

28.5 Stability constants

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS stability constant • complex • complex ion • ligand
• ligand exchange

Objective

Build the skills to answer exam questions on **stability constants** (K_{stab}) – what they are, writing the expression, and using them.

You must be able to:

- define the stability constant of a complex
- write a K_{stab} expression (leaving out water)
- use K_{stab} values to compare stability and predict ligand exchange

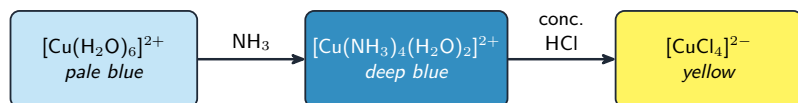
1 Key knowledge and worked examples

■ Stability constants

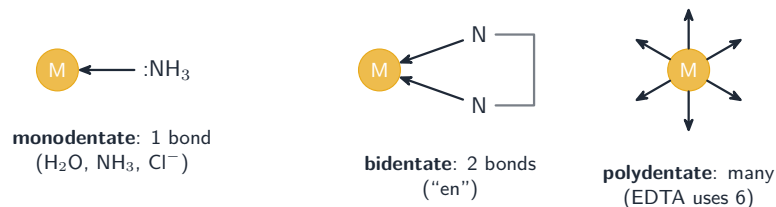
The **stability constant** K_{stab} is the equilibrium constant for forming a complex ion from the metal ion and its ligands in solution. **Water is left out** of the expression.

For $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{NH}_3 \rightleftharpoons [\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+} + 4\text{H}_2\text{O}$:

$$K_{\text{stab}} = \frac{[[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}]}{[[\text{Cu}(\text{H}_2\text{O})_6]^{2+}][\text{NH}_3]^4}$$



A **large** K_{stab} = a very stable complex; ligand exchange moves towards the larger K_{stab}



Ligand denticity affects stability constants

2 Practice

2.1 Define the **stability constant** of a complex. [1]

2.2 State what a large value of K_{stab} tells you about a complex. [1]

3 Exam-style questions

3.1 Which species is **omitted** from a K_{stab} expression in aqueous solution? [1]

- ☐ A the metal ion
☐ B the incoming ligand
☐ C water
☐ D the complex ion

3.2 In a ligand exchange, the equilibrium moves towards the complex with the: [1]

- ☐ A smaller K_{stab}
☐ B larger K_{stab}
☐ C smaller charge
☐ D more water ligands

3.3 For $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{NH}_3 \rightleftharpoons [\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+} + 4\text{H}_2\text{O}$:

(a) Write the expression for K_{stab} . [2]

(b) The ammonia complex has a much larger K_{stab} than the water complex. Explain what this means for the ligand-exchange reaction. [2]

3.4 Explain why adding excess ammonia to $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ forms the ammonia complex. [2]