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$log2=0.30$ $log3=0.48$ $ln2=0.7$ $ln3=1.1$ $ln5=1.61$ $R=8.3\ J\cdot K^{-1}\cdot mol^{-1}$

(1) $[P_{obs}+a(\frac{n}{V})^2][V-b]=nRT$ (van der Waals equation) (6%)
(a) Explain the meaning of the first term, $[P_{obs}+a(\frac{n}{V})^2]$.
(b) Why is the "a" for NH_3 (4.2 atm·L^2/mol) larger than N_2 (1.4 atm·L^2/mol)?

(2) (a) Propose a method to prepare an acid-base buffer soluteon. (6%)
(b) A weak acid solution, HA, is titrated with 30.0 mL of 0.1 M NaOH to reach the end point. Then, 10.0 mL of 0.1 M HCl is added and the pH of the solution is measured to be 5.0. Calculate the pK_a of the HA.

(3) For the process $B_2O_{(s)} \rightarrow B_2O_{(l)}$, (6%)
$\Delta H^o=4000\ J\cdot mol^{-1}$, $\Delta S_{univ}= -1.0\ J\cdot K^{-1}\cdot mol^{-1}$.
Calculate ΔS^o and ΔG^o at 27 °C.

(4) For $N_2+3H_2 \rightarrow 2NH_3$ (27 °C), (5%)
assuming that $\Delta G= -21.9\ kJ\cdot mol^{-1}$ at $[H_2]=[N_2]=1.0$ atm and $[NH_3]=10$ atm, calculate the ln K (K: equilibrium constant).

(5) (a) A concentration cell contains a copper electrode and aqueous copper nitrate in both compartments, with $[Cu^{2+}]=0.1$ M and $[Cu^{2+}]=1.0$ M respectively. Calculate the cell-potential (25 °C). (6%)
(b) Write down the electron configuration for Cu and Cu^{2+}.

(6) $Cu^{2+}+2e^- \rightarrow Cu$ $\varepsilon^o=0.34$ V, $Fe^{3+}+e^- \rightarrow Fe^{2+}$ $\varepsilon^o=0.77$ V. For the galvanic cell at 25 °C,
(a) calculate the cell potential at $[Fe^{3+}]=[Fe^{2+}]=[Cu^{2+}]=0.1$ M
(b) calculate the cell potential at equilibrium of the reaction. (6%)

(7) The wave function for the particle in an one-dimensional box is $\psi(x)=\sqrt{\frac{2}{L}}sin(\frac{n\pi}{L}x)$.
Indicate the positions that the particle is most probably found at n=3. (5%)

(8) The electron energy for a hydrogen-like atom (or ion) is $E= -2.178\times10^{-18}\ (Z^2/n^2)$ J.
(a) What is the energy of the 3p orbital of Li^{2+}? (6%)
(b) Describe the state of the electron at $n=\infty$, i.e. at E=0.

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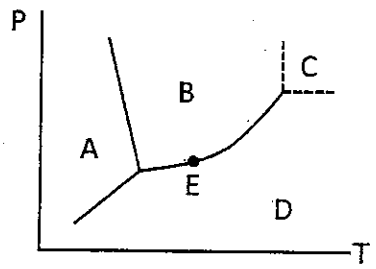
(9) (a) Draw the Lewis structures for N_2F_4 and N_2F_2. (6%)
(b) Which one has a shorter N-N bond (Give your reason)?
(c) What are the hybridization orbitals used for the N atoms in N_2F_4 and N_2F_2.

(10) For a H_2 molecule (H_A-H_B), write down the antibonding molecular orbital using a linear combination of atomic orbitals ($1S_{HA}$, $1S_{HB}$) and draw the shape of the orbital. (4%)

(11) $M_{(s)} \rightarrow M_{(g)}$　150 kcal·mol^{-1}　　$M_{(g)} \rightarrow M_{(g)}^{+} + e^{-}$　550 kcal·mol^{-1}. (5%)
$X_{2(g)} \rightarrow 2X_{(g)}$　400 kcal·mol^{-1}　　$X_{(g)} + e^{-} \rightarrow X^{-}_{(g)}$　-250 kcal·mol^{-1}.
$MX_{(s)} \rightarrow M_{(s)} + \frac{1}{2}X_{2(g)}$　700 kcal·mol^{-1}.
Calculate the lattice energy of $MX_{(s)}$.

(12) Write down the order (from large to small) for the ionization energies of C, N, O and your reasons. (6%)

(13) aA→Products (initial concentration $[A]_0$=0.1 M, second order in A, half-life=20 min). How much time is required for this reaction to be 75% complete? (5%)

(14) 

(H_2O phase diagram) (6%)

(a) What is the phase in region A?
(b) Explain the states of C and E.
(c) Give a reason that the melting point of H_2O drops as the pressure is increased.

(15)(a) Draw the body-centered cubic unit cell for lithium. (6%)
(b) How many atoms are there in the unit cell?
(c) Calculate the percentage of the space that is actually occupied by the lithium atoms.

國立成功大學 104 學年度轉學生招生考試試題

系所組別：化學系學士班

考試科目：普通化學

考試日期：0712，節次：3

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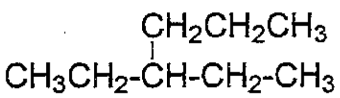
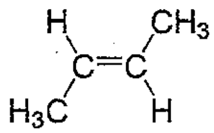
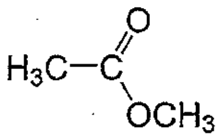
(16) (a) Hg in a glass tube has a convex meniscus. Why? (9%)

(b) Why glycerol has an unusually high viscosity?

(c) Diamond is hard, while graphite is soft. Why?

(17) Write the English names for the following compounds. (7%)

(a) 
(b) 
(c) 

Draw the structures for the following compounds.

(d) ethanal (e) 2-aminopropane

(f) Draw the two monomers of 6,6-nylon, -(NH-$(CH_2)_6$-NH-C(O)-$(CH_2)_4$-C(O)$)_n$-.