

Test-4 Result: The highest grade is 130; the lowest one is 30; the class average is 89

Answers to Test-4-Spring 2007



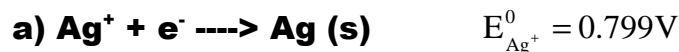
Please come to my office hours or talk to your classmates if you cannot get the right answers. If you find any grading error, please let me know.

I. Multiple choices:

1. (b)
2. (a)
3. (a)
4. (c)
5. (b)
6. (b)
7. (a)
8. (a)
9. (a)
10. (b)

II. Problems.

1.



$$\mathbf{K_{sp} = [Ag^+][Cl^-] = 1.82 \times 10^{-10}}$$

$$[Ag^+] = \frac{K_{sp}}{[Cl^-]} = \frac{1.82 \times 10^{-10}}{0.0100} = 1.82 \times 10^{-8} M$$

$$E = E_{Ag^+}^0 - \frac{0.0592}{n} \text{Log} \frac{1}{[Ag^+]} = E_{Ag^+}^0 - \frac{0.0592}{1} \text{Log} \frac{1}{1.82 \times 10^{-8}} = 0.340V$$



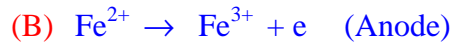
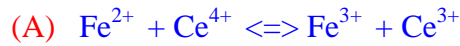
$$\mathbf{[Cl^-] = 0.0100 M}$$

$$E = E_{AgCl}^0 - \frac{0.0592}{n} \text{Log} \frac{[Cl^-]}{1} = E_{AgCl}^0 - \frac{0.0592}{1} \text{Log} (0.0100) = 0.340V$$

2.



3.



(C)

$$E_{\text{system}} = E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 - \frac{0.0592}{1} \log \frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]}$$

$$E_{\text{system}} = E_{\text{Ce}^{4+}/\text{Ce}^{3+}}^0 - \frac{0.0592}{1} \log \frac{[\text{Ce}^{3+}]}{[\text{Ce}^{4+}]}$$

(D) Equivalent point volume:

$$C_{\text{Ce}^{4+}} V_{\text{Ce}^{4+}} = C_{\text{Fe}^{2+}} V_{\text{Fe}^{2+}}$$

$$V_{\text{Ce}^{4+}} = \frac{C_{\text{Fe}^{2+}} V_{\text{Fe}^{2+}}}{C_{\text{Ce}^{4+}}} = \frac{0.0100 \times 50.00}{0.100} = 50.0 \text{ mL}$$

(a) Addition of 0.00 mL of Ce^{4+} ; before the equivalence point

absence of Fe^{3+}

Hence: no sufficient information for E_{system}

(b) Addition of 25.00 mL of Ce^{4+} ; before the equivalence point: excess of Fe^{2+}

$$E_{\text{system}} = E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 - \frac{0.0592}{1} \log \frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]}$$

$$= 0.68 - \frac{0.0592}{1} \log \frac{(50.00 \text{ mL} \times 0.100 \text{ M} - 25.00 \text{ mL} \times 0.100 \text{ M})}{\frac{(50.00 + 25.00) \text{ mL}}{(25.00 \text{ mL} \times 0.100 \text{ M})}} = 0.68 \text{ V}$$

1) Addition of 50.00 mL of Ce^{4+} ; at the equivalence point:

$$E_{\text{system}} = \frac{E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 + E_{\text{Ce}^{4+}/\text{Ce}^{3+}}^0}{2} = 1.145 \text{ V}$$

3) Addition of 75.00 mL of Ce^{4+} ; after the equivalence point: excess of Ce^{4+}

$$E_{\text{system}} = E_{\text{Ce}^{4+}/\text{Ce}^{3+}}^0 - \frac{0.0592}{1} \log \frac{[\text{Ce}^{3+}]}{[\text{Ce}^{4+}]}$$

$$= 1.610 - \frac{0.0592}{1} \log \frac{\frac{50.00\text{mL} \times 0.100\text{M}}{(50.00 + 75.00)\text{mL}}}{\frac{75.00\text{mL} \times 0.100\text{M} - 50.00\text{mL} \times 0.100\text{M}}{(50.00 + 75.00)\text{mL}}} = 1.592\text{V}$$

Note: you have 50.00-mL of 0.100 M (5.00 mmol) Fe^{2+} , which will react with 50.00mL of 0.100 M (5.00 mmol) Ce^{4+} , to generate 5.00 mmol of Ce^{3+} and Fe^{3+} .

You add 75.00-mL of 0.100 M (7.50 mmol) Ce^{4+} to react with 50.00-mL of 0.100 M (5.00 mmol) Fe^{2+} . Hence, you will have 2.50 mmol or (75.00-50.00) mL of 0.100 M of Ce^{4+} left.

- (E) (a-b) is before the equivalence point
 (c) at the equivalence point
 (d) after the equivalence point

