Time : 90 Minutes

Chemistry 216
Final Eamination

Feb. 7,1998

Family Name_____ First Name _____

ID Number _____ Section _____

I. The following data table summarizes the measurements reported by a student in Experiment 5 , "Ion Selective Electrodes" , for the construction of a calibration curve by the Titration Method to determine the concentration of an unknown NaCl solution :

	V_{soln} , ml	[NaCl] , M	Emf (mv) ± 5 mv
1	25.00	0.00100	-172
2	(1) + 1.00	0.00481	-139
3	(2) + 1.00	0.00833	-128
4	(3) + 1.00	0.0116	-120
5	(4) + 1.00	0.0146	-113
6	(5) + 1.00	0.0175	-109
7	(6) + 1.00	0.0202	-106
8	(7) + 1.00	0.0226	-102
9	(8) + 1.00	0.0250	-100
10	(9) + 1.00	0.0272	-98

A. For each solution , calculate the ionic strength μ , the activity coefficient for the sodium ion , $\gamma\pm$, using the Davies equation , and log a_{Na^+} . Tabulate your results in the following table :

	μ	$\gamma\pm$	a_{Na^+}	log a_{Na^+}	Emf , mv
1					-172
2					-139
3					-128
4					-120
5					-113
6					-109
7					-106
8					-102
9					-100
10					-98

B. Plot Emf versus log a_{Na^+} on a millimeter graph paper . Determine , graphically , the slope and the intercept of the best straight line . Give the equation of the line on the graph paper . Label the axes clearly; also , indicate on the graph paper the value of the smallest scale division on each axis .

C. An unknown solution gave the following readings on the same potentiometer:

	$V_{unknown}$ (ml)	Emf (mv)
Trial 1	25.00	-104
Trial 2	25.00	-106

i) Determine a_{Na^+} for the unknown solution from the calibration curve .

Show your method clearly :

ii) Estimate the γ_{Na^+} from section A ; calculate [Na^+] in the unknown .

II. Given the following information :

Table 1 : % T of a 3.930×10^{-4} M $K_2Cr_2O_7$ solution

λ (nm)	% T (± 0.1)
440	66.0
545	99.0

Table 2: Molar absorptivities of $KMnO_4$ at different wavelengths

λ (nm)	$\in$ $M^{-1} cm^{-1}$
440	122
545	2.20×10^3

Table 3 : % T of a mixture of $KMnO^4$ and $K_2Cr_2O_7$ solution of unknown concentration

λ (nm)	% T (±0.1)
440	58.5
545	12.0

Calculate the molar concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in the mixture. Show your method clearly

III. A. Give three important characteristics of a primary standard :

B. Name two primary standards :

C. Define buffer capacity as precisely as you can :

D. Calculate the masses of KH_2PO_4 and Na_2HPO_4 needed to prepare 250ml of a standard buffer of pH = 6.86 and a total concentration of 0.0100 M . K_2 (H_3PO_4) = 6.32×10^{-8}

E. Name the radiation source in the spectrophotometers you used in the visible region .