

UNIT 4 • d- AND f-BLOCK ELEMENTS

Magnetic Properties of Transition Elements

Diamagnetism

Repelled by an applied magnetic field.
Occurs when all electrons are paired.

Paramagnetism

Attracted by an applied magnetic field.
Occurs when unpaired e^- are present.

Bohr Magneton (BM)

The standard unit used to express
magnetic moment.

Spin-Only Formula

$$\mu = \sqrt{n(n+2)}$$

where n = number of unpaired electrons.

Base Unit Reference

$$1 \text{ unpaired } e^- = 1.73 \text{ BM}$$

A single unpaired electron yields this baseline magnetic moment.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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Key Highlights

- » Free Study Material, Videos & Infographics
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Worked Example: Target Mn^{2+} ion

- Identify Configuration
Atomic number 25 $\rightarrow [\text{Ar}] 3d^5 4s^0$
- Count Unpaired Electrons
 $n = 5$
- Apply Formula
 $\mu = \sqrt{5(5+2)} \rightarrow \mu = \sqrt{35}$
- Resolve
 $\mu = 5.92 \text{ BM}$

Comparison Matrix: Calculated vs. Observed Magnetic Moments

Ion	Config	Unpaired (n)	Calculated (BM)	Observed (BM)
Ti ³⁺	3d ¹	1	1.73	1.75
Cr ³⁺	3d ³	3	3.87	3.86
Mn ²⁺	3d ⁵	5	5.92	5.96

Watch for this

The spin-only formula assumes full quenching of orbital angular momentum. In practice, experimental observations for Fe^{2+} , Co^{2+} , and Ni^{2+} run higher than calculated values due to unquenched orbital contributions.

Fe^{2+} (d^6): Calc 4.90 BM $\rightarrow$ Obs 5.3–5.5 BM

Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.

A) 1.73 BM

B) 5.92 BM

C) 4.90 BM

D) 0 BM

Mn^{2+} has a $3d^5$ configuration. $n=5$. $\mu = \sqrt{5(7)} = 5.92 \text{ BM}$.

Key Takeaways

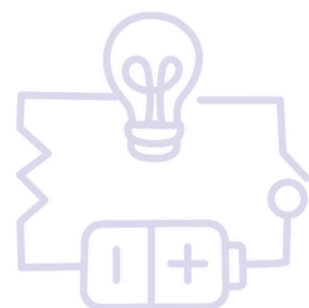
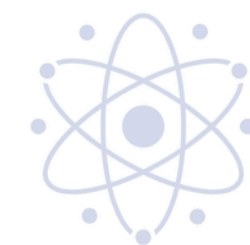
Magnetic moment scales predictably with the number of unpaired d-electrons via the spin-only formula $\mu = \sqrt{n(n+2)}$.

Experimental observations mostly align with calculated values, but watch for **Fe²⁺**, **Co²⁺**, and **Ni²⁺** which consistently yield higher observed values due to orbital contributions.



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