CHEM 260

Assignment 4

Due Monday 3rd February 2003

13. Which of the following functions are eigenfunctions of the operator d/dx? Give the eigenvalues where appropriate. (*k* is a constant.)

    kx^2 $\quad \sin kx \quad (\sin kx + \cos kx) \quad e^{kx} \quad e^{kx^2} \quad e^{-ikx}$

14. Suppose that the function e^{ax+bx^2} is an eigenfunction of the operator $\frac{d}{dx} + cx$, where *a*, *b* and *c* are constants. How are the constants related? What is the eigenvalue?

15. Explain briefly the meaning of each of the following terms. Use words, diagrams, mathematical equations as appropriate:

    (a) Degeneracy (b) Normalization (c) Expectation value

    (d) Boundary condition (e) Separation of variables.

16. Classify the following molecules as spherical top, symmetric top, asymmetric top, or linear: CO_2, SF_6, XeF_4, HCN, NH_3, PF_5, C_6H_6, CH_4, C_{60}, HCCH, H_2O, SF_4.

17. (a) Explain why the lines of the microwave spectrum of carbon monoxide are equally spaced.

    (b) The spacing between the lines for $^{12}C^{16}O$ is 115.3 GHz. Calculate the bond length. Predict the spacing for $^{13}C^{16}O$.

18. Given that the bond length of NO is 0.115 nm, calculate the frequency of the 7th line in the rotational spectrum. Give your answer in units of cm^{-1}.