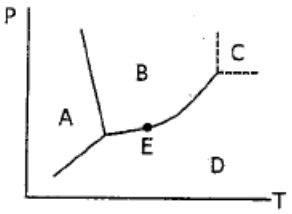
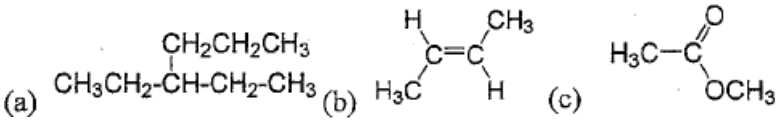
(1)	$[P_{obs}+a\left(\frac{n}{v}\right)^2][V-b]=nRT$ (van der Waals equation) (a)Explain the meaning of the first term, $[P_{obs}+a\left(\frac{n}{v}\right)^2]$. (6%) (b)Why is the "a" for NH_3 (4.2 atm · L^2/mol) larger than N_2 (1.4 atm · L^2/mol)?
(2)	(a) Propose a method to prepare an acid-base buffer 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%) ΔH^o=4000 J · mol^{-1}, $\Delta S_{univ}=-1.0$ J · $K^{-1}\cdot mol^{-1}$ Calculate ΔS^o and ΔG^o at 27 ℃.
(4)	For $N_2+3H_2\rightarrow 2NH_3$(27 ℃), (5%) assuming that $\Delta G=-21.9$ K$J^{-1}\cdot mol^{-1}$ 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℃). (6%) (b) Write down the electron configuration foe Cu and Cu^{2+}
(6)	$Cu2++2e^-\rightarrow Cu$ ε^0=0.34 V, $Fe^{3+}+e^-\rightarrow Fe^{2+}$ ε^0=0. 77 V. For the galvanic cell at 25°C, (a) calculate the cell potential at $[Fe^{3+}]=[Fe^{2+}]=[Cu^{2+}]$ =O.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 $\Psi(x)=\sqrt{\frac{2}{L}}\sin(\frac{n\pi}{L}\cdot x)$. 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 $E=-2.718\times10^{-18}(Z^2/n^2)J$. (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 $E=0$.
(9)	(a) Draw the Lewis structure 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 orbital 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 (1SHA, 1SHB) 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}. $MX_{(s)}\rightarrow M_{(s)}+\frac{1}{2}X_{2(g)}$ 700kcal · Mol^{-1}.

	Calculate the lattice energy of $MX_{(s)}$.
(12)	Write down the order (from large to small) foe the ionization energies of C,N,O and your reason. (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.
(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%)  Draw the structure for the following compounds. (d)ethanol (e)2-aminopropane. (f)Draw the two monomers of 6,6-nylon,-(NH-$(CH_2)_6$-NH-C(O)-$(CH_2)_4$-C(O))$_n$-.

$\log_2 = 0.30 \;\; \log_3 = 0.48 \;\; \ln 2 = 0.7 \;\; \ln 3 = 1.1 \;\; \ln 5 = 1.61$

$R = 8.3\ \mathrm{J \cdot K^{-1} \cdot mol^{-1}}$