

## Solutions - Chapter 12

27. Back titration involving analyte metal ions vs EDTA is necessary when;
- analyte ion precipitates in the absence of complexing titrant EDTA.
  - if the analyte ion reacts too slowly with the titrant EDTA
  - 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  $\text{Ni}^{+2}$  from a  $\text{Ni}(\text{CN})_4^{-2}$  by  $\text{Ag}^+$ . The liberated  $\text{Ni}^{+2}$  is then titrated with EDTA to find out how much  $\text{Ag}^+$  was present.

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

Titration data:  $V_{\text{addEDTA}} := 25.00$        $M_{\text{EDTA}} := 0.0500$        $V_{\text{Ni}} := 50.00$

moles EDTA added;  $\text{mmoles}_{\text{addEDTA}} := V_{\text{addEDTA}} \cdot M_{\text{EDTA}}$

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

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

$$\text{mmoles}_{\text{excessEDTA}} := V_{\text{Zn}} \cdot M_{\text{Zn}}$$

Moles of EDTA reacted with Ni;

$$\text{mmoles}_{\text{reactedEDTA}} := \text{mmoles}_{\text{addEDTA}} - \text{mmoles}_{\text{excessEDTA}}$$

$$\text{mmoles}_{\text{Ni}} := \text{mmoles}_{\text{reactedEDTA}}$$

$$M_{\text{Ni}} := \frac{\text{mmoles}_{\text{Ni}}}{V_{\text{Ni}}} \quad M_{\text{Ni}} = 0.02$$

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

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

Total EDTA added;  $\text{mmoles}_{\text{EDTA}} := 25.00 \cdot 0.0452$

$$\text{mmoles}_{\text{Zn}} + \text{mmoles}_{\text{Ni}} = \text{mmoles}_{\text{EDTA}} - \text{mmoles}_{\text{excessEDTA}}$$

$$\text{mmoles}_{\text{Ni}} := -\text{mmoles}_{\text{Zn}} + \text{mmoles}_{\text{EDTA}} - \text{mmoles}_{\text{excessEDTA}}$$

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

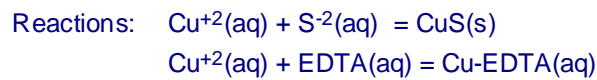
$$M_{\text{Zn}} := \frac{\text{mmoles}_{\text{Zn}}}{50.00}$$

$$M_{\text{Zn}} = 7.183 \times 10^{-3}$$

$$M_{\text{Ni}} := \frac{\text{mmoles}_{\text{Ni}}}{50.00}$$

$$M_{\text{Ni}} = 0.012$$

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



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

mmoles of Cu(II) employed for sulfide reaction;  $\text{mmol}_{\text{Cu}} := 25.00 - 0.04332$

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

$$\text{mmol}_{\text{Cu}} - \text{mmoles}_{\text{excessCu}} = 0.607$$

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