1. A car is advertised as having a gasoline mileage of 15 km/L. Convert this rating to miles per gallon of gasoline ? (1m = 1.094yd , 1760yd = 1miles, 1gallon = 4qt, 1.06qt = 1L) 　　　　　　(5%)

2. Give the (English and Chinese) names of the metals that correspond to the following symbols: Sn, Pt, Co, Ni, Mg, Ba, K, Na, H, O? 　　　　　(10%)

3. Briefly describe two methods one might use to find the molar mass of a newly synthesized gas for which a molecular formula was not known? 　　　(5%)

4. Given the following data :

   $H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(l)$, $\triangle H = -285.8$ kJ

   $N_2O_5(g) + H_2O(l) \rightarrow 2\ HNO_3(l)$, $\triangle H = -76.6$ kJ

   $1/2\ N_2(g) + 3/2\ O_2(g) + 1/2\ H_2(g) \rightarrow HNO_3(l)$, $\triangle H = -174.1$ kJ

   Calculate the $\triangle H$ for the reaction : $2\ N_2(g) + 5\ O_2(g) \rightarrow 2\ N_2O_5(g)$? 　　(10%)

5. (1) Explain why the first ionization energies tends to increase as one proceeds from left to right across a period in the chemical periodic table ?

   (2) Why is the first ionization energy of aluminum lower than that of magnesium ? 　　　　　　(10%)

6. Consider the following reaction : $H_2(g) + O_2(g) \rightarrow H_2O_2(g)$, $\triangle H = -153$ kJ

   Given that the H_2 bond energy is 432 kJ/mol, the O_2 bond energy is 495 kJ/mol, and the OH bond energy is 467 kJ/mol, estimate the bond energy for the O—O (oxygen-oxygen) single bond ? 　　　　　　(5%)

7. Which one of the following groups is predicted by the molecular orbital model to be the most stable diatomic species? (a) H_2^+, H_2, H_2^-, H_2^{2-} ; (b) He_2^{2+}, He_2^+, He_2 (5%)

8. Calcium has a cubic closest packed structure as a solid. Assuming that calcium has an atomic radius of 197 pm, calculate the density of solid calcium. (Ca = 40.08 g/mol) 　　　　　　(10%)

9. In lab you need to prepare at least 100 ml of each of the following solutions. Explain how you would proceed using the given information. 　　　(10%)

   (a) 2.0 m KCl in water(density of water=1.00 g/cm^3 ;K=39.1g/mol, Cl=35.45g/mol)

   (b) 25% NaOH by mass in CH_3OH(density of CH_3OH=0.79 g/cm^3;Na=23g/mol)

10. A first order reaction A → P (rate = $-dC_A/dt = kC_A$) is 38.5% complete in 480 s. (seconds) (a) Calculate the rate constant k =?

    (b) What is the value of the half-life $t_{1/2}$ =? 　　　　　(10%)

11. At 2200°C, K_p = 0.050 for the reaction : $N_2(g) + O_2(g) \rightarrow 2NO(g)$ 　　(10%)

    What is the partial pressure of NO in equilibrium with N_2 and O_2 that were placed in a constant volume flask at initial pressures of 0.80 atm and 0.20 atm, respectively?

12. Calculate the pH values of the following solutions :

    (a) 0.10 M HNO_3(aq)? ; (b) 1.0×10^{-10} M HCl(aq)? ; (c) 0.010 M H_2SO_4(aq)? (For H_2SO_4 : $K_{a1} = \infty$,$K_{a2} = 1.2 \times 10^{-2}$) 　　　　　(10%)