Periodic table trends & hybridization

Problem set 2+3

Part A — Multiple Choice Questions (MCQ)

Q1. Why does atomic size decrease from left to right across a period? A. The number of electron shells increases.

B. The nuclear charge increases and attracts electrons more strongly.

C. The number of protons decreases.

D. Electrons move farther away from the nucleus.

Q2. Why does atomic size increase from top to bottom within a group?

A. The number of electron shells increases.

B. The nuclear charge decreases.

C. The number of protons decreases.

D. The number of valence electrons becomes zero

Q3. Which statement correctly describes elements in the same group of the periodic table?

A. They have the same atomic number.

B. They have the same atomic mass.

C. They generally have the same number of valence electrons.

D. They have the same number of electron shells.

Q4. Which of the following elements has the highest tendency to attract electrons?

A. Sodium (Na)

B. Potassium(K)

C. Fluorine (F)

D. Calcium (Ca)

Q5. Which statement correctly describes the atomic number of an element?

A. It represents the number of neutrons in the nucleus.

B. It represents the total number of protons and neutrons.

C. It represents the number of protons in the nucleus. D. It represents the average atomic mass.

Q6. Why are Zn^{2+} compounds generally colorless according to the lecture? A. Zinc has no electrons.

B. Zn^{2+} has completely filled d-orbitals, preventing d–d transitions. C. Zinc has no protons.

D. Zn^{2+} has only one electron in its d-orbitals

Q7. How many sigma (σ) and pi (π) bonds are present in a carbon–carbon triple bond (C≡C)?

A. 3σ and 0π

B. 2σ and 1π

C. 1σ and 2π

D. 1σ and 1π

Q8. Which statement correctly compares carbon–carbon single, double, and triple bonds?

A. Single bonds are the shortest and strongest.

B. Double bonds are longer than single bonds.

C. Triple bonds are generally the shortest and strongest overall. D. All three bonds have the same length.

Q9. What is the steric number of the central oxygen atom in water (H_2O)?

A 4

B 6

C 10

D. 5

Q10. Which statement correctly describes the nitrogen atom in ammonium (NH_4^+)?

A. It has three sigma bonds and one lone pair.
B. It has four sigma bonds and no lone pairs.
C. It has two sigma bonds and two lone pairs.
D. It has four sigma bonds and one lone pair.

Q11. Atomic mass is best described as:

A. The number of protons only
B. The number of electrons only
C. The average mass of atoms of an element considering its isotopes
D. The mass of a molecule

Q12. Which bond generally allows free rotation around the bond axis?

A. Single bond
B. Double bond

C. Triple bond

D. All bonds equally

Part B — True / False

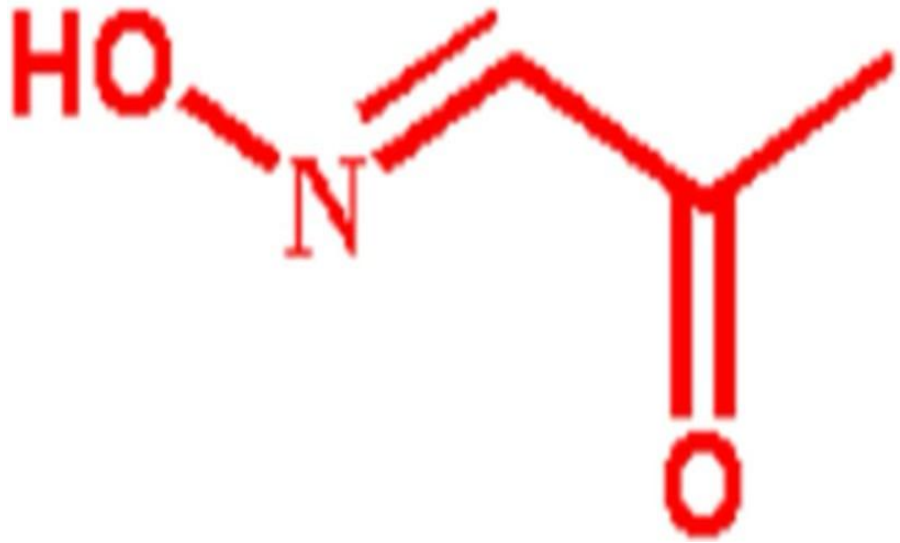
Q1. The hybridization generally is not assigned to sodium chloride (NaCl) because Sodium chloride is an ionic compound rather than a covalent molecule.

A. True

B. False

Q2. The hybridization of Nitrogen (N)atom in the following structure is SP^3

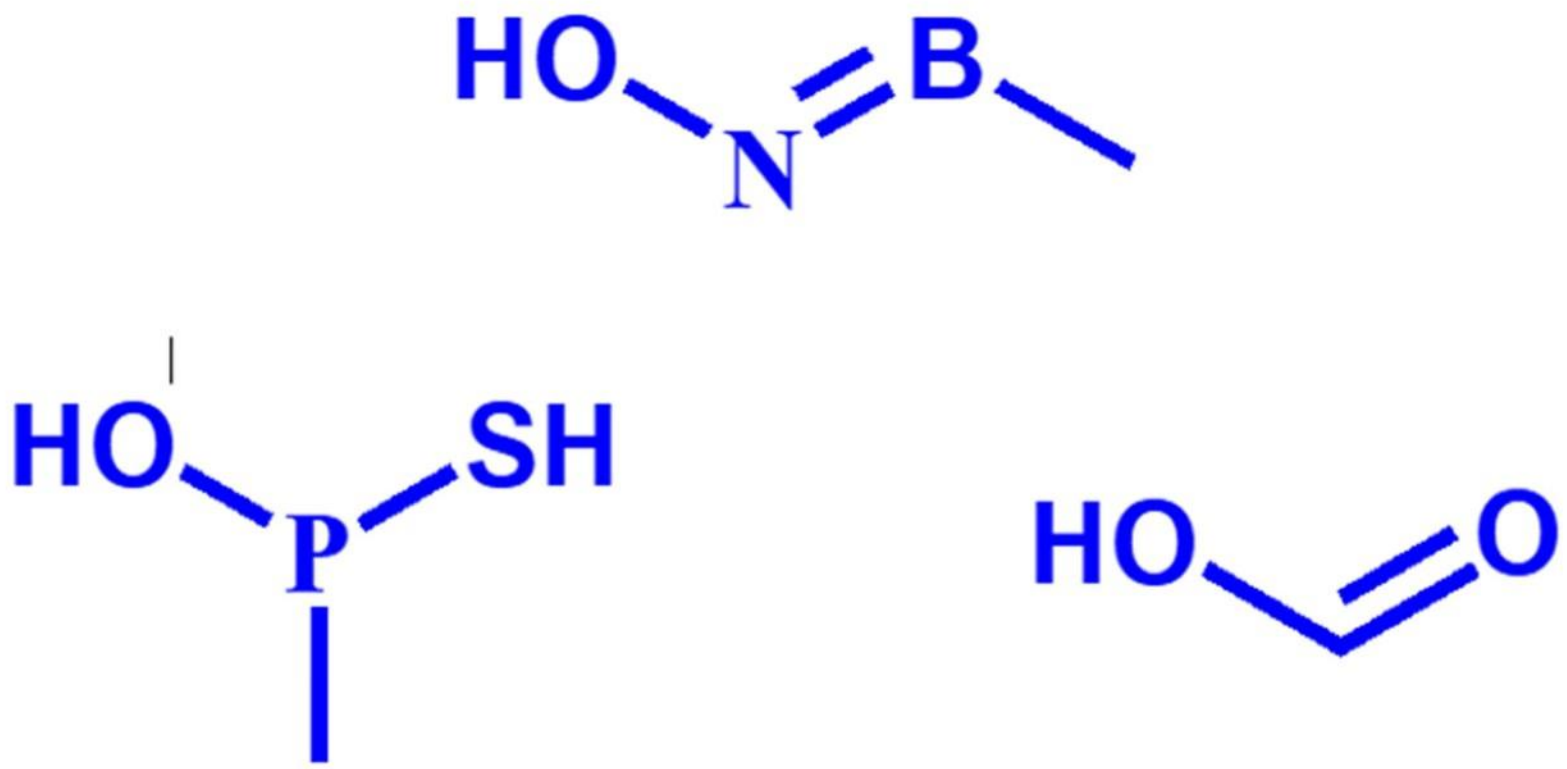
A. True B. False



Q3. All Oxygen atoms (O) in the following structures have the same hybridization.

A. True

B. False

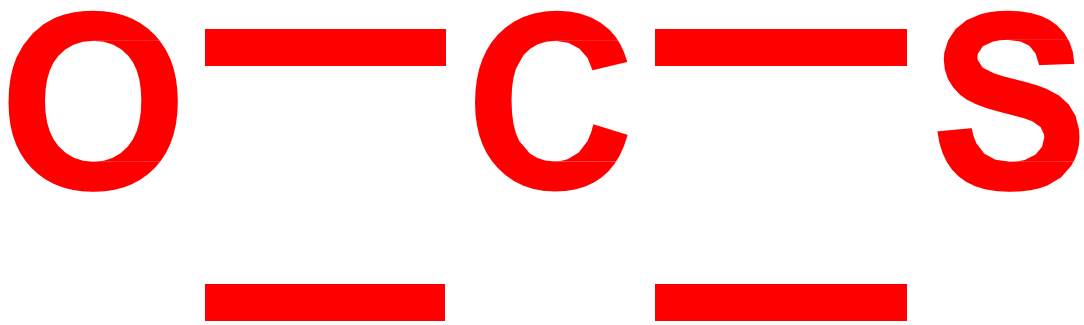


Q4. Oxygen atom (O) as well as Sulfur atom

(S) in the following structures has two lone pairs each; while carbon has no lone pair.

A. True

B. False

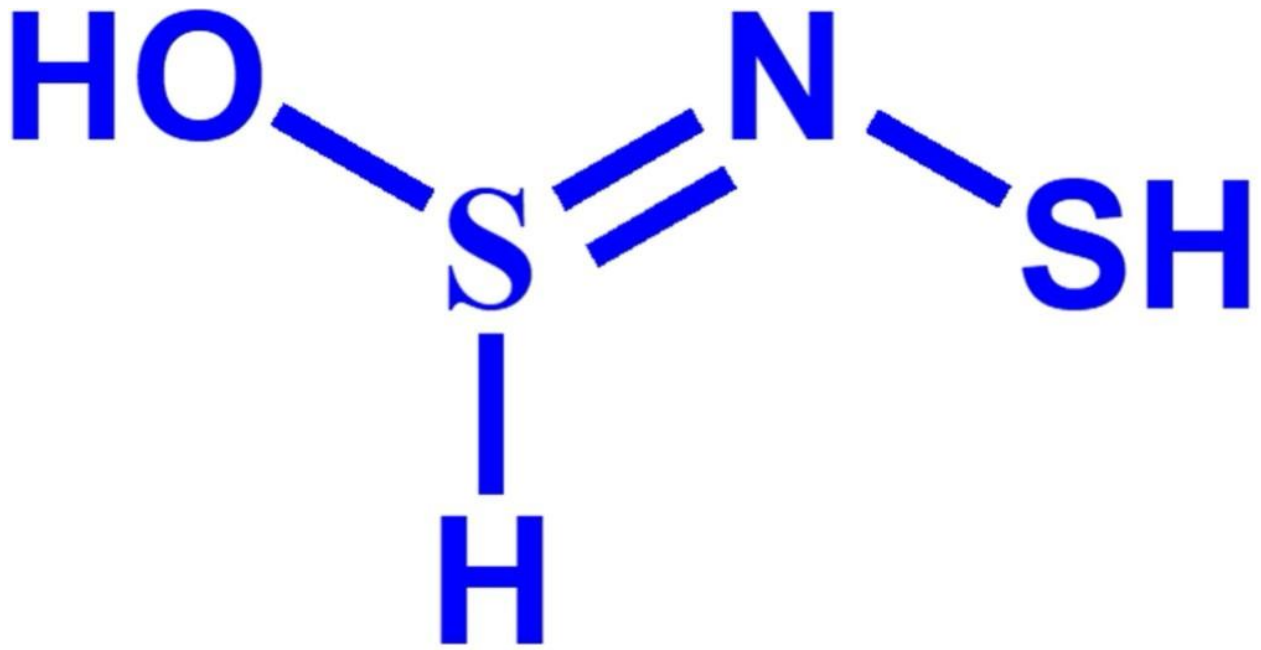


Q5.

The Sulfur atoms in the following compound have the same type of hybridization

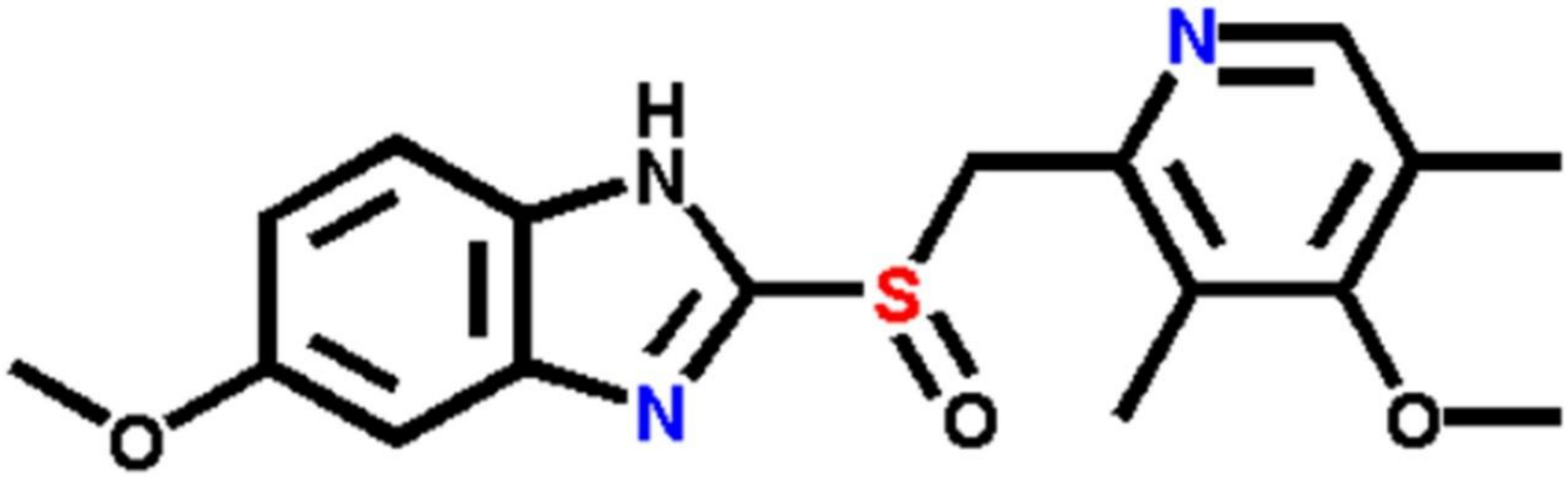
A. True

B. False



Q6. In Omeprazole; the blue two nitrogen atoms have SP^2 type of hybridization while Sulfur atom has SP^3 type of hybridization

A. True



Omeprazole

B. False

The correct sequence of events

Q7.
responsible for producing color is:

Absorption → Excitation → Emission of Light → Color.

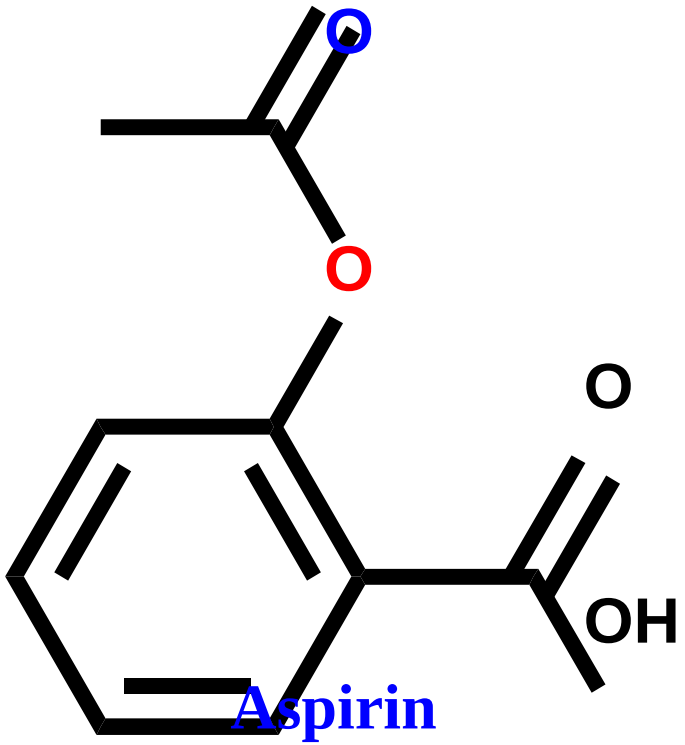
A. True

B. False

Q8. In Aspirin; the blue Oxygen atom has steric number = 3; while the red Oxygen atom has steric number = 4

A. True

B. False



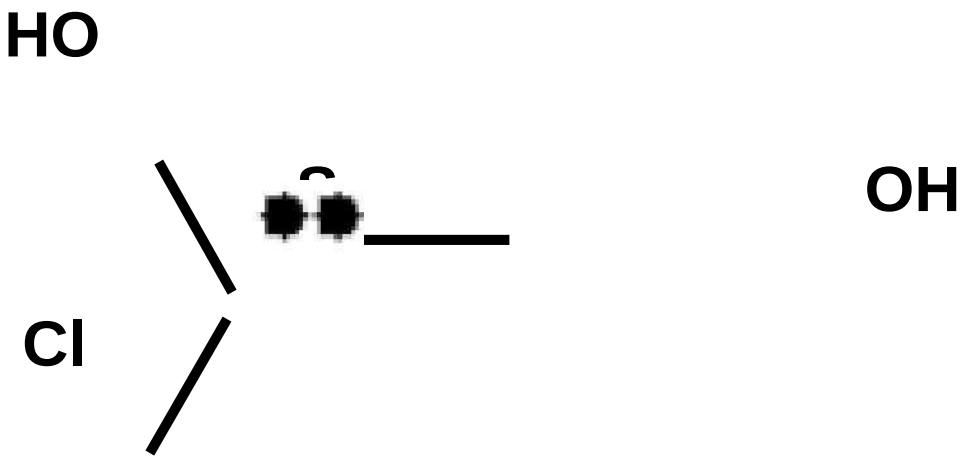
Aspirin

Q9.

The sulfur atom in the given chemical structure possesses two lone pairs of electrons.

A. True

B. False



Q10. Poisoning of Sulfur leads to Neurotoxicity results from the biological activity of sulfur.

A. True B.

False

C.

Q11. Atomic radius increases from left to right because the nuclear charge increases, pulling electrons closer while they remain in the same energy level; while Atomic radius increases from top to bottom because additional electron shells are added, increasing the distance between the outer electrons and the nucleus.

A. True B. False

Q12. All the following statements are correct ❖ σ bond

arises from head to head overlapping of orbital ❖ π

bond arises from side by side (Bilateral overlapping).

Q11.

- Sigma bond “σ” is stronger than π bond. Because in sigma the electrons are applied on the same nuclear axes while in Pi they are not.

❖ Chloride ion has SP^3 hybridization type; since it has 4 lone pairs

A. True
B. False

Q13. All the following statements are correct ❖ Double bonds are shorter than the single bonds ❖ Triple bond has 1 sigma with 2 Pi bonds ❖ In hybridization both sigma and Pi bonds are taken into consideration.

❖ Chloride ion has SP3 hybridization type; since it has 4 lone pairs

A. True
B. False

Q14. Electronegativity (EN) of N is much more than Oxygen and Fuorine is the most electronegative atom in the periodic table

A. True
B. False

Q15. Electropositivity (EP) of Cs is more than Potassium and Sodium, Fr atom is the most electropositive atom in the periodic table

A. True
B. False

Q16. Hybridization involves Mixing atomic orbitals to form hybrid orbitals used in bonding

A. True
B. False