7.7: Suboxides of Carbon

Carbon suboxide

Carbon suboxide is the third oxide of carbon, C_3O_2. It is made from the dehydration of malonic acid, (7.7.1), with P_4O_{10} above 140 °C Like carbon dioxide, the C_3O_2 molecule is linear, with pπ-pπ bonding.

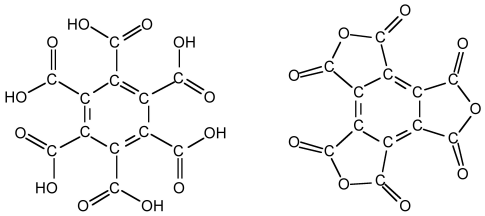
$$\mathrm{CH_2(CO_2H)_2 \rightarrow O{=}C{=}C{=}C{=}O + 2\ H_2O} \tag{7.7.1}$$

Gaseous carbon suboxide has an evil smell and while stable at –78 °C it polymerizes at 25 °C. Photolysis of C_3O_2 yields the unstable C_2O. As expected from its synthesis, carbon suboxide reacts slowly with water to form malonic acid, i.e., the reverse of (7.7.1); however, the reaction with stronger nuceophiles such as amines is rapid, (7.7.2).

$$\mathrm{C_3O_2 + 2\ HNR_2 \rightarrow R_2NC(O)CH_2C(O)NR_2} \tag{7.7.2}$$

Mellitic acid anhydride

The anhydride of mellitic acid (Figure 7.7.1a) may be considered as an oxide of carbon since its chemical formula contains only carbon and oxygen, i.e., $C_{12}O_9$ (Figure 7.7.1b).



(a) (b)

Figure 7.7.1: Structures of (a) mellitic acid and (b) its anhydride.