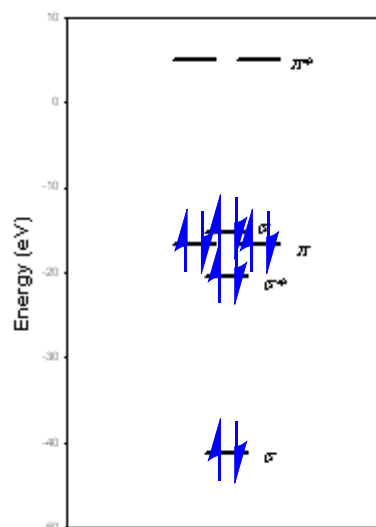


- Nitrogen gas constitutes about 78% of the Earth's atmosphere.

Complete the MO diagram for the valence electrons for the ground state electronic configuration of the nitrogen molecule by inserting the appropriate number of electrons into the appropriate orbitals.



Is N_2 paramagnetic or diamagnetic? Explain your answer.

The electrons in N_2 are all paired up – there are as many up as down-spin electrons so that there is no resultant spin. The molecule is diamagnetic.

The N_2^- anion can be generated as a transient species in an electrical discharge. What is the bond order of this molecular ion?

N_2^- has an additional electron in the π^* level. Overall there are 8 bonding electrons (a pair in each σ and two pairs in the π levels) and 3 antibonding electrons (a pair in σ^* and a single electron in π^*). Hence the bond order is:

$$\frac{1}{2} (8 - 3) = 5/2$$

- Why is the H_2 molecule lower in energy than two isolated H atoms?

The electrons are delocalised over two nuclei in H_2 , as opposed to being localised around one nucleus in the case of two isolated H atoms. This delocalisation results in an increase in their wavelength and hence a decrease in their momentum from the de Broglie relationship:

$$p = \frac{h}{\lambda}$$

The lower momentum is associated with a lower kinetic energy.

Marks

4

2