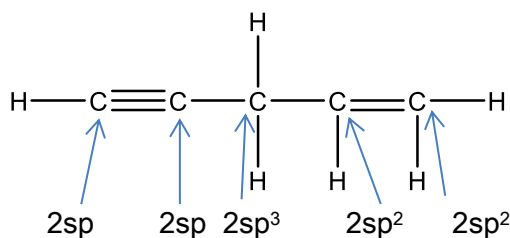




RAFFLES INSTITUTION
YEAR 5 H2 CHEMISTRY 2024
Tutorial 8: Chemical Bonding II

Suggested Answers

1.

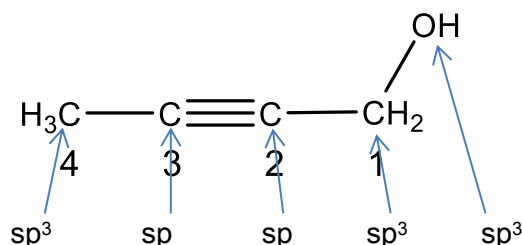


There is no $2sp - 2sp^2$ overlap since the sp and sp^2 C are not next to each other.

At the $C=C$ and $C\equiv C$ bonds, the π bonds are formed by the side-on overlap between the $2p$ orbitals of C. The $1s$ and $2sp$ overlap occur between the triple bonded C and the H atom which uses its $1s$ orbitals for σ bond with the $2sp$ hybrid orbital of C.

Answer: C

2.

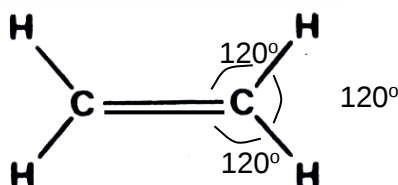


The terminal carbon atoms (1 and 4) are sp^3 and not sp^2 hybridised. Hence option C is **not** correct and so is the answer.

Answer: C

3.

(a)

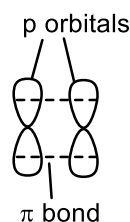
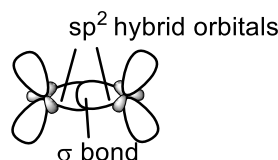


(b)

A σ -bond is formed when valence orbitals overlap **head-on** while a π -bond is formed when valence orbitals overlap **side-on**.

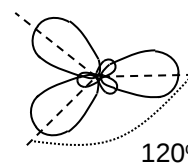
In ethene, the two carbon atoms form a σ -bond via the **head-on** overlapping of **two sp^2 hybrid orbitals** i.e.

In ethene, the two carbon atoms also form a π -bond via the **side-on** overlapping of the **two unhybridised p orbitals** i.e.



(c)

sp^2 hybridisation

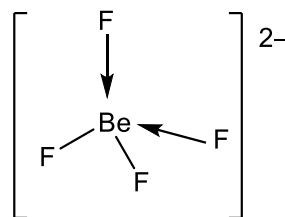


(d) 3 sp^2 orbitals (each with one small and one large lobe):

4. (a) BeF_2



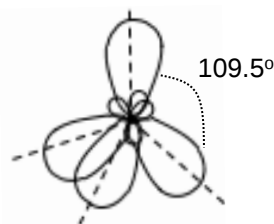
$[BeF_4]^{2-}$



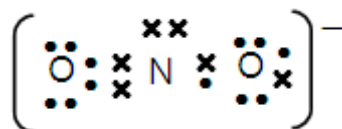
(b) sp hybridisation



sp^3 hybridisation



5. (a)



(b) Shape: Bent

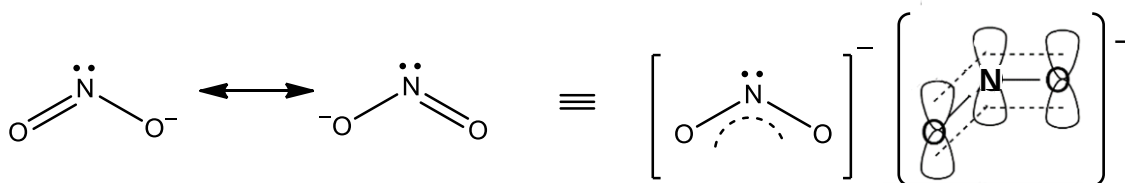
O-N-O Bond angle: 115° (Any answer between 109.5° and 120° is acceptable)

(c) sp^2 .

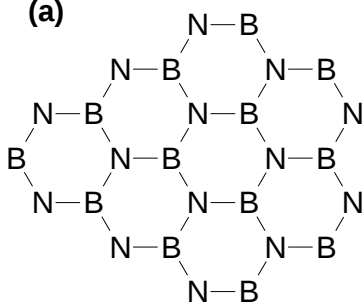
(d) The unhybridised p orbital of N and p orbitals of the O atoms are perpendicular to the plane of the ion (containing σ bonds).

These p orbitals **overlap side-on continuously**, so that the **π electrons are delocalised** over the N and O atoms.

Thus, NO_2^- exhibits resonance and the two N-O bonds are equivalent, with the same bond length.



6. (a)



Both B and N are sp^2 hybridised and each B and N atom has an unhybridised p orbital perpendicular to the plane of atoms. Each B atom forms 3 σ bonds with 3 N atoms and each N atom also forms 3 σ bonds with 3 B atoms. B is from Group 13 and its unhybridised p orbital is empty while N is from Group 15 and its unhybridised p orbital has 2 electrons. **The unhybridised p orbitals overlap side-on continuously with its neighbours resulting in the delocalisation of π electrons over the whole layer.**

- (b) It is expected that BN is an electrical conductor due to the delocalisation of π electrons from the continuous side-on overlap of p orbitals. However, since N is **more electronegative** than B, the π electrons tend to stay with N rather than delocalise throughout the π -electron cloud. Hence, BN is a poorer electrical conductor than graphite.