Solutions - Chapter 12

27. Back titration involving analyte metal ions vs EDTA is necessary when;
    a. analyte ion precipitates in the absence of complexing titrant EDTA.
    b. if the analyte ion reacts too slowly with the titrant EDTA
    c. if there is no suitable metal ion indicator for direct titration of analyte vs EDTA..

28. In a displacement titration, analyte cation displaces a metal ion (M) quantitatively from a M-complex. The displaced metal M ion is then titrated vs standard EDTA.

Example: Liberation of Ni^{+2} from a $Ni(CN)_4^{-2}$ by Ag^+. The liberated Ni^{+2} is then titrated with EDTA to find out how much Ag^+ was present.

32. Reactions: $Ni^{+2}(aq) + EDTA(aq) = Ni\text{-}EDTA(aq)$
    $Zn^{+2}(aq) + EDTA(aq) = Zn\text{-}EDTA(aq)$

Titration data: $Vadd_{EDTA} := 25.00$ $M_{EDTA} := 0.0500$ $V_{Ni} := 50.00$

moles EDTA added; $mmoles_{addEDTA} := Vadd_{EDTA} \cdot M_{EDTA}$

Back titration $V_{Zn} := 5.00$ $M_{Zn} := 0.0500$

Moles of excess EDTA after complexation (Zn:EDTA=1:1);

$$mmoles_{excessEDTA} := V_{Zn} \cdot M_{Zn}$$

Moles of EDTA reacted with Ni;

$$mmoles_{reactedEDTA} := mmoles_{addEDTA} - mmoles_{excessEDTA}$$

$$mmoles_{Ni} := mmoles_{reactedEDTA}$$

$$M_{Ni} := \frac{mmoles_{Ni}}{V_{Ni}} \qquad M_{Ni} = 0.02$$

36. The excess EDTA; $mmoles_{excessEDTA} := 12.4 \cdot 0.0123$

EDTA equivalent of Zn^{+2} (=moles of Zn^{+2}); $mmoles_{Zn} := 29.2 \cdot 0.0123$

Total EDTA added; $mmoles_{EDTA} := 25.00 \cdot 0.0452$

$$mmoles_{Zn} + mmoles_{Ni} = mmoles_{EDTA} - mmoles_{excessEDTA}$$

$$mmoles_{Ni} := -mmoles_{Zn} + mmoles_{EDTA} - mmoles_{excessEDTA}$$

Molarities of Zn(II) and Ni(II);

$$M_{Zn} := \frac{mmoles_{Zn}}{50.00} \qquad M_{Zn} = 7.183 \times 10^{-3}$$

$$M_{Ni} := \frac{mmoles_{Ni}}{50.00} \qquad M_{Ni} = 0.012$$

37. Again the reactions are of stoichimetric ratio 1:1.

Reactions: $Cu^{+2}(aq) + S^{-2}(aq) = CuS(s)$

$Cu^{+2}(aq) + EDTA(aq) = Cu\text{-}EDTA(aq)$

mmoles of Cu(II) remaining after reaction with sulfide; $mmoles_{excessCu} := 12.11 \cdot 0.03927$

mmoles of Cu(II) employed for sulfide reaction; $mmol_{Cu} := 25.00 \cdot 0.04332$

mmoles of Cu(II) reacted with sulfide ions (=mmoles of sulfide);

$$mmol_{Cu} - mmoles_{excessCu} = 0.607$$

molarity of sulfide; $\frac{0.607}{25.00} = 0.024$