1. Describe the techniques to decompose solid samples into aqueous solutions for analysis. (10%)

2. How to reduce the interference by coprecipitation during gravimetric analysis. (10%)

3. Describe and compare the atomizers used in atomic absorption spectrometry. (15%)

4. Calculate the hydroxide ion concentration in a 0.0100 M sodium hypochloride (NaOCl) solution. The acid dissociation constant for HOCl is 3.0×10^{-8}. (15%)

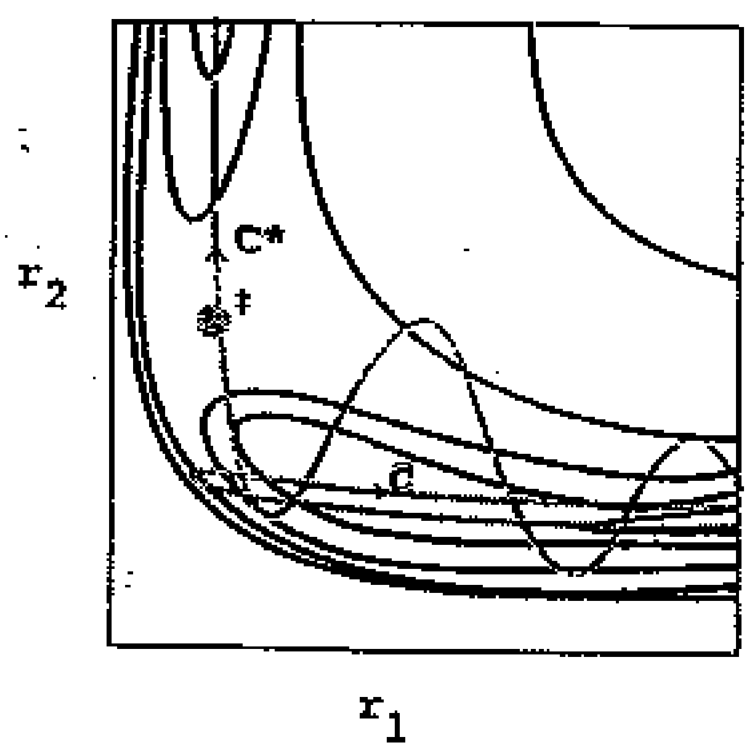
5. Plot the probability density function for orbitals 3*s* and 3*d* and explain the penetrating effect for these two orbitals. (6%)

6. Explain why molecules N_2 and O_2 are considered to be IR inactive? (3%)

7. Draw the vibrational motion for all the normal modes of carbon dioxide. Write down the symmetry for three vibrational normal modes for a water molecule. You need to define the axes and character table for C_{2v} group first. (8%)

8. One of the excited states of H_2 is $^1\Pi_u$ and can be considered to be formed from one H atom in its ground state and the other in an excited state. Give the electronic configuration of the molecules. (3%)

9. For the subject to dynamics of molecular reaction, a repulsive potential energy surface is shown below. The symbol ‡ denotes the position of the transition state. Two trajectories are plotted to be C and C*. Explain the behavior of these two trajectories shown in the following plot. Why do they behave differently? (5%)



10. Explain or derive equations to show that for ideal gases, $\Delta U=0$ and $\Delta H=0$ at constant T. (8%)

11. Show that the Joule-Thomson coefficient $\mu=(\partial T/\partial P)_H=0$ for ideal gases. (9%)

12. z is an exact state function of variable x and y, i.e., $z=f(x,y)$. Show that $(\partial x/\partial y)_z(\partial y/\partial z)_x(\partial z/\partial x)_y=-1$. (8%)