普 通 化 學

一. 選擇題 (單選; 每題 3 分, 答錯倒扣 0.5 分, 30 %):

1. You dissolve a 1.28 g sample of NaCl in a total volume of 125 mL solution, You lab partner has 1.50 M aqueous NaCl and wants to make a solution with the same concentration and volume as yours. How much of solution does your lab partner need to use? (NaCl: 58.8 g/mol)
   (A). 1.83 mL, (B).14.6 mL, (C). 107 mL, (D). 125 mL, (e). none of these.

2. A 250.0 L cylinder contains 65.0 % $He_{(g)}$ and 35.0 % $Kr_{(g)}$ by volume at 25 °C and 1.35 atm total pressure. What is the partial pressure of He in this container?
   (A). 0.473 atm, (B). 0.675 atm, (C). 0.878 atm, (D). 1.32 atm, (E). 1.35 atm.

3. A system at a state of chemical equilibrium is:
   (A). microscopically dynamic and macroscopically static; (B). microscopically dynamic and macroscopically dynamic (C). microscopically static and macroscopically static (d). microscopically static and macroscopically dynamic (E). none of these.

4. $Mn^{2+} + C_2O_4^{2-} \rightleftharpoons MnC_2O_4$ $\quad K_1 = 7.9 \times 10^3$;
   $[Mn(C_2O_4)_2]^{2-} \rightleftharpoons MnC_2O_4 + C_2O_4^{2-}$ $\quad K_2 = 1.26 \times 10^{-2}$
   What is the equilibrium constant for the following formation?
   $Mn^{2+} + 2C_2O_4^{2-} \rightleftharpoons [Mn(C_2O_4)_2]^{2-}$
   (A). 1.0, (B). 3.7×10^2, (C). 2.1×10^{-1}, (D). 6.3×10^5, (E). none of these.

5. The Cl-Kr-Cl bond angle in $KrCl_4$ is close to
   (A). 90°, (B). 109°, (C). 120°, (D). 150°, (D). 180°

6. Which of the following is paramagnetic?
   (A). O_2^-, (B). O_2^+, (C). O_2, (D). N_2, (E). At least two of the above are paramagnetic.

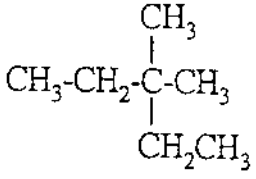
7. The rate constant k is dependent on: I. the concentration of the reactants, II. The nature of the reactants, III. the temperature, IV. the order of the reaction.
   (A). none of these, (B). one of these, (C). two of these, (D). three of these, (E). all of these.

(背面仍有題目,請繼續作答)

8. Identify the major attraction force in HI molecules.
(A). London dispersion, (B). Dipole-dipole, (C). Hydrogen bonding, (D). Ionic.

9. A crystal of NaCl is: (A). soft, low melting, a good electrical conductor. (B). hard, high melting, a good electrical conductor, (C). soft, low melting, a poor electrical conductor, (D). hard, high melting, a poor electrical conductor. (E). soft, high melting, a poor electrical conductor.

10. Name of the compound:
(A). n-heptane, (B). 2-methyl-2-ethylbutane,
(C). 3,3-dimethylpentane, (D). 2,2-diethylpropane

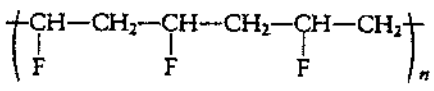


二. 問答題與計算題:

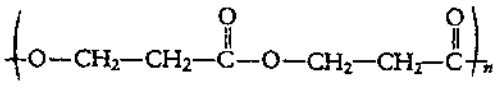
1. (1). Write down the ideal gas law and van der Waals gas equation.
(2). What are the assumptions for the ideal gas?
(3). What condition does the real gas approach to the ideal gas? (9 %)

2. What monomer (s) must be used to produce the following polymers? (8 %)

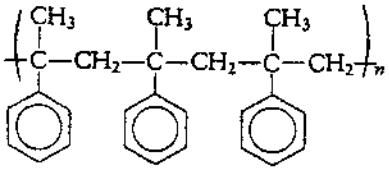
(a).



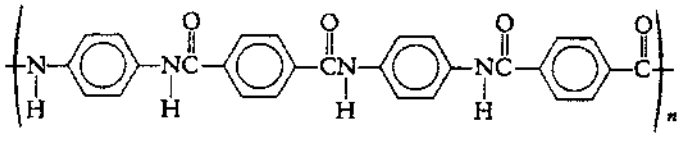
(b).



(c).



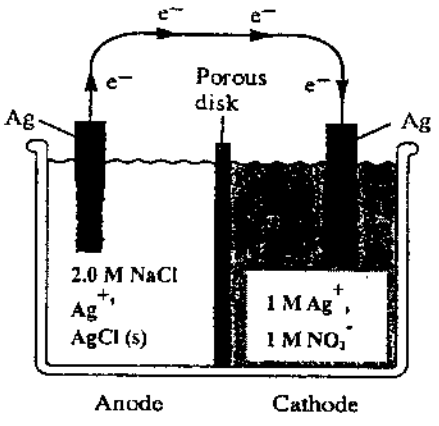
(d).



3. Consider the reaction: $2\,SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)}$
carried out at 25 °C and 1 atm. Calculate ΔH^0, ΔS^0, ΔG^0, and K using the following data. (10 %)

Substance	ΔH_f° (kJ/mol)	S° (J K^{-1} mol^{-1})
$SO_2(g)$	−297	248
$SO_3(g)$	−396	257
$O_2(g)$	0	205

4. A silver concentration cell shown in the figure on the right side is set up at 25 °C with 1.0 M $AgNO_3$ in the right compartment and 2.0 M NaCl along with exceed AgCl in the left compartment. The measured cell potential is 0.58 V. Calculate the $[Ag^+]$ = ? and K_{sp} value for AgCl at 25 °C. ($Ag^+ + e^- \rightarrow Ag$, ε^0 = 0.80 V) (8 %)



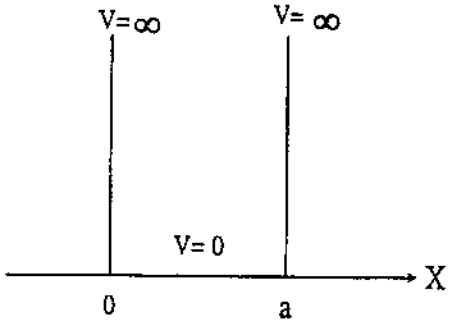
5. Which is more likely to be paramagnetic, $Fe(CN)_6^{4-}$ or $Fe(H_2O)_6^{2+}$? Explain. (8 %)

6. A rock containing ^{238}U and ^{206}Pb was examined to determine its approximate age. Analysis showed the ratio of $^{206}Pb/^{238}U$ to be 0.115. Assume that no ^{206}Pb was originally present and that all ^{206}Pb formed from ^{238}U remained in the rock. Calculate the age of the rock. ($t_{1/2}$ of ^{238}U is 4.5×10^9 yr.) (9 %)

7. One can use the simply 1-dimensional box model to consider the electronic and optical behaviors of the nanomaterials. Please derive the energy (E) of an electron in a 1-dimensional box (left figure) as

$$\mathbf{E = n^2 \mathit{h}^2 / 8 \mathit{m} a^2},$$

by using Schrödinger equation. (n = 1, 2, 3.....; *h*: Planck's constant, m: mass of an electron, **a**: the length of the 1-dimensional box). (10 %)



8. To determine the molar mass of a certain protein, 1.00×10^{-3} g of the protein was dissolved in enough water to make 1.00 mL solution. The osmotic pressure of this solution was found to be 1.12 torr at 25 °C. Calculate the molar mass of the protein. (1 atm = 760 torr) (8 %)