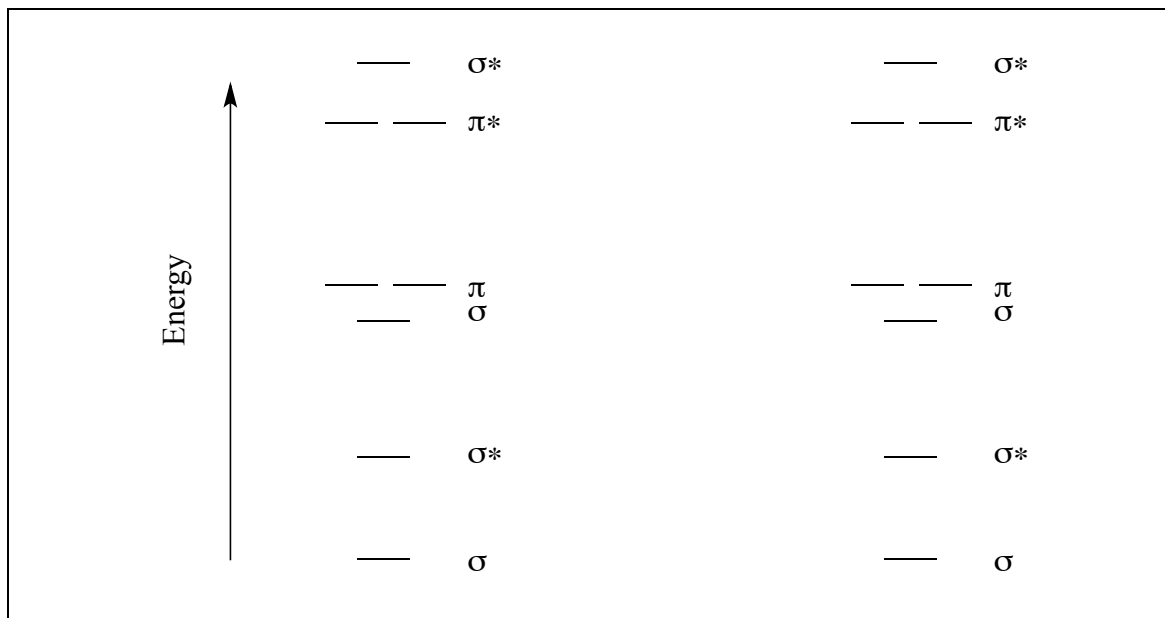


- Oxygen exists in the troposphere as a diatomic molecule.

**Marks**  
**8**

How many valence electrons in the O<sub>2</sub> molecule?

The molecular orbital energy levels for O<sub>2</sub> are shown below. On the left-hand diagram, fill in the **valence** electrons for oxygen, O<sub>2</sub>, in the ground state.



- (a) What is the bond order for O<sub>2</sub>?
- (b) Clearly label a bonding orbital and an anti-bonding orbital on the left-hand diagram.
- (c) Clearly label the HOMO of O<sub>2</sub> on the left-hand diagram.
- (d) On the right-hand diagram, indicate the lowest energy electronic configuration for O<sub>2</sub> which has no unpaired electrons.

The blue colour of liquid O<sub>2</sub> arises from an electronic transition whereby one 635 nm photon excites two molecules to the state indicated by the configuration in (d) *at the same time*. What wavelength photon would be emitted by one molecule returning from this state to the ground state?

Answer:

Suggest a heteronuclear diatomic species, isoelectronic with O<sub>2</sub>, that might be expected to have similar spectroscopic behaviour.