CHAPTER 4

d- and f- Block Elements

CBSE · Chemistry · Class 12

WHAT THIS CHAPTER DOES

Boards prep that builds confidence, not anxiety.

TODAY'S MISSION

WHY THIS MATTERS

The Big Picture

TOPIC

Before we begin — quick check

TOPIC

A

Part A — Position and Configuration

TOPIC

Position and general configuration

POINT 1	POINT 2

TOPIC

The four transition series — at a glance

TOPIC

B

Part B — General Trends

WORKED EXAMPLE

Comparing trends across two d-series

Unit	Formula	Used for

TOPIC

Variable oxidation states and colour

POINT 1	POINT 2

TRY IT · SOLVE BEFORE YOU PEEK

Quick check — Colour

Which of the following ions is colourless in aqueous solution?

SOLUTION

TOPIC

C

Part C — Magnetism, Catalysis, Alloys

WORKED EXAMPLE

Numerical — spin-only magnetic moment

TOPIC

Magnetic moment ladder (spin-only)

TOPIC

Catalysis, interstitial compounds and alloys

POINT 1	POINT 2	POINT 3

TOPIC

D

Part D — KMnO4 and K2Cr2O7

WORKED EXAMPLE

Oxidising action of KMnO4 across media

TOPPER TEMPLATE · MARK-BY-MARK

Topper's 2-mark answer — spin-only magnetic moment

1. **STEP 1**
2. **STEP 2**
3. **STEP 3**
4. **STEP 4**

TOPIC

$KMnO_4$ vs $K_2Cr_2O_7$ — side by side

POINT 1	POINT 2	POINT 3	POINT 4

TOPIC

E

Part E — f-Block Elements

TOPIC

Lanthanides and lanthanide contraction

POINT 1

POINT 2

TOPIC

Lanthanides vs Actinides

PYQ PATTERNS

Top 5 PYQ patterns — boards 2018-2024

MARKS DISTRIBUTION

Sub-topic weight in CBSE boards (2018-2024 average)

TRY IT · SOLVE BEFORE YOU PEEK

Quick check — Configuration

> Which transition element shows the maximum number of oxidation states?

SOLUTION

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** All d-block elements are transition elements.

✓ **CORRECT** A transition element must have a partially filled d-subshell in its atom OR in a common ion. Zn, Cd, Hg (d10 ns2) have completely filled d in both atom and common +2 ion, so they are d-block but NOT typical transition metals.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Colour of transition metal ions comes from the s-electrons jumping.

✓ **CORRECT** Colour arises from d-d transitions: an electron in a lower-energy d-orbital absorbs visible light and jumps to a higher-energy d-orbital (split by ligands). Ions with d0 (Sc^3+) or d10 (Zn^2+) are colourless because no d-d transition is possible.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Magnetic moment is calculated from the total number of electrons.

✓ **CORRECT** The spin-only magnetic moment uses only UNPAIRED electrons: mu = sqrt(n(n+2)) BM, where n = number of unpaired electrons. Paired electrons cancel and contribute nothing.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Lanthanide contraction means the lanthanide atoms expand down the series.

✓ **CORRECT** It is the steady DECREASE in atomic and ionic radii from La to Lu, caused by poor shielding of the 4f electrons, so the increasing nuclear charge pulls electrons closer.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Higher oxidation states of transition metals are more stable as we go down a group.

✓ **CORRECT** Higher oxidation states become MORE stable down a group (3d to 4d to 5d), opposite to the p-block. For example, in group 6, Mo(VI) and W(VI) are more stable than Cr(VI), and CrO4^2- / Cr2O7^2- are strong oxidisers while MoO4^2- and WO4^2- are not.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Melting points of d-block metals keep rising across a series.

✓ **CORRECT** Melting point rises to a maximum around the middle (d5, e.g. Cr/Mo/W region) where the number of unpaired d-electrons available for metallic bonding is maximum, then falls. Mn and Tc dip due to stable half-filled d5 reducing bonding electrons; Zn, Cd, Hg are low (filled d10).

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** Actinides and lanthanides behave identically.

✓ **CORRECT** Actinides show a wider range of oxidation states (up to +7) because 5f, 6d and 7s have comparable energies; lanthanides are dominated by +3. Actinides are all radioactive; most lanthanides are not. Actinide contraction is greater per element due to even poorer 5f shielding.

TOPIC

Trap

TRAP → TRUTH

× **MISTAKE** KMnO4 acts the same way in acidic, neutral and alkaline media.

✓ **CORRECT** The Mn change differs: acidic medium Mn goes +7 to +2 (5-electron change, MnO4^- to Mn^2+); neutral/faintly alkaline +7 to +4 (3-electron, MnO2); strongly alkaline +7 to +6 (1-electron, MnO4^2-). Equivalent weight therefore differs (M/5 vs M/3 vs M/1).

PYQ PATTERNS

Top PYQ patterns to drill

#1	Spin-only magnetic moment of a given ion (2 marks)	85%
#2	Lanthanide contraction: define + cause + two consequences (3 marks)	80%
#3	KMnO4 / K2Cr2O7 preparation and oxidising-action equations (3 marks)	75%
#4	Reason-type: colour / variable states / catalytic property (2 marks)	70%
#5	Lanthanides vs actinides comparison (2 marks)	60%

RECAP · MEMORISE THESE

What you must walk away with

1 General config (n-1)d^1-10 ns^0-2; remember Cr 3d5 4s1 and Cu 3d10 4s1 exceptions

2 mu = sqrt(n(n+2)) uses only UNPAIRED electrons; remove ns before (n-1)d for ions

3 Colour = d-d transition; d0 and d10 ions are colourless

4 Variable oxidation states arise from close (n-1)d and ns energies; Mn shows +2 to +7

5 KMnO4 acidic: Mn +7->+2 (M/5); K2Cr2O7 acidic: Cr +6->+3 (M/6)

6 Lanthanide contraction = steady decrease in size (poor 4f shielding); actinides show wider

WHAT'S NEXT

Next class

Your move

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