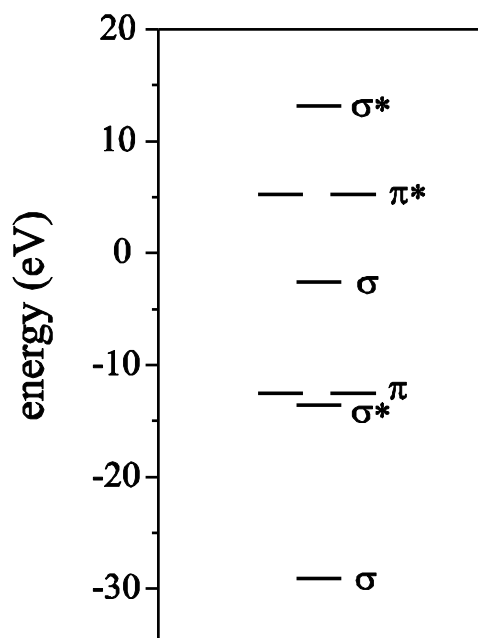


**Marks**  
**5**

- $C_2$  is a reaction intermediate observed in flames, comets, circumstellar shells and the interstellar medium. In 2011, a new state of  $C_2$  was observed with 4 parallel spins.

How many *valence* electrons are there in  $C_2$ ?

Complete the calculated MO diagram for the lowest energy state of  $C_2$  with 4 parallel spins by inserting the appropriate number of electrons into the appropriate orbitals.



What is the bond order of this state of  $C_2$ ?

Is this state paramagnetic? Give reasoning.

What is the bond order of the ground state of  $C_2$ ?

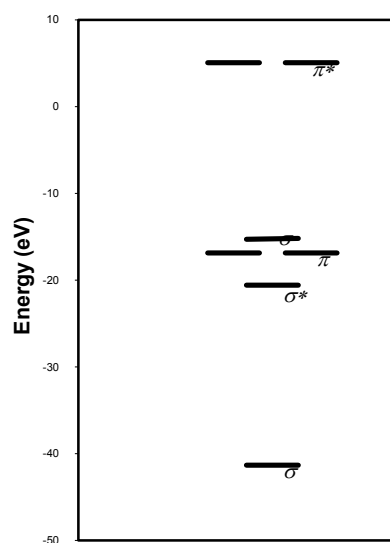
- Molecules with multiple resonance structures are said to be “resonance stabilised”. Briefly explain the origin of this extra stability in terms of electron waves and molecular orbitals.

**2**

**Marks****4**

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

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

**2**