1. Draw a molecular orbital diagram and determine the bond order expected for the molecule B₂. For full credit on MO diagrams,
   - label increasing energy with an arrow next to the diagram.
   - pay attention to whether the question asks for valence electrons or all electrons.
   - for any bonding orbital drawn, include the corresponding anti-bonding orbital, even if it is not filled with any electrons.
   - Label each atomic orbital (1s, 2s, 2pₓ, 2pᵧ, 2pₗ etc.) and each molecular orbital (σ2s, π2pₓ, π2pᵧ, etc.) that you draw.
   - Fill in the electrons for both the atomic and molecular orbitals.

2. (a) Write the valence electron configuration (from lowest to highest orbital energies) for the ion N⁻². Your answer should be in a form similar to (σ2s)², which is the valence configuration for Li₂.
   (b) What is the bond order of N⁻²?
   (c) Which has a longer bond, N⁻² or N²? Justify your answer using bond order.

3. (a) Draw a MO diagram for the valence electrons of BC. Label all atomic and molecular orbitals.
   (b) Write the molecular orbital configuration for the valence electrons in BC and in BC⁻¹.
   (c) Which of the molecular orbitals in BC do not have a planar node along the internuclear axis?
   (d) Which has the stronger B–C bond, BC or BC⁻¹? Justify your answer using bond order.

4. For each of the following molecules, (i) write the valence electron configuration (Your answer should be in a form similar to (σ2s)², which is the valence configuration for Li₂) and (ii) determine if the molecule is paramagnetic (has unpaired electrons) or diamagnetic (does not have unpaired electrons). If the species is paramagnetic, identify the number of unpaired electrons. (a) Cl⁺²; (b) O⁺²