國立中央大學 114 學年度碩士班考試入學試題

系所： 大氣科學學系大氣物理 碩士班 不分組(一般生)
大氣科學學系大氣物理 碩士班 不分組(在職生)

科目： 普通化學

＊本科考試禁用計算器

問答題與計算題　計算題應詳列計算過程

1. Describe the following laws: (20 points, 4 points each)
   (A) Raoults's Law
   (B) Boyle's Law
   (C) Avogadro's Law
   (D) Henry's Law
   (E) The First Law of Thermodynamics

2. Explain the following terms: (20 points, 4 points each)
   (A) Activation Energy
   (B) Mass Number
   (C) Buffer Solution
   (D) Covalent Bond
   (E) Catalyst

3. Considering a rain droplet suspends in the air and in equilibrium with the atmospheric CO_2. Giving the following conditions, what are the concentrations of H_2CO_3 and HCO_3^- in the rain droplet? No need to consider other chemical reactions. (10 points)
   pH of the rain droplet = 6.0
   $P_{CO2} = 0.00042$ atm
   $CO_{2(g)} + H_2O \leftrightarrow H_2CO_3$ $\quad K_H = 3.4\times10^{-2}$ M atm^{-1}
   $H_2CO_3 \leftrightarrow HCO_3^- + H^+$ $\quad K_{a1} = 4.5\times10^{-7}$ M

4. Considering this chemical reaction: $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + H_2O + O_2$
   (10 points, 5 points each)
   (A) Please balance the above chemical equation.
   (B) How many moles of O_2 will be formed by the complete reaction of 3 moles of CO_2 with H_2O?

5. Balance the following chemical equation: (10 points)
   $Fe^{2+}_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + H^+_{(aq)} \rightarrow Fe^{3+}_{(aq)} + Cr^{3+}_{(aq)} + H_2O_{(l)}$

6. Calculate the pOH and the pH of a solution in which 20.0 mL of 0.100 M HCl is added to 25.0 mL of 0.200 M NaOH. (10 points)

7. The rate of decay of chemical A involved in a second order reaction is given by $\mathbf{-d[A]/dt = k\times[A]^2}$, where k is a constant. Derive an expression for the half-life of A in terms of k and the concentration of A at time t = 0 (A_0)? (10 points)

8. Concentrations of CO were 200 ppb, 5.0×10^{12} molecules cm^{-3}, and 168 μg m^{-3} in Taipei, Taoyuan and Taichung, respectively. Assuming temperature was 25°C and pressure was 1 atm at the three cities, which city had the highest CO concentration? MW of CO is 28 g/mole and the universal gas constant is 0.082 L atm K^{-1} mole^{-1}. (10 points)