

EU EE CHEMISTRY

Starting from Molecular Geometry.

EU EE-2003

- What is the orbital hybridization of the oxygen atom in water?
A. sp B. sp^2 C. sp^3 D. sp^3d
- NF_3 , BF_3 and ClF_3 all have molecular formulae of the type XF_3 . Which molecule(s) has(have) trigonal pyramidal molecular geometry?
A. NF_3 & BF_3 B. BF_3 & ClF_3 C. NF_3 & ClF_3 D. NF_3
- Which of the following molecules can't be formed?
A. NCl_3 B. OF_6 C. ONF_3 D. PCl_3
- Of Br_2 , Ne, HCl and N_2 , which of likely to have the largest intermolecular dispersion forces?
A. Br_2 B. Ne C. HCl D. N_2
- What kind of hybridization is used by carbon in C_2H_2 (acetylene)?
A. sp B. sp^3 C. sp^2 D. sp^2d
- What is the molecular geometry of O_3 ?
A. T-planar B. Bent C. T-pyramidal D. Tetrahedral
- According to molecular orbital theory, which one of the following is paramagnetic?
A. F_2 B. H_2 C. NO^+ D. NO

EU EE-2004

- There is a strong covalent bond between the N atoms in nitrogen gas N_2 . Why, then, does nitrogen have such a low boiling point of $-196^\circ C$?
A. The bond between the N-atoms is triple
B. N is very electronegative, only next to F and O
C. The strong bond, an intramolecular one, determine the boiling point of the substance
D. Boiling point is determined by intermolecular force, which in this case is weak as the molecule is non-polar
- Which molecule listed below has two sigma and two pi bonds?
A. N_2 B. C_2H_4 C. N_2F_2 D. HCN^-
- Which of the following explains why, at room temperature I_2 is solid, Br_2 is liquid and Cl_2 is a gas?
A. Ionic bonding B. Hybridization C. Hydrogen bonding D. London dispersion forces
- What is the hybridization of phosphorus in PCl_5 ?
A. sp^3d B. sp^3d^2 C. sp^3 D. sp^2
- Which of the following species has the smallest H-X-H bond angle where x is the central atom?
A. OH_2 B. NH_3 C. CH_4 D. BH_3

EUEE-2005

- Which of the following molecules has a trigonal bi-pyramidal structure?
A. SF₄ B. IF₅ C. ICl₄ D. BrF₅
- Which of the following crystals possess high electrical and thermal conductivity?
A. Ionic crystals B. Metallic crystals C. Molecular crystals D. Covalent network crystals
- Which of the following hybrid orbitals is favoring the formation of trigonal bipyramidal?
A. sp³d B. sp³ C. sp³d³ D. sp³d³
- which one of the following molecules/molecular ions is paramagnetic according to the molecular orbital theory?
A. O₂²⁻ B. O₂ C. F₂ D. O₂²⁺

EUEE-2006

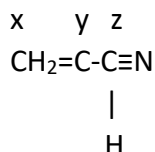
- Which molecule or ion does NOT have a tetrahedral shape?
A. XeF₄ B. SiCl₄ C. BF₄⁻ D. NH₄⁺
- How many π bonds are present in CO₂?
A. One B. two C. three D. four
- What is the correct molecular electronic configuration for the molecular ion B₂⁺?
A. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \delta 2p^2$
B. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p_y^2$
C. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p_x^1$
D. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p_x^1 \pi 2p_y^1$
- Based on molecular orbital theory, the bond orders of H₂, H₂⁺, H₂⁻ are _____ respectively.
A. 1, 0 & 0 B. 1, $\frac{1}{2}$ & 0 C. 1, 0 & $\frac{1}{2}$ D. 1, $\frac{1}{2}$ & $\frac{1}{2}$

EUEE-2007

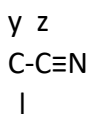
- According to valence bond theory, which orbitals on bromine atoms overlap in the formation of the bond in Br₂?
A. 3s B. 3p C. 4s D. 4p
- How many sigma and pi bonds are present in the following molecule?
 $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3$
A. 8σ bonds and 1π bond C. 10σ bonds and 2π bond
B. 8σ bonds and 2π bond D. 11σ bonds and 1π bond
- What hybridization change does the carbon atom undergo in the combustion of methane?
 $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
A. sp → sp² B. sp² → sp³ C. sp³ → sp D. sp² → sp
- the molecular geometry of H₃O⁺ ion is
A. Linear B. Tetrahedral C. Bent D. Trigonal pyramidal
- The hybridization of the central atom in XeF₄ molecule is
A. sp² B. sp³ C. sp³d D. sp³d²

EUEE-2008

- Which of the following molecules does NOT have a tetrahedral central atom?
A. SF_4 B. AlH_4^- C. BF_4^- D. SiCl_4
- Acrylonitrile has the following Lewis structure with designation of x, y and z for each carbon atom:



What will be the value of the bond angle and geometry of



- 109°, tetrahedral B. 120°, trigonal pyramidal C. 180°, linear D. 90°, T-shaped
- Antimony(Sb) is a group V element. What will be the molecular geometry and number of lone pair electrons, respectively that exist in the ions $[\text{SbCl}_5]^{2-}$?
A. Seesaw, 1 B. square planar, 2 C. seesaw, 2 D. linear, 3
 - Which of the following molecules does NOT have a trigonal bipyramidal electron pair geometry?
A. SF_4 B. ClF_3 C. XeF_2 D. BrF_5
 - How many atomic orbitals are required for an sp^3 hybridization?
A. 2 B. 6 C. 4 D. 8
 - Formic acid, which is released by ants, has a molecular formula HCOOH . What are the possible hybridization that exist in the molecule?
A. sp^2 and sp^3 B. sp and sp^3 C. sp , sp^2 and sp^3 D. sp and sp^2

EUEE-2009

- What is (are) the F-S-F bond angle(s) in SF_6 ?
A. 109.5° B. 120° C. 90° & 120° D. 90° & 180°
- What is the bond order of superoxide anion, with the chemical formula O_2^- ?
A. 3.0 B. 2.5 C. 2.0 D. 1.5
- what kind of hybrid orbitals are utilized by the carbon atom in CF_4 molecules?
A. sp B. sp^2 C. sp^3 D. $\text{sp}^3 \text{d}$
- Which of the following molecule is INCORRECTLY matched with the electronic geometry of the central atom?
A. CF_4 : tetrahedral
B. H_2O : tetrahedral
C. PF_3 : pyramidal
D. BeBr_2 : linear

EUEE-2010

- In the following equation, what type of hybridization change, if any, occurs at the Xe atom?
 $\text{XeF}_2(\text{s}) + \text{F}_2(\text{g}) \rightarrow \text{XeF}_4(\text{g})$
 A. sp^3d to sp^3 B. sp^3d to sp^3d^2 C. sp^3 to sp^3d D. dsp^2 to sp^3
- What is(are) the bond angle(s) in SF_6 ?
 A. 90° and 109.5° B. 109.5° C. 90° D. 180°
- Which of the following molecular orbital diagram is correct for the carbide ion (C_2^{2-})?
 A. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p^4 \delta 2p^2$
 B. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p^4$
 C. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p^4 \delta 2p^2 \pi^* 2p^2$
 D. $\delta 1s^2 \delta^* 1s^2 \delta 2s^2 \delta^* 2s^2 \pi 2p^4 \delta 2p^2 \pi^* 2p^4$
- How many electrons are present in the $\delta 2p$ molecular orbital of N_2^+ ?
 A. 1 B. 3 C. 2 D. 4
- Given the following AF_n species, BF_3 , BeF_2 , CF_4 , NF_3 , OF_2 , what is the correct order of F-A-F bond angles?
 A. $\text{OF}_2 < \text{NF}_3 < \text{CF}_4 < \text{BF}_3 < \text{BeF}_2$
 B. $\text{OF}_2 < \text{BeF}_2 < \text{NF}_3 < \text{BF}_3 < \text{CF}_4$
 C. $\text{CF}_4 < \text{BF}_3 < \text{BeF}_2 < \text{OF}_2 < \text{OF}_2$
 D. $\text{BeF}_2 < \text{OF}_2 < \text{NF}_3 < \text{BF}_3 < \text{CF}_4$
- From CO_2 , H_2O , BeCl_2 AND N_2O , which have the same molecular geometry?
 A. CO_2 , H_2O & N_2O B. CO_2 & BeCl_2 ONLY C. H_2O & N_2O ONLY D. CO_2 , BeCl_2 & N_2O_2

EUEE-2011

- There is a progressive decrease in the bond angle in the series of molecules CCl_4 , PCl_3 & H_2O . According to the VSEPR model, this is best explained by:
 A. Increasing electronegativity of the central atom
 B. Decreasing size of the central atom
 C. Increasing number of the lone pair electrons
 D. Decreasing bond strength
- What is the molecular shape of ICl_4^- ?
 A. Octahedral B. T-shaped C. trigonal bipyramidal D. square planar
- What hybridization change, if any, occurs at the underlined atom in the following reactions?
 $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
 A. $\text{sp}^2 \rightarrow \text{sp}^3$ B. $\text{sp} \rightarrow \text{sp}^2$ C. $\text{sp}^3 \rightarrow \text{sp}^3\text{d}$ D. No hybridization change occurs
- which of the ff statement is correct about nitrosyl chloride (NOCl)?
 A. It has a trigonal planar geometry with O as central atom
 B. It has a bent angular geometry with O as central atom
 C. It has a trigonal planar geometry with N as central atom
 D. It has a bent or angular geometry with N as central atom

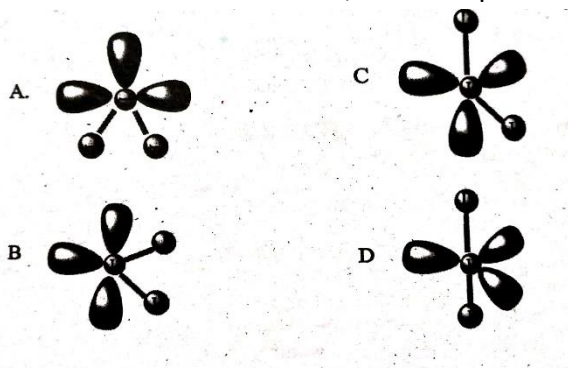
EUEE-2012/13

- Which of the following is NOT the correct geometric configuration for the given molecule?
A. BF_3 , trigonal planar B. SF_6 , octahedral C. NF_3 , trigonal planar D. CH_4 , tetrahedral
- Which one of the following substances has London dispersion forces as its only intermolecular force? (No hydrogen bonding, no dipole-dipole forces)
A. CH_4 B. H_2S C. NH_3 D. CH_3OH
- Which of the following is a basic chemical bonding theory?
A. Valence shell electron repulsion(VSEPR) theory
B. Ionic bonding theory
C. Covalent bonding theory
D. Molecular orbital theory
- Which type of intermolecular forces are present molecular crystalline solids?
A. Metallic, dispersion, dipole-dipole, hydrogen bonding
B. Covalent, dispersion, dipole-dipole, hydrogen bonding
C. Dispersion, dipole-dipole, hydrogen bonding
D. Ionic, dispersion, dipole-dipole, hydrogen bonding
- Which statement is NOT correct about valence bond theory?
A. According to the valence bond theory, each bond only involves two atoms
B. Valence bond theory treats electrons as localized between pairs of atoms
C. According to valence bond theory, molecular orbitals are formed by combining atomic orbitals
- For the molecule[phosgene] shown below, why do the lone pairs and double bonds affect the bond angles?



- Lone pairs occupy less space, but multiple bonds occupy more space than single bonds
- Both multiple bonds and lone pairs occupy less space
- Lone pairs repel smaller than bonded pairs and multiple bonds have a higher charge density around the central atom
- Lone pairs repel more due to a greater charge density than bonding pairs

7. Based on the VSEPR model, what shape would you expect for the molecule $[I_3]^-$?



EUEE-2014/15

1. In which of the following molecules is the central atom sp^2 hybridized?

- A. CO_2 B. N_2O C. SO_2 D. CO

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THE END!