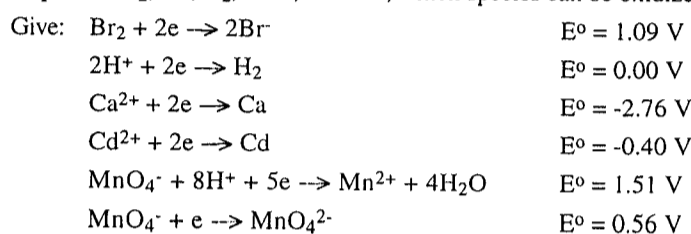


1. Answer the following terms or questions. (60%)

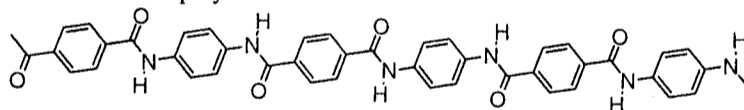
- (1) Give an element for a member of the alkali earth metal family whose +2 ion contains 18 electrons.
- (2) Arrange the ions ${}_{8}\text{O}^{2-}$, ${}_{9}\text{F}^{-}$, and ${}_{11}\text{Na}^{+}$ in order of decreasing size.
- (3) Arrange the compounds $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$, $\text{C}_6\text{H}_5\text{NH}_2$, and $\text{CH}_3\text{CH}_2\text{CONH}_2$ in order of decreasing basicity.
- (4) Arrange the elements Si, Ge, and Pb in order of decreasing metallic character.
- (5) Arrange the compounds SiH_4 , SiCl_4 , Si_2Cl_6 in order of decreasing boiling point.
- (6) Draw a Lewis structure of SO_2 .
- (7) Predict the shape (or geometry) of ion ICl_4^{-} .
- (8) Explain in terms of their electronic configurations why Fe^{2+} is more easily oxidized to Fe^{3+} than Mn^{2+} to Mn^{3+} .
- (9) Draw the d-orbital electronic configuration for the octahedral complex ions of high spin ${}_{26}\text{Fe}^{2+}$.
- (10) Oxalic acid is often used to remove rust stain (Fe_2O_3). Write a chemical equation for it.
- (11) Write a chemical equation for the halogenation of benzene.
- (12) For the species Br_2 , H^+ , H_2 , Ca^{2+} , and Cd , which species can be oxidized by MnO_4^{-} in acid?



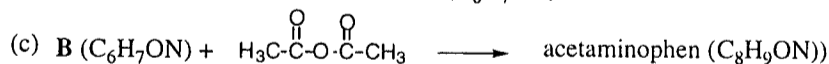
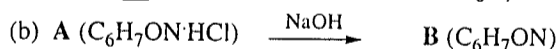
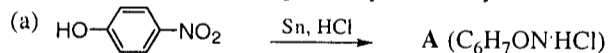
- (13) Which of the following results in buffered solution
 - (a) Mixed 0.1 M HCl 75 mL and 0.1 M NH_4Cl 100 mL
 - (b) Mixed 0.1 M NaOH 75 mL and 0.1 M NH_4Cl 50 mL
 - (c) Mixed 0.1 M NaOH 75 mL and 0.1 M NH_4Cl 100 mL
- (14) Glycine ($\text{NH}_2\text{CH}_2\text{CO}_2\text{H}$) has $K_a = 4.3 \times 10^{-3}$ for carboxylic acid group; $K_b = 6.0 \times 10^{-3}$ for the amine group. Draw a structure that exists predominantly in a solution with $\text{pH} = 13$.
- (15) Uranium-235 undergo a decay series in which the following particles are produced in succession: α β α β α α α β α β . What is the atomic number and mass number of the final product of the decay of ${}_{92}\text{U}^{235}$?
- (16) Is ethylene glycol, $\text{HOCH}_2\text{CH}_2\text{OH}$ more soluble in water or in benzene?

(17) Give a reaction mechanism for the reaction: $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{CH}_3\text{CH}_2\text{OH}$

(18) What is the monomers for the polymer:



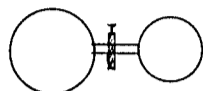
(19) The aspirin substitute, acetaminophen, is produced by the following three steps:



What is the structure of A and acetaminophene?

(背面仍有題目,請繼續作答)

2. (a) Helium is mixed with oxygen gas for deep sea diver. Calculate the percent by volume of oxygen gas in the mixture if the diver has to submerge to a depth where the total pressure is 4.0 atm. The partial pressure of oxygen is maintained at 0.2 atm. (5%)
- (b) At 25°C, nitric oxide (NO) reacts with oxygen to form nitrogen dioxide when the valve is opened. The reaction quickly goes to completion. Determine what gases remain at the end and calculate their partial pressure.



4.00 L, 2.00 L,
0.500 atm 1.00 atm

(5%)

3. (a) One molecule of hemoglobin contains 0.33% iron by mass. Each hemoglobin molecule contains four ions of iron. Calculate the molecular mass for hemoglobin. (atomic mass Fe = 56, Ni = 58) (5%)
- (b) Impure nickel can be purified by first forming the complex $\text{Ni}(\text{CO})_4$ by direct reacting Ni with gaseous CO. If 2.95 g pure Ni produce 6.80 g of $\text{Ni}(\text{CO})_4$, what is the percentage yield of the complex? (5%)
4. (a) A sample of gaseous PCl_5 was introduced into an evacuated flask so that the pressure of pure PCl_5 would be 0.50 atm at 523°C. However, PCl_5 decomposes to gaseous PCl_3 and Cl_2 , and the actual pressure in the flask was found to be 0.84 atm at equilibrium. Calculate K_p for the reaction:



- (b) What mole of AgBr can dissolve in 1.00 L of 0.500 M $\text{Na}_2\text{S}_2\text{O}_3$. Assume K_{sp} of AgBr is 5×10^{-13} and the formation constant for $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$ is 3×10^{13} . (5%)

5. (a) The combustion of methanol: $2\text{CH}_3\text{OH}(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$, calculate the ΔG° for this reaction. (5%)

	ΔH° (kJ/mol)	S° (J/mol K)	ΔG° (kJ/mol)
$\text{CH}_3\text{OH}(\text{g})$	-201	240	-163
$\text{O}_2(\text{g})$	0	205	0
$\text{CO}_2(\text{g})$	-394	214	-394
$\text{H}_2\text{O}(\text{g})$	-242	189	-229

- (b) Butadiene (C_4H_6) reacts to form its dimer (C_8H_{12}) according to the equation:



The following data were collected for this reaction at a given temperature. Determine the reaction order.

Time, (sec)	$[\text{C}_4\text{H}_6]$, (M)
0	0.01000
1000	0.00625
1800	0.00476
2800	0.00370
3600	0.00313

(5%)