1. Choose the wrong statement according to the valence bond theory:

A. A σ-bond is stronger than a π-bond

B. p-orbitals always have only sideways overlapping

C. s-orbitals never form π-bonds

D. There can be only one sigma bond between two atoms

(a) σ bond is stronger than π bond, because overlapping of atomic orbitals can take place to a greater extent during the formation of sigma bond compared to the formation of a π bond.

(b) p-orbitals can form $s-p$, $p-p$ overlapping axially also. Such bonds are called σ bonds. π bond is formed by sideways overlapping of p - orbitals.

(c) Only p and d-orbitals can form π bonds. s - orbitals always form sigma bonds.

(d) When the orbitals of an atoms undergoes head on overlapping to form a σ bond, sharing of only two electrons are possible. For more electrons to be shared, lateral orbital overlapping takes place. So, there can be only one σ bond between two atoms.

2. Which of the following statements is not correct for sigma and pi bond formed between two carbon atoms?

A. Free rotation of atoms about a sigma bond is allowed but not in the case of pi - bond

B. Sigma bond determines the direction between carbon atoms but a pi bond has no primary effect in this regard

C. Sigma bond is stronger than a pi bond

D. Bond energies of sigma and pi bonds are of the order of 264 kJ/mol and 347 kJ/mol respectively

a) Sigma bonds are formed by the axial overlap of orbitals while pi bonds are formed by the sideways or lateral overlap of orbitals. Thus, free rotaion is allowed only for sigma bonds.

b) Sigma bond determines the direction between the carbon atoms beacuse, it is formed by the head on overlapping of the constituting atomic orbitals along the internuclear axis and pi bonds are only form by sideways overlapping of the orbitals.

c) The extent of overlapping is more in case of sigma bonds compared to pi bonds. Thus, a sigma bond is stronger than a pi bond.

d) This is not correct because sigma bonds will have a higher bond energy as sigma bonds are stronger than pi bonds.

3. Which of the following statements are correct for the formation of a stable bond according to the valence bond theory?

A. The electrons should have opposite spins

B. The two atoms should be close to each other

C. Higher overlapping of the electron clouds

D. All are correct

According to the valence bond theory, when two atoms approach each other with opposite electron spins, overlapping takes place between the electron clouds and a bond is formed to achieve greater stability.

4. The strength of sigma bonds formed by the overlapping of atomic orbitals is in the order:

A. $s-s<s-p<p-p$

B. $s-s<p-p<s-p$

C. $s-p<s-s<p-p$

D. $p-p<s-s<s-p$

We know, more is the extent of overlapping, stronger is the bond formed. The charge distribution in s - orbital is spherical thus it is non directional. On the other hand p - orbital has directional charge distribution. Thus, the sigma bond formed from overlapping of two p - orbitals will have greater overlapping compared to the bond formed by overlapping of s-p orbitals followed by the bond formed by the overlapping of s-s orbitals.
So, the strength of bond will also follow the same order and thus option (a) is correct.

5. Which of the following is not correct?

A. A sigma (σ) bond is weaker than a π bond

B. The extent of overlapping of orbitals in sigma bonds (σ) is more than that in pi (π) bonds

C. A double bond is stronger than a single bond

D. The bond dissociation energy of a sigma bond is more than that of a pi bond

As the extent of overlap of atomic orbitals forming the sigma bonds is more compared to the extent of overlapping of orbitals forming the pi bonds, a sigma bond is stronger than a pi bond.

A double bond contains a sigma bond and a pi bond whereas a single bond contains only a sigma bond. Thus, a double bond is stronger compared to a single bond.

Since sigma bonds are stronger compared to pi bonds, the bond dissociation energies of sigma bonds are also high.