🤼 KADEN'S CHEM CH 6 DAILY MEMORY SHEET

Goal: 87.17% → 90% (A-). About 3 points. Read this 10–15 min a day on the trip. Say it out loud. Rep it like a drill.

🎸 Practice it like scales: same reps every day until it's automatic.

ROUND 1 · Valence Electrons (A-groups)

Group	1	2	13	14	15	16	17	18
Valence e^-	1	2	3	4	5	6	7	8 (He = 2)
Example	H, Na	Be, Mg	B, Al	C, Si	N, P	O, S	F, Cl	Ne, Ar

Ions: **add** 1 e^- for each negative charge, **subtract** 1 e^- for each positive charge.
$NH_4^+ = 5 + 4(1) - 1 =$ **8** · $CO_3^{2-} = 4 + 3(6) + 2 =$ **24**

ROUND 2 · Lewis Structure Takedown (7 moves)

1. **Count** total valence e^- (adjust for charge).
2. **Pick the central atom**: least electronegative (usually C; never H).
3. **Connect** with single bonds (each bond = 2 e^-).
4. **Fill outer atoms** to an octet with lone pairs (H only gets 2).
5. **Leftover e^- go on the central atom as lone pairs.**
6. Central atom short of an octet? **Move a lone pair in to make a double/triple bond.**
7. **Check:** e^- drawn = e^- counted. Formal charge = V − (lone-pair e^-) − ½(bonding e^-). Best structure has charges closest to 0.

⚠️ **DR. K'S #1 NOTE: "Lewis structures need lone pairs, name of the shapes missing." → DRAW EVERY LONE PAIR. WRITE THE SHAPE NAME NEXT TO EVERY STRUCTURE.**

Octet exceptions: H = 2 · Be = 4 · B = 6 (BF_3) · Period 3+ central atoms can expand past 8 (PCl_5 = 10, SF_6 = 12) · Odd-electron molecules (NO).

ROUND 3 · Resonance

- Used when **more than one valid Lewis structure** exists (a double bond could go in different spots).
- Only **electrons** move — atoms stay put. Draw with a **double-headed arrow ↔**.
- The real molecule is an **average (hybrid)**: all those bonds are the same length.
- Classic examples: **O_3, NO_3^-, CO_3^{2-}** (3 resonance structures for NO_3^- and CO_3^{2-}).

ROUND 4 · VSEPR Shapes & ABE (AXE) Notation

A = central atom · **B (X)** = atoms bonded to it · **E** = lone pairs on the central atom. A double or triple bond counts as **ONE** electron domain.

Notation	Domains	Electron geometry	Shape name	Angle	Example
AB_2	2	linear	**Linear**	180°	CO_2, $BeCl_2$
AB_3	3	trigonal planar	**Trigonal planar**	120°	BF_3
AB_2E	3	trigonal planar	**Bent**	<120° (~119°)	SO_2
AB_4	4	tetrahedral	**Tetrahedral**	109.5°	CH_4
AB_3E	4	tetrahedral	**Trigonal pyramidal**	~107°	NH_3
AB_2E_2	4	tetrahedral	**Bent**	~104.5°	H_2O
AB_5	5	trigonal bipyramidal	**Trigonal bipyramidal**	90° & 120°	PCl_5
AB_6	6	octahedral	**Octahedral**	90°	SF_6

Bonus (expanded octets): AB_4E seesaw (SF_4) · AB_3E_2 T-shaped (ClF_3) · AB_2E_3 linear (XeF_2) · AB_5E square pyramidal (BrF_5) · AB_4E_2 square planar (XeF_4).

> **Why angles shrink:** lone pairs push harder than bonding pairs. 109.5° → 107° (1 lone pair) → 104.5° (2 lone pairs).

ROUND 5 · Polarity & IMFs

- **Bond type by electronegativity difference:** 0–0.3 nonpolar covalent · 0.3–1.7 polar covalent · >1.7 ionic.
- **Molecule polarity:** polar bonds + **unsymmetrical shape** (lone pairs on center, or different outer atoms) = **polar** (H_2O, NH_3). Symmetrical shapes cancel = **nonpolar** (CO_2, BF_3, CH_4).
- **London dispersion:** in ALL molecules; stronger with more electrons.
- **Dipole–dipole:** between polar molecules.
- **Hydrogen bonding:** H bonded directly to **F, O, or N** → strongest IMF (why water boils so high).

ROUND 6 · Ch 4 Refresher (light + electrons)

- **$c = \lambda\nu$** c = 3.00 × 10^8 m/s (λ = wavelength in m, ν = frequency in Hz or s^{-1})
- **$E = h\nu$** h = 6.626 × 10^{-34} J·s. Higher frequency = higher energy = shorter wavelength.
- **Quantum numbers:** n = energy level (1, 2, 3…) · l = sublevel (0 = s, 1 = p, 2 = d, 3 = f; up to n − 1) · m_l = orbital (−l to +l) · m_s = spin (+½ or −½)
- **Orbitals / max e^-:** s = 1 / 2 · p = 3 / 6 · d = 5 / 10 · f = 7 / 14 · per energy level max = $2n^2$
- **Fill order (Aufbau):** 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p
- **Hund's rule:** one e^- in each orbital of a sublevel (same spin) before any pair up.
- **Pauli exclusion:** max 2 e^- per orbital, opposite spins.
- **Noble gas shorthand:** Na = [Ne] $3s^1$ · Fe = [Ar] $4s^2$ $3d^6$

🎤 SAY IT OUT LOUD · Daily Self-Quiz

1. How many valence e^- in CO_2?	☐
2. AXE notation and shape of NH_3? Angle?	☐
3. AXE notation and shape of H_2O? Angle?	☐
4. Bond angle in CH_4? Shape name?	☐
5. Which has resonance: O_3 or H_2O?	☐
6. Is CO_2 polar? Why or why not?	☐
7. Shape of BF_3, and how many e^- around B?	☐
8. SO_2: total valence e^-, AXE, shape?	☐
9. Lone pairs on the central atom of NH_3? Of H_2O?	☐
10. Strongest IMF between H_2O molecules?	☐
11. Formula linking energy and frequency?	☐
12. Max electrons in a p sublevel?	☐
13. Electron configuration of oxygen?	☐
14. Formal charge formula?	☐
15. Valence e^- in CO_3^{2-}?	☐

Answers on the next page — cover them up first! 💪

✅ ANSWER KEY

1	**16** (4 + 6 + 6)
2	**AB_3E, trigonal pyramidal, ~107°**
3	**AB_2E_2, bent, ~104.5°**
4	**109.5°, tetrahedral** (AB_4)
5	**O_3** (the double bond can sit on either side)
6	**No** — the C=O bonds are polar, but the linear shape is symmetrical so they cancel
7	**Trigonal planar, 120°**; only **6** e^- around B (octet exception)
8	**18** e^- (6 + 6 + 6); **AB_2E, bent**, a bit under 120°; it has resonance
9	NH_3: **1** lone pair · H_2O: **2** lone pairs
10	**Hydrogen bonding** (H bonded to O)
11	**$E = h\nu$**
12	**6** (3 orbitals × 2)
13	**$1s^2\ 2s^2\ 2p^4$** (8 electrons)
14	**FC = V − (lone-pair e^-) − ½(bonding e^-)**
15	**24** (4 + 3×6 + 2)

🏆 **Training camp schedule (10–15 min/day)**
Days 1–3 (Nov 16–18): Rounds 1–2 · draw 3 Lewis structures a day with EVERY lone pair
Days 4–6 (Nov 19–21): Round 4 · say each AXE row out loud, name every shape
Days 7–9 (Nov 22–24): Round 3 + bond angles
Days 10–12 (Nov 25–27): Round 5 · polarity & IMFs
Days 13–14 (Nov 28–29): Round 6 · Ch 4 refresher
Days 15–17 (Nov 30–Dec 2): full self-quiz every day. Aim for 15/15.

3 points. One match. Go get that A. 🤼‍♂️🎸
— Dad