

UNIT 5 • COORDINATION COMPOUNDS

Importance and Applications of Coordination Compounds

How complex ions act as precision tools in analytical chemistry, metallurgy, biology, and medicine.

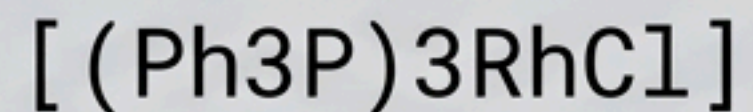
Key Vocabulary

Chelate Therapy

The use of chelating ligands (polydentate ligands) to bind toxic metal ions in the body, forming highly stable, excretable coordination compounds.

Wilkinson Catalyst

A specific rhodium coordination complex used industrially to catalyze the hydrogenation of alkenes.



Industrial & Analytical Applications



Chemical Analysis

Used for qualitative/quantitative detection via distinct color reactions.

Key Reagents: EDTA, DMG, α -nitroso- β -naphthol, cupron



Water Hardness

Estimated by simple volumetric titration with Na_2EDTA .

Ca^{2+} and Mg^{2+} form stable complexes with EDTA; differences in stability constants allow for selective estimation.



Gold Extraction

Metallurgical separation via complex formation.

Forms $[\text{Au}(\text{CN})_2]^-$ in aqueous solution, which is later separated by metallic Zinc.



Nickel Purification

Mond process for refining impure metals.

Impure Ni is converted to volatile $[\text{Ni}(\text{CO})_4]$, which is then thermally decomposed to yield pure Nickel.



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$$E=mc^2$$



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Biological & Technical Applications

Biological Systems

Core Concept: Vital biological pigments and vitamins are coordination compounds.

- Chlorophyll (Mg)
- Haemoglobin (Fe)
- Vitamin B12 / Cyanocobalamin (Co)

Electroplating

Core Concept: Yields smoother, more even metal coats than simple ions.

Key Complexes: $[\text{Ag}(\text{CN})_2]^-$ for silver plating; $[\text{Au}(\text{CN})_2]^-$ for gold plating.

Industrial Catalysis

Core Concept: Transition metal complexes act as highly efficient catalysts for organic reactions.

Key Example: Wilkinson catalyst $[(\text{Ph}_3\text{P})_3\text{RhCl}]$ for alkene hydrogenation.

Photography

Core Concept: Black & white film fixing (washing with hypo solution).

Mechanism: Dissolves undecomposed AgBr to form the soluble complex ion $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$.

Chelate Therapy in Medicine

Toxic Metal Poisoning

Target Condition:
Lead (Pb) Poisoning

Specific Treatment:

EDTA
(Ethylenediamine-
tetraacetate)

Oncology

Target Condition:
Tumour Growth

Specific Treatment:

cis-platin

(effectively inhibits tumor
cell division)

Excess Metal Accumulation

Target Condition:
Copper (Cu) & Iron (Fe)
Overload

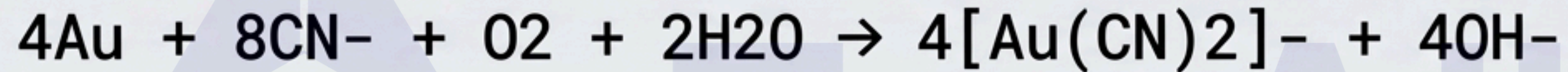
Specific Treatment:

**D-penicillamine &
desferrioxamine B**

Process Sequence: Gold Extraction

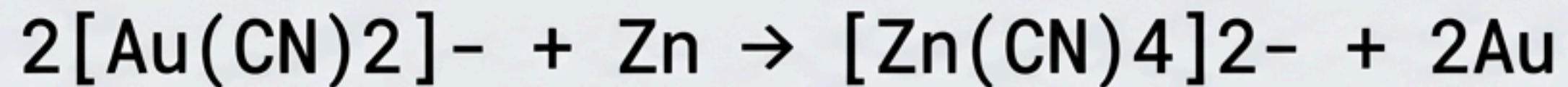
Step 1: Complex Formation

Gold combines with cyanide in the presence of oxygen and water to form a soluble coordination entity.



Step 2: Metal Displacement

The stable aqueous complex is treated with a more reactive metal (Zinc) to precipitate out pure metallic gold.

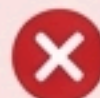


Watch for this: Specificity in Medical Applications

Exam questions often try to trick you by generalizing highly specific coordination compounds.

The Trap

EDTA is a universal treatment for all heavy metal poisoning.



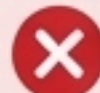
The Reality



EDTA is specifically highlighted for **lead poisoning**. Excess Copper or Iron requires D-penicillamine or desferrioxamine B.

The Trap

Platinum compounds in general are used to cure cancer.



The Reality



It is specifically **cis-platin** (and structurally related compounds) that inhibits tumor growth, not just any platinum complex.

Key Takeaways

1. Coordination compounds are ubiquitous molecular tools—functioning as essential biological pigments (Mg in Chlorophyll, Fe in Haemoglobin) and powerful industrial catalysts (Wilkinson's catalyst for hydrogenation).
2. Chelate therapy leverages the extreme stability of polydentate ligands to treat specific conditions, requiring precise matching between treatments and targets (e.g., EDTA for Lead, cis-platin for Tumours).



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