國立中央大學113學年度碩士班考試入學試題

所別： 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，無計算過程者不予計分

1. Explain the following terms: (20 points, 4 points each)
   (A) Isotope
   (B) Isomer
   (C) Activation Energy
   (D) Atomic Number
   (E) Chemical Equilibrium

2. Describe the following gas laws: (8 points, 4 points each)
   (A) Boyle's Law
   (B) Charles's Law

3. List the types of chemical bond and tell the difference. Also give some examples for each type of chemical bond. (12 points)

4. Please balance the following chemical equations: (10 points, 5 points each)
   (A) $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + H_2O + O_2$
   (B) $Cl^-_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + H^+_{(aq)} \rightarrow Cl_{2(g)} + Cr^{3+}_{(aq)} + H_2O_{(l)}$

5. What volume of a 0.25 M NaOH solution is needed to neutralize 80.0 mL of a 0.50 M HCl solution? (10 points)

6. Total Hg concentration in a rain water sample is 30 $ng \cdot L^{-1}$. MW of Hg is 200 $g \cdot mol^{-1}$ and density of rain water is 1 $g \cdot mL^{-1}$. (10 points, 5 points each)
   (A) This is equivalent to how many ppb?
   (B) How many nM?

7. CO_2 concentration in the air is 420 ppm. Please convert the CO_2 concentration to molecules$\cdot cm^{-3}$ (that is, number density) if the pressure is 1 atm and temperature is 20 °C. The universal gas constant (R) is 0.082 $L \cdot atm \cdot mol^{-1} \cdot K^{-1}$。(10 points)

8. Given the following balanced chemical equation $A \leftrightarrow B+C$ and equilibrium constant $K = 2 \times 10^{-5}$ M at 30°C. What is the concentration of C at equilibrium at 30°C if [A] = 5 M, [B] = [C] = 0 M in the beginning of the reaction? (10 points)

9. The rate of decay of a chemical involved in a reaction that is first order in one reactant A is given by $\mathbf{-d[A]/dt = kx[A]}$, 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)