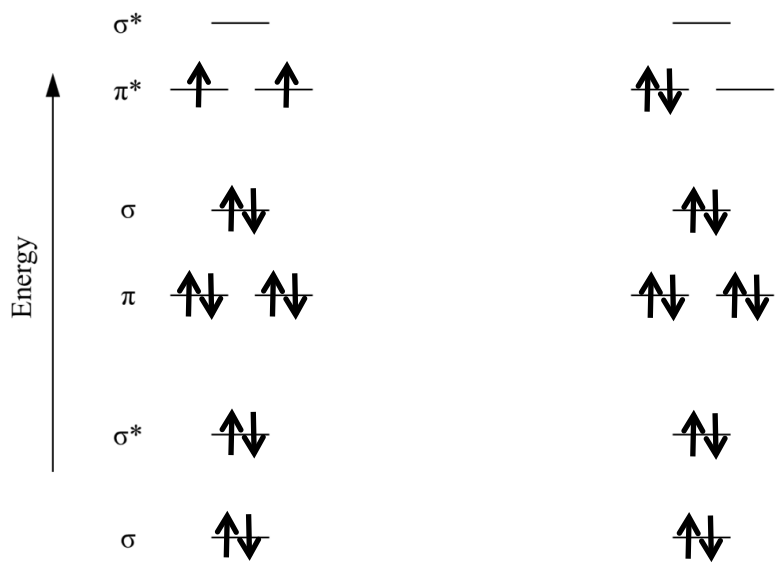
Marks 4

- Oxygen exists in the troposphere as a diatomic molecule.



(a) Using arrows to indicate relative electron spin, fill the left-most **valence** orbital energy diagram for O_2, obeying Hund's Rule.

(b) Indicate on the right-most **valence** orbital energy diagram the lowest energy electronic configuration for O_2 which has no unpaired electrons.

Suggest a heteronuclear diatomic species, isoelectronic with O_2, that might be expected to have similar spectroscopic behaviour.

NO^-, NF

The blue colour of liquid O_2 arises from an electronic transition whereby one 635 nm photon excites two molecules to the state indicated by the configuration in (b) *at the same time*. What wavelength photon would be emitted by one molecule returning from this state to the ground state?

635 nm excites two molecules. The energy emitted by one molecule will be half as much required to excite two molecules.

Energy, *E*, is inversely related to the wavelength, λ, through Plank's equation:

$$E = hc / \lambda.$$

Hence, if the energy is halved, the wavelength is *doubled*: 2 × 635 nm = 1270 nm.

Answer: **1270 nm**