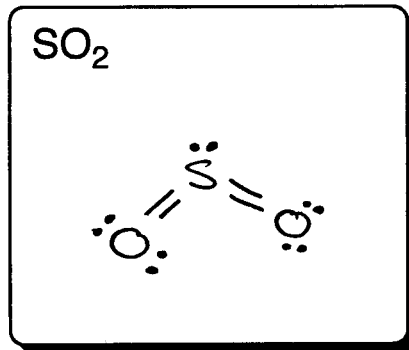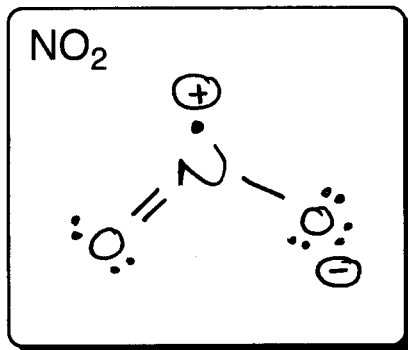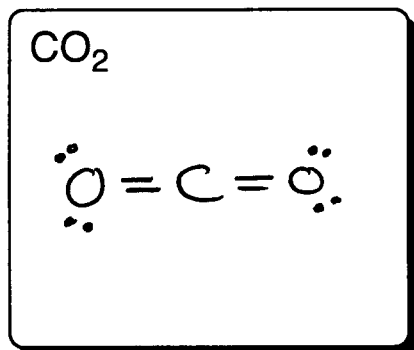1. (a) In the boxes below, draw the structural formulae for the dioxides of carbon, nitrogen, and sulfur; in each case, the atom connectivity is O—X—O. Include all necessary bonds, lone pairs of electrons (or single unshared electrons if appropriate), and non-zero formal charges. (4 pts each)

(b) Which of these molecules has an O—X—O bond angle of 180°? Briefly explain your answer. (2 pts)

CO_2 => central C atom has two atoms attached to it, and no lone pairs, hence is linear with an angle of 180°

(c) Which of these molecules has the smallest O—X—O bond angle? Briefly explain your answer. (8 pts)

SO_2 => both NO_2 and SO_2 are based on a trigonal planar geometry, but in NO_2 (134°) the single unshared electron on N requires less room than the lone pair on S in SO_2 (119°)

(d) One of these molecules is very reactive, and is observed to dimerize (two molecules join together) to form a new species with the formula X_2O_4. Which of the molecules above does this, what is the structural formula of the new species, and more importantly, why does this happen? (8 pts)

NO_2 => it is a radical, has an unshared electron on N, and the N atom does not have a full octet ($7e^-$)

By dimerizing, the octets can all be satisfied, hence:

N_2O_4