

OFFICIAL AP COURSE COMPANION



PRINT THIS GUIDE & KEEP IT IN YOUR AP CHEMISTRY BINDER!

What is this guide? This is your official study, homework walkthrough, and exam revision guide for **Topic 1.5 (Atomic Structure & Electron Configurations)**. Print this full packet now, hole-punch it, and file it into your 3-ring binder under Unit 1. Refer to it during daily study, homework walkthroughs, and exam review!

STUDENT FULL NAME _____

CLASS PERIOD / SECTION _____

DATE _____

TARGET AP SCORE

[1] [5] [1] [4] [1] [3]

Prerequisite Knowledge Self-Check (Are You Ready for Topic 1.5?)

Read each question honestly before beginning Topic 1.5. If you have any doubt, flip straight to the Annex page indicated at the end of this packet.

#	Prerequisite Skill & Diagnostic Question	Confidence	Action If In Doubt
1	Cations vs. Anions: Do you remember how charges form (losing vs. gaining electrons) and why atoms ionize?	✓ Know ⚠ Review	→ Annex Page 23
2	Subatomic Particles ($^{56}_{26}\text{Fe}$): Can you immediately state protons (26), neutrons (30), and electrons (26)?	✓ Know ⚠ Review	→ Annex Page 24
3	Coulomb's Law: Do you know how charge magnitude and distance dictate electrostatic attraction?	✓ Know ⚠ Review	→ Annex Page 25
4	Bohr Shells & Shielding: Can you distinguish outer valence electrons from inner shielding core electrons?	✓ Know ⚠ Review	→ Annex Page 26
5	Criss-Cross Ionic Formulas: If element X forms X^{3-} , can you write Mg_3X_2 when combined with Mg^{2+} ?	✓ Know ⚠ Review	→ Annex Page 27
6	Periodic Geography: Can you locate alkali metals, halogens, and noble gases with their charges?	✓ Know ⚠ Review	→ Annex Page 28

What is a Cation?

Positively charged ion (lost e^- , e.g., $\text{Na} \rightarrow \text{Na}^+ + e^-$).*Memory Trick:* The letter "t" in *cation* looks like a + sign!

What is an Anion?

Negatively charged ion (gained e^- , e.g., $\text{Cl} + e^- \rightarrow \text{Cl}^-$).*Memory Trick:* A Negative Ion = ANIon!

Guide Index & Table of Contents

Complete 28–page roadmap: 8 Concept Subsections, 8 Homework Models, and 6 Prerequisite Refreshers.

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 **How to Navigate:** Every homework question in Part 2 is directly explained in the matching **Section 1.5.X** notes on pages 3–10. If you need foundational review, turn to **Annexes A–F** on pages 22–28.

Section 1.5.1: Subatomic Particles, Nuclide Symbols & Isotopes

Every atom is composed of three fundamental particles: protons, neutrons, and electrons.

Particle	Symbol	Mass	Charge	Location	Role in Chemical Behavior
Proton	p^+	$\approx 1 \text{ amu}$	+1	Nucleus	Defines atomic number (Z) and element identity.
Neutron	n^0	$\approx 1 \text{ amu}$	0	Nucleus	Nuclear stability and mass. Varies between isotopes.
Electron	e^-	$\approx 0 \text{ amu}$	-1	Cloud	Responsible for chemical bonds, valence, and ions.

1. The Standard Nuclide Symbol Format: ${}^A_ZX^{\text{charge}}$

- Z (Atomic Number):** Number of **protons**. Found directly on the periodic table.
- A (Mass Number):** Total **protons + neutrons**. Always a whole integer.
- Net Charge:** **Protons - Electrons**. In neutral atoms, electrons = protons.

2. What Exactly Are Isotopes?

Isotopes are atoms of the **same element** (same atomic number Z) that have **different numbers of neutrons** (different mass numbers A). Because isotopes have identical electron configurations, they exhibit **identical chemical reactivity**, but differ in mass-dependent physical properties (density, effusion rate).

Concrete Worked Example

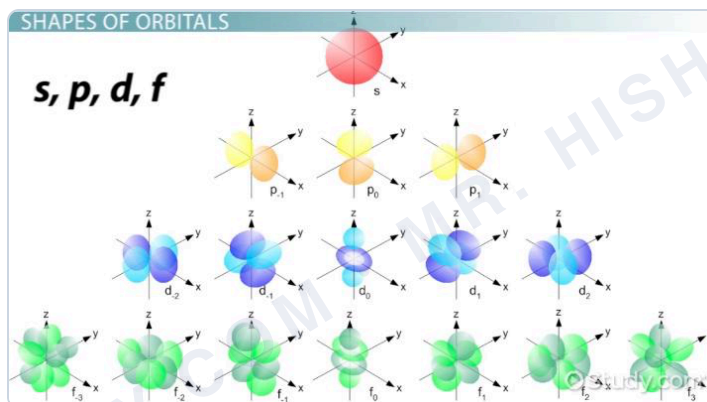
Accounting for Particles in ${}^{56}_{26}\text{Fe}$

- Protons:** Z = **26 protons** (defines Iron).
- Neutrons:** A - Z = 56 - 26 = **30 neutrons**.
- Electrons:** Neutral atom $\rightarrow$ electrons = protons = **26 electrons**.

AP Exam Trap: Never confuse mass number (A) with atomic mass! Mass number is an integer for a single nucleus (56 for ${}^{56}\text{Fe}$); atomic mass is a weighted average decimal on the periodic table (55.85 amu).

Section 1.5.2: Architecture of the Atom (Shells, Subshells & Orbitals)

The electron cloud is organized into Principal Energy Levels (n), Subshells (s, p, d, f), and Orbitals.



AP Exam Scope Requirement:

ONLY s and p orbital shapes are required for the AP Chemistry Exam!

- **s-orbital:** Spherically symmetrical boundary surface.
- **p-orbitals:** Dumbbell shape with two lobes oriented along the 3D axes (p_x, p_y, p_z).
- **d and f orbitals:** You only need to know their electron capacities (d holds 10 e⁻, f holds 14 e⁻). Sketching or identifying complex d or f spatial lobes is **NOT tested on the AP Exam**.

Subshell Capacity Breakdown Table

Subshell	Geometric Description	Number of Orbitals	Max Electrons	First Appears
s	Spherical symmetry	1 orbital	2 e ⁻	n = 1 (1s)
p	Dumbbell (p _x , p _y , p _z)	3 orbitals	6 e ⁻	n = 2 (2p)
d	Four-leaf clover / donut	5 orbitals	10 e ⁻	n = 3 (3d)
f	Complex multi-lobed	7 orbitals	14 e ⁻	n = 4 (4f)

Principal Shell Capacity (2n² Formula)

Level n = 1: 1s ²	Capacity = 2 electrons (2 × 1 ²)
Level n = 2: 2s ² 2p ⁶	Capacity = 8 electrons (2 × 2 ²)
Level n = 3: 3s ² 3p ⁶ 3d ¹⁰	Capacity = 18 electrons (2 × 3 ²)
Level n = 4: 4s ² 4p ⁶ 4d ¹⁰ 4f ¹⁴	Capacity = 32 electrons (2 × 4 ²)

Section 1.5.3: The Three Fundamental Quantum Rules

Writing any ground-state electron configuration requires obeying three non-negotiable rules:

1. The Aufbau Principle ("Building Up")

Electrons occupy the lowest available energy orbital first: $1s \rightarrow 2s \rightarrow 2p \rightarrow 3s \rightarrow 3p \rightarrow 4s \rightarrow 3d \dots$

2. Hund's Rule ("The Bus Seat Rule")

When filling degenerate orbitals (orbitals of equal energy, like the three 2p orbitals), electrons occupy them **singly with parallel spins** before pairing up to minimize electron repulsion.

3. The Pauli Exclusion Principle

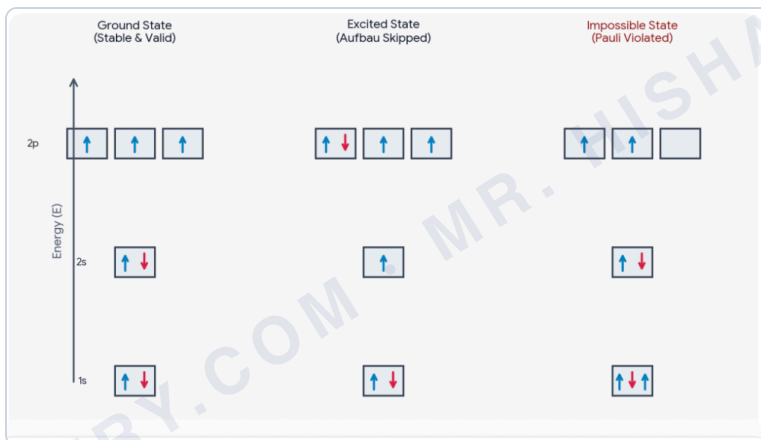
An orbital can hold at most **two electrons**, and they must have **opposite spins** ($\uparrow\downarrow$).

Visual Comparison: Professional Orbital Box Filling

Element	Subshell	Correct Ground State (Hund's Rule)		Common Violation / Error
Carbon (Z=6)	2p ²	↑ ↑	✔ Correct	↑↓ ✗ Hund's Violation
Nitrogen (Z=7)	2p ³	↑ ↑ ↑	✔ 3 Half-Filled	↑↓ ↑ ✗ Premature Pairing
Oxygen (Z=8)	2p ⁴	↑↓ ↑ ↑	✔ Paired 1st Box	↑↑ ↑ ↑ ✗ Pauli Violation

Section 1.5.4: Ground State vs. Excited State vs. Impossible Violations

How to classify any electron configuration on the AP Chemistry Exam:



Classification	Definition	Electron Count & Rule Check
Ground State	Lowest energy arrangement.	Obeys Aufbau, Hund, and Pauli completely.
Excited State	Electron absorbed energy and jumped up.	Aufbau skipped, BUT subshell capacities ($s \leq 2$, $p \leq 6$, $d \leq 10$) respected!
Impossible	Violates quantum physics.	Subshell overfilled (e.g. $1s^3$) or wrong spin pairing in same orbital!

The 3-Step Decision Highway (AP Exam Checklist)

Step 1: Sum superscripts	Must equal atomic number Z (neutral) or ion electron count.
Step 2: Check orbital limits ($s \leq 2$, $p \leq 6$, $d \leq 10$)	If exceeded (e.g. $1s^3$ or $2p^7$), IMPOSSIBLE VIOLATION!
Step 3: Check Aufbau energy ordering	If a lower orbital has empty spots while higher is filled, EXCITED!

Section 1.5.5: Electron Configurations of Ions & Transition Metal Exceptions

1. Anions (Gain e^-): Fill lowest open valence orbital to reach octet (e.g. F: $2p^5 + 1e^- \rightarrow F^-: 2p^6$).

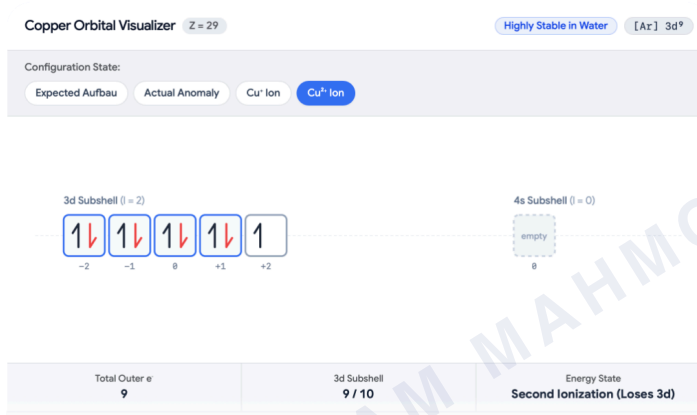
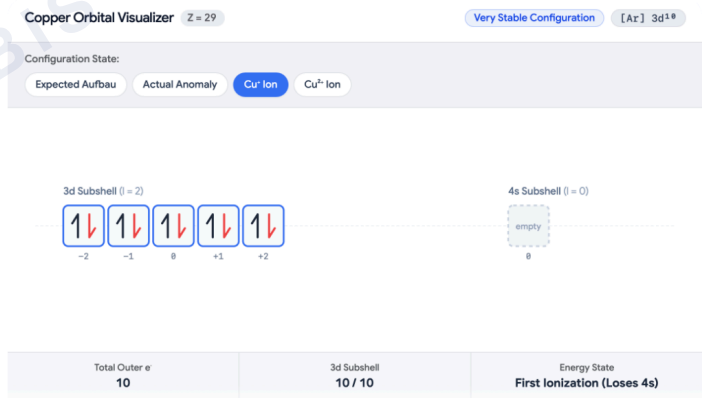
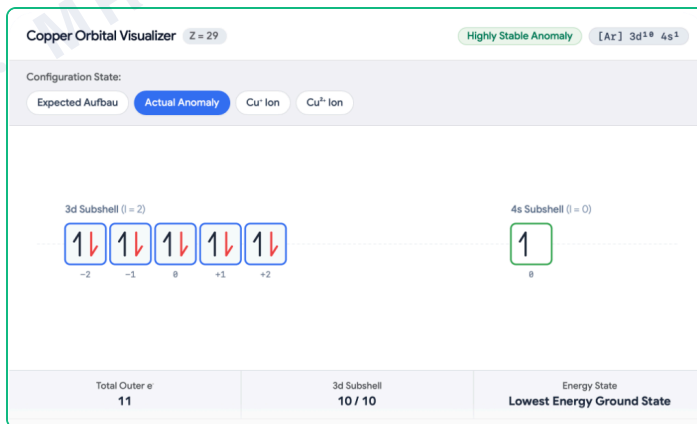
2. Main-Group Cations (Lose e^-): Outermost s-electrons lost first (e.g. Mg: $[Ne] 3s^2 \rightarrow Mg^{2+}: [Ne]$).

THE TRANSITION METAL "FIRST IN, FIRST OUT" (FIFO) RULE:

In neutral atoms, 4s fills before 3d. **When forming cations, electrons are ALWAYS removed from 4s FIRST before 3d!**

Visual Deep-Dive: The Copper (Cu, Z = 29) Orbital Visualizer

Follow the 4 distinct stages of Copper from expected Aufbau to actual ground-state anomaly and sequential ionization:



Element	Neutral Configuration	Stripped Cation	Cation Configuration
Iron (Fe)	$[Ar] 3d^6 4s^2$	Fe^{2+} (Ferrous)	$[Ar] 3d^6$
Iron (Fe)	$[Ar] 3d^6 4s^2$	Fe^{3+} (Ferric)	$[Ar] 3d^5$
Copper (Cu)	$[Ar] 3d^{10} 4s^1$	Cu^{2+} (Cupric)	$[Ar] 3d^9$

Section 1.5.6: Isoelectronic Series & Ionic Radii

An **isoelectronic series** is a group of species having the exact same number of electrons (same configuration).

Visual Comparison Drawing: 10-Electron Series ($1s^2 2s^2 2p^6$)

Notice how increasing nuclear charge (more protons) contracts the electron cloud:



The Official AP Justification Template

Why is F^{-} smaller than O^{2-} ?

- Both F^{-} and O^{2-} are isoelectronic with 10 electrons in the $n = 2$ shell (identical shielding).
- Fluorine has **9 protons ($Z = +9$)**, while oxygen has only **8 protons ($Z = +8$)**.
- By Coulomb's Law, the greater nuclear charge in F^{-} exerts a **stronger electrostatic attraction**, pulling the cloud tighter and resulting in a **smaller radius**.

Section 1.5.7: Coulomb's Law & First Ionization Energy

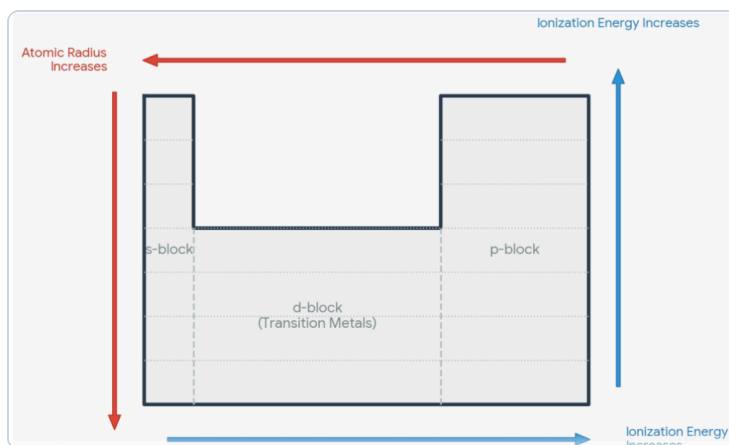
1. Coulomb's Law Governing Periodic Trends (Vertical Ratio Form)

$$\text{Force of Electrostatic Attraction} \propto \frac{q_1 \times q_2}{r^2}$$

- **Numerator ($q_1 \times q_2$):** Charge magnitude. Higher effective nuclear charge (Z_{eff}) → Stronger attraction.
- **Denominator (r^2):** Distance squared. As valence electrons enter higher shells (larger r), attraction decreases exponentially!

2. First Ionization Energy (IE_1) Trends

- **Across a Period (Left to Right):** IE_1 **Generally INCREASES**. Distance r is roughly constant (same shell n), but proton count Z increases. Valence electrons are held more tightly.
- **Down a Group (Top to Bottom):** IE_1 **DECREASES**. Shell n increases, placing valence electrons farther away with more inner core shielding.



3. Periodic Anomalies (AP Exam Favorites!)

- **Be > B:** Boron's 2p electron is higher energy and partially shielded by 2s² electrons, requiring less energy to remove.
- **N > O:** Oxygen has **electron-electron repulsion** between paired electrons in its 2p orbital, making that electron easier to remove.

Section 1.5.8: Predicting Ionic Formulas from Valence Configurations

1. Deducing Group & Charge from Configuration

Given element X with configuration: $1s^2 2s^2 2p^6 3s^2 3p^3$

1. Outermost shell: $n = 3$.
2. Valence electrons: $3s^2 + 3p^3 = 5$ valence electrons $\rightarrow$ Group 15.
3. Stable ion: Needs 3 electrons to complete octet $\rightarrow$ forms X^{3-} .

2. Combining with Magnesium (Mg) for Electrical Neutrality

- Magnesium is in Group 2 $\rightarrow$ forms Mg^{2+} .
- Element X forms X^{3-} .

Total Positive Charge + Total Negative Charge = 0

$$3 \times (+2) + 2 \times (-3) = (+6) + (-6) = 0$$

Balanced Empirical Formula:



Example Identity: Element X is phosphorus ($Z = 15$); the compound formed is magnesium phosphide, Mg_3P_2 .

Prepares for Homework Question 1

Model 1: Counting Subatomic Particles in $^{56}_{26}\text{Fe}$

Scenario: How many protons, neutrons, and electrons are in an atom of Iron-56 ($^{56}_{26}\text{Fe}$)?

Step-by-Step Solution:

1. **Protons:** Equal to atomic number Z (lower number) → **26 protons**.
2. **Neutrons:** Mass number minus atomic number: $A - Z = 56 - 26 = \mathbf{30 \text{ neutrons}}$.
3. **Electrons:** Neutral atom (no charge indicated) → electrons = protons = **26 electrons**.

Answer: 26 protons, 30 neutrons, 26 electrons.

Watch-Out: Never treat mass number 56 as the number of neutrons!

Prepares for Homework Question 2

Model 2: Identifying True Pairs of Isotopes

Scenario: Which represents a true pair of isotopes? (A) $^{14}_6\text{C}$ & $^{14}_7\text{N}$ (B) $^{23}_{11}\text{Na}^+$ & $^{24}_{11}\text{Na}$ (C) $^{35}_{17}\text{Cl}$ & $^{37}_{17}\text{Cl}$ (D) $^{16}_8\text{O}$ & $^{16}_8\text{O}^{2-}$

Step-by-Step Solution:

- Criteria: Must have **same atomic number Z** (same element) and **different mass number A** (different neutrons).
- Choice C has $Z = 17$ for both, with $A = 35$ (18 neutrons) and $A = 37$ (20 neutrons).

Answer: (C) $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.

Prepares for Homework Question 3

Model 3: Ground-State Configuration of F⁻ Anion

Scenario: What is the ground-state electron configuration of the fluoride ion (F⁻)?

Step-by-Step Solution:

1. Neutral fluorine (Z = 9) has 9 electrons: $1s^2 2s^2 2p^5$.
2. The -1 charge means 1 electron is gained: $9 + 1 = 10$ electrons.
3. Adding 1 electron to 2p completes the octet: $1s^2 2s^2 2p^6$.

Answer: $1s^2 2s^2 2p^6$ (isoelectronic with Neon, [Ne]).

Prepares for Homework Question 4

Model 4: Determining Isolelectronic Species for Br^-

Scenario: Which of the following ions has the same number of electrons as Br^- ? (A) Cl^- (B) Se^{2-} (C) K^+ (D) I^-

Step-by-Step Solution:

1. Bromide (Br^-): $Z = 35$, gained $1\text{e}^- \rightarrow$ **36 electrons** (Krypton core).
2. Selenium (Se , $Z = 34$): Se^{2-} gained $2\text{e}^- \rightarrow 34 + 2 =$ **36 electrons**.

Answer: (B) Se^{2-} .

Prepares for Homework Question 5

Model 5: Valence Configurations & Predicting Mg_3X_2

Scenario: Element X has configuration $1s^2 2s^2 2p^6 3s^2 3p^3$. What compound does it form with magnesium?

Step-by-Step Solution:

1. Element X has 5 valence electrons ($3s^2 3p^3$) $\rightarrow$ gains $3 e^-$ to form X^{3-} .
2. Magnesium (Group 2) forms Mg^{2+} .
3. Criss-cross for neutrality: $3 \times (+2) + 2 \times (-3) = 0 \rightarrow \text{Mg}_3\text{X}_2$.

Answer: Mg_3X_2 .

Prepares for Homework Question 6

Model 6: Greatest First Ionization Energy

Scenario: Which configuration has the greatest first ionization energy? (A) $[\text{Ne}] 3s^1$ (B) $[\text{Ne}] 3s^2 3p^2$ (C) $[\text{Ne}] 3s^2 3p^6$ (D) $[\text{Ar}] 4s^1$

Step-by-Step Solution:

- Configuration C is **Argon**, a noble gas with a closed shell octet ($3s^2 3p^6$).
- It has the highest effective nuclear charge (Z_{eff}) in Period 3 and holds its electrons most tightly.

Answer: (C) $1s^2 2s^2 2p^6 3s^2 3p^6$.

Prepares for Homework Question 7

Model 7: Detecting Excited-State Configurations

Scenario: Which represents an excited state? (A) $1s^2 2s^2 2p^6 3s^2$ (B) $1s^2 2s^2 2p^5 3s^1$ (C) $1s^2 2s^2 2p^7$ (D) $1s^2 2s^2 2d^4$

Step-by-Step Solution:

- In B, total electrons = 10 (Neon). An electron from 2p jumped to 3s. Capacities are respected.
- C is impossible (2p cannot hold 7 e^-); D is impossible (no 2d orbital).

Answer: (B) $1s^2 2s^2 2p^5 3s^1$.

Prepares for Homework Question 8

Model 8: Explaining Why F^- is Smaller than O^{2-}

Scenario: Which best accounts for F^- being smaller than O^{2-} ?

Step-by-Step Solution:

1. Both ions have 10 electrons (isoelectronic) and identical shielding.
2. Fluorine has **9 protons**; Oxygen has **8 protons**.
3. Greater nuclear charge pulls the electron cloud closer.

Answer: (B) F^- has a larger nuclear charge (more protons) than O^{2-} .

Diagnostic Matrix of AP Exam Errors & Traps

Common Error	Why Students Make It	Correct AP Principle
Removing 3d before 4s in cations	4s filled first in neutral atom.	4s electrons are farthest out and always lost first .
Thinking F^- is smaller due to fewer electrons	Forgot both ions have 10 e^- .	F^- is smaller because it has more protons (9 vs 8) .
Calling $2p^7$ an excited state	Assumed weird means excited.	Subshell capacities cannot be exceeded; $2p^7$ is impossible .
Confusing Mass # with Atomic Mass	Saw decimal on periodic table.	Mass number is an integer for one nucleus; decimal is average.

Part 3: Student Subtopic Mastery Checklist

Audit your mastery before quizzes or unit exams:

Target Skill	Ref.	I Got This!	Need Review
1. Count subatomic particles from nuclide notation A_ZX .	p. 3	☐	☐
2. Distinguish isotopes from isobars and ions.	p. 3, 12	☐	☐
3. State orbital capacities for s, p, d, f subshells.	p. 4	☐	☐
4. Apply Aufbau, Hund's Rule, and Pauli Exclusion.	p. 5	☐	☐
5. Identify ground, excited, and impossible states.	p. 6, 17	☐	☐
6. Write electron configurations of anions and cations (FIFO).	p. 7	☐	☐
7. Compare isoelectronic species using Coulomb's Law.	p. 8, 18	☐	☐
8. Justify ionization energy trends and anomalies (Be/B, N/O).	p. 9, 16	☐	☐
9. Predict ionic formulas from electron configurations (Mg_3X_2).	p. 10, 15	☐	☐

Part 4: Student Misconception Vault

Record your homework mistakes here to ensure 100% retention for the AP Exam:

Question #	My Initial Mistake	The Correct AP Chemistry Principle
Example	Subtracted 3d electrons for Fe^{2+}	4s electrons are lost first in transition metal ionization.

End-of-Week Action Commitment:

- The hardest concept for me was: _____
- Action: ☐ Re-solve homework models ☐ Review Annex Pages 22–28

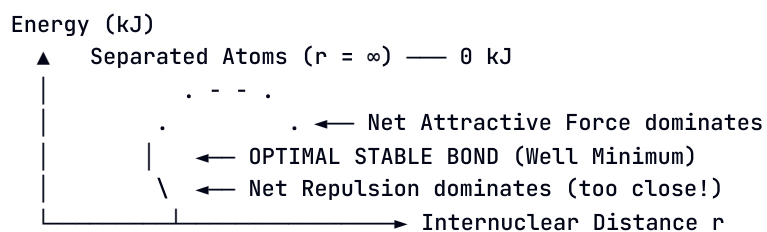
Visual Annex: Reference Diagrams

1. The Aufbau Diagonal Filling Ladder



Filling Order: $1s \rightarrow 2s \rightarrow 2p \rightarrow 3s \rightarrow 3p \rightarrow 4s \rightarrow 3d \rightarrow 4p \rightarrow 5s \rightarrow 4d \rightarrow 5p \rightarrow 6s \rightarrow 4f \rightarrow 5d \rightarrow 6p \rightarrow 7s$

2. Coulombic Potential Energy Curve



3. Isoelectronic Radius Contraction

N^{3-} (146 pm) > O^{2-} (140 pm) > F^- (133 pm) > Na^+ (102 pm) > Mg^{2+} (72 pm) > Al^{3+} (54 pm)

More Protons (Higher Z) → Stronger Coulombic Inward Pull → Smaller Radius

Prerequisite Annex A: Cations vs. Anions

Property	Cation (+)	Anion (-)
Formation	Atoms lose electrons.	Atoms gain electrons.
Particles	Protons > Electrons.	Electrons > Protons.
Typical Elements	Metals (Groups 1, 2, 13, Transition).	Nonmetals (Groups 15, 16, 17).
Size vs. Atom	Always smaller (empties outer shell).	Always larger (e^- - e^- repulsion).
Memory Trick	"t" in cation looks like a + sign!	A Negative Ion = AN Ion!

Predictable Charges:

- Group 1: +1 (Na^+) | Group 2: +2 (Mg^{2+}) | Group 13: +3 (Al^{3+})
- Group 15: -3 (N^{3-}) | Group 16: -2 (O^{2-}) | Group 17: -1 (F^- , Cl^-)

Prerequisite Annex B: Subatomic Particle Accounting

Formulas for ${}^A_ZX^{\text{charge}}$:

- **Protons:** Equal to atomic number **Z**.
- **Neutrons:** Mass number minus atomic number: **A – Z**.
- **Electrons:** Atomic number minus charge: **Z – Charge**.

Nuclide	Protons (Z)	Mass Number (A)	Neutrons (A–Z)	Electrons
${}^{12}_6\text{C}$	6	12	6	6
${}^{14}_6\text{C}$	6	14	8	6
${}^{23}_{11}\text{Na}^+$	11	23	12	10
${}^{31}_{15}\text{P}^{3-}$	15	31	16	18

Prerequisite Annex C: Coulomb's Law Fundamentals

$$\text{Force of Attraction} = k \times \frac{q_1 \times q_2}{r^2}$$

- **Rule 1 (Charge Factor):** Greater charge product ($|q_1 \cdot q_2|$) → Stronger attraction.
- **Rule 2 (Distance Factor):** Greater distance (r) → Exponentially weaker attraction ($1/r^2$).

Application to Trends:

- **Ionization Energy:** Increases across period because q_1 (Z_{eff}) increases while r is similar.
- **Atomic Radius:** Increases down group because valence electrons enter higher shells (larger r).

Prerequisite Annex D: Bohr Shells & Shielding

1. Valence vs. Core Electrons

- **Valence Electrons:** Electrons in the outermost shell n . Participate in bonding.
- **Core Electrons:** Inner electrons that shield valence electrons from the nuclear charge.

2. Effective Nuclear Charge Formula

$$Z_{\text{eff}} = Z - S \quad (\text{where } S \approx \text{number of core electrons})$$

- Sodium: $Z_{\text{eff}} \approx 11 - 10 = +1$
- Chlorine: $Z_{\text{eff}} \approx 17 - 10 = +7$

Core shielding remains constant across Period 3, but protons increase $\rightarrow Z_{\text{eff}}$ pulls electrons tighter!

Prerequisite Annex E: Balancing Ionic Compounds

The Criss-Cross Method:

Step 1: Write ions with charges: Al^{3+} O^{2-}
Step 2: Cross charge numbers to subscripts: $\backslash$ /
Step 3: Drop signs: Al_2 O_3

Cation	Anion	Subscripts	Balanced Formula
Na^+	Cl^-	1:1	NaCl
Mg^{2+}	F^-	1:2	MgF_2
Ca^{2+}	O^{2-}	2:2 → 1:1 (Reduce!)	CaO
Mg^{2+}	N^{3-}	3:2	Mg_3N_2

Prerequisite Annex F: Periodic Table Geography

Periodic Table Block Architecture

The diagram illustrates the periodic table's block architecture. It shows groups 1 through 18. Groups 1 and 2 are colored red and labeled 'S'. Groups 3 through 12 are colored yellow and labeled '(n-1)d'. Groups 13 through 18 are colored blue and labeled 'P'. The bottom two rows (groups 3-12) are colored green and labeled '(n-2)f'.

Group	Family	Valence	Charge	Key Characteristic
Group 1	Alkali Metals	ns^1	+1	Soft, highly reactive with water.
Group 2	Alkaline Earths	ns^2	+2	Reactive metals, form basic oxides.
Groups 3–12	Transition Metals	Variable	+2, +3	Lose 4s before 3d; colored solutions.
Group 17	Halogens	ns^2np^5	-1	Highly reactive nonmetals.
Group 18	Noble Gases	ns^2np^6	0 (Inert)	Full stable octet; very high IE_1 .

Metals vs. Nonmetals:

- **Metals (Left):** Low IE_1 and electronegativity; readily form cations.
- **Nonmetals (Right):** High electronegativity; readily form anions or share electrons.



CONGRATULATIONS! YOU HAVE COMPLETED THE ENTIRE 28-PAGE COMPANION!