given part iv) above. (Numbering of atoms is as in part iv).)

I) $N^2 — C^3$ N^2 .....

II) $O^4 — N^5$ O^4 ..... C^3 .....

III) $N^5 — H^6$ N^5 ..... N^5 .....

IV) $C^3 — O^7$ C^3 ..... H^6 .....

O^7 .....

b) i) Identify the sub-shells (atomic orbitals) along with their azimuthal quantum number (l), and magnetic quantum number/ s (m_l) for the energy level with principal quantum number n = 3 in an atom. What is the maximum number of electrons present in each sub-shell?

Write your answers in the table given below.

Sub-shell	Azimuthal quantum number (l)	Magnetic quantum number /s (l)	Maximum number of electrons in each Sub-shell
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

ii) Identify the type/ s of intermolecular forces present in I, II and III given below.

I) Ar gas

.....

II) No gas

.....

III) Water sample containing a small amount of dissolved KCl

.....

iii) "The boiling point of *n*-butane (C_4H_{10}) is higher than the boiling of propane (C_3H_8)." Given reasons, state whether this statement is true or false.

.....

.....

.....

.....

.....

.....

.....

.....

iv) Arrange the following in the decreasing order of the property indicated in parentheses. (Reasons are not required)

I) Li_2CO_3, Na_2CO_3 , K_2CO_3 (solubility in water)

..... > ..... > .....

II) NF_3, NH_3, NOCl, NO_2^+ (bond angle)

..... > ..... > ..... > .....

III) $COCl_2$, CO_2, HCN, CH_3Cl (electronegativity of carbon)

..... > ..... > ..... > .....