



1. Nickel has a face-centered cubic unit cell (4 atoms inside). The density of nickel is  $6.84 \text{ g/cm}^3$ . Calculate a value for the atomic radius of nickel. (Ni=58.69 g/mol)  
 .....(15%)

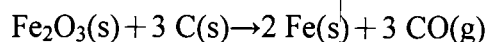
2. An excited hydrogen atom emits light with a frequency of  $1.141 \times 10^{14} \text{ Hz}$  to reach the energy level for which  $n=4$ . If you want to calculate what principal quantum level did the electron begin, please write down the calculating processes. (You should not show the final answer)

Hint:  $\Delta E = h\nu$

$$\Delta E = -2.178 \times 10^{-18} \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right) \dots\dots\dots(15\%)$$

3. For each of the following molecules, write the Lewis structure, predict the molecular structure (including bond angles), and give the expected hybrid orbitals on the central atoms. (a).  $\text{SF}_2$ ; (b).  $\text{S}_2\text{O}_3^{2-}$  .....(10%)

4. An iron ore sample contains  $\text{Fe}_2\text{O}_3$  plus other impurities. A 652-g sample of impure iron ore is heated with excess carbon, producing 343 g of pure iron by the following reaction:(Fe=55.85)



What is the mass percent of  $\text{Fe}_2\text{O}_3$  in the impure iron ore sample? Assume that  $\text{Fe}_2\text{O}_3$  is the only source of iron and that the reactions is 100% efficient.

.....(10%)



5. The logarithmic values of a pure substance's vapor pressure are inversely proportional to their corresponding temperatures. (a) List the equation that can describe this relationship. (b) Calculate the vapor pressure of water at 50°C if the vapor pressure of water at 25°C is 23.8 torr and the heat of vaporization of water at 25°C is 43.9 kJ/mol. .... (15%)  
 (where:  $e^{-1.37} = 0.254$ )
6. A certain first-order reaction has a half-life of 20.0 minutes. (a) Calculate the rate constant for this reaction. (b) How much time is required for this reaction to be 75% complete? (where:  $\ln(2)=0.693$ )..... (10%)
7. (a) Calculate the percent dissociation of acetic acid ( $K_a=1.8\times 10^{-5}$ ) in 1.00 M  $\text{HC}_2\text{H}_3\text{O}_2$  solutions. (b) Which solution has a higher value of percent dissociation, a 1.00 M or a 0.10 M  $\text{HC}_2\text{H}_3\text{O}_2$  solutions? ..... (15%)
8. Calculate the solubility of solid  $\text{CaF}_2$  ( $K_{sp} = 4.0 \times 10^{-11}$ ) in a 0.025 M NaF solution. .... (10%)