Class 12 Chemistry – d-Block & f-Block Elements | Study Guide

---

1. Theory in Simple Words with Visuals

1.1 What are d-Block Elements?

- **Definition:** Elements in which the **last electron enters the d-orbital**.
- **Location:** Groups 3–12, Periods 4–7
- **Analogy:** d-orbitals are like "workshop tools" for transition metals; they allow metals to **form colorful compounds and multiple oxidation states**.

Visual Table – General Properties

Property	Trend / Description	Example / Note
Metallic character	Strong metallic character	Fe, Cu
Oxidation states	Multiple (+1 to +7 depending on element)	Fe: +2, +3
Color	Compounds are often colored	Cu^{2+} → Blue, Ni^{2+} → Green
Magnetic properties	Paramagnetic (due to unpaired electrons)	Fe^{3+} has 5 unpaired e^-

Stepwise Understanding of Trends:

1. Atomic size ↓ across period (Zeff ↑)
2. Ionization energy ↑ across period
3. Metallic character ↓ across period

1.2 What are f-Block Elements?

- **Definition:** Elements in which the **last electron enters the f-orbital**.
- **Location:** Lanthanides (4f, period 6) & Actinides (5f, period 7)
- **Analogy:** f-block elements are "hidden treasures" because their chemistry is **similar and sometimes tricky to memorize**.

Visual Table – f-Block Elements

Block	Period	Typical Elements	Key Feature
Lanthanides	6	La → Lu	4f electrons, similar properties, "Rare Earth Metals"
Actinides	7	Th → Lr	5f electrons, mostly radioactive

Special Features:

- High melting points
- Strong reducing agents (especially Actinides)
- Lanthanide contraction → affects chemistry of following elements

---

1.3 Important Reactions & Applications

d-Block Highlights

- **Formation of Complexes:** $Fe^{3+} + 6CN^- \rightarrow [Fe(CN)_6]^{3-}$
- **Catalytic properties:** Fe in Haber process, V_2O_5 in Contact process
- **Alloy formation:** Cu + Zn → Brass

f-Block Highlights

- **Oxidation states:** +3 (Lanthanides), +3 & +4 (Actinides)
- **Radioactivity:** U, Th used in nuclear energy
- **Spectroscopic applications:** La^{3+}, Nd^{3+} in lasers

---

2. Key Concepts & Formulas

Concept	Formula/Definition	Mnemonic / Tip
Oxidation states	Variable, due to (n-1)d electrons	d-block "multitalented electrons"
Complex formation	[Metal + Ligands]$^{n+}$	e.g., $[Fe(CN)_6]^{3-}$
Color of compounds	Due to d-d transitions	Think "unpaired electrons absorb light"
Magnetic behavior	Paramagnetic → unpaired e^-, Diamagnetic → paired e^-	Count unpaired e^-
Lanthanide contraction	Gradual decrease in ionic radius	"Shrinkage trick" across 4f series

Mnemonic for Lanthanides:
"La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu" → "Lazy Cats Prefer Nice Peaceful Soft Even Gentle Tiny Dandy Happy Energetic Tigers Laugh"

---

3. Solved Numerical Problems

Example 1: Oxidation State

Problem: Find oxidation state of Cr in $K_2Cr_2O_7$.
Solution:
K = +1, O = -2, Let Cr = x
2(+1) + 2x + 7(-2) = 0 → 2 + 2x - 14 = 0 → 2x = 12 → x = +6

Example 2: Number of unpaired electrons

Problem: Determine unpaired electrons in Fe^{3+} (d^5).
Solution: Fe: [Ar] $3d^6 4s^2$ → Fe^{3+}: $3d^5$ → all 5 electrons unpaired → 5 unpaired e^-

---

4. Previous Years' Board Questions (Solved)

- Variable oxidation states → frequently asked
- Complex compounds & color → 2016–2022 recurring
- Lanthanide contraction → high-weightage
- f-block applications → 1 mark or short answer
- Catalytic activity & alloy formation → numerical/short answer

---

5. Quick Revision Notes / Important Points

- **d-block:** Transition metals, variable oxidation states, colored compounds, catalysts, alloys
- **f-block:** Lanthanides (4f), Actinides (5f), radioactive (Actinides), lanthanide contraction
- **Trends:** Atomic radius ↓ across period, oxidation state increases, metallic character decreases
- **Mnemonic:** "d-block = diverse colors; f-block = hidden treasures"
- **Diagrams:** Flowcharts for d-block oxidation states, f-block series

---

6. Predicted / Likely Questions

1. Oxidation states of Cr, Mn, Fe, Cu
2. Color of complexes & reason (d-d transitions)
3. Catalytic reactions (Haber, Contact, Hydrogenation)
4. Lanthanide contraction & its effects
5. Radioactivity & applications of f-block elements
6. Numerical on oxidation states & unpaired electrons

---

7. Exam Tips & Tricks

- Always **memorize oxidation states & common complexes**
- Use **color diagrams for d-block colors**
- Check **f-block contraction trends for ionic radii and reactivity**

- Practice **unpaired electron calculations**
- Use **tables & flowcharts** for revision → saves time in exams

---

8. Visual & Kid-Friendly Learning Style

- **d-block:** “Rainbow of colors” → visualize each transition metal’s solution color
- **f-block:** “Hidden treasure chest” → similar looking lanthanides, radioactive actinides glow
- **Use cartoons or simple sketches**: for complex formation, electron filling, catalysis
- Color-code metals, oxidation states, and trends in diagrams