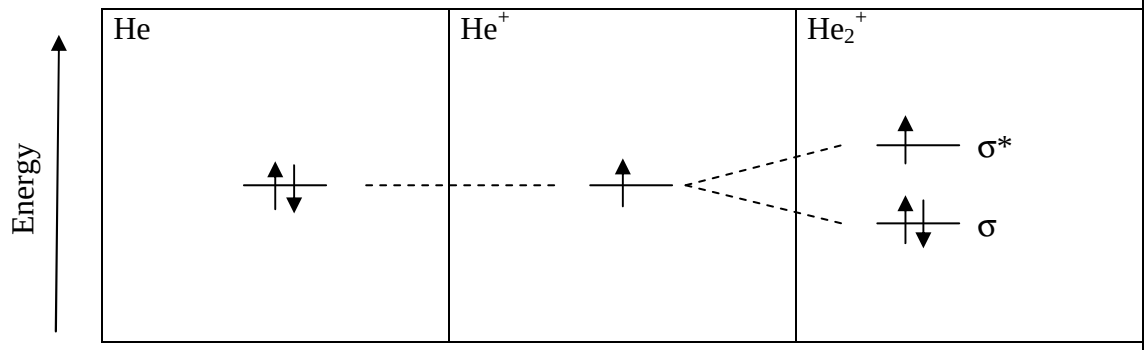
Marks 6

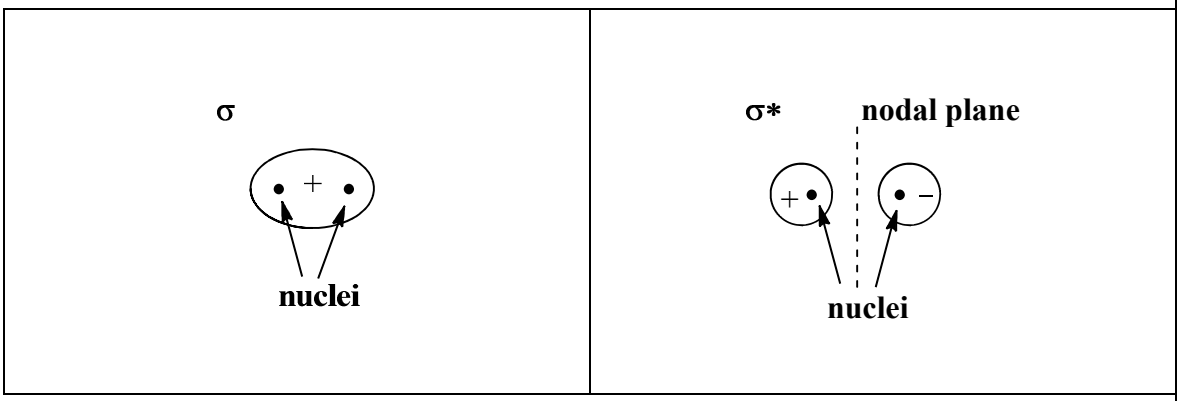
- In order to predict if it is possible to form the He_2^+ cation, complete the following steps.

  In the boxes below, draw an energy level diagram showing labelled electron orbitals and their occupancies for the two reacting species, He and He^+.

  In the other box below, draw an energy level diagram showing labelled electron orbitals and their occupancies in a postulated He_2^+ molecule. Use the same energy scale.



Draw the lobe representation of the two occupied molecular orbitals in this molecule. Show all nuclei and nodal surfaces.



What is the bond order of this molecular ion?

It has 2 bonding (σ) and 1 antibonding (σ*) electron. Hence:

bond order = ½ (number of bonding – number of antibonding electrons)
= ½ (2 – 1) = ½

Make a prediction about the stability of He_2^+ in comparison to the H_2 molecule.

H_2 has a bond order of 1 and He_2^+ has a bond order of ½ so the bond in H_2 is probably stronger.

As the nuclear charge in He is larger than H, the bonding orbital is more stable in He_2^+ than the bonding orbital in H_2 so the ½ bond in He_2^+ is likely to be more than half as strong as the single bond in H_2.