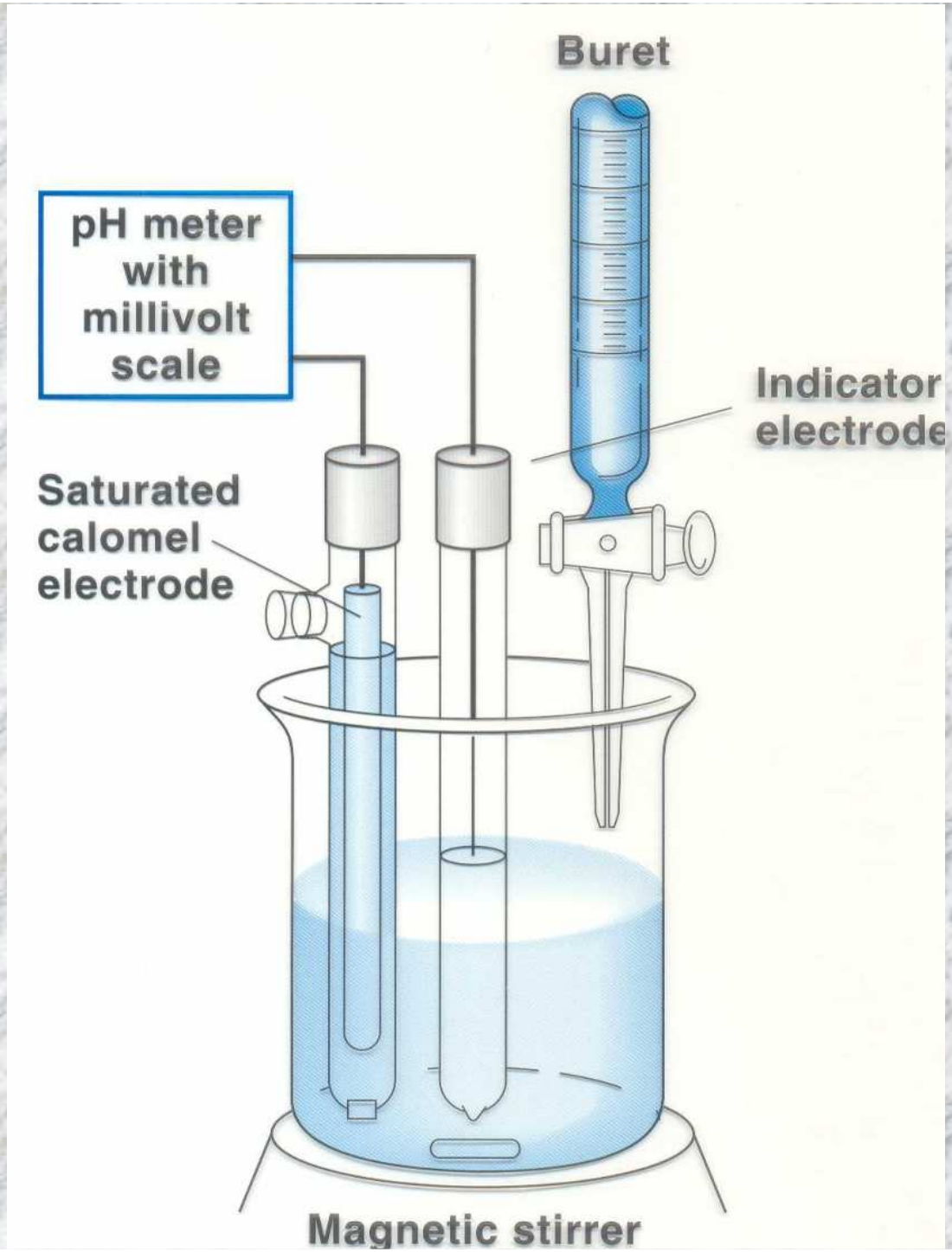
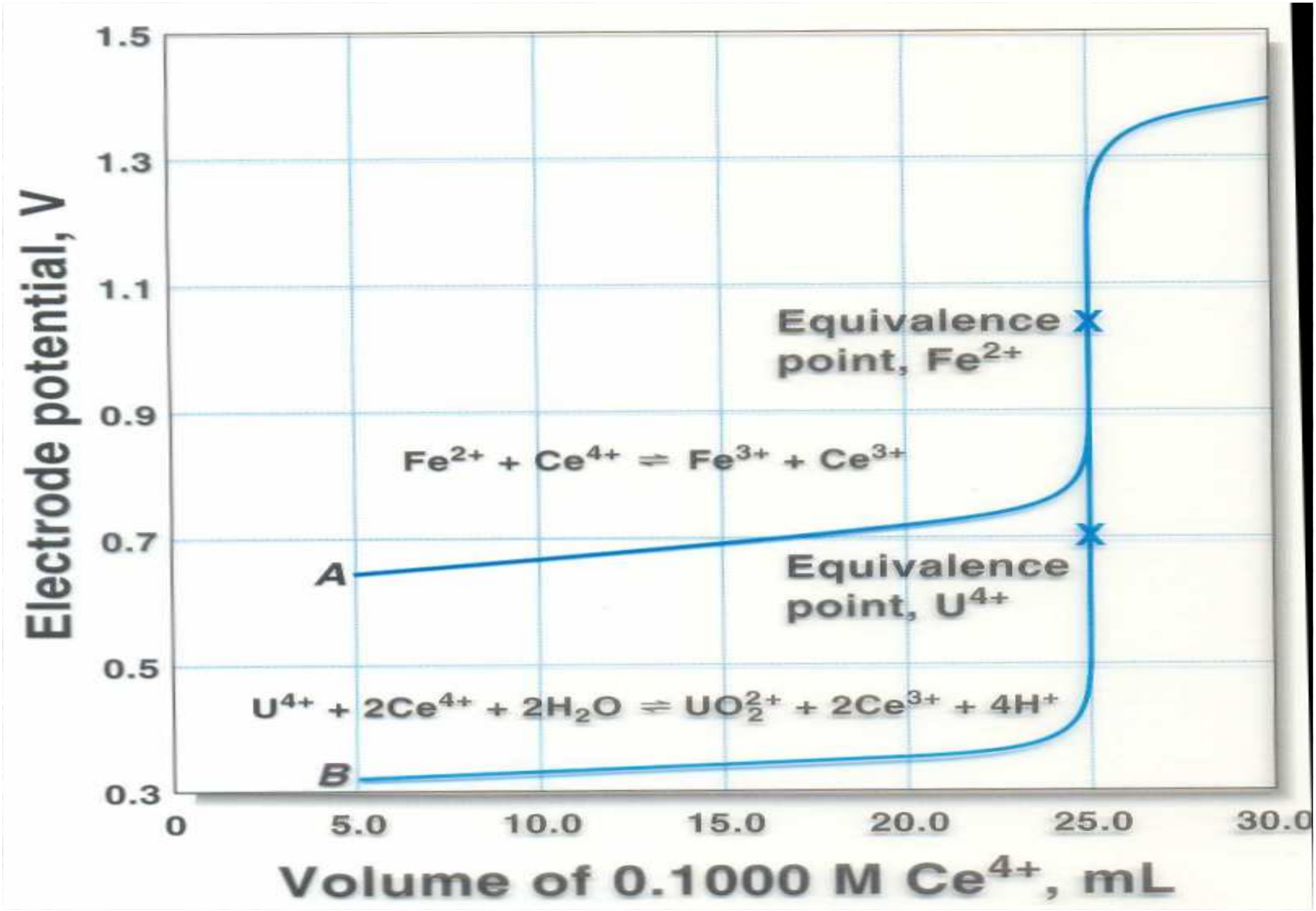

Buret
pH meter with millivolt scale
Indicator electrode
Saturated calomel electrode
Magnetic stirrer


Electrode potential, V
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0
5.0
10.0
15.0
20.0
25.0
30.0
Volume of 0.1000 M Ce4+, mL
Equivalence point, Fe2+
Equivalence point, U4+
Fe2+ + Ce4+ ⇌ Fe3+ + Ce3+
U4+ + 2Ce4+ + 2H2O ⇌ UO22+ + 2Ce3+ + 4H+
A
B

Consider the titration of 50.00 mL of 0.0500 M Fe^{2+} with 0.1000 M Ce^{4+} in a medium that is 1.0 M in H_2SO_4 at all times. Formal potential data for both half-cell processes are available in Appendix 4 and are used for these calculations. That is,

$$Ce^{4+} + e^- \rightleftharpoons Ce^{3+} \qquad E^{0\prime} = 1.44 \text{ V } (1 \text{ M } H_2SO_4)$$

$$Fe^{3+} + e^- \rightleftharpoons Fe^{2+} \qquad E^{0\prime} = 0.68 \text{ V } (1 \text{ M } H_2SO_4)$$

Potential after the Addition of 5.00 mL of Cerium(IV)

$$[Fe^{2+}] = \frac{50.00 \times 0.0500 - 5.00 \times 0.1000}{55.00}$$

$$[Fe^{3+}] = \frac{0.500}{55.00}$$

$$E_{system} = +0.68 - \frac{0.0592}{1} \log \frac{2.00\,/\cancel{55.00}}{0.20\,/\cancel{55.00}} = 0.64 \text{ V}$$

Equivalence-Point Potential

$$E_{eq} = \frac{E^{0'}_{Ce^{4+}/Ce^{3+}} + E^{0'}_{Fe^{3+}/Fe^{2+}}}{2} = \frac{1.44 + 0.68}{2} = 1.06\ V$$

Potential after the Addition of 25.10 mL of Cerium(IV)

$$[Ce^{4+}] = \frac{25.10 \times 0.1000 - 50.00 \times 0.0500}{75.10}$$

$$[Ce^{3+}] = \frac{25.00 \times 0.1000}{75.10}$$

$$E = +1.44 - \frac{0.0592}{1} \log \frac{[Ce^{3+}]}{[Ce^{4+}]} = +1.44 - \frac{0.0592}{1} \log \frac{2.500/\cancel{75.10}}{0.010/\cancel{75.10}}$$

$$= +1.30 \text{ V}$$

	A	B	C	D	E	F	G	H	I	J	K
1	**Spreadsheet for titration of 50.00 mL of 0.0500 M Fe^{2+} with 0.1000 M Ce^{4+}**										
2	Initial Conc. Fe^{2+}, M	0.0500	$E^{0'}_{Fe,\,V}$	0.68							
3	Vol. Fe^{2+}, mL	50.00	$E^{0'}_{Ce,\,V}$	1.44							
4	Conc. Ce^{4+}, M	0.1000									
5											
6	**Volume Ce^{4+}, mL**	**$[Fe^{3+}]$**	**$[Fe^{2+}]$**	**$[Ce^{3+}]$**	**$[Ce^{4+}]$**	**E_{system}, V**					
7	5.00	0.009091	0.036364			0.64					
8	10.00	0.016667	0.025000			0.67					
9	15.00	0.023077	0.015385			0.69					
10	20.00	0.028571	0.007143			0.72					
11	24.00	0.032432	0.001351			0.76					
12	24.90	0.033244	0.000134			0.82					
13	25.00					1.06					
14	25.10			0.033289	0.000133	1.30					
15	26.00			0.032895	0.001316	1.36					
16	30.00			0.031250	0.006250	1.40					
17	35.00			0.029412	0.011765	1.42					
18	40.00			0.027778	0.016667	1.43					
19											
20	**Spreadsheet Documentation**										
21	Cell B7=A7*$B$4/($B$3+A7)			Cell D14=$B$2*$B$3/($B$3+A14)							
22	Cell C7=($B$2*$B$3-$B$4*A7)/($B$3+A7)			Cell E14=(A14*$B$4-$B$2*$B$3)/($B$3+A14)							
23	Cell F7=$D$2-0.0592*LOG10(C7/B7)			Cell F14=$D$3-0.0592*LOG10(D14/E14)							
24	Cell F13=($D$2+$D$3)/2