

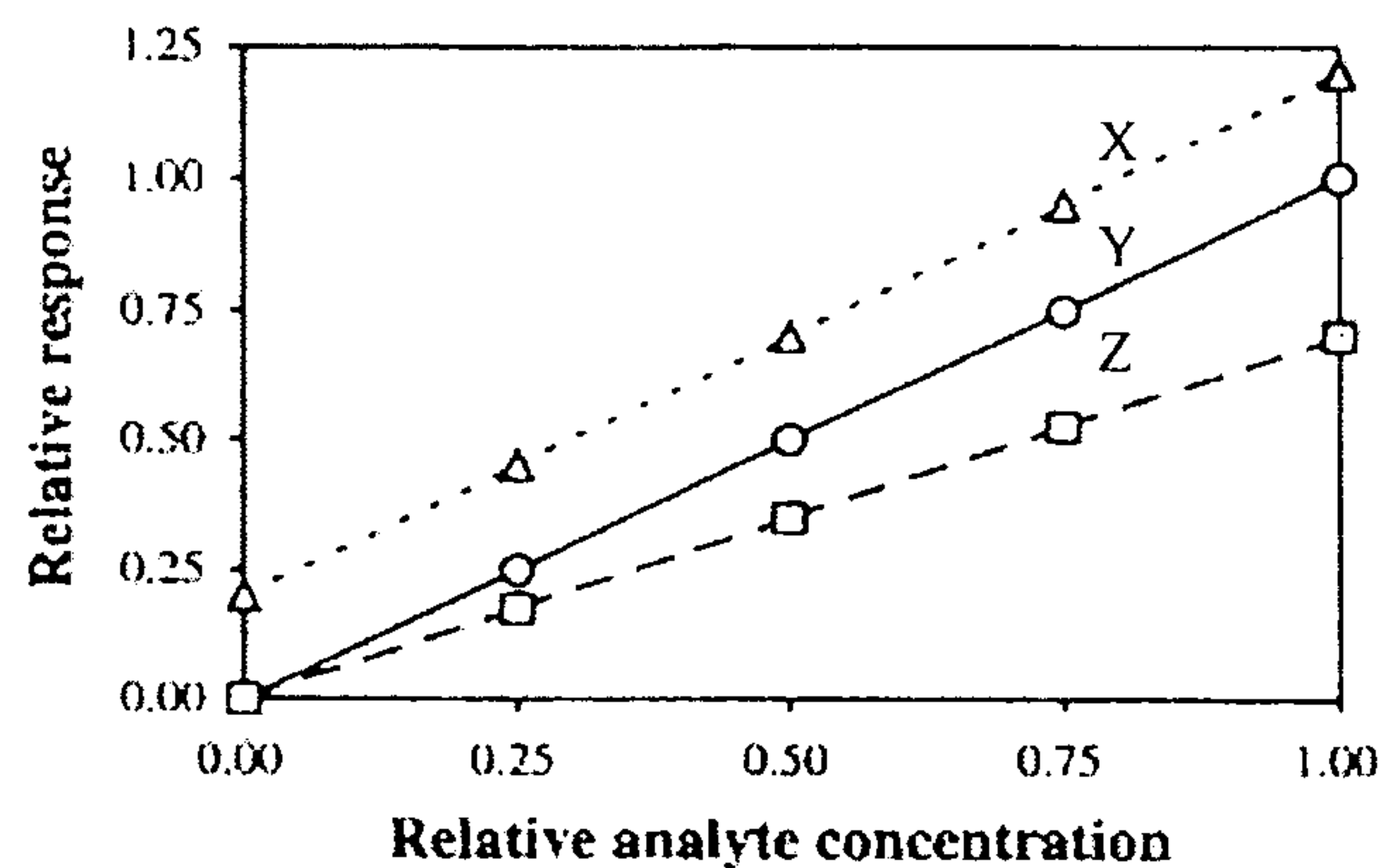
國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(化學組)

考試科目 (代碼)：分析化學(2301)

共 6 頁，第 1 頁 *請在【答案卷】作答

1. (5%) Most analytical methods are not absolute and require that results be compared with results on standard materials of accurately known composition. Basically, both the accuracy and precision of instrument measurements is dependent, in part, upon the calibration technique used. Additionally, the analysis of real samples is complicated by the presence of the sample matrix. However, those standards used to calibrate instruments and procedures are free from matrix interference effects in the analytical sample.
- (1) Please illustrate the effects of multiplicative and additive interferences on the obtained analytical signals.
 - (2) Based on following Figure, please indicate which curve is obtained (a) in the absence of any interference, (b) in the presence of additive interference, and (c) in the presence of multiplicative interference.



2. (5%) (1) The MDL protects against incorrectly reporting the presence of an analyte species at low concentrations in cases when noise and actual analyte signal may be indistinguishable. Based on the definition of U.S. Environmental Protection Agency (USEPA), please define the MDL.
- (2) Is the following true or false? -- The MDL concentration does not imply accuracy or precision of the quantitative measurement.
 - (3) In the absence of a definitive answer, most of us have settled for reporting results below a detection limit cL in one of the following possible ways. (a) Not detected, (b) Less than cL, (c) A value of zero, (d) The result found, with a statement of its uncertainty

國立清華大學 104 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(化學組)

考試科目 (代碼)：分析化學(2301)

共 6 頁，第 2 頁 *請在【答案卷】作答

3. (10%) Two different analytical methods were used to determine residual chlorine in sewage effluents. Both methods were used on the same samples, but each sample came from various locations, with differing amounts of contact time with the effluent. The concentration of Cl in mg/L was determined by the two methods, and the following results were obtained:

Sample	Method A	Method B
1	0.39	0.36
2	0.84	1.35
3	1.76	2.56
4	3.35	3.92
5	4.69	5.35
6	7.70	8.33
7	10.52	10.70
8	10.92	10.91

- (a) What type of t test should be used to compare the two methods, and why?
- (b) Do the two methods give different results? State and test the appropriate hypotheses.
- (c) Does the conclusion depend on whether the 90%, 95%, or 99% confidence levels are used?

TABLE 7-3

Values of t for Various Levels of Probability

Degrees of Freedom	80%	90%	95%	99%	99.9%
1	3.08	6.31	12.7	63.7	637
2	1.89	2.92	4.30	9.92	31.6
3	1.64	2.35	3.18	5.84	12.9
4	1.53	2.13	2.78	4.60	8.61
5	1.48	2.02	2.57	4.03	6.87
6	1.44	1.94	2.45	3.71	5.96
7	1.42	1.90	2.36	3.50	5.41
8	1.40	1.86	2.31	3.36	5.04
9	1.38	1.83	2.26	3.25	4.78
10	1.37	1.81	2.23	3.17	4.59
15	1.34	1.75	2.13	2.95	4.07
20	1.32	1.73	2.09	2.84	3.85
40	1.30	1.68	2.02	2.70	3.55
60	1.30	1.67	2.00	2.62	3.46
∞	1.28	1.64	1.96	2.58	3.29

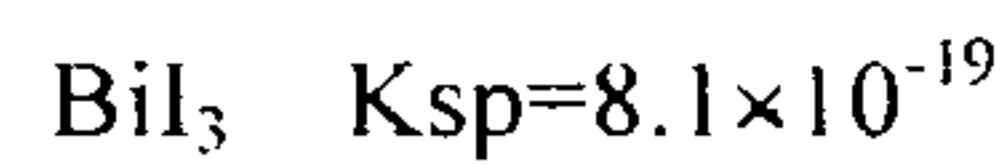
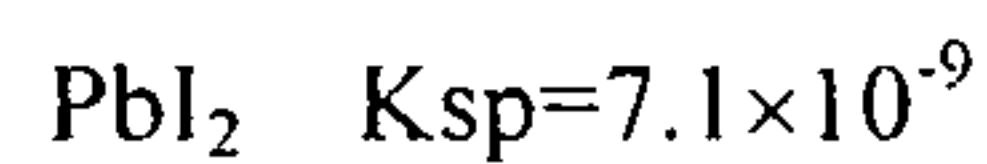
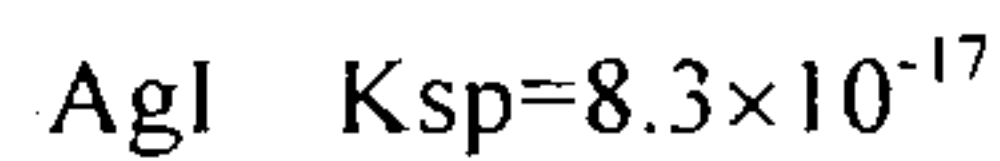
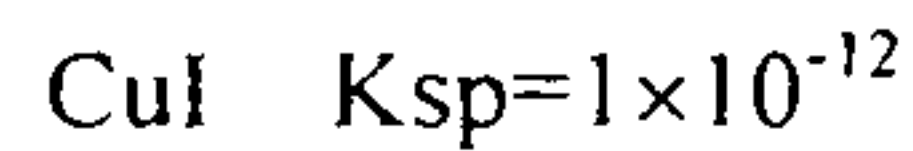
國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(化學組)

考試科目 (代碼)：分析化學(2301)

共 6 頁，第 3 頁 *請在【答案卷】作答

4. (10%) The solubility-product for a series of iodides are



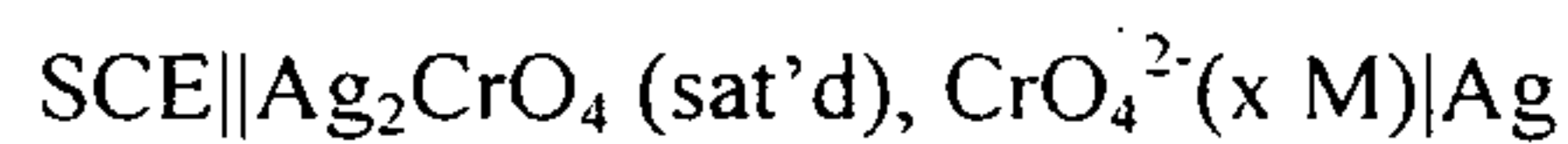
List these four compounds in order of decreasing molar solubility in

- (1) water
- (2) 0.10 M NaI
- (3) a 0.010 M solution of the solute cation.

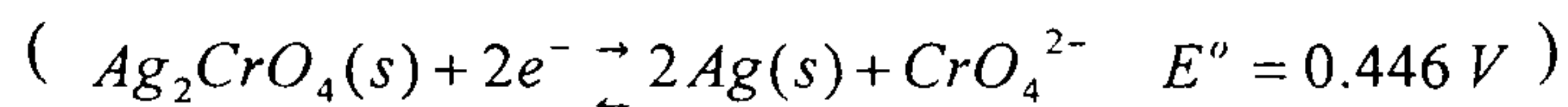
5. (10%) (1) Please define buffer capacity and indicate which buffer shown below has greater buffer capacity. (a) a mixture containing 0.100 mol of NH_3 and 0.200 mol of NH_4Cl , (b) a mixture containing 0.0500 mol of NH_3 and 0.100 mol of NH_4Cl .

(2) What volume of 0.200 M HCl must be added to 250.0 mL of 0.300 M sodium mandelate to produce a buffer solution with a pH of 3.37? (K_a of mandelate = 4.0×10^{-4})

6. (10%) The cell



is used for the determination of pCrO_4 . Calculate pCrO_4 when the cell potential is 0.336 V.



7. (5%) Mass spectrometry is an extremely versatile detection system for GC. Interfacing an HPLC system to a mass spectrometer is a much more difficult task, however. Describe the major reasons why it is more difficult to combine HPLC with mass spectrometry than it is to combine GC with mass spectrometry.

國立清華大學 104 學年度碩士班考試入學試題

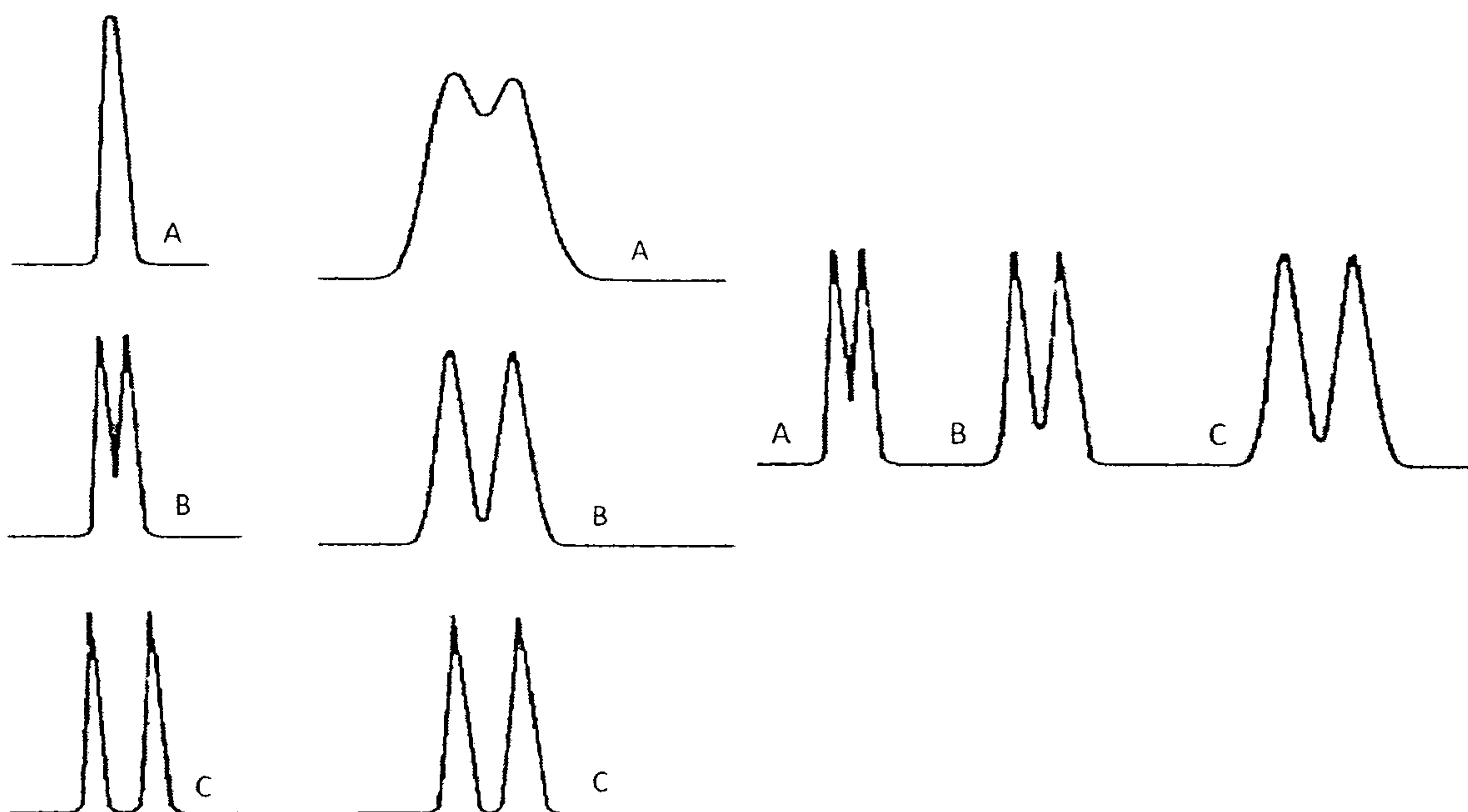
系所班組別：生醫工程與環境科學系 乙組(化學組)

考試科目 (代碼)：分析化學(2301)

共 6 頁，第 4 頁 *請在【答案卷】作答

8. (10%) Following figures show the separation efficiencies obtained under different conditions. Please indicate and state the reason resulting in the order in which the following parameters would lead to.

(a) Selectivity factor (2) Plate number (3) K : difference in partition coefficients of two analytes



9. (10%) A 0.6004-g sample of Ni/Cu condenser tubing was dissolved in acid and diluted to 100.0 mL in a volumetric flask. Titration of both cations in a 25.00-mL aliquot of this solution required 45.81 mL of 0.05285 M EDTA. Mercaptoacetic acid and NH_3 were then introduced; production of the Cu complex with the former resulted in the release of an equivalent amount of EDTA which required a 22.85-mL titration with 0.07238 M Mg^{2+} . Calculate the percent Cu and Ni in the alloy.

(Atomic weight of Ni and Cu are 58.963 and 63.546 g/mole, respectively.)

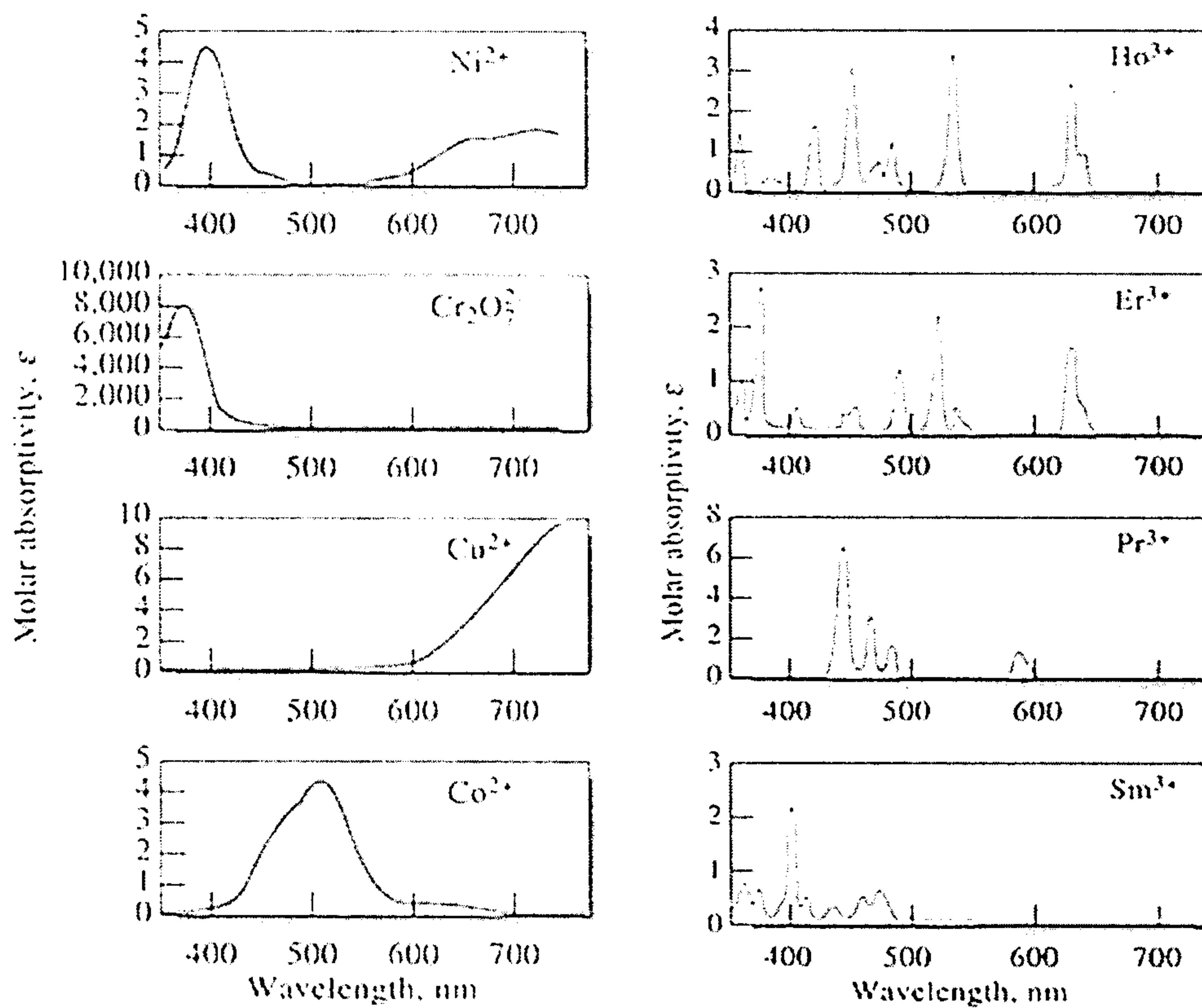
國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(化學組)

考試科目 (代碼)：分析化學(2301)

共 6 頁，第 5 頁 *請在【答案卷】作答

10. (10%) Following two figures are the absorption spectra of transition and rare earth ions. Apparently, these two spectra differ substantially from each other. Please state the reason why the absorption spectra of transition and rare earth ions are different.



© 2004 Thomson - Brooks/Cole

© 2004 Thomson - Brooks/Cole

11. (10%) (1) A typical modern pH probe is a combination electrode, which combines both the glass and reference electrodes into one body. Please give the name of the following parts of a combination electrode shown below.
- (2) Please define asymmetry potential
- (3) Based on following diagram of glass cell, please illustrate the principle of glass electrode for the measurement of pH.

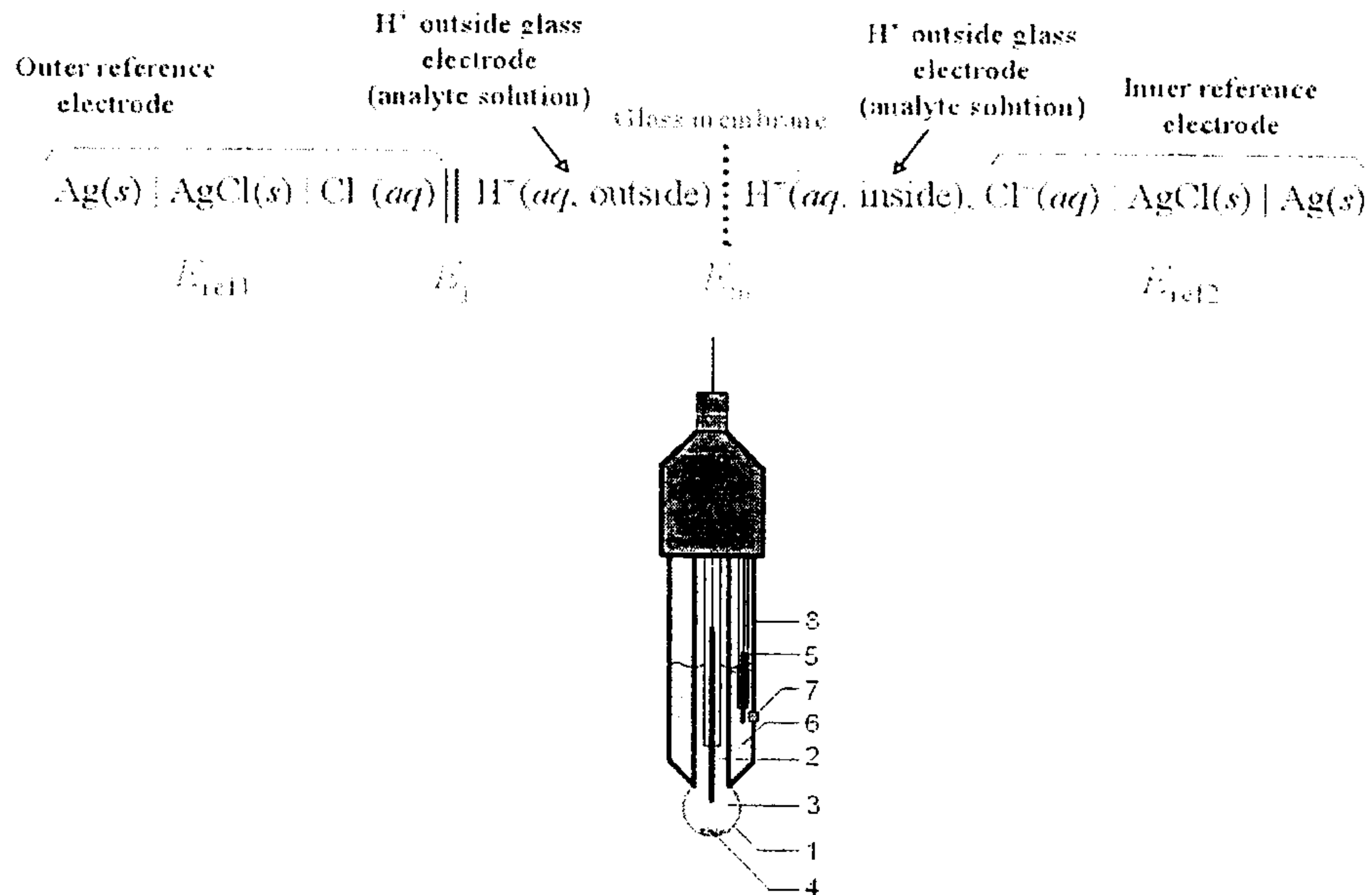
國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(化學組)

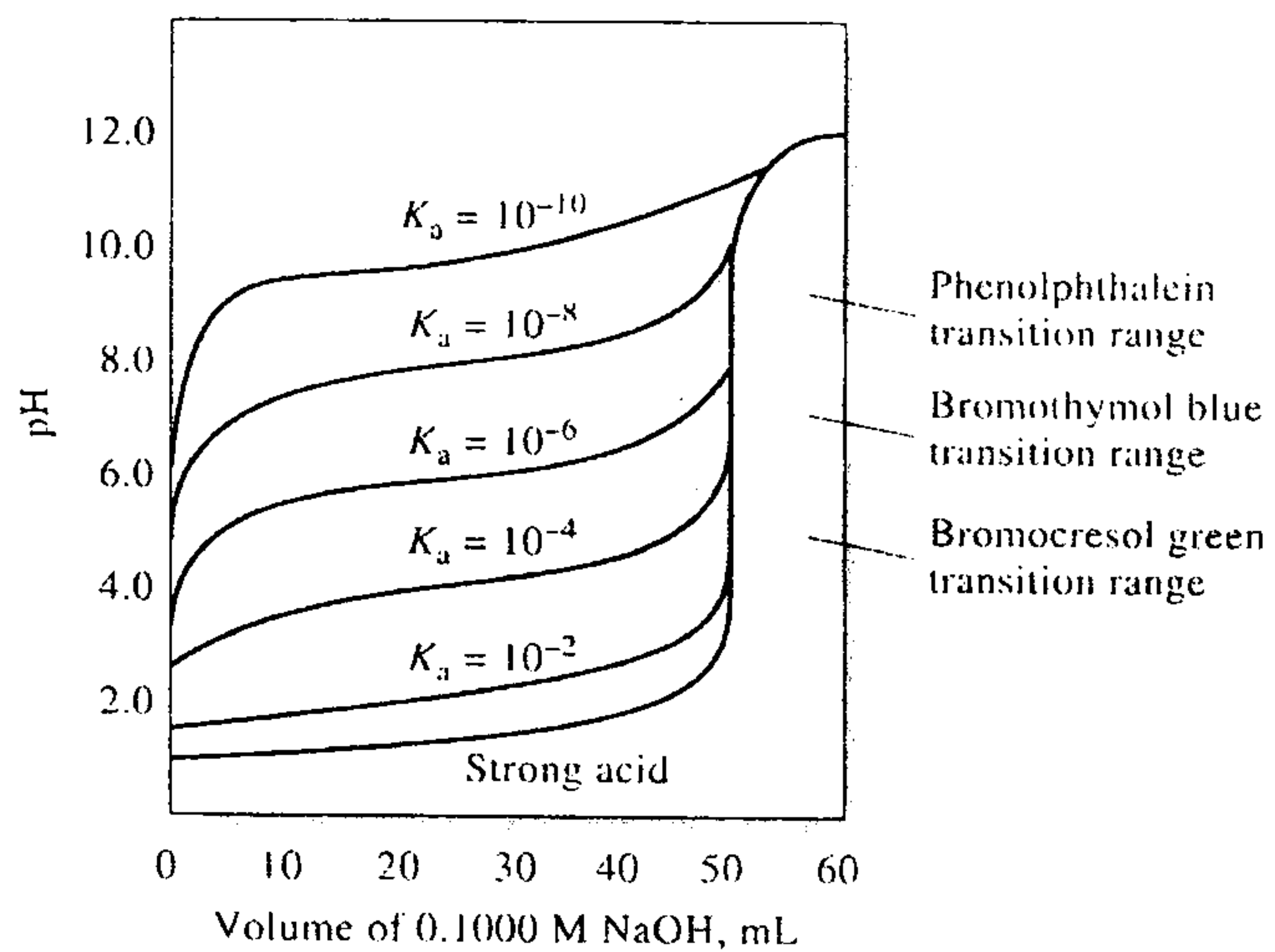
考試科目 (代碼)：分析化學(2301)

共 6 頁，第 6 頁

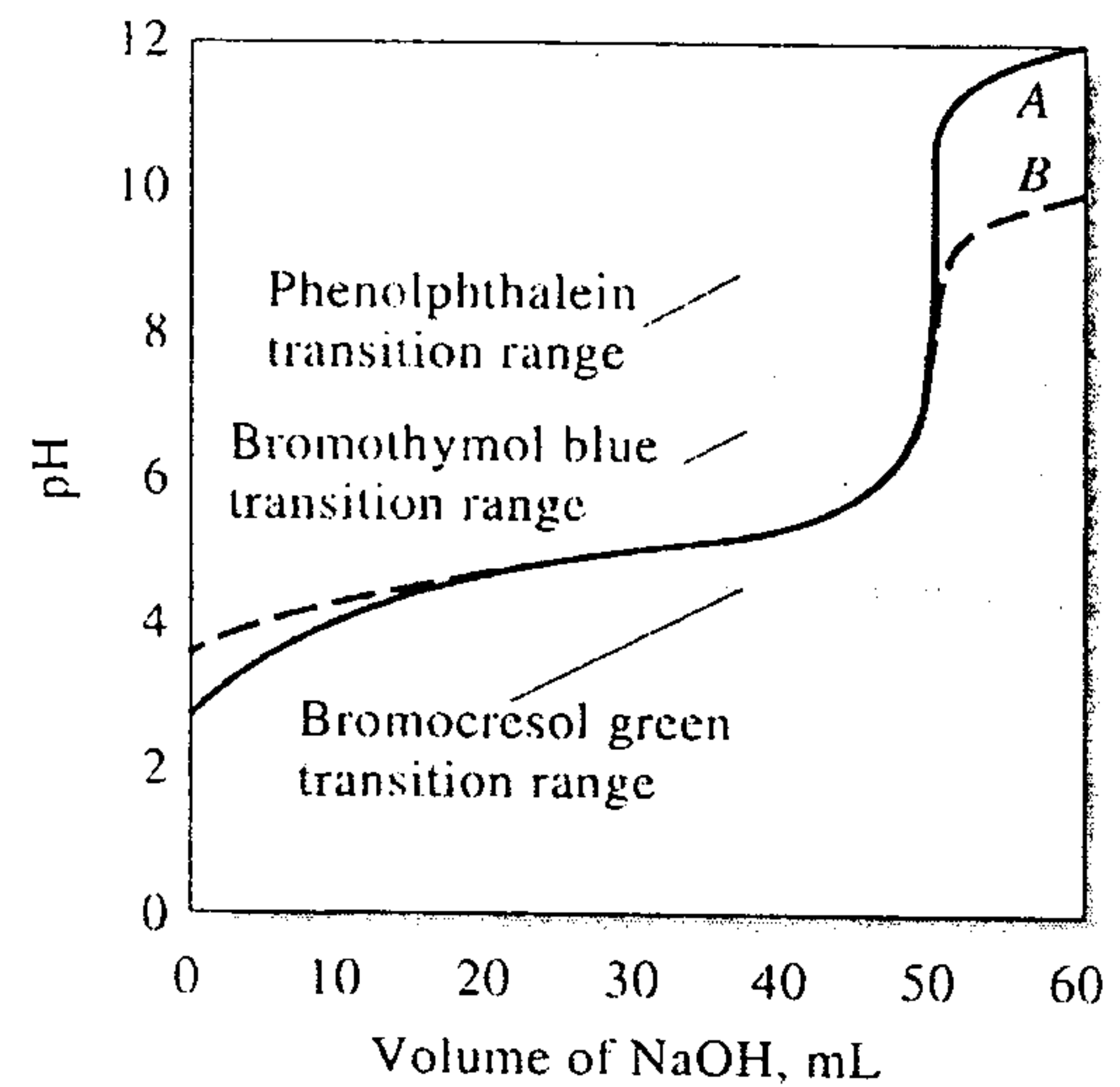
*請在【答案卷】作答



12. (5%) Following two figures show the effects of concentration and reaction completeness on the shape of titration curves. Please illustrate the effects of analyte concentration and reaction completeness on the titration curve and applicability of titration method.



© 2004 Thomson - Brooks/Cole



© 2004 Thomson - Brooks/Cole

A: High Concentration

B: Low Concentration