Zn-EDTA Titration

You would like to perform a titration of 50.00 mL of a 1.00×10^{-4} M Zn^{2+} solution with a 1.00×10^{-4} M EDTA solution.

What is pZn at the equivalence point?

Log K_f for the ZnY^{2-} complex is 16.5.
Both solutions are buffered to a pH of 10.0.
The alpha fraction for Y^{4-} is 0.355 at a pH of 10.0.

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Total moles of Zinc = $(1.00 \times 10^{-4}\ M)(0.050L)$

$= 5.0 \times 10^{-6}$ moles

Zn-EDTA Titration

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Total moles of Zinc = 5.0×10^{-6} moles

Equivalence point volume = 0.100L

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Equivalence point volume = 0.100L

[ZnY^{2-}] = 5.0×10^{-5} M

We first assume a stoichiometric reaction.

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Equivalence point volume = 0.100L

[ZnY^{2-}] = 5.0×10^{-5} M

[Zn^{2+}] = ??

$$K_f = \frac{[ZnY^{2-}]}{[Zn^{2+}][Y^{4-}]}$$

Then we assume a little bit of free Zinc is formed as required by K_f.

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Total moles of Zinc = 5.0×10^{-6} moles

Equivalence point volume = 0.100L

[ZnY^{2-}] = 5.0×10^{-5} M

[Zn^{2+}] = ??

$$K_f = \frac{[ZnY^{2-}]}{[Zn^{2+}][Y^{4-}]}$$

$$[Zn^{2+}] = C^{Total}_{Free\ EDTA}$$

For every free Zn^{2+}, there is a free EDTA species

$$[Y^{4-}] = \alpha_{Y^{4-}} C^{Total}_{Free\ EDTA}$$

Y^{4-} concentration is obtained from the alpha fraction.

Zn-EDTA Titration

You would like to perform a titration of 50.00 mL of a 1.00×10^{-4} M Zn^{+} solution with a 1.00×10^{-4} M EDTA solution.

Total moles of Zinc = 5.0×10^{-6} moles

Equivalence point volume = 0.100L

[ZnY^{2-}] = 5.0×10^{-5} M

[Zn^{2+}] = ??

$$[Zn^{2+}] = \sqrt{\frac{[ZnY^{2-}]}{\alpha_{Y^{4-}} K_f}}$$

Plug everything in and solve for Zn^{2+}...

Zn-EDTA Titration

You would like to perform a titration of 50.00 mL of a 1.00×10^{-4} M Zn^{+} solution with a 1.00×10^{-4} M EDTA solution.

Total moles of Zinc = 5.0×10^{-6} moles

Equivalence point volume = 0.100L

[ZnY^{2-}] = 5.0×10^{-5} M

[Zn^{2+}] = 6.67×10^{-11} M

$$[Zn^{2+}] = \sqrt{\frac{[ZnY^{2-}]}{\alpha_{Y^{4-}} K_f}}$$

pZn = 10.2

And we are done!