

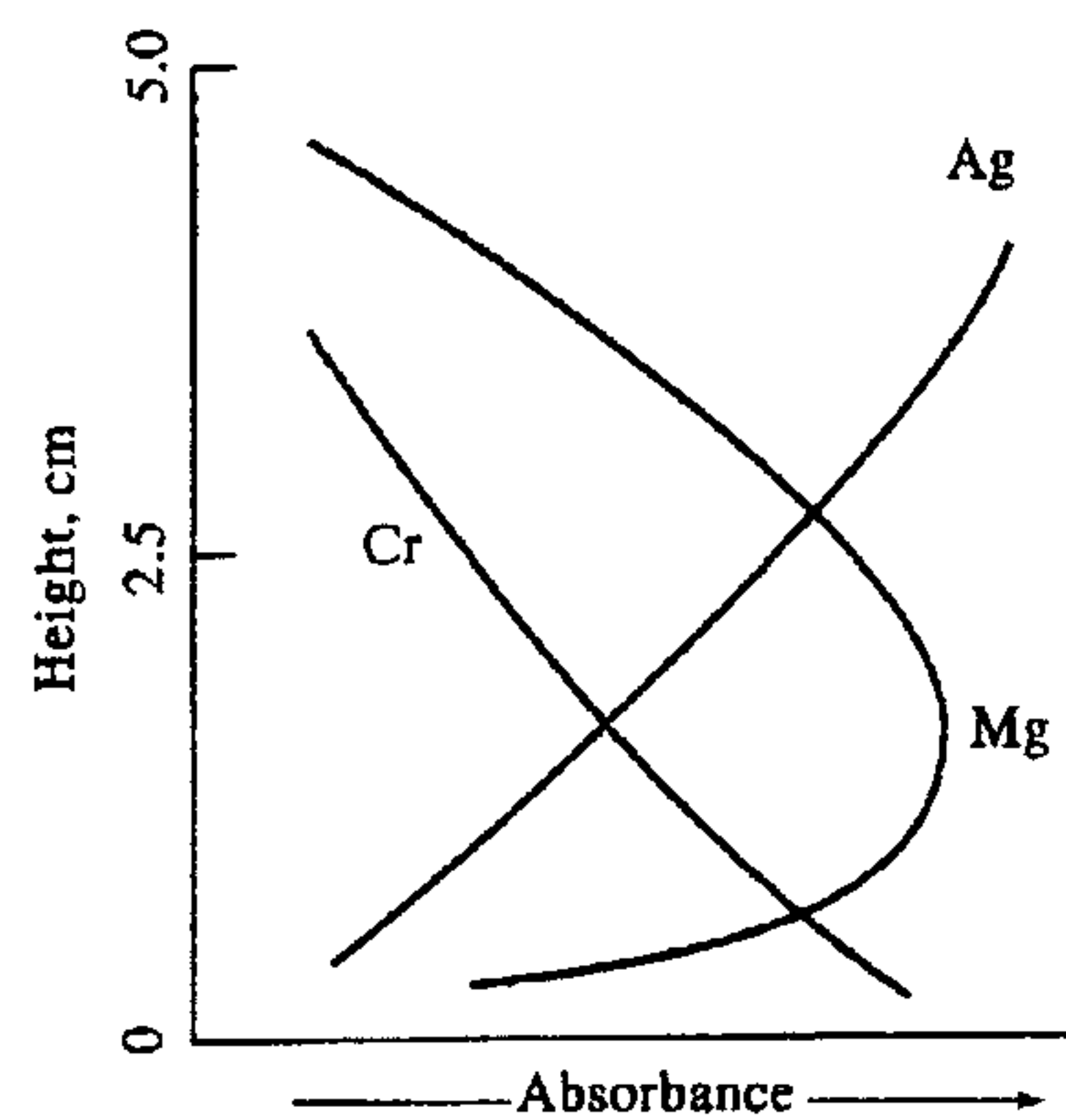
國立清華大學 101 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組（環境分子科學組）

考試科目（代碼）：分析化學（2303）

共 4 頁，第 1 頁 \*請在【答案卷】作答

1. (10%) In flame atomic absorption spectrometry with a hydrogen/oxygen flame, the absorbance for iron decreased in the presence of large concentrations of sulfate ion.
- (a) Suggest an explanation for this observation.
- (b) Suggest three possible methods of overcoming the potential interference of sulfate in a quantitative determination of iron.
- (c) According to following figure, please explain the reasons for the changes in the absorbance of three elements as function of distance above the burner head?



2. (10%) A 4.97-g petroleum specimen was decomposed by wet-ashing and subsequently diluted to 500 mL in a volumetric flask. Cobalt was determined by treating 25.00-mL aliquots of this diluted solution as follows:

Reagent Volume, mL			
Co(II), 3.00 ppm	Ligand	H <sub>2</sub> O	Absorbance
0.00	20.00	5.00	0.398
5.00	20.00	0.00	0.510

Assume that the Co(II)/Ligand chelate obeys Beer's law, and calculate the percentage of cobalt in the original sample.

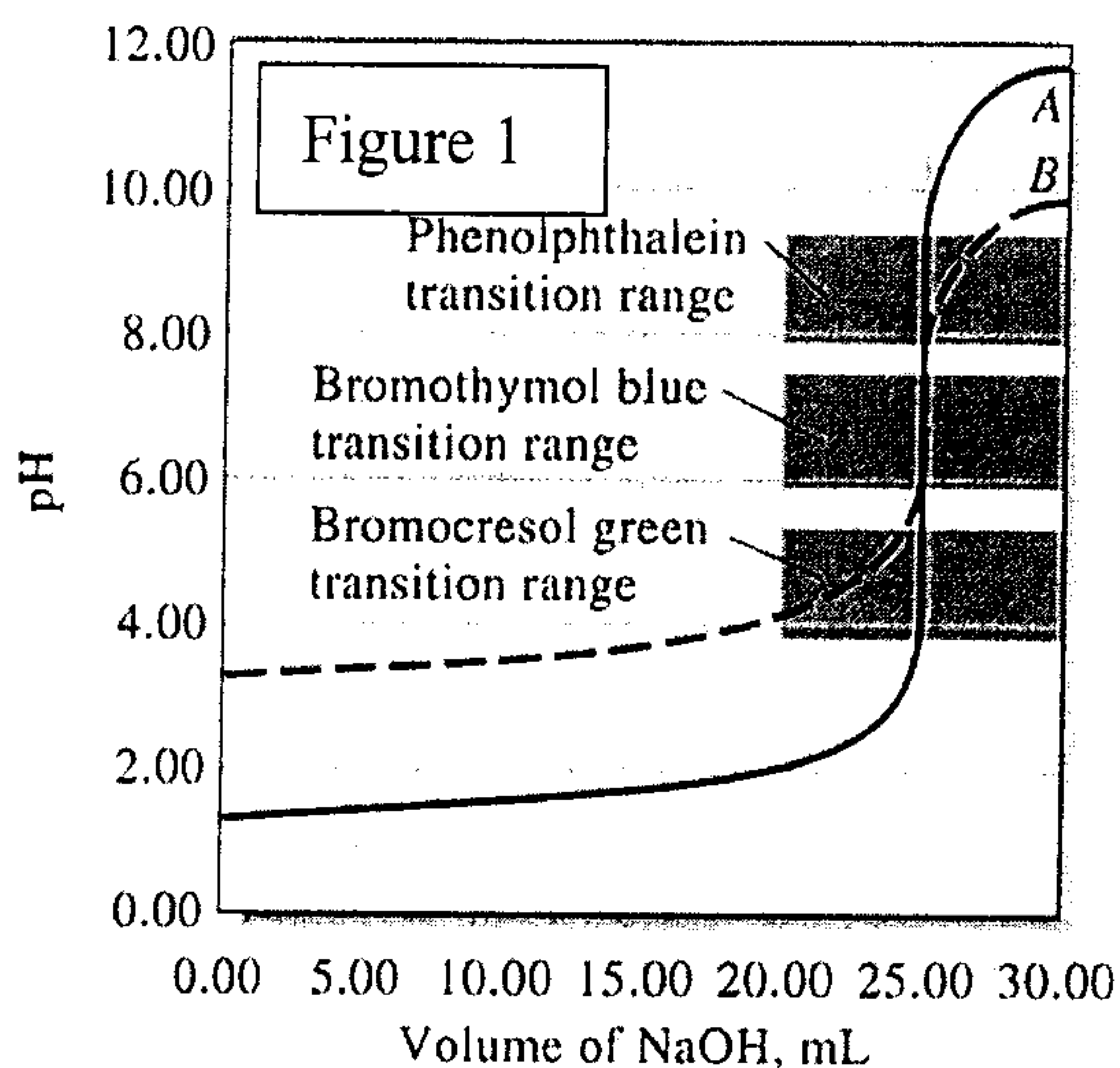
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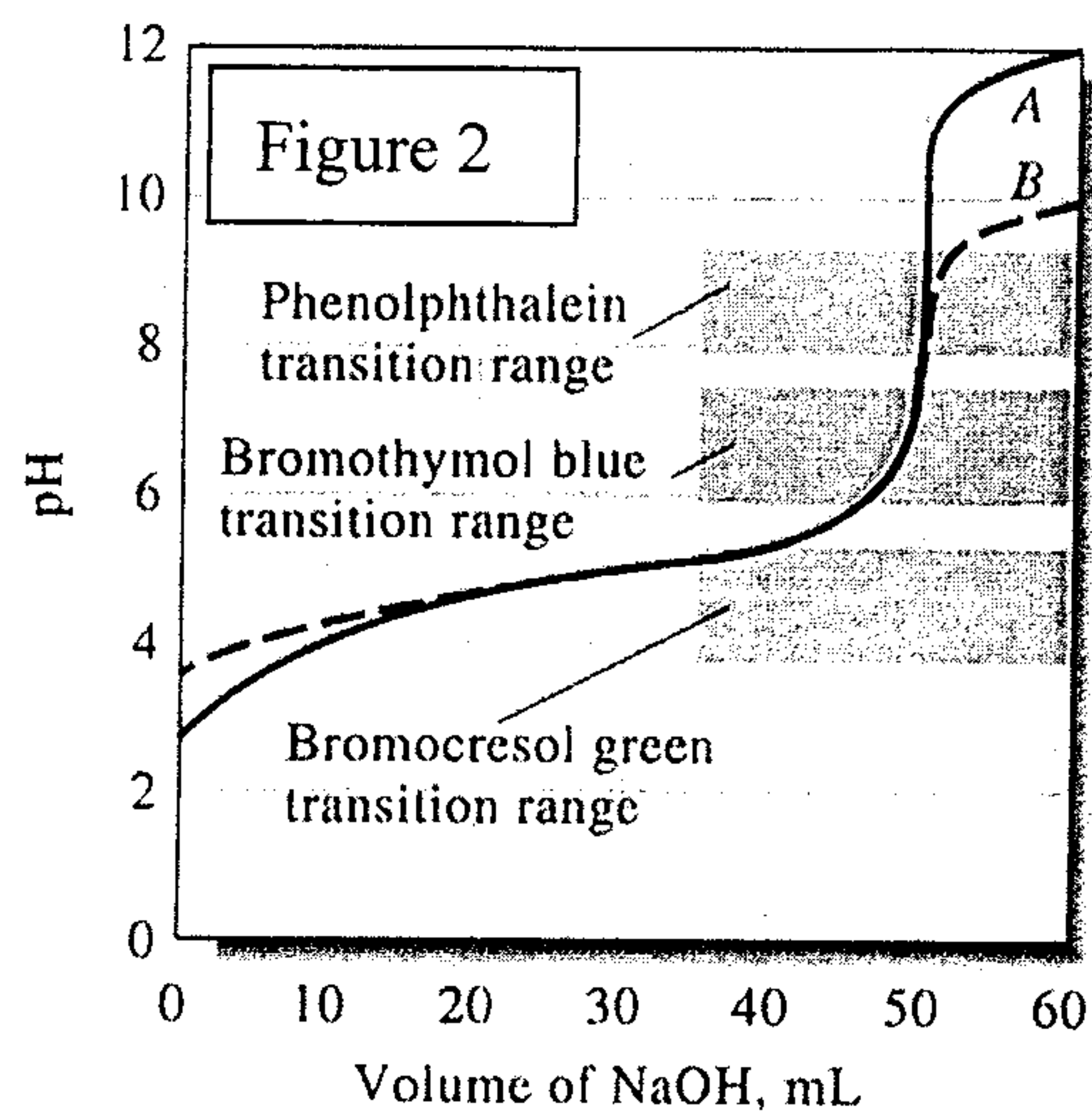
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共 4 頁，第 2 頁 \*請在【答案卷】作答

3. (10%) Following Figures show the titration curves of strong and weak acids with different concentrations.
- (1) Please indicate which Figure shows the titration curves of weak acid.
  - (2) Please indicate which curve is obtained by titrating the lower concentration acid with NaOH solution.
  - (3) Please explain the reason why the pH ranges of buffer regions of curve A and curve B in Figure 1 are different.
  - (4) Please explain the reason why the pH ranges of buffer regions of curve A and curve B in Figure 2 are the same.

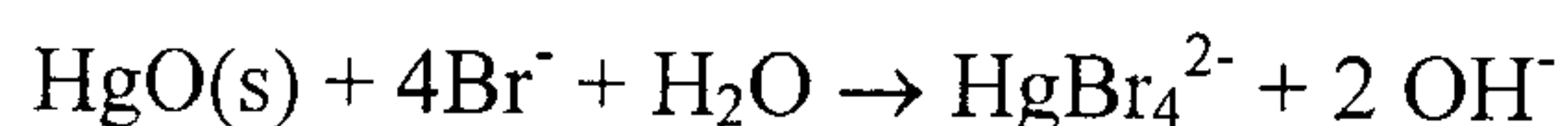


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4. (10%) A solution of  $\text{HClO}_4$  was standardized by dissolving 0.4125 g of primary-standard-grade  $\text{HgO}$  in a solution of  $\text{KBr}$ :



The liberated  $\text{OH}^-$  consumed 46.51 mL of the acid. Calculate the molarity of the  $\text{HClO}_4$ .

$$\left( \mathcal{M}_{\text{HgO}} = 216.59 \frac{\text{g}}{\text{mole}} \right)$$

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共 4 頁，第 3 頁 \*請在【答案卷】作答

5. (5%) How many grams of  $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$  must be added to 400.0 mL of 0.200 M  $\text{H}_3\text{PO}_4$  to give a buffer of pH 7.30?  
 $([\text{H}_3\text{O}^+][\text{HPO}_4^{2-}]/[\text{H}_2\text{PO}_4^-] = 6.32 \times 10^{-8})$
6. (10%) A 50.00-mL aliquot of a solution containing Fe(II) and Fe(III) required 13.73 mL of 0.01200 M EDTA when titrated at pH 2.0 and 29.62 mL when titrated at pH 6.0. Express the concentration of the solution in terms of the parts per million of each solute.
7. (10%)
- (1) As described in the text book, few chemical or physical properties of importance in chemical analysis are unique to a single chemical species. Instead, the reactions used and the properties measured are characteristic of a group of elements or compounds. Please define the species other than the analyte that may affect the final measurement and state its effect on the final result.
  - (2) All analytical results depend on a final measurement X (signal intensity) of a physical or chemical property of the analyte.  $C_A = kX$  is the relationship between the property and the concentration ( $C_A$ ) where k is a proportionality constant. The process of determining k is thus an important step in most analyses. Please define process of determining k and give an example how we can determine the k value.
8. (10%) The solubility-product constant for  $\text{Ag}_2\text{SO}_3$  is  $1.5 \times 10^{-14}$ . Calculate potential for the process  $\text{Ag}_2\text{SO}_3(s) + 2e^- \rightleftharpoons 2\text{Ag}(s) + \text{SO}_3^{2-}$ , where  $[\text{SO}_3^{2-}] = 1.00 \text{ M}$ .  
 $(2\text{Ag}^+ + 2e^- \rightleftharpoons 2\text{Ag}(s) \quad E^\circ = 0.779 \text{ V})$
9. (10%) Based on following figure, please explain the reason
- (1) why the response of a  $\text{Ca}^{2+}$  membrane electrode to the concentration is not linear.

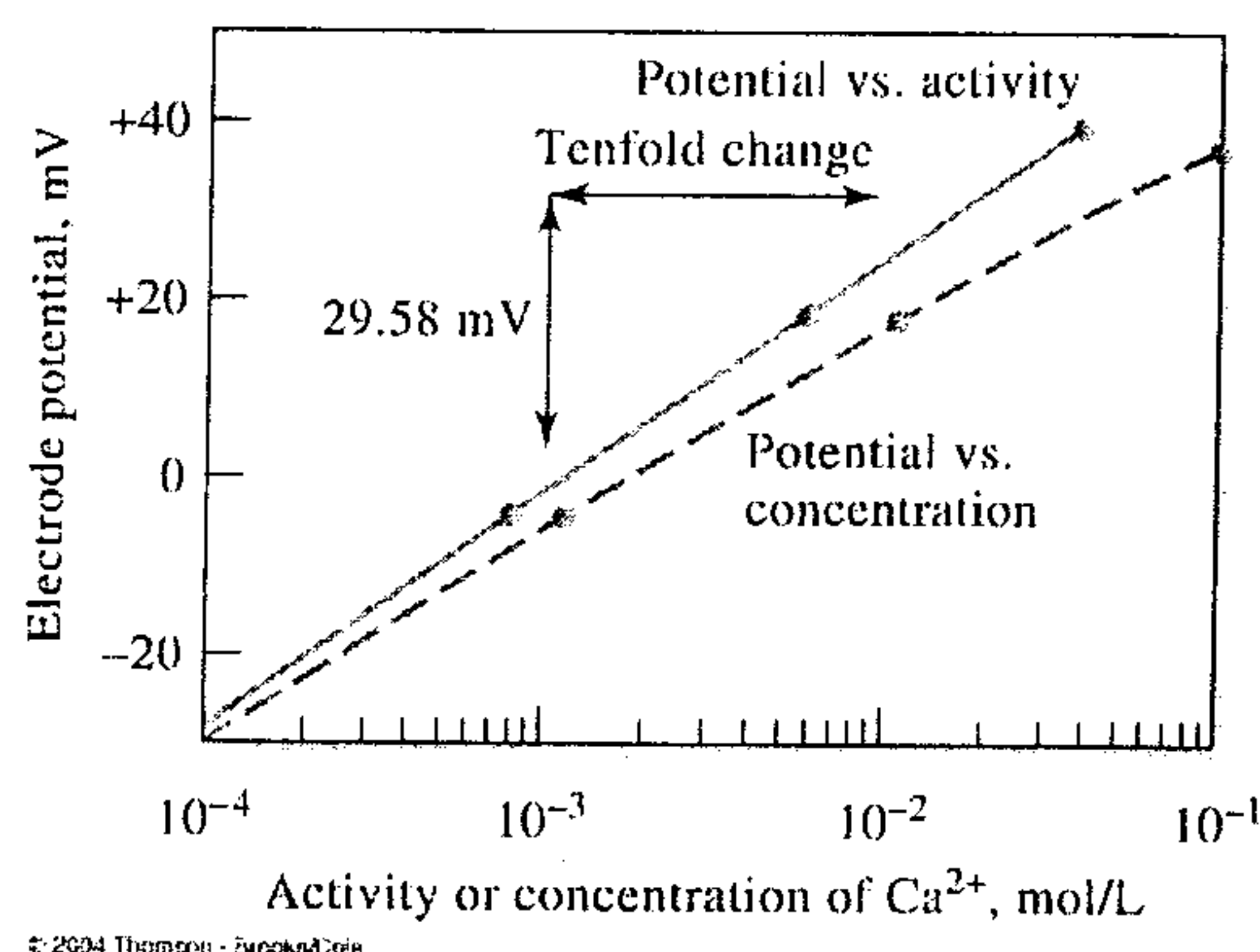
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(2) why the slopes of calibration curves obtained based on the activity and concentration of  $\text{Ca}^{2+}$  are different.



10. (10%) Base on the data shown in following Table

- (1) Please state the difference among (a) PLOT column, (b) WCOT column and (c) SCOT column.
- (2) Please state the reason why FSOT column can provide better separation efficiency.

TABLE 31-4

	Type of Column			
	FSOT <sup>a</sup>	WCOT <sup>b</sup>	SCOT <sup>c</sup>	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 <sup>6</sup>
Relative pressure	Low	Low	Low	High
Relative speed	Fast	Fast	Fast	Slow
Flexible?	Yes	No	No	No
Chemical inertness	Best	→ Poorest		

<sup>a</sup>Fused-silica open tubular column.

<sup>b</sup>Wall-coated open tubular column.

<sup>c</sup>Support-coated open tubular column (also called porous layer open tubular or PLOT).

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11. (5%) Indicate the order in which the following compounds would be eluted from a HPLC column containing a reversed-phase packing:

- (1) Benzene, diethyl ether, n-hexane
- (2) acetone, dichloroethane, acetamide