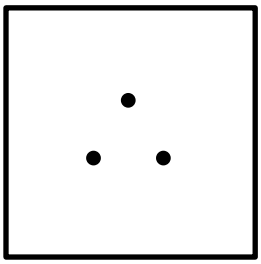
上海科技大学
ShanghaiTech University

General Chemistry I, Fall 2024
Problem Set 5

This set consists of 5 problems and the total points is 4.

6.72. (0.5 point) The stable molecular ion H_3^+ is triangular, with H–H distances of 0.87 Å. Draw the molecule shape based on the image below, the dots represent the nucleus (0.3 pt) and indicate the region of greatest electron density of the lowest energy MO (0.1 pt).



6.69. (0.6 point) By considering the stability of the formed species in relation to bonding and antibonding electrons, explain the following facts

(a) The ionization energy of molecular hydrogen (H_2) is *greater* than that of atomic hydrogen (H).

(b) The ionization energy of molecular oxygen (O_2) is *lower* than that of atomic oxygen (O)..

(c) What prediction would you make for the relative ionization energies of atomic and molecular fluorine (F and F_2)?

(0.8 pt) Use an energy-level correlation diagram to predict the valence electron configuration (and write it down), bond order, and likely existence of the Na_2^- ion, and likely activity of the Na_2^- ion (inert or highly reactive).

(1.5 pt) write down the valence electron configuration of the following species in such form: $(\sigma_{ns})^2(\sigma\star_{ns})^2\ (\sigma_{npz})^2$……, and calculate their bond order.

(a) S_2

(b) O_2^-

(c) CN^-

(0.6 pt) Draw an energy-level diagram showing promotion and hybridization to describe the bonding in CH_3^-. How does your diagram compare with that for methane? What is the molecular shape?