

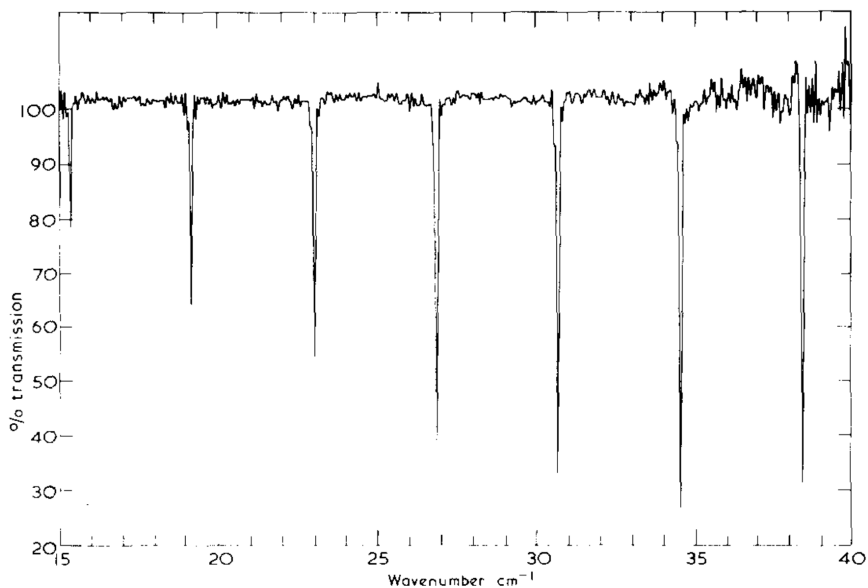
Chem 3322 homework #10, due April 19, 2024

**Problem 1**

A portion of the pure rotational spectrum of carbon monoxide was recorded on a far infrared spectrophotometer, as shown. The instrument cannot obtain data below  $15\text{ cm}^{-1}$ .

a) From the given spectrum, estimate the bond length of CO as accurately as you can (in other words, use all the data).

b) For the seven observed peaks, assign each of them to their corresponding carbon monoxide rotational transition in terms of the rotational quantum numbers by carefully analyzing the given data.



Transmission spectrum of carbon monoxide. Pressure 200 torr, path length 203 mm.

FIG. 1:

**Problem 2**

Do problem 5-13 from your textbook.

**Problem 3**

Do problem 5-22 from your textbook.

#### **Problem 4**

For HCl (isotopic information not known), you measure the following vibrational transitions:

$$n = 0 \rightarrow 1 \quad 2885.64 \text{ cm}^{-1}$$

$$n = 1 \rightarrow 2 \quad 2781.54 \text{ cm}^{-1}$$

$$n = 2 \rightarrow 3 \quad 2677.44 \text{ cm}^{-1}$$

$$n = 3 \rightarrow 4 \quad 2573.32 \text{ cm}^{-1}$$

What tells you that this molecule is not a harmonic oscillator?

Estimate its dissociation energy in kJ/mol.

#### **Problem 5**

From Figures 15.1 and 15.2 of the textbook, and the class discussion, explain the “mirror image” statement on page 595 of the textbook in your own words (and sketches). You are to provide as much detail as you can. The book’s description is terse – you need to provide more detail.