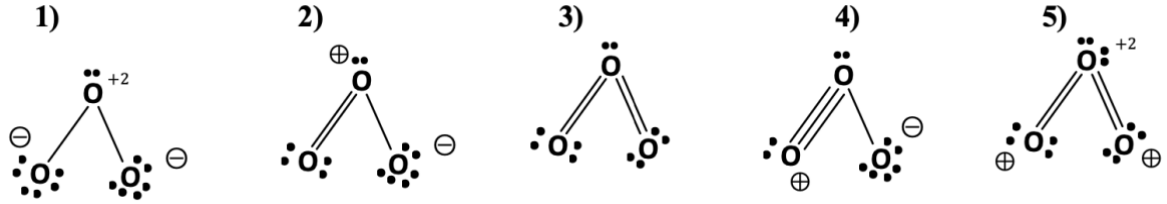
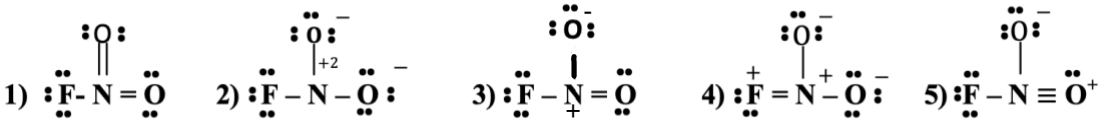
Unit 2- Structure and Bonding: Tutorial~8

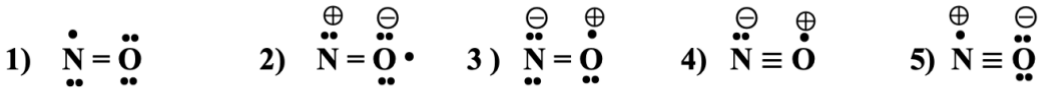
1. What is the most acceptable Lewis structure of O_3?



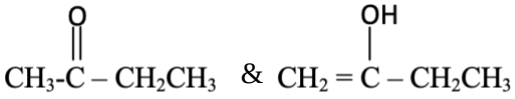
2. What is the correct structure of NO_2F out of the following?



3. What is the most acceptable Lewis structure of NO?

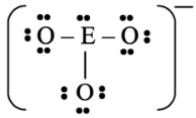


4.

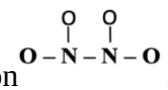
 Are resonance structures of the same compound	A given resonance structures of a compound must contain equal number of π bonds

5. What is the total number of resonance structures that is possible for HN_3?

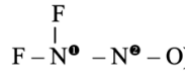
1) 2 **2) 3** **3) 4** **4) 5** **5) 6**

6.  The E in the structure given belongs to the p block of the periodic table. Which groups of the periodic table does E belongs to?

1. Group 13/IIIA 2. Group 14/IVA 3. Group 15/ VA 4. Group 16/ VIA
5. Group 17/ VIIA

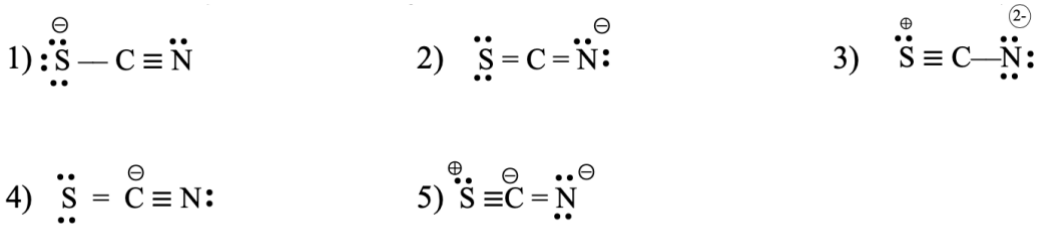
7. How many resonance structures can you draw for the molecule N_2O_5. Skeleton  .

1. 5 2. 6 3. 8 4. 9 5. None of the answers

8. What are the oxidation states of N^1 and N^2 atoms in $F_2N^1N^2O$: Skeleton: 

1. +2 and +2 2. +1 and +3 3. +2 and +3 4. +1 and +2 5. +3 and +1

20. What is most suitable structure for the SCN^- ion?



21. What is number of stable resonance structures that can be drawn for the oxalate ion $[C_2O_4^{2-}]$?

1. 2 2. 3 3.4 4. 5 5. 6

	First statement	Second Statement
22.	All ionic crystal lattices have the same shape	NaCl has a cubic shaped crystal lattice
23.	Ionic compounds can be identified separately from covalent compounds due to their high melting points	Ionic compounds exhibit strong electrostatic forces.
24.	NaBr(s) conducts electricity	There is Na^+ and Br^- ions in NaBr.
25.	There is no electrical conductance in $CaBr_2(s)$	It is impossible to identify Ca^{2+} and Br^- in $CaBr_2(s)$
26.	All ionic compounds are soluble in water.	Enthalpy of solution of ionic compounds are always exothermic.
27.	NaCl(s) can conduct electricity.	There is free Na^+ and Cl^- in NaCl(s)
7	The ionic character increases when the electronegativity difference of the two atoms increases.	An ionic compound is formed by sharing electrons between two atoms
28.	NaH is an ionic compound	An ionic compound is formed between two nonmetals.
29.	An ionic compound is formed between two atoms having an electronegativity difference greater than 2.1.	Ionic compounds do not have any covalent character.
30.	NaCl dissolves in petrol	Ionic compounds have higher densities
31.	In dative bonds there is no sharing of electrons	Only one atom provides both electrons to form a dative bond.

32.	AgCl dissolves in water.	AgCl is an ionic compound.
33.	SiO_2 shows a very high melting point	All covalent compounds have lower melting point

34. The number of Cl^- ionically bounded to each Na^+ in a NaCl crystal lattice is

a. 4 b. 6 c. 8 d. 12 e. 16

35. Which one of the following compounds have the highest ionic character?

a. LiCl b. HF c. LiBr d. RbCl e. HI

36.

Material	**Nature**	**Melting point/℃**	**Electrical Conductivity**	**Solubility in water**
A	Soft, Yellow in colour	145	none	Not soluble
B	Brittle and white in colour	750	Conducting when dissolved in water	Soluble
C	Ductile	1725	High	Not soluble

Which is/ are the ionic compound/s out of the above?

a. A b. B c. C d. A and C e. B and C

37. Which compound is the most ionic compound out of the following?

a. MgO b. RbCl c. NaI d. CsF e. CsI

38. Which compound is the most ionic compound out of the following?

a. LiCl b. HF c. LiBr d. RbCl e. HI

39. Which compound out of the following has the highest tendency to dissolve in CCl_4?

a. LiBr b. AgBr c. NaBr d. $MgBr_2$ e. HBr

40. The compound X is a brittle compound at the room temperature. It is also a good thermal insulator in the solid state but conducts electricity well in the liquid state. What is X?

a. Sulphur b. NaCl c. Carbon d. Mercury e. Aluminium

41. Ionic compounds are easily soluble in

a. H_2O b. Polar solvents c. non-polar solvents d. CCl_4

42. Some of the properties of compounds V, W, X, Y and Z are given below. Which one is the ionic compound out of the following?

	Compound	**Physical state at STP**	**Electrical conductivity at the solid state**	**Electrical conductivity at the liquid state**
1	V	Liquid	None	None
2	W	Liquid	High	High

3	X	Solid	None	High
4	Y	Solid	None	None
5	Z	Liquid	None	High

43. Which species/ Compound shows the highest melting point out of the following?

a. He b. CsF c. CsCl d. $CHCl_3$

44. Explain the variation of the polarizing power in Na^+, K^+ and Rb^+.

45. Arrange the polarizability of O^{2-}, S^{2-} and Se^{2-} in the decreasing order. Explain the reason.

46. Arrange the variation of the melting points of K_2O, K_2S, K_2Se in the increasing order and explain the reason.

47. Arrange the variation of the melting points of $BeSO_4$, $CaSO_4$, $MgSO_4$ in the increasing order and explain the reason.

48. Variation of melting points of Li salts is LiF < LiCl<LiBr < LiI. Explain.

_____

_____

_____

_____

49. Which out of Na_2O and NaCl has the higher boiling point? Explain your reason.

_____

_____

_____

_____

	Statement One	Statement Two
50	Metals are malleable	Whenever a metallic lattice is subjected to an external force, its structure changes without any strong repulsive forces
51	Covalent bonds are formed only between two elements that have an electronegativity difference of zero.	There is an electronegativity difference between two atoms forming an ionic bond.
52	NH_3 is soluble in water	Both water and NH_3 are polar compounds

1. The behavior of electrons responsible for the conduction in metals

    a. Similar to the behavior of electrons in NaCl.
    b. Similar to the behavior of electron in HF.
    c. Similar to the behavior of electron in graphite.
    d. Similar to the behavior of electron in CF_4
    e. Similar to the behavior of electrons in $H_3N{:}BF_3$

2. Metals are good thermal conductors because
    a. There are free electrons in metals
    b. The metal cations are in larger distances in a metallic lattice
    c. Metal atoms consistently collide with each other
    d. Metal surfaces can reflect thermal energy well
    e. Metals are good electrical conductors

3. Na_2 molecules that are formed in the gaseous state contain the following bond type
    a. A metallic bond
    b. An ionic bond
    c. A dative bond
    d. A polar covalent bond
    e. None of the above
4. Which compound out of the following can conduct electricity in both liquid and solid state?
    a. SiO_2
    b. LiF
    c. HBr
    d. S
    e. Rb
5. Explain the following observations of the boiling points compounds given.

Molecule	Molar mass/ $g\ mol^{-1}$	Dipole moment/ D	Boiling point/ ^0C
O_2	32	0	-183
NO	30	0.153	-152
Kr	83.8	0	-152
HBr	81	0.82	-62
Br_2	160	0	59
ICl	162.5	1.6	97

6. Out of Xe, CH_3Cl, HF which compound/ compounds shows the following intermolecular interaction?
    (i) Dipole-Dipole forces_____
    (ii) Hydrogen bonds_____
    (iii) London dispersion forces_____

7. Out of Ne, CH_3Cl, H_2O which compound/ compounds shows the following intermolecular interaction?
   (i) Dipole-Dipole forces_____
   (ii) Hydrogen bonds_____
   (iii) London dispersion forces_____

1. Out of CO_2, SO_2, NH_3 and $XeCl_2$ which compound/ compounds shows the following intermolecular interaction?
   (i) Dipole-Dipole forces_____
   (ii) Hydrogen bonds_____
   (iii) London dispersion forces_____

61. Out of Ar, Cl_2, $XeCl_4$ which compound/ compounds shows the following intermolecular interaction?
   (i) Dipole-Dipole forces_____
   (ii) Hydrogen bonds_____
   (iv) London dispersion forces_____

62. Identify the intermolecular forces between the following species
   1. H_2O/ CH_3OH

   2. NO_2

   3. CH_3OH/ I_2

   4. NH_3/$CHCl_3$

   5. I_2/KI

   6. KI/H_2O

   7. NH_3

   8. CH_2O

   9. CH_3COOH

   10. $CH_3CH_2CH_3$ and CCl_4

63. Which statement is the wrong statement about the following molecules? CO_2, BF_4, PF_3, CF_4, XeF_4, SF_6

a. All these molecules have polar covalent bonds
b. They have different shapes
c. They do not obey the octet rule
d. They are all non-polar
e. Only 2 molecules have lone pairs in their central atoms

64. The molecular shapes generated by trigonal bipyramidal electron geometry of the central atom are

a. Linear, bent, see saw
b. Linear, T-shaped, see saw
c. Linear, trigonal pyramid, T-shaped
d. Trigonal planer, bent, T-shaped
e. Linear, trigonal planer, see saw

65. What is true regarding the O-N-O bond angle?

1) $NO_2^+ > NO_2^- > NO_2 > NO_4^{3-}$
2) $NO_4^{3-} > NO_2^+ > NO_2 > NO_2^-$
3) $NO_2^+ > NO_2 > NO_2^- > NO_4^{3-}$
4) $NO_4^{3-} > NO_2 > NO_2^- > NO_2^+$
5) $NO_2^+ > NO_2^- > NO_4^{3-} > NO_2$

66.

First Statement	Second Statement
All C-O bonds in bicarbonate are the same	Bicarbonate ion the common hybrid of three stable resonance structures.

67. What is correct order of increasing electronegativity of the S atom of the following SO_2, SO_3, SO_3^{2-}, SO_4^{2}, SCl_2?

1) $SCl_2 < SO_3^{2-} > SO_2 < SO_3 < SO_4^{2-}$
2) $SO_3 < SO_4^{2-} < SO_2 < SO_3^{2-} < SCl_2$
3) $SO_3^{2-} < SO_4^{2-} < SCl_2 < SO_3 < SO_2$
4) $SCl_2 < SO_3^{2-} < SO_4^{2-} < SO_2 < SO_3$
5) $SCl_2 < SO_4^{2-} < SO_3^{2-} < SO_2 < SO_3$

68. The two nitrogen atoms N^1 and N^2 in H_2NNO are labelled as (H-N^1-N^2-O). The electron pair geometry and the shape are

N^1	N^2
(1) Tetrahedral, Pyramidal	Trigonal planer, Bent
(2) Pyramidal, trigonal planer	Trigonal planer, bent
(3) Trigonal planer, pyramidal	Trigonal planer, trigonal planer

(4) Tetrahedral, pyramidal	Bent, trigonal pyramidal
(5) Tetrahedral, bent	Trigonal pyramidal, trigonal pyramidal

STRUCTURED ESSAY QUESTIONS

69. Acidic, aqueous nitride solutions are reacted with H_2O_2 to form nitrates. Peroxonitrous acid (HOONO) is formed as an intermediate. Answer the following questions regarding peroxonitrous ion $[OONO]^-$. The skeleton is given below. O-O-N-O

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

ii. Draw resonance structures for the ion above and comment on relative stabilities.

iii. Use the VSEPR theory to deduce the structure around the following atoms

1. N

2. O atom bound to both N and O

iv. Complete the electron pair geometry, hybridisation of the atoms in the following table

	N	**O attached to both N and O**
Electron pair geometry		
Hybridisation		

v. Draw the structure of the anion showing the rough bond angle.

70. A) Arrange the property denoted by brackets in the increasing order. No explanation required.

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

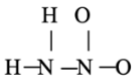
(ii) Electronegativity of N in NO_2^+, NO_3^-, NH_3

(iii) Thermal decomposition temperature of $BeSO_4$, $MgSO_4$, $CaSO_4$

(iv) Boiling point of Ne, Ar, Kr

(v) Atomic radius of S, F, Si and Cl

B) Nitroamide (H_2NNO_2) is a weak acid. In the presence of a base this dissociates to N_2O and H_2O. Answer the following questions based on nitroamide. The skeletal structure is given below.



(i) Draw the most stable Lewis structure of the above .

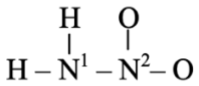
(ii) Draw the resonance structures of the above and comment on their stabilities providing reasons.

(iii) Indicate (i) electron pair geometry, (ii) shape around the atoms (iii) hybridisation of the atom of the central atoms in the following table.

	N attached to 2 H atoms	**N attached to 2 O atoms**
i. Electron pair geometry		
ii. Shape around the atom		
iii. Hybridisation of the atom		

(iv) Is this molecule polar or non-polar?

(v) Identify the orbitals or hybrid orbitals responsible for the following bond formation. N atoms are indicated as 1 and 2 below.



1. N^1 and N^2_____
2. N^1 and H_____

C. Xe, CH_3Cl, HF

(1) Which compound of the above contain the following interactions?

a. Dipole-dipole interactions _____
b. H-bonds _____
c. London dispersion forces _____

71. A. Arrange the following species in the decreasing order of the property given in brackets.

i. (The first ionisation energy) of Li, Na, Mg, Al and Si

ii. (First electron gain energy of) C, O, F, Al, Cl

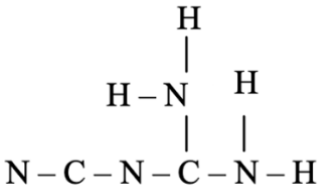
iii. (Melting point) $BaCl_2$, $CaCl_2$, $BeCl_2$

iv. (Bond angle) NCl_3, $SiCl_4$, ICl_4^-

v. (Electronegativity of the oxygen atom) H_3O^+, H_2O, HO^-

v. (Bond length in N-O) NO^+, FNO_2, ClNO, NH_2OH

B. 2-cyanoguvanidine ($C_2H_6N_4$) is a compound that is extensively used in agriculture. Answer the following questions based on the structure of 2-cyanoguvanidine. Its skeleton is shown below.

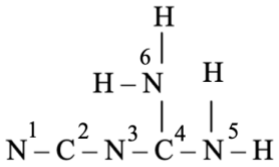


(i) Draw the most acceptable Lewis structure of the molecule.

(ii) Draw 4 more resonance structures for the Lewis structure you drew above.

(iii) Consider the C and N atoms in the molecule

1. Electron pair geometry
2. Geometry around the atoms
3. Hybridisation of the atom



		C^2	**N^3**	**C^2**	**N^5 or N^6**
1	Electron pair geometry				
2	Shape				
3	Hybridization				

(iv) Draw a sketch of the molecule above showing the approximate bond angles. (Show all other angles except N-H bonds)

(v) Identify the orbitals or hybrid orbitals responsible for the σ-bond formation between the following atoms.

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 two chemical CH_3Cl (Melting point 249 K) and CH_3I (Melting point 316 K)

1. Which molecule has a higher dipole moment?

2. Which molecule has the higher London dispersion forces?

3. Which compound have greater total molecular interactions?

4. Comparing these two substances, which interaction is the more dominant force?

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

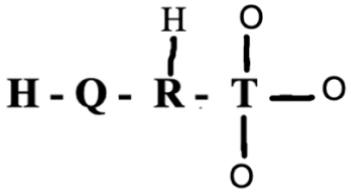
72. A. Consider the chemical species given below.

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

1. Which compound/compounds contain both ionic and covalent compounds? _____
2. Which is iso electronic with BF_3? _____
3. Which one is square pyramidal? _____
4. Which species contain equal number bonding and non-bonding electrons? _____
5. Which one contains a σ-bond formed by the overlap of 1s orbital and a 2p orbital? _____
6. Which species contain a 180 ° bond angle? _____

B. H_3O_3QRT compound exhibits acidic properties. Upon dissolution in water, this releases H^+ to form $[H_2O_3QRT]^-$ anion. There is a negative charge on the oxygen atom in the most stable Lewis structure.

There are no other charges on other atoms. Q, R and T elements have a greater electronegativity than 2 and are nonmetals. Q and R belongs to the second period and T belongs to the third period.



Identify the elements Q, R and T.

Q = _____ R =_____ T =_____

II. Draw the most acceptable Lewis structure.

III. Draw 6 resonance structures for the anion.

IV. Fill in the following table on elements Q, R and T

a. Electron pair geometry
b. Shape of the molecule around the atom
c. Hybridisation
d. Approximate bond angles

	Q	R	T
i. Electron pair geometry			
ii. Shape			
iii. Hybridisation			
iv. Bond angle			

V. By referring to the Lewis structure you drew in II above, identify the hybrid orbitals/ atomic orbitals that are used to make following σ bonds.

a. Q-R Q_____, R_____

b. R-T R_____, T_____

c. T-O T_____, O_____

VI. What are the information that is provided directly by a Lewis structure of a molecule?

What the information that is not directly provided by a Lewis structure?

73. A. You are provided with several p-block elements in the periodic table.

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

Select out of the list above

1. Identify the element which is also a non-metal and forming the homoatomic covalent lattice having a higher hardness. _____
2. Identify the element showing a greater range of oxidation numbers. _____
3. Identify the element with the highest first ionisation energy _____
4. Identify the element which is amphoteric _____
5. Identify the element having two allotropic forms of gases _____
6. Identify the element which is the most oxidising _____

B. The sections (i) to (v) below are based on the molecule CN_4. Its' skeletal formula is given below.

N-C-N-N-N

1. Assuming that all N-N bond lengths are roughly equal, propose a most suitable Lewis structure for the molecule.

2. Draw three resonance structures for the molecule.

3. Fill in the following table on elements C and N
    a. VSEPR Pairs
    b. Electron pair geometry
    c. Shape of the molecule around the atom
    d. Hybridisation

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

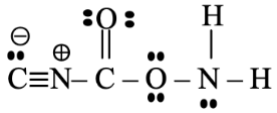
	C	**N^2**	**N^3**
i. VSEPR Pairs			
ii. Electron pair geometry			
iii. Shape			
iv. Hybridisation			

4. State whether the following statements are true or false.
    a. SF_6 OF_6 are both stable molecules _____
    b. Electron pair geometry of $SiCl_4$, NCl_3 and SCl_2 are tetrahedral but their bond angles are different._____
    c. The boiling point of Kr is larger than that of Xe_____
    d. The solubility of group II sulphates decreases down the group mainly due to the reduction in the hydration enthalpy of cations_____.

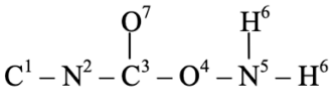
II. a. Draw the most acceptable Lewis structure for $ClO_2F_2^+$.

    b. Draw two extra resonance structures for $ClO_2F_2^+$.

c. Based on the following hypothetical structure identify 1. VSEPR pairs around the atoms 2. Electron pair geometry 3. Shape around the atom 4. Hybridisation of the atom for C, N, O.



Numbering of the atoms are done in the following manner



	C^3	**N^2**	**O^4**	**N^5**
i. VSEPR Pairs				
ii. Electron pair geometry				
iii. Shape				
iv. Hybridisation				

d. Identify the atomic or hybrid orbitals that would participate in the formation of the following σ bonds.

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

II. $O^4 - N^5$ O^4 ---------- N^5 ----------

III. $N^5 - H^6$ N^5 ---------- H^6 ----------

IV. $C^3 - O^7$ C^3 ---------- O^7 ----------

Identify the intermolecular forces present in the following species

1. Ar gas _____
2. NO gas_____
3. A water sample with a small amount of KCl dissolved in it_____
4. State whether the following statement is true giving reasons "*n*-butane has a higher boiling point than *n*-propane.

5. (i) Arrange the following molecules in the increasing order

   Li_2CO_3, Na_2CO_3, K_2CO_3 (the water solubility)

   _____>_____>_____>

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

   _____>_____>_____>_____

(ii) $COCl_2$, CO_2, HCN, CH_3Cl (Electronegative character of carbon)

_____>_____>_____>_____

74. A) State whether the following statements are true or false.

a. The polarizability of halides increases with the size.

b. O-N-O bong angle of NO_2 is greater than that of NO_2^+.

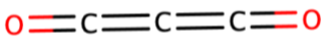
c. London dispersion force strength in CCl_4 is much smaller than that present among SO_3

d. HSO_4^- has a trigonal by pyramidal shape.

e. Addition of an electron to a gaseous P atom is exothermic whereas the process in endothermic for a N atom.

B) i. Draw the most acceptable Lewis structure for the SF_3N molecule.

ii. Most stable Lewis structure of C_3O_2 (carbon suboxide) is shown below. Draw two more resonance structures for this.



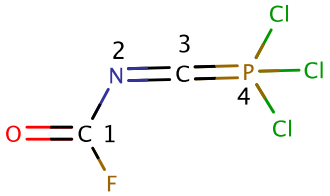
(III) Based on the Lewis structure given below, state the following regarding the C, N and P atoms given in the table below.

a. VSEPR pairs around the atoms

b. Electron pair geometry around the atom

c. Shape around the atom

d. Hybridisation around the atom, the atom is numbered as follows.



		C^1	N^2	C3	P^4
i	VSEPR pairs				
ii	Electron pair geometry				
iii	Shape				
iv	Hybridisation				

(IV) Identify the atomic/ hybridised orbitals participated in the formation of following σ bonds.

a. $F\text{-}C^1$ =

b. $C^1\text{-}N^2$ =

c. $N^2\text{-}C^3$ =

d. $C^3\text{-}P^4$ =

e. $P^4\text{-}C^l$ =

(iii) Identify the atomic orbitals participated in the formation of following π-bonds.

i. $N^2\text{-}C^3$ =

ii. $C^3\text{-}P^4$ =

C. Arrange the following elements in the increasing order of the property indicated in the simple bracket.

i. B, Na, P, Be, N (1^{st} ionisation energy)

……..<……..<……<…….

ii. NH_3, NOCl, NO_2Cl, NH_4^+, $F_3C\text{-}NC$

……..<……..<……<…….

iii. Quantum number of electrons in an atom

$\left(3,1,0,-\frac{1}{2}\right)$, $\left(3,0,0,+\frac{1}{2}\right)$, $\left(2,0,0,+\frac{1}{2}\right)$, $\left(2,1,+1,+\frac{1}{2}\right)$, $\left(3,2,-1,+\frac{1}{2}\right)$ Energy of an electron

75. Following are questions related to the second period of elements in the periodic table. Write down the elemental symbol in answering these questions.

i. What is the most electronegative element?--------

ii. Identify the allotropic from of the element that conducts electricity.---------

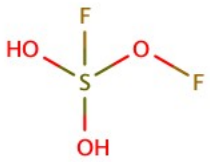
iii. Identify the element that forms the largest ion by a mono atom.------

iv. Identify the element that does not contain and **p** electrons but forms a stable **s** configuration. ----

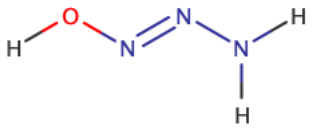
v. Identify the element having the highest first ionisation energy-----

vi. Identify the element that forms an electron deficient molecule which is trigonal planer_____

(b) i) Draw the most acceptable Lewis structure formed for SO_3F_2. The skeletal form of the molecule is given below.



(ii) Draw two more resonance structures for the most stable Lewis structure of H_3N_3O shown below. Write the word unstable underneath the structures you drew.

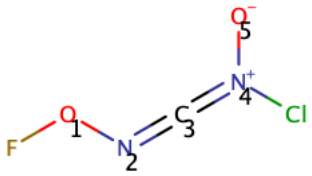


(iii) Based on the Lewis structure provided to you, indicate the followings on C, N and O atoms.

a. VSEPR pairs on atoms b. Electron pair geometry

c. Shape around the atom d. Hybridisation of the atom

The structure is numbered for you



		O^1	N^2	C^3	N^4
1	VSEPR Pairs				
2	Electron geometry				
3	Shape				
4	Hybridisation				

(iv) Identify the atomic/ hybrid orbitals that would participate in the σ bond formations of the following.

a. $F\text{-}O^1$ =_____

b. $O^1\text{-}N^2$ =_____

c. $N^2\text{-}C^3$ =_____

d. $C^3\text{-}N^4$ =_____

e. $N^4\text{-}O^5$ =_____

f. $N^4\text{-}Cl$ =_____

(iv) Identify the atomic orbitals responsible to the formation of π bonds in the in the following bonds.

1. $N^2\text{-}C^3$ =
2. $C^3\text{-}N^4$ =

(v) Explain how the 2 π bonds are oriented in three-dimensional space by drawing a molecular orbital diagram.

(vi) Draw a similar molecule/ ion that has a similar orientation as above. (The example must contain only three atoms and the elements must be restricted to the 2nd and 3rd period)

b. An atomic orbital is described using 3 quantum numbers, *n*, *l* and m_l. Write down the corresponding name of the atomic orbital in the spaces given below.

	n	***l***	**m_l**	**Atomic orbital**
1			+1	3p
2	3	2	-2	
3				2s

ii) Arrange the following compounds in the increasing order of the property given in the bracket.

a. LiF, LiI, KF (Melting point)

_____<_____<_____

b. NO_2^-, NO_4^{3-}, NF_5 (Stability)

_____<_____<_____

c. NOCl, $NOCl_3$, NO_2F (N-O Bond length)

_____<_____<_____

76. Complete the following table, columns of A, B, C and D by choosing the correct word from that is given below.

Material	**A-Type of lattice**	**B- Positions of particles**	**C- Type of interactions**	**D- Electrical nature**
Diamond				
KF(s)				
Ice(s)				
Li(s)				

A: Ionic lattice, giant covalent lattice, metallic lattice, molecular lattice,

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

C: Covalent bonds, van der Waals bonds, Hydrogen bonds, Metallic bonds, Electrostatic interactions

D: Conductors, non-conductors, electrolytes

77. Write answers to following questions.

(i) The species that contain 5 unpaired electrons out of Fe^{3+}, Co^{2+} and Ni^{2+} is _____

(ii) The element with the highest melting point out of Ti, V and Cr _____

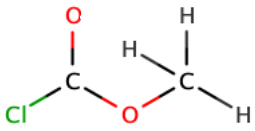
(iii) The element with the highest first ionisation energy out of Si, P and S _____

(iv) The increasing order of the radius of Na^{+}, Mg^{2+}, O^{2-} and F^{-} _____

(vi) Hybridisation of the oxygen atom in OF_2 _____

(viii) The increasing order of melting points for H_2O, H_2S and H_2Se_____

b. The skeletal view of CO_2ClCH_3 is shown below

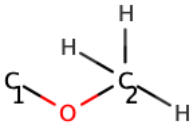


i. Draw the most acceptable Lewis structure for this species.

ii. The resonance structures for the above species and state whether they are stable or unstable.

iii. Complete the following table which is related to the structure above

	Cl bounded C	**O bounded to 2 Cs**	**H bounded C**
Electron pair geometry			
Shape			
Hybridisation			

iv. Consider the part of 

related to the above structure. Identify the atomic/ hybridised orbitals related to the following bond formation.

a. C_1-O bond = _____
b. O-C_2 bond = _____
c. C_2-H bond = _____

v. Identify the main secondary interactions that is shown by the following pairs.

a. $CO_2(g)$ and $CH_4(g)$ _____
b. $CH_3COOH(l)$ and $H_2O(l)$ _____
c. $I_2(s)$ and $I^-(aq)$_____

78.

01. (a) Consider the following Chemical species.

SO_2F_2, SF_6, IOF_2, CNO^-, ClF_2^+

(i) Species with number of lone pairs of the central atom equals to the number of double bonds to the central atom is .....

(ii) Equals to the shape of $^-NH_2$ .....

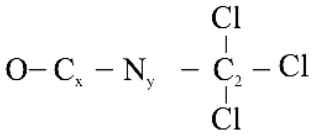
(iii) Molecule without dipole moment .....

(iv) Total number of lone pairs in the molecule is three times of the bonds. .....

(v) Has the shape of trigonal bipyramidal .....

(vi) Which species is isoelectronic with $^+NO_2$ .....

(b) The skeleton of trichloromethyl isocyanate which is a very poisonous compound, is given below.



i. Draw the most acceptable lewis structure for this compound.

ii. Draw the resonance structures possible for the above molecule. Giving reasons comment on the stability of those structures.

iii. State the following.

(a) electrone pair geometry around the atoms.

(b) Shape around the atom.

(c) Hybridization of the atoms given in the table below.

	C_x	N_y	C_z
(a) Electrone pair geometry			
(b) Shape around the atom.			
(c) Hybridization			

iv. Identyfy the atomaic / hybrid orbitals involved in the formation of the following bonds in the lewis structure drawn in part (b) i above Atoms are labelled as x,y and z.

(A) C_x and N_y .....

(B) N_y and C_z .....

(C) (i) Arrange the following in decreasing order of the radius and mention the reasons. Li, Be, O^{-2}, Na^{-}

.....

.....

.....

.....

79.

1. (*a*) Complete the following blanks in (i) to (v) in a suitable way.

(i) Atomic radii of He, O, Mg and Cl vary in the ascending order,
..... < .....< ..... < ..... .

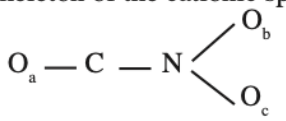
(ii) Out of Li, Be and Ne, the second ionization enthalpy is highest in ..... .

(iii) Out of the gases nitrogen, chlorine and argon,the boiling point is highest in ..... .

(iv) When consider CO, CO_2 and CH_4, the electronegativity of carbon increases as,
..... < ..... < ..... .

(v) The bond length of N – O in the species NO_2^+ , NO_2^- and NO_3^- increases as,
..... < ..... < ..... .

(*b*) Atomic skeleton of the cationic species CNO_3^+ is given below.



Some information of a possible Lewis structure of this ion is given in the table given below.

Atom	Hybridization
O_a	sp
O_b	sp^3
O_c	sp^2
C	sp
N	sp^2

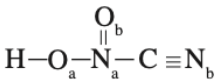
(i) Draw the Lewis structure for CNO_3^+ in accordance with the data given in the table above.

(ii) Draw the resonance structures possible for the above mentioned ion. Giving reasons, comment on the stability of those ions.

(iii) Under the certain conditions, the cationic species given above dissociates into NO_2^+ and a gaseous compound.
What could be that gaseous compound?

.....

(*c*)



Complete the following table by considering the structure given above.

Atom	Hybridization	Electron pair geometry around the atom
O_a		
N_a		
C		

(*d*) Explain the reasons for the following observations.
(It is sufficient to consider the main reason only).

(i) Melting point of Zn is less than that of Co.

.....

.....

.....

.....

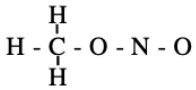
(ii) Boiling point of CH_3COOH is higher than that of CH_3CH_2CHO.

.....

.....

80.

(b) CH_3O_2N is the molecular formula of the compound A, named methyl nitrite. The skeletal structure of the compound is



(i) Draw the most acceptable Lewis structure of A

.....

.....

.....

.....

.....

(ii) Give possible resonance structures and comment on their stablity.

.....

.....

.....

.....

.....

(iii) B is a structrural isomer of A. Give the possible Lewis structure of B

.....

.....

.....

81.

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

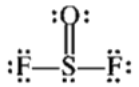
$\mathbf{N_A}$ = number of valence electrons in the atom

$\mathbf{N_{LP}}$ = number of electrons in lone pairs

$\mathbf{N_{BP}}$ = number of electrons in bonding pairs around the atom

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

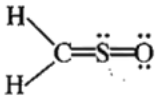
II. Fill in the values for $\mathbf{N_A}$, $\mathbf{N_{LP}}$ and $\mathbf{N_{BP}}$ in the appropriate boxes and calculate the charge on S, **Q**(sulfur), in the structure SOF_2 given below.



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

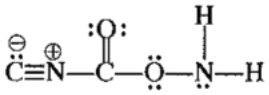
(ii) Draw the **most** acceptable Lewis structure for the ion, $ClO_2F_2^+$.

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

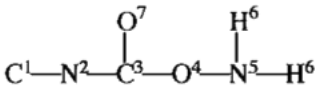


(iv) Based on the hypothetical Lewis structure given below, state the following regarding the C, N and O atoms given in the table below.

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 in part (iv) above. (Numbering of atoms is as in part (iv).)

I. N^2—C^3 N^2....., C^3 .....

II. O^4—N^5 O^4....., N^5 .....

III. N^5—H^6 N^5....., H^6 .....

IV. C^3—O^7 C^3....., O^7 .....

(5.5 *marks*)

(*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 (m_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 point of propane (C_3H_8)." Giving 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)

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

82.

01.(a)Arrange the following in the **increasing** order of the property indicated in parenthesis.

i. S, C, H, Br (electro negativity)

……..…<……..……..……<……..……..……..<……...……..……

ii. Ag^{+}, Mg^{2+}, Zn^{2+}, Fe^{2+} (Ability to act as an oxidizing agent in aqueous solution)

…….<……<……..<……

iii. AgI, AgBr, AgCl, AgF (covalent character)

…….<……<……..<……

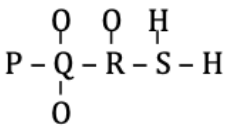
iv. CH_4, HCl, PH_3, H_2S (boiling point)

…….<……<……..<……

v. $SOCl_2$, XeF_2, ICl_4^-, CO_3^{2-} (number of repulsive units around the central atom)

…….<……<……..<……

(b) Elements P, Q, R and S are nonmetals with atomic number less than 20. The corresponding maximum stable valences are 7, 6, 4 and 5. R and S have maximum electro negativity in their respective groups. The fundamental structure of the molecule H_2RQPSO_3 formed by these elements is given below.



i. Identify the elements P, Q, R and S.

P -……..…….. Q -……..……..……

R -……..….. S -……...……..……

ii. Draw the most acceptable Lewis structure for this molecule.

…….

…….

…….

…….

iii. Draw six resonance structures for this molecule. (excluding the structure draw in the part (ii) above)

…….

…….

…….

…….

…….

…….

…….

…….

…….

iv. State the following regarding Q, R and S atoms in the table given below using the structure drawn in part (ii) above

1. Electron pair geometry (arrangement of electron pair) around the atom
2. Shape around the atom
3. Hybridization of the atom
4. Approximate value of bond angle around the atom.

		Q	R	S
1.	Electron pair geometry			
2.	Shape			
3.	Hybridization			
4.	Bond angle			

v. Identify the atomic/ hybrid orbital involved in the formation of the following σ – bond in the Lewis structure draw in part (ii) above

P – Q : P……. . Q……..…….....
Q – R : Q…….. R……..……..……
R – S : R……... S……..…..…….

vi. 1. Among the elements Q and R in the above molecule, which is more electronagative?

……..…

2. State two main factors which determine the electro negativity of an atom in a molecule.

……
……
……
……..……..…

(c) Consider the halogen hydrides HCl, HBr and HI.

1. Give the increasing order of the strength of London forces

…….<……..……<……..……..

2. Give the increasing order of the strength of dipole-dipole interactions

…….<……<……..……..

3. Give the increasing order of boiling points

…….<……..……<……...……..……..

4. Which interaction mainly contributes for the increase of boiling point

……...

83.

1. (a) Arrange the following in the **increasing** order of the property indicated in parenthesis.

   i. C, Li, Si (electron affinity)

   ……..……<……..……<……

   ii. N_2H_4, $NaNH_2$,NH_2OH (oxidation state of N atom)

   ……..……<……..……<……

   iii. Li^+, Cl^-, Al^{3+} (Hydration energy)

   ……..……<……..……<……

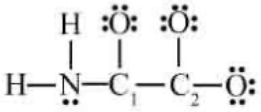
   iv. $KHCO_3$,$NaHCO_3$, $Mg(HCO_3)_2$ (Decomposition temperature)

   ……..……<……..……<……

   v. $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$ (Solubility)

   ……..……<……..……<……

(b) The compound with the molecular formula $H_3C_2NO_3$ reacts with NaOH $_{(aq)}$ solution and gives a compound with the molecular formula $H_2C_2NO_3Na$ and water as the products. Answer the following questions which are based on the anion of this sodium salt. The **first step** of the Lewis structure of anion is given below,



i. Mark the appropriate formal charges of carbon and oxygen atoms in the above structure.

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

iii. Draw all the possible resonance structures for this anion.

iv. Giving reasons, comment on their relative stabilities of the resonance structures drawn in part (iii) above.

……

……

……

……

v. State the followings regarding the C and N atoms, given in the table below.

1. VSEPR pairs around the atom
2. electron pair geometry (arrangement of electron pairs) around the atom
3. shape around the atom
4. hybridization of the atom

		C_1	C_2	N
⚀	VSEPR pairs			
⚁	electron pair geometry			
⚂	shape			
⚃	hybridization			

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

1. C_1–C_2 ……...
2. C_1 – N ……...…
3. N – H……
4. C_1 – O ……...…

vii. When dil HCl is added to the above anion, a compound with molecular formula $H_3C_2NO_3$ is obtained.

1. Draw the structure obtained, by considering whether H^+ ion joins with oxygen atom / nitrogen atom.

2. By considering the atom in which H^+ ion is joined, underline the suitable phrase.

State of Hybridization	(changes/ does not change)
Oxidation state	(increases/ decreases/ does not change)
Charge	(increases/ decreases/ does not change)
Number of VSEPR pairs	(increases/ decreases/ does not change)
Electronegativity	(increases/ decreases/ does not change)

c) Among the following molecules which one /ones will have the following intermolecular attractive forces.

$CS_{2(l)}$, $CH_2Cl_{2(l)}$, $NH_2OH_{(l)}$, $XeO_{3(l)}$, $C_6H_{6(l)}$

i. hydrogen bond

.....

ii. dipole – dipole interaction

.....

iii. london dispersion forces.

....

84.

01. (a) Mark whether the following statements (i) to (vi) are true (✓) or false (×)

(i) Polarizing ability of alkali metal cations increases down the group. .....

(ii) The bond angle of H_2O is higher than that of H_2O_2. .....

(iii) Hydrogen bonds are present between the molecules of $CHCl_3$ and CH_3COCH_3 .....

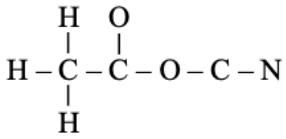
(iv) The principal quantum number is associated with the size of the orbital and the spin quantum number is associated with the shape of the orbital. .....

(v) The electron pair geometry around the central atom of XeF_2 and SCl_4 is trigonal bipyramidal. .....

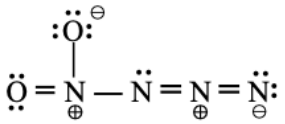
(vi) Electron affinity of Mg(g) is higher than that of Na(g). .....

(24 marks)

(b) (i) Draw the **most** acceptable Lewis dot-dash structure for the molecule Methyl cyanoformate ($C_3H_3NO_2$). Its skeleton is given below.



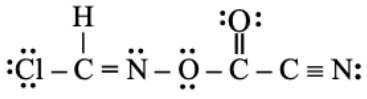
(ii) The most stable Lewis dot-dash structure for the molecule N_4O_2 is shown below. Draw **three** more acceptable Lewis dot-dash structures (resonance structure) for this molecule.

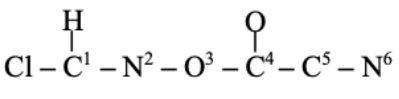


(iii) Based on the Lewis dot-dash structure given below, state the following regarding the C, N and O atoms given in the table.

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.





		C^1	N^2	O^3	C^5
I.	VSEPR pairs				
II.	electron pair geometry				
III.	shape				
IV.	hybridization				

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

I. $C^1 - N^2$ C^1 –…… N^2–……

II. $N^2 - O^3$ N^2 –…… O^3–……

III. $O^3 - C^4$ O^3 –…… C^4–……

IV. $C^5 - N^6$ C^5 –…… N^6 –……

(v) Identify the atomic orbitals involved in the formation of the following π bonds in the Lewis dot-dash structure given in part (iii) above. (Numbering of atoms is as in part (iii).)

I. $C^1 - N^2$ C^1 –…… N^2 –……

II. $C^5 - N^6$ C^5 –…… N^6 –……

(vi) Compare the electronegativity of carbon atoms labelled as C^1, C^4 and C^5 in the Lewis dot-dash structure given in part (iii) above. Give reasons for your answer.

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……

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(51 marks)

(c) (i) Sub energy level of an atom is described by the *n* and *l* quantum numbers. Give the respective quantum numbers, name of the sub energy level and the maximum number of electrons that can be filled in that sub energy level.

	n	***l***	**Number of electrons**	**Sub energy level**
I	3	……..	6	……..
II	4	2	……..	……..
III	……..	……..	……..	3s

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

I. K_2O, MgO, CaO, Al_2O_3 (Lattice enthalpy)

……<……<……<……

II. SO_2, SO_4^{2-}, SO_3^{2-},SO_3 (Electronegativity of S atom)

……<……<……<……

III. $\left(4,0,0,+\frac{1}{2}\right), \left(3,1,1,-\frac{1}{2}\right), \left(3,2,-1,-\frac{1}{2}\right), \left(3,0,0,+\frac{1}{2}\right)$ (Energy of electron)

……<……<……<……

85.

01. (a) Arrange the following in the increasing order of the properties mentioned in the brackets.

i. H, Si, C, Br (Electronegativity)

……..……..<……..……..<……..<……..

ii. Li, B, Cl, F (Electron affinity)

……..……..<……..……..<……..<……..

iii. SCl_2, SF_2, SF_4, SF_6 (Bond length)

……..……..<……..……..<……..<……..

iv. K_2CO_3, $MgCO_3$, $(NH_4)_2CO_3$, $CaCO_3$ (Decomposition temperature)

……..……..<……..……..<……..<……..

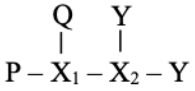
v. NO_2^-, SO_2, SO_3, CO_2 (Bond angle)

……..……..<……..……..<……..<……..

vi. NH_2^-, OH^-, CH_3O^-, HCO_3^- (Basic character)

……..……..<……..……..<……..<……..

(b) P, Q, X and Y are 4 elements with atomic numbers less than 20. These are not their actual notations. P, Q and X can form neutral oxides. Y obtains positive oxidation state only in the compound produced in the reaction between Y and P. The highest oxidation state oxide of X shows strongly acidic nature. Q does not have lone pair electrons in any of the covalent compounds formed by it. The skeletal structure of the molecule QX_2Y_2P formed by these elements is given below.



i. Identify the elements P, Q, X and Y.

……

……

ii. Draw the most acceptable Lewis structure of this molecule.

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……

……

……

iii. Draw the resonance structures of the above molecule and compare their relative stabilities with reasons.

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iv. Write down the

1. Electron pair geometry around the atom
2. Geometrical shape around the atom
3. Hybridization of the atom
4. Approximate value of the bond angles around the atom

of the atoms X_1 and X_2 in the following table.

	X_1	X_2
Electron pair geometry		
Shape		
Hybridization		
Bond angle		

v. Compare the electro negativities of X_1 and X_2 with proper reasons.

……
……
……
……

(c) i. Write down the types of lattices of the following compounds using the terms given in the brackets. [Ionic lattice, nonpolar molecular lattice, metallic lattice, homogenous atomic lattice, polar molecular lattice, heterogeneous atomic lattice]

1. $CsCl_{(s)}$ ……
2. Silicon [$Si_{(s)}$]……
3. Dry ice ……
4. Cu ……
5. Rhombic sulphur ……

ii. Consider the following carbon compounds.

Formaldehyde (H_2CO), Formic acid (H_2CO_2), oxalic acid ($H_2C_2O_4$)

1. Arrange them in the increasing order of their boiling point and acidic nature.

   Boiling point ……<……<……

   Acidic nature ……<……<……

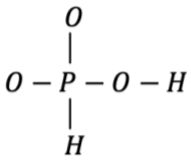
2. Mention all the types of molecular attractive forces present in the following compounds.

   Formaldehyde ……

   Formic acid ……

   Oxalic acid ……

b) The skeletal structure of $H_2PO_3^-$ ion is given below.



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

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ii) Draw the resonance structures of it and comment on their relative stabilities.

……
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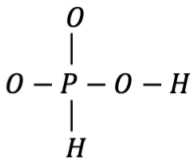
……

86.

a The skeletal structure of $H_2PO_3^-$ ion is given below.



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

.....

.....

.....

ii) Draw the resonance structures of it and comment on their relative stabilities.

.....

.....

b. You are provided with the following list of some elements and compounds

$Ice, SiO_2,\ He,\ K,\ Li,\ Mn,\ V,\ Cl,\ Cr,\ Na,\ O,\ I_2$ From the list

(i) Identify the element which can conduct electricity and can form highest positive oxidation state compound

.....

(ii) Identify the element which has lowest ionization energy

.....

(iii) Identify the element which has highest reducing ability

.....

(iv) Identify the compound which is the polar molecular lattice

.....

(v) Identity the element with highest number of unpaired electrons in its ground state electronic configuration

.....

(vi) Identify the element with high electronegativity

.....

c. The following parts (i) to (iv) are based on the molecule Thiourea $(CS(NH_2)_2)$. It has the following skelection.

(i) Draw the most acceptable lewis structure for this molecule?

(ii) Draw resonance structures for this molecule? Comment on their stability?

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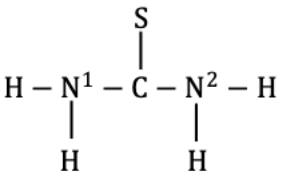
(iii) Based on the lewis structure drawn in (i) above, state the following regarding C, N atoms given in the table below.

(i) VSEPR pairs around the atom

(ii) Electron pair gcometry around the atom

(iii) Shape around the atom

(iv) Hybridization of the atom



	C	N^{1}
VSEPR pairs		
Electron pair gcometry		
Shape		
Hybridization		

(iv) Identify the atomic / hybrid orbitals involved in the following σ bonds in the lewis structure drawn in part (i) above.

(i) $N^{1} - C$ N^{1} ..... C .....

(ii) $C - S$ C ..... S .....

(v) $N^{1} - H$ N^{1} ..... H .....

87.

01) (a)

I. To calculate formal charge (FC) of an atom in Lewis structure, fill in the cages given below with N_G, N_B, N_{NBE} to complete the expression.

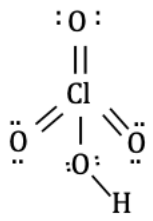
N_G - group number

N_B – number of bonds

N_{NBE} – number of un bonded electrons.

FC = ☐ – ☐ – ☐ (02 x 3 = 06 Marks)

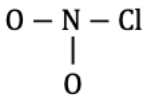
II. By filling the values for N_G, N_B, N_{NBE} in suitable cages, calculate formal charge (F_C) for Cl atom in the structure of $HClO_4$ given below.



FC = ☐ – ☐ – ☐ = ☐

(02 x 4 = 08 Marks)

III. Basic structure of NO_2Cl molecule is given below.



(i) Draw three suitable resonance structures. (05 x 3 = 15 Marks)

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(ii) Identify the unstable structure and name it. (02 Marks)

(iii) State two reasons for the instability of the unstable structure. (02 x 2 = 04 Marks)

.....

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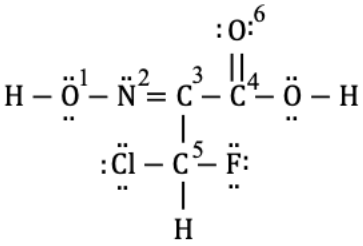
IV. On the basis of Lewis dot – cross structure given below. Complete the table for the atoms C, N, O

(i) VESPR around the atom

(ii) geometry of electron pair around atom

(iii) hybridisation of atom

(iv) Shape around the atom.



		O^1	N^2	C^3	C^4	C^5
1	VSEPR Pairs					
2	Geometry of electron pair					
3	hybridization					
4	Shape.					

(01 x 20 = 20 Marks)

V. In the Lewis dot – cross structure given in part (iv) above identify the atom / hybrid orbitals related to the formation of the following σ bonds.

(i)	$H - O^1$	H	O^1	.....
(ii)	$O^1 - N^2$	O^1	N^2	.....
(iii)	$N^2 - C^3$	N^2	C^3	.....
(iv)	$C^3 - C^4$	C^3	C^4	.....
(v)	$C^3 - C^5$	C^3	C^5	.....
(vi)	$C^5 - F$	C^5	F	.....

(01 x 12 = 12 Marks)

VI. In the Lewis dot – cross structure given in part (iv) above identify the atomic orbitals related to the formation of two double bonds.

(i) $N^2 - C^3$ N^2 ..... C^3 .....

(ii) $C^4 - O^6$ C^4 ..... O^6 .....

(02 x 4 = 08 Marks)

(b)

(i) An atomic orbital is explained by three quantum numbers n, l and m_l. In the table given below indicate the proper quantum number and name of atomic orbital.

	n	l	m_l	atomic orbital
I			-3	4*f*
II			-2	4d
III			-1	4P
IV	4			4S
V			+1	2P
VI				2S

(01 x 13 = 13 Marks)

(ii) Arrange the following in the ascending order of the property given in brackets.

I. SO_2, H_2S, SO_4^{2-}, (Bond angle) .....

II. NO^+, NO_2^+, NO_3^- (N – O bond length) .....

III. Li_2CO_3, Na_2CO_3, $NaHCO_3$ (Solubility in water) .....

(04 x 3 =-12 Marks)

88.

1) (A) Arrange the following in increasing order of the property indicated within the Parenthesis.

(i) C, N, Cl, Ar (First ionization Energy)

.....

(ii) Li, F, Al, Ca (Atomic radius)

.....

(iii) P, Mg, O, Cl (First electron affinity energy)

.....

(iv) SO_2 , SO_3 , H_2S , H_2SO_4 (Electro negativity of sulfer)

.....

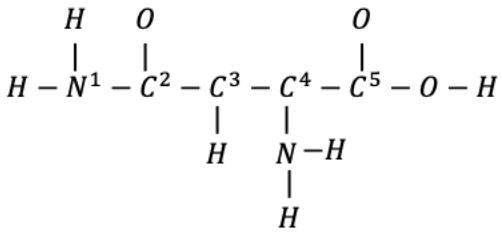
(v) NF_3 , NH_3 , CCl_4 , $AlCl_3$ (Bond angle)

.....

(vi) $NaCl, KCl, RbCl, LiCl$ (Melting point)

.....

(B) The following questions (i) to (v) are based on the amino acid. The Skelton of which is given below



(i) Draw the most acceptable Lewis structure for the above amino acid.

……..

……..

(ii) Draw the resonance structure for the given amino acid molecule and comment on the stability of this resonance structure.

……..

……..

……..

……..

……..

……..

(iii) Based on the Lewis structure drawn in part (i) state, the following regarding the N^1, C^2, C^3 and C^4 atoms given in the table.

a) VSEPR pairs around atom.
b) Electron pair geometry around atom.
c) Hybridization of the atom.
d) Shape around the atom.

		N^1	C^2	C^3	C^4
(a)	VSEPR Paris				
(b)	Electron Pair geometry				
(c)	Hybridization				
(d)	Shape				

(iv) Identify the atomic / hybrid orbitals involved in the formation of the following σ bonds in the Lewis structure drawn in Part (i)

(a) $N^1 - C^2$ N^1 ..... C^2 .....
(b) $C^2 - C^3$ C^2 ..... C^3 .....
(c) $C^4 - C^5$ C^4 ..... C^5 .....

(v) Sketch the shape of the Lewis structure of amino acid drawn in Part (i) indicating approximate values for the bond angles.

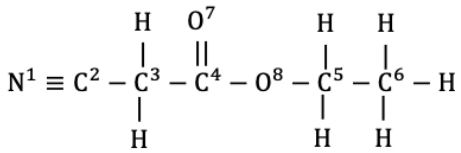
……..

……..

……..

……..

The atoms are numbered as follows.



		N^1	C^3	C^4	O^8
(i)	VESPR pairs				
(ii)	Electron pair geomatry				
(iii)	Shape				
(iv)	Hybridization				

(6 x 1 = 16 Marks)

(ii) Identify the atomic / hybride orbitals involve in the formation of σ bonds in the lewis structure given in part (i) above. The atoms are numbered as in part (i).

(i) N^1 - C^2 N^1 ..... C^2 .....

(ii) C^4 - O^7 C^4 ..... O^7 .....

(iii) C^4 - O^8 C^4 ..... O^8 .....

(iv) C^5 - C^6 C^5 ..... C^6 .....

(8 x 1 = 08 Marks)

(iii) Identify the atomic orbitals involve in the formation of π bonds in the Lewis structure given in part (i)

i. N^1 - C^2 N^1 ..... C^2 .....

ii. C^4 - O^7 C^4 ..... O^7 .....

(4 x 1 = 04 Marks)

(iv) Draw the Lewis dot – dash structure of the following molecules and deduce their shapes.

i. SO_3 ii. CH_2Cl_2

89.

1) (A) Arrange the following in the descending order of the property given in Paranthesis.

(i) HCHO, CO_2, CH_3Br, HCN (Electro negativity of carbon)

……..

(ii) $LiNO_3$, $NaNO_3$, $RbNO_3$, KNO_3 (Solubility in water)

……..

(iii) Be, F, S, P (First ionization energy)

……..

(iv) (3, 0, 0, +1/2) , (3, 1, 0, +1/2), (2, 0, 0, +1/2), (2, 1, 0, +1/2) (Energy states of orbitals filled by electrons)

……..

(v) $SO_2, SO_3, SO_3^{2-}, SO_4^{2-}$ (Bond angle)

……..

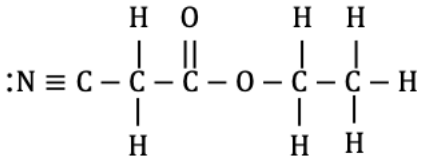
(vi) P, Cl, Al, Na (Electron gain enthalpy)

……..

(B)

(i) Based on the following Lewis structure mention the following with regard to the atoms C, N, O and H.

1. VSEPR pairs around the atom.
2. Electron pair geometry around the atom.
3. Shape around the atom.
4. Hybridization of the atom.



(C) The following questions are related to the σ and π bonds between carbon atoms (C – C) in ethyne molecule ($CH \equiv CH$). Underline the correct choice of answer.

i. Which type of overlaping is formed by the contribution of the hybride orbitals of two carbon atoms in ethyne molecule.
(Linear over laping / Latteral over laping)

ii. The type of bond involve in the above overlaping
(σ bond / π bond)

iii. Which type of overlaping is involved with the contribution of the two carbon atoms in ethyne molecule
(Linear overlap / latteral overlap)

iv. Type of bond involve in the above overlaping
(σ bond / π bond)

(4 x 3 = 12 Marks)

(D) Mention the type / s of secoundary interactions that exists between the following pairs.

I. $HCl_{(g)}$ and $Ar_{(g)}$ .....

II. $C_6H_5OH_{(l)}$ and $H_2O_{(l)}$ .....

III. $KCl_{(s)}$ and $H_2O_{(l)}$ .....

(8 x 2 = 16 Marks)

You can reach your highest potential only through perseverance and hard work. Believe in the true strength in you.