

Quiz 7 — Principles for Isomers & "Precision"

(this still isn't complete, but will be later tonight)

Finding Patterns - organizing your knowledge improves understanding, remembering, using; is emphasized in lecture, and illustrated in Quizzes 1 (tnksueaeoehgyhtcadlm) and 2 (lunch dog my sneaky the ate), and 3 (making it a story).

isomers have *same* **chemical formula** (number of each atom), *different* **structural formula** (connectivity of atoms).

to **convert a name into a structure**, begin at name's right side and work leftward: 2,2,4-trimethylpentane (Lecture 25, slide 24) shows there are no double bonds (ane), # of Cs in the longest chain (pent), what else (trimethyl) and where (2,2,4).

alkyl groups: e.g., ethane (CH₃-CH₃, complete as-is) vs ethyl (CH₃-CH₂-, must connect to another C to be complete with 4 bonds for each C); similar for methane vs methyl, ...

carbons are numbered so sum of numbers is minimized; e.g. slides 33-34 show 2-methylhexane, not 5-methylhexane; for slides 49-55 it's 1-pentene (not 2-) and 2-pentene (not 3-). { also priorities* that (I think) are not used in 108 [* not just sums] }

hydrocarbon name is based on **longest continuous chain**, which may not be longest **straight** chain; e.g., 2-ethyl pentane is wrong, it's 3-methyl hexane. (slides 37-38)

n- (n-butane, n-pentane,...) has all C's in a continuous "straight chain" with no branching.

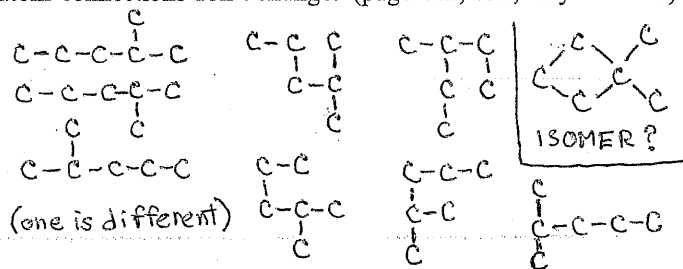
usually, **iso-** (iso-butane, iso-pentane,...) has simplest possible branching, with methyl group on 2-carbon, forms "V" in line diagram; these are named for total number of carbons (iso-pentane is 2-methyl butane,...); for historical reasons, iso-octane (2,4,4-trimethylpentane) doesn't fit this pattern.

drawing isomers: creative thinking (get all possibilities) + critical thinking (eliminate duplicates with same connectivity).

draw 3 isomers of C₅H₁₂ (longest chains have 5 Cs, 4, and 3).
draw 9 isomers for C₅H₁₀ (five alkenes; four cyclo, 5 4 3 3).
draw all 5 isomers of C₆H₁₄ (one with 6 in longest chain, two with 5 in longest chain, and two with 4 in longest chain).

a **saturated hydrocarbon** (alkane) is totally "loaded up" with maximum possible H's; **unsaturated hydrocarbon** (e.g. alkene with one or more C=C's) can have more H's added to it. each C=C or **cyclic ring** removes 2 H's (draw to see why) so C₅H₁₀ can be alkenes or cyclo-alkanes, which are isomers. But n-pentane and cyclopentane (both alkanes) are not isomers.

only connectivity matters — you can "flip" & "bend" & "rotate" molecules without changing structural formula, so the name doesn't change (use this to check for duplicates), IF the atom-connections don't change. (page 442, #31; key on A-27)



These (above) are not structural formulas. (wrong on a test)

chemical formula (shows only atoms), e.g. C₃H₈ or C₃H₈O.
condensed structural formula (shows connectivity, but is symbolically encoded) as in CH₃CH₂CH₃ or CH₃CH₂CH₂OH.
structural formula: shows all atoms and all bonds.

Lewis structure: structural formula + unshared electrons; shared electrons can be drawn as dots (:) or line (-).

unshared els (non-bonding els, lone els) ≠ **unpaired** el (in a radical); for a radical (Lewis or structural formula) you must put unpaired el on atom where it belongs (•OH instead of OH•).

in a condensed structural formula, you have **options when writing location of Hs**, so either of these (H₂C=CH-CH₂-CH₃ or CH₂=CH-CH₂-CH₃) is OK.

line diagrams: C (with Hs) is at each **corner** and **line-end**. in slide 63, all are acceptable; pentane =

shape around C=C bond is trigonal planar (≈ 120° angles).

for **molecular shape**, imagine sitting on central atom, asking two questions: A) in how many directions can I see **electrons**? B) in how many directions can I see **atoms**? The combinations,

A:	4	4	4	3	3	2	2
B:	4	3	2	3	2	2	1
	CH ₄	NH ₃	H ₂ O	SO ₃	SO ₂	CO ₂	CO
	tetrahedral	trigonal pyramid	bent	trigonal planar	bent	linear	(trivial)

(*symmetric* *not-sym* *not-sym* *sym* *not-sym* *sym*)
(*nonpolar* *polar* *polar* *nonpolar* *polar* *nonpolar*)
but atoms also must be symmetric (CH₄ nonpolar, CH₂F₂ polar)
{ Be careful — a "yes" for symmetry causes "no" for polarity. }

gasoline is a homogeneous mixture of hydrocarbons (mostly C₅-C₁₀) so it's nonpolar, a liquid with density of ≈ 7 g/mL (less than H₂O, 1.00 g/mL), a fuel. [mix: alkanes, alkenes, aromatics]

Precision in Arithmetic

Significant Figures (underlined): .0070800 70800. 70800,
19.00 g F / 1 mole F, .692 g iso-octane / 1 mL iso-octane;
"infinite" sig figs: 1000 g / 1 kg, 8 mole CO₂ / 1 mole C₈H₁₈

Arithmetic Operations with Sig Figs and Decimal Columns:

multiplication or division (use sig figs)	addition or subtraction (use decimal columns)
$\begin{array}{r} 387.1 \\ \times 1.25 \\ \hline 483.875 \end{array} \rightarrow 484$	$\begin{array}{r} 387.1 \\ + 1.25 \\ \hline 388.35 \end{array} \rightarrow 388.4$

No single H-isotope is 1.0079 g/mole; the **atomic mass** is the "averaged" mass (in g/mole) for a naturally occurring mix of isotopes. In lab a **mole** = an amount of H with mass of 1.0079 g.

Acid-Forming Reactions [some 2nd-H⁺ come from all H₂...]

