

國立中央大學九十一年度碩士班研究生入學試題卷

所別： 化學學系 不分組 科目： 綜合化學 共 2 頁 第 1 頁

1. Mercury vapor is dangerous because it can be ingested into the lungs. We wish to estimate the vapor pressure of mercury at two different temperatures from the data in the table.

Substance	ΔH_f° , kJ/mol	ΔG_f° , kJ/mol	S° , J/K.mol
Hg(l)	0	0	76.02
Hg(g)	61.317	31.85	174.85

Estimate the temperature at which K_p for the process $\text{Hg}(l) \rightarrow \text{Hg}(g)$ is equal to (a) 1.00 bar and (b) (1/760) bar. (given $\ln(1/760) = -6.633$) (12%)

2. Nitrogen oxides, NO_x (a mixture of NO and NO_2 collectively designated as NO_x), play an essential role in the production of pollutants found in photochemical smog. The NO_x in the atmosphere is slowly broken down to N_2 and O_2 in a first-order reaction. The average half-life of NO_x in the smoke-stack emissions in a large city during daylight is 3.9 hours. How many hours of daylight must be elapsed to decrease 1.50 mg of NO_x to 0.30 mg? (given $\ln 5 = 1.609$) (6%)

3. Describe the structures of SiO_2 and CO_2 . Explain why SiO_2 has a very high melting point, whereas CO_2 is a gas. (12%)

4. Write down the repeated units of the following polymers:

(a) Teflon

(b) Polystyrene

(c) Polyvinyl alcohol

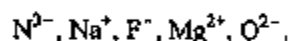
(d) Polyethene oxide

(e) The condensation polymer obtained by combining $\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{H}$ (succinic acid) and $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$ (1,2-ethylenediamine) (20%)

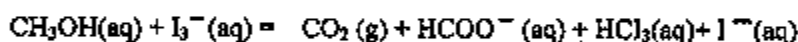
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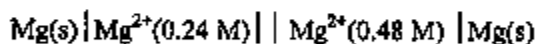
5. Explain why diamond is an insulator, while the other allotropic form of carbon, graphite, is a conductor. (2 pts)
6. List the following ions in order of increasing ionic radius: (2 pts)



7. (a) Draw Lewis structures, and determine (b) the molecular shape, (c) formal charge of the center atoms and (d) polarity of ClF_3 and N_3^- . (8 pts)
8. Balance the following equation. (6 pts)



9. (a) Calculate the *emf* of the following concentration cell, $E^\circ = -2.37 \text{ V}$.



- (b) What is the equilibrium concentration of Mg^{2+} ? (10 pts) ($\log 2 = 0.3$)
10. (a) Which of the following salts are acidic in water? (12 pts)
- $$\text{Fe}(\text{NO}_3)_3, \text{NH}_4\text{Cl}, \text{KI}, \text{CH}_3\text{COONa}, \text{NaBr}$$
- (b) Explain the $\text{Al}(\text{OH})_3$ is amphoteric.
- (c) Compare the relative strength of the following acids. $\text{HClO}_3, \text{HBrO}_3, \text{HIO}_3$
11. (a) The pH of blood plasma is 7.40. Assuming the principal buffer system is $\text{HCO}_3^-/\text{H}_2\text{CO}_3$, calculate the ratio $[\text{HCO}_3^-]/[\text{H}_2\text{CO}_3]$. K_{a1} and K_{a2} are 4.2×10^{-7} , 4.8×10^{-11} , respectively.
- (b) Is this buffer more effective against an added acid or an added base? Explain. (10 pts)

