

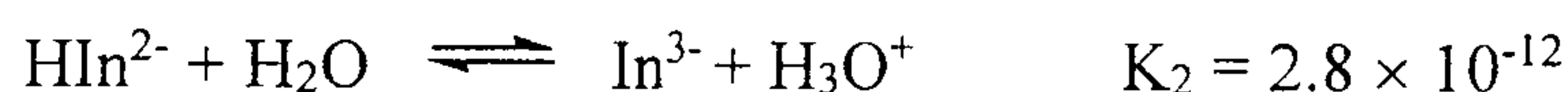
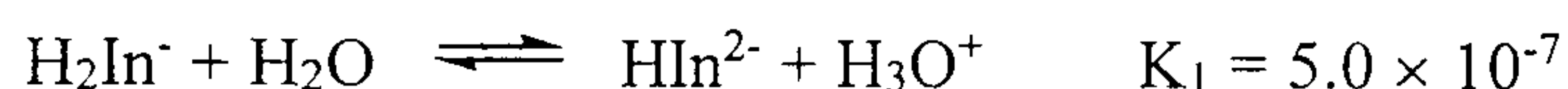
國立清華大學 105 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(環境與分子科學組)

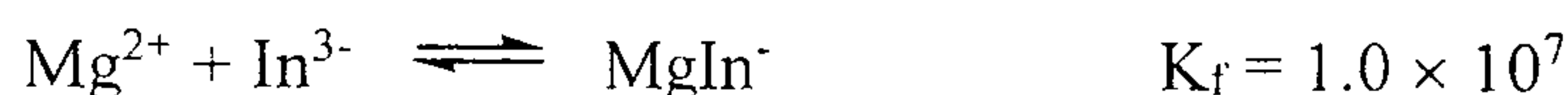
考試科目 (代碼)：分析化學(2201)

共 3 頁，第 1 頁 *請在【答案卷】作答

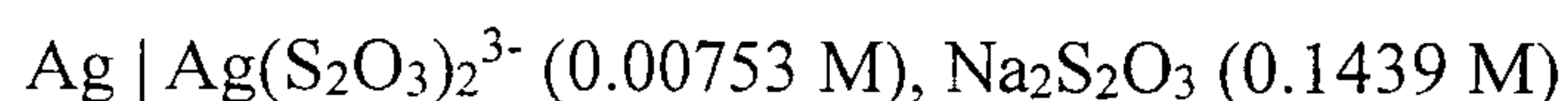
1. (15%) (a) What are the structural characteristics of a chelating agent?
(b) Why are multidentate ligands preferable to unidentate ligands for complexometric titration?
(c) Determine the transition ranges for Eriochrome Black T in titrations of Mg^{2+} at pH 10.0, given that the acid dissociation constant for the indicator is:



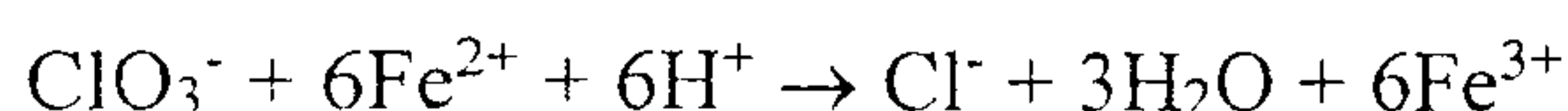
The formation constant for MgIn^- is:



2. (5%) Indicate whether the following half-cells would act as an anode or a cathode when coupled with a standard hydrogen electrode in a galvanic cell. Calculate the cell potential.



3. (10%) (a) Describe the source of pH-dependence in a glass membrane electrode. (b) List several sources of uncertainty in pH measurements with a glass/calomel electrode system.
4. (10%) The KClO_3 in a 0.1342-g sample of an explosive was determined by reaction with 50.0 mL of 0.09601 M Fe^{2+} :



When the reaction was complete, the excess Fe^{2+} was back-titrated with 12.99 mL of 0.08362 M Ce^{4+} . Calculate the percentage of KClO_3 in the sample.

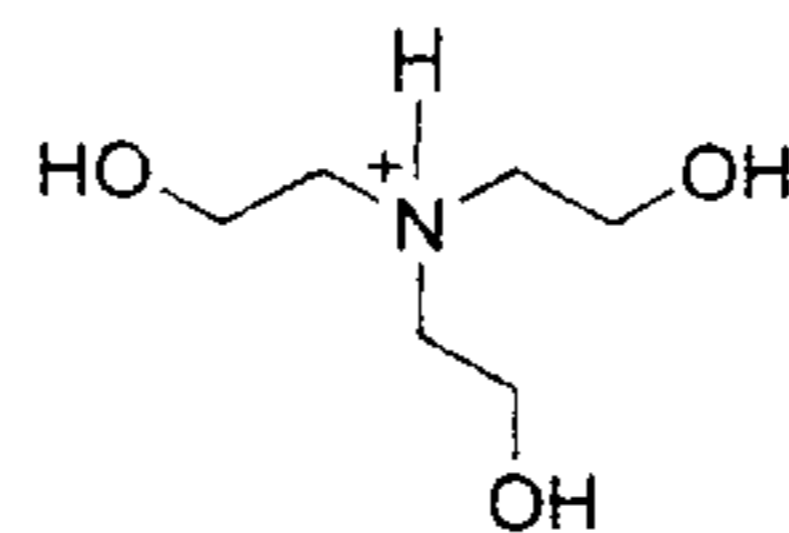
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5. (10%) The structure of triethanolamine in its fully protonated form is:



Its pK_a is 7.8. You have available at your lab bench 0.1 M solutions of HCl, NaOH, and the uncharged (free base) form of triethanolamine, as well as ample distilled water. Describe the preparation of a 1 L solution of 0.05 M triethanolamine buffer, pH 7.6.

6. (10%) (a) Describe the fundamental difference between ion-exchange and size-exclusion chromatography. (b) For a normal-phase separation, predict the order of elution of:
- n*-hexane, *n*-hexanol, benzene.
 - Ethyl acetate, diethyl ether, nitrobutane.
7. (4%) A 2.5-mL aliquot of a solution that contains 3.8 ppm iron (III) is treated with an appropriate excess of KSCN and diluted to 50.0 mL. What is the absorbance of the resulting solution at 580 nm in a 2.5-cm cell? (The complex $\text{Fe}(\text{SCN})^{2+}$ has a molar absorptivity of $7.0 \times 10^3 \text{ L}\cdot\text{cm}^{-1}\cdot\text{mol}^{-1}$) (Fe = 56 amu)
8. (10%) Why are stripping methods more sensitive than other voltammetric procedures? What are the advantages of performing voltammetry with ultramicroelectrodes?
9. (10%) In flame AA with a hydrogen/oxygen flame, the absorbance for iron decreased in the presence of large concentrations of sulfate ion.
- Suggest an explanation for this observation.
 - Suggest three possible methods of overcoming the potential interference of sulfate in a quantitative determination of iron.

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10. (6%)

Types of Transition	Absorption Spectroscopic Technique
Nuclear	Mossbauer spectroscopy
Inner electron	(a)
Bonding electron	(b)
Rotation/Vibration	(c)
Rotation	Microwave

11. (10%) Base on the data shown in following Table, (a) describe the difference between (i) FSOT column, (ii) WCOT column, and (c) SCOT column. (b) Explain the reason why FSOT column can provide better separation efficiency.

Table 1. Properties and Characteristics of Typical Gas-Chromatographic Columns.

	Type of Column			
	FSOT*	WCOT ⁺	SCOT [#]	Packed
Length, m	10-100	10-100	10-100	1-6
Inside diameter, mm	0.1-0.3	0.25-0.75	0.5	2-4
Efficiency, plates/m	2000-4000	1000-4000	600-1200	500-1000
Sample size, ng	10-75	10-1000	10-1000	10-10 ⁶
Relative pressure	Low	Low	Low	High
Relative speed	Fast	Fast	Fast	Slow
Chemical inertness	Best	—————→		Poorest
Flexible	Yes	No	No	No

*Fused silica open tubular column.

⁺Wall coated open tubular column.

[#]Support coated open tubular column (also called porous layer open tubular, or PLOT)