Bond Parameters Chemistry Questions with Solutions

Q1. The angle between hydrogen through oxygen is-

a.) 104.5°
b.) 104°
c.) 105.4°
d.) 105°

Correct Answer– (a.) 104.5°

Q2. The bond enthalpy of H_2O and OH are 502 kJ mol^{-1} and 427 kJ mol^{-1}. Then what will be the average bond enthalpy?

a.) 502 kJ mol^{-1}
b.) 464.5 kJ mol^{-1}
c.) 427 kJ mol^{-1}
d.) 75 kJ mol^{-1}

Correct Answer– (b.) 464.5 kJ mol^{-1}

Q3. The bond order of CO is-

a.) 1
b.) 2
c.) 3
d.) 4

Correct Answer– (c.) 3

Q4. Out of the given options, choose the one which cannot be used to measure bond lengths?

a.) Spectroscopy
b.) X-ray diffraction
c.) Electron diffraction
d.) Young's Double-slit method

Correct Answer– (d.) Young's Double-slit method

Q5. Which of the following pairs has dipole-induced dipole interactions?

a.) HCl and He atoms

b.) SiF_4 and He atoms
c.) H_2O and alcohol
d.) Cl_2 and CCl_4

Correct Answer– (a.) HCl and He atoms.

Q6. State True or False.
Strength of the bond between the two atoms can be known from bond dissociation enthalpy.

Answer. True.
Bond dissociation enthalpy is the energy required to break a molecule into atoms. The stronger the bond between the atoms, the higher the bond dissociation energy. Bond dissociation enthalpy can thus be used to calculate the strength of the bond between two atoms.

Q7. Fill in the blank.
All the ___ species have the same bond order.

Answer. All the isoelectronic species have the same bond order.
Isoelectronic species are the molecules and ions that contain the same number of electrons, and they have the same bond order.

Q8. Give the increasing order of O_2, O_2^+, O_2^{2-} and O_2^-

Answer. According to Molecular Orbital Theory,

$$Bondorder = \frac{(No.ofelectronsinbondingorbital) - (No.ofelectronsinanti - bondingorbital)}{2}$$

Bond Order for O_2 is 2
Bond Order for O_2^+ is 2.5
Bond Order for $O_2^{2-}$is 1
Bond Order for O_2^- is 1.5
Therefore, the increasing order will be $O_2^2 < O_2^- < O_2 < O_2^+$.

Q9. Out of sigma and pi bonds, which one is stronger bond and why?

Answer. A Sigma (σ) bond is stronger than a pi(π) bond. This is because the sigma(σ) bond is formed by head-on overlapping of orbitals and therefore, overlapping is large. On the other hand, the pi(π) bond is formed by the sidewise overlapping which is small.

Q10. State the factors affecting bond length?

Answer. The factors affecting bond length are as follows-

- Size of the atoms- The bond length increases with an increase in the size of the atoms.

- Multiplicity of bond- The bond length decreases with the multiplicity of the bond. For example- the bond length of t=carbon - carbon bonds are in order Alkynes (C ≡ C) < Alkenes (C = C) < Alkanes (C – C).
- TYpe of hybridization- As an s orbital is smaller in size, shorter is the hybrid orbital and hence shorter is the bond length.

Q11. Calculate the bond order of: N_2, O_2, O_2^+, and O_2^-.

Answer. According to Molecular Orbital Theory,

$$Bondorder = \frac{(No.ofelectronsinbondingorbital) - (No.ofelectronsinanti - bondingorbital)}{2}$$

In N_2, Bond order will be (10 – 4) / 2 = 3.
In O_2, Bond order will be (10 – 6) / 2 = 2
In O_2^+ Bond order will be (10 – 5) / 2 = 5/2 = 2.5
In O_2^- Bond order will be (10 – 7) / 2 = 3/2 = 1.5

Q12. Determine the bond order for hydrogen gas, H_2 and Cyanide.

Answer. The lewis structure of H_2 is-

There is only 1 pair of shared electrons and no lone pairs. This indicates that there is a single bond present. Therefore, the bond order of H_2 is 1.

The Lewis structure of cyanide CN^- is

There are three pairs of shared electrons. This indicates that there is a triple bond between the atoms. Therefore, the bond order of CN^- is 3.

Q13. Predict the dipole moment of:
(i) a molecule of the type AX_2 having a linear geometry.
(ii) a molecule of type AX_4 having tetrahedral geometry.
(iii) a molecule of the type AX_2 having angular geometry.
(iv) a molecule of the type AX_4 having square planar geometry.

Answer.
(i) The dipole moment will be zero in a molecule of the type AX_2 having a linear geometry.
(ii) The dipole moment will be zero in a molecule of type AX_4 having tetrahedral geometry.
(iii) There will be some appreciable dipole moment in a molecule of the type AX_2 having angular geometry.
(iv) The dipole moment will be zero in a molecule of the type AX_4 having square planar geometry.

Q14. Out of NH_3 and NF_3, which one has a higher dipole moment and why?

Answer. The dipole moment of ammonia (1.47D) is greater than that of NF_3 (0.24D). Both molecules have pyramidal molecular geometry. N atoms in each molecule have one lone pair. F has a higher electronegative potential than H, and the NF bond is more polar than the NH bond. As a result, NF_3 is expected to have a much higher dipole moment than NH_3. However, in the case of ammonia, the direction of the lone pair dipole moment and the bond pair dipole moment are the same, whereas, in the case of NF_3, they are opposite. Individual dipole moment vectors in ammonia molecules add whereas they cancel in NF_3.

Q15. CO_2 is non-polar while H_2O is polar. What conclusions can be drawn about their structures?

Answer. Co_2 is a linear molecule, therefore the resultant dipole moment of two C = O bonds gets cancelled, giving zero dipole moment. On the other hand, the water molecule is not linear, it has an angular shape and the bond moments of two O–H bonds give the resultant dipole moment.

Practise Questions on Bond Parameters

Q1. Which of the following molecules have a dipole moment?

a.) N_2
b.) CH_4
c.) BeF_2
d.) H_2O

Correct Answer– (d.) H_2O
In the molecules N_2, CH_4, and BeF_2 the net dipole moment is zero, as they cancel each other due to symmetry. The water molecule is V-shaped and thus, exhibits dipole moment.

Q2. What can be the covalent radius and Van der Waal's radius between chlorine molecules?

a.) 99 pm,198 pm
b.) 198 pm, 99 pm
c.) 198 pm, 198 pm
d.) 99 pm, 99 pm

Correct Answer– (a.) 99 pm,198 pm

Q3. Does Resonance stabilize the molecule?

Answer. Since the resonance hybrid contains less energy than other canonical structures, it stabilises the molecule. Resonance is made up of many structures that change frequently in molecules in order to keep the molecule stable.

Q4. Select the molecule or ion having larger property mentioned in each of the following pairs:
(i) NF_3, NH_3 : Dipole moment
(ii) NH_3, PH_3 :Bond angle
(iii) CO_2, BF_3 : Bond angle

Answer. (i) Larger Dipole moment– NH_3
(ii) Larger Bond angle– NH_3
(iii) Larger Bond angle– CO_2

Q5. Define Bond enthalpy and state the factors on which it depends?

Answer. Bond dissociation enthalpy may be defined as the amount of energy required to break one mole of bonds of a particular type between the atoms in the gaseous state.

The factors on which bond dissociation enthalpy depends are as follows-
(i) Size of the bonded atoms- The smaller the size of the bonded atoms, the stronger is the bond, and consequently larger is the value of bond dissociation enthalpy.
(ii) Bond length- Shorter the bond length, the larger is the value of bond enthalpy.