Office Hours: M 1:30pm – 3:00pm
(in Park 169) W 11:00am – 12:00pm
or by appointment (email me)
or just email me with questions!

TA Hours: TBD

Q-center: https://www.brynmawr.edu/inside/offices-services/q-center/q-center-schedule

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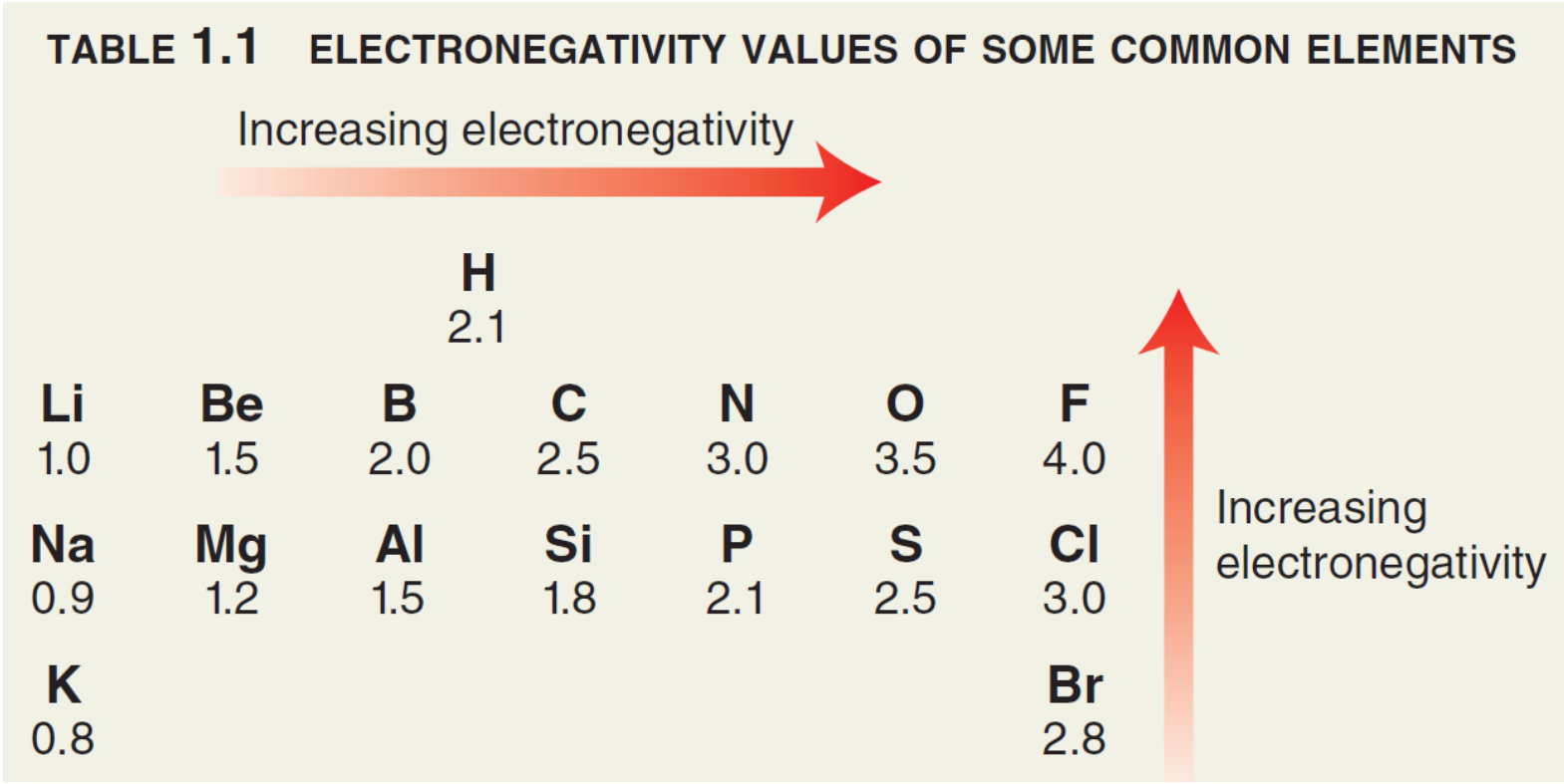
Bonding, Hybridization, and VSEPR Geometry

9/2/2026

Bond polarity

TABLE 1.1 ELECTRONEGATIVITY VALUES OF SOME COMMON ELEMENTS



Bond polarity is shown with a crossed arrow pointing toward the more Electronegative (EN) atom.

Partial charges (δ) depict unequal distribution of electrons in a bond.

For an individual bond between two atoms…. (from Gen Chem)

If ΔEN < 0.5 → bond is *nonpolar*

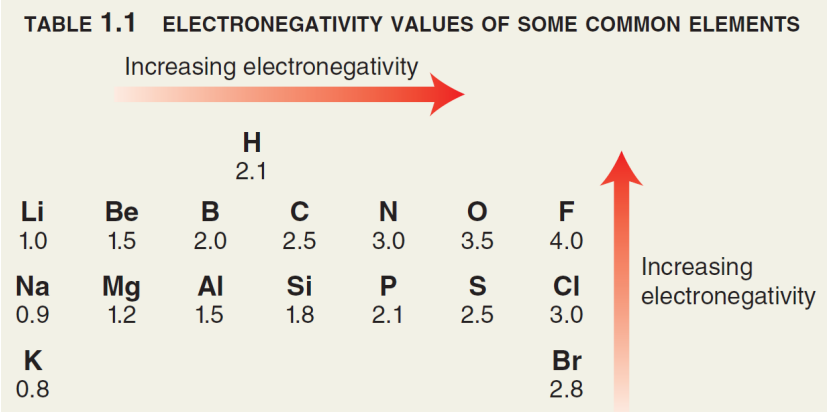
If ΔEN is between 0.5 and 1.7 → bond is *polar*

If ΔEN > 1.7 → "bond" is *ionic* & e^- are not shared!

Bond polarity (for Organic Chemists)

- Organic chemists characterize bonds between Carbon & Friends based more on

  _____ _____ than Pauling Scale EN values.



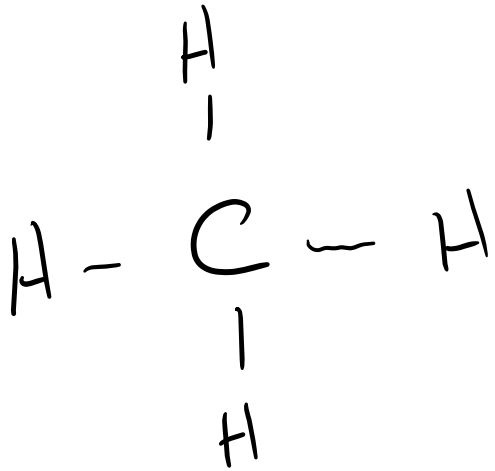
"Pauling Scale" electronegativity (EN)

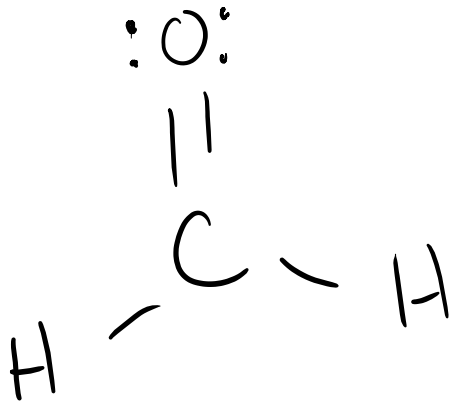
Common **nonpolar** *bonds*:

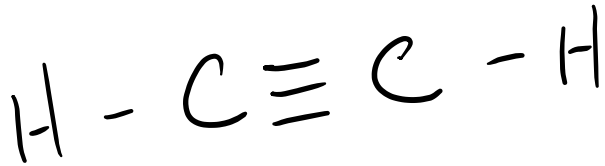
Common **polar** *bonds*:

- Formal charge/octet – prediction about stability/plausibility of structure
- **VSEPR** – predictions about geometry

Give approximate bond angles around each C, and "name" the molecule's geometry







- *Very* simplistic model of "where electrons are" in a molecule

Atomic orbitals

- What is an orbital?

- Recall from Gen Chem that the energy of electrons is quantized and not continuous –

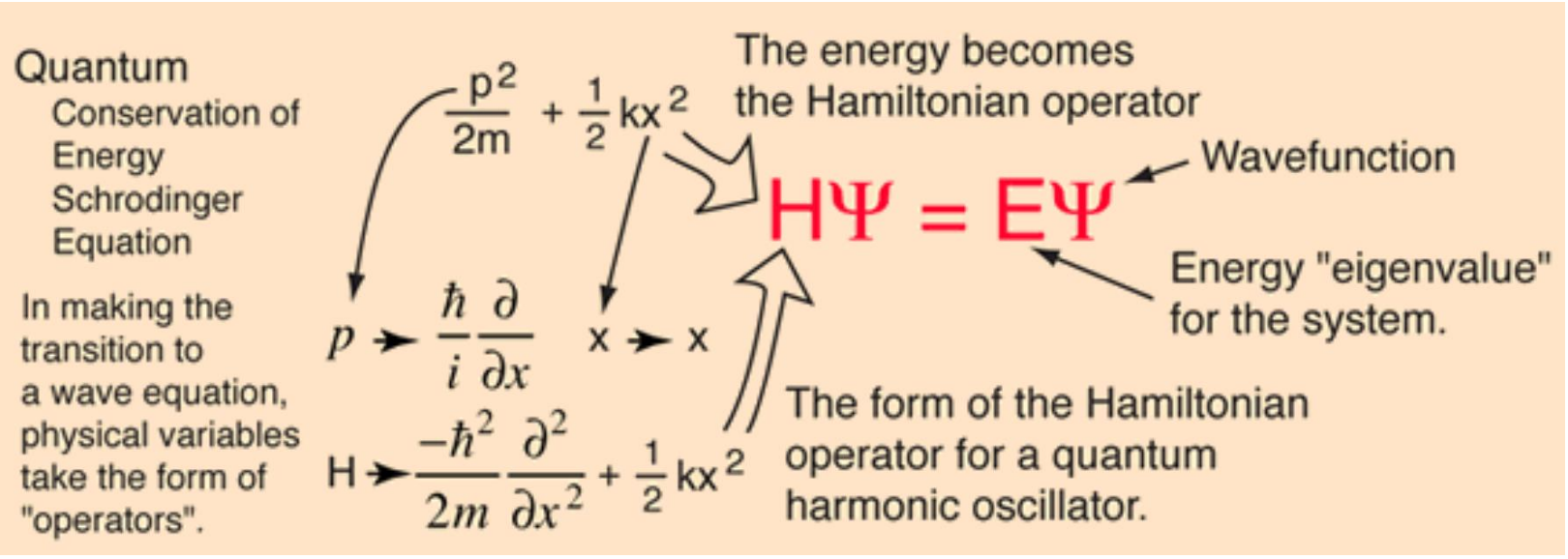
- Visualized as 3D probability density maps: region or “shape” where an electron is _____ _____ to be found, if it’s at a certain energy.

- An orbital holds a maximum of _____

- Cool story and all, but where do these shapes of orbitals come from?

The Schrödinger equation

- Electrons have both wave- and particle-like nature
- Schrödinger modeled electron as a 3D standing wave around nucleus
- Quantized energy levels of orbitals come from this model
  as do their corresponding 3D “shapes” at each energy level!



Solutions to the Schrödinger equation for Hydrogen

Orbital shapes:

s p d f

[Visualizer of solutions for Hydrogen orbitals]

More about p orbitals

Valence Bond Theory

- Bonding is a result of _____ _____ between two atoms
- Two important flavors of overlap in this class:

σ (sigma) π (pi)

σ-bond is _____ and _____ than π-bond!

Geometry of CH_4 (methane)

Valence electron configurations of C and H:

What bond angles does Valence Bond theory predict, given the orbitals involved that can overlap?

What bond angle does VSEPR predict for CH_4?

Valence Bond theory needs an adjustment!

Hybridized atomic orbitals

General idea: within one atom, the orbitals involved in sigma bonding or containing lone-pairs ***MIX*** (hybridize) to get <u>new atomic orbital shapes</u> that are **<u>degenerate</u>**.

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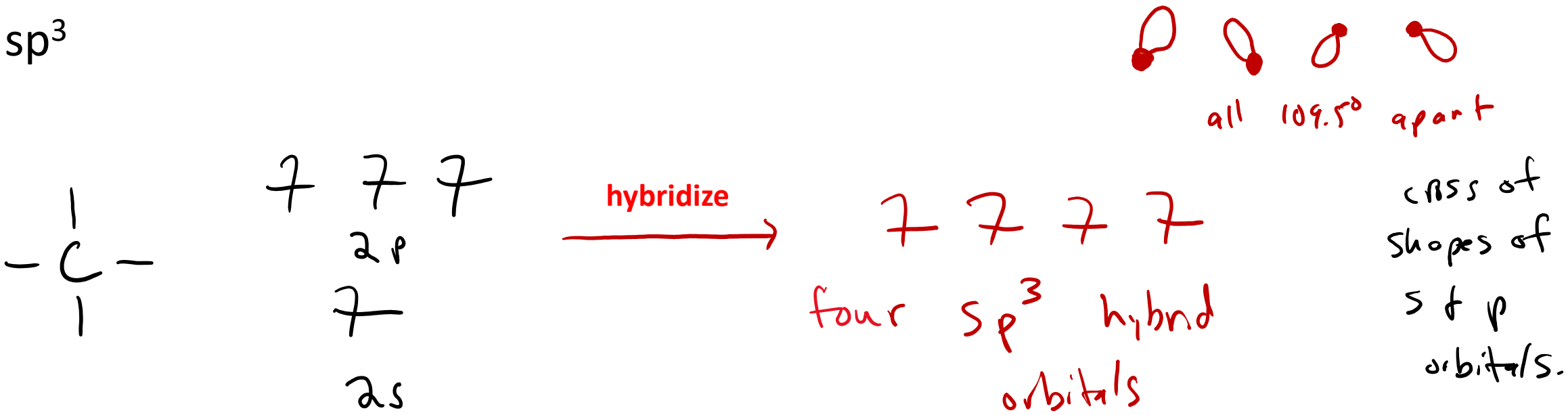
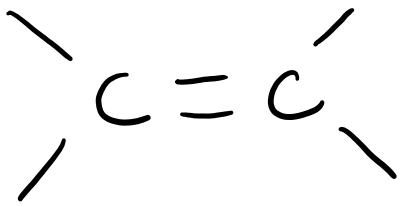
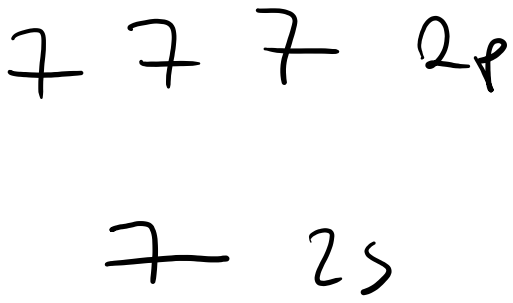
sp^3

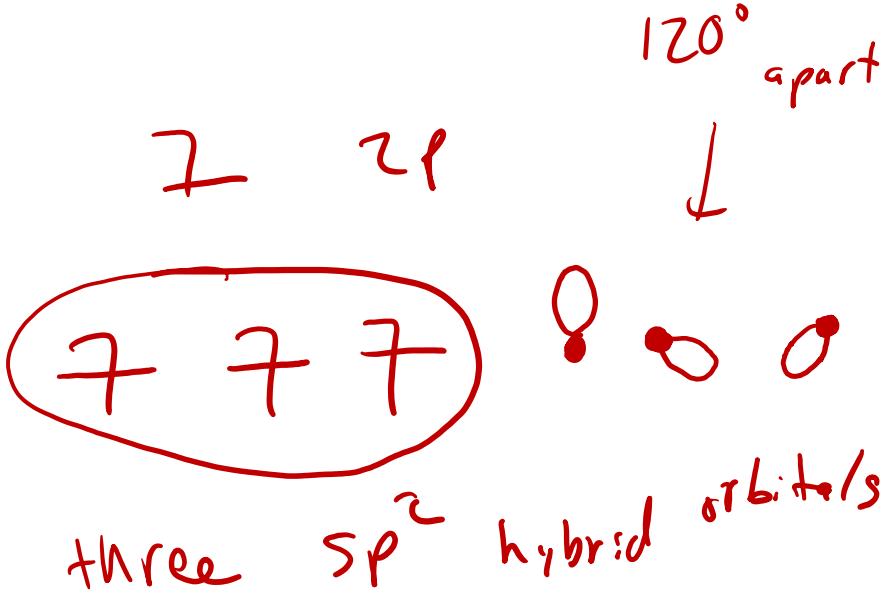


sp²





hybridize



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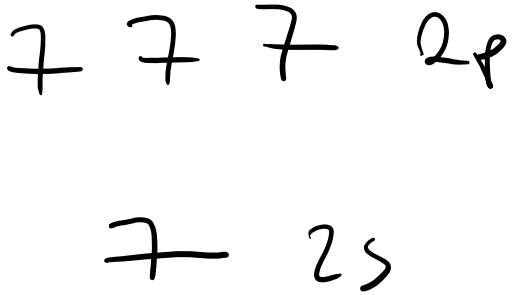
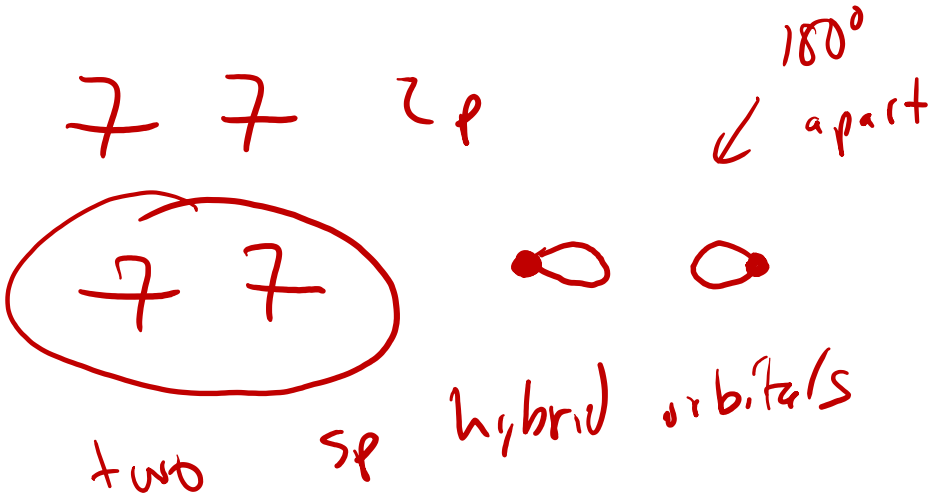
sp



hybridize

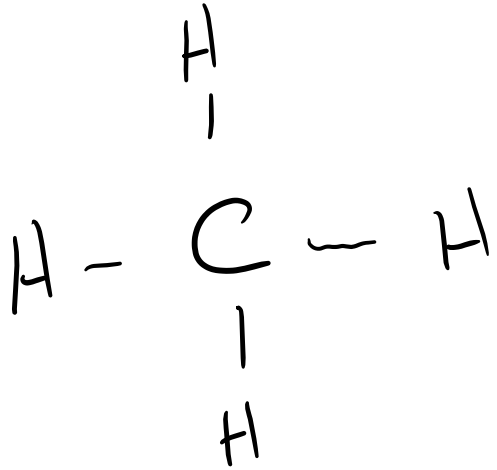


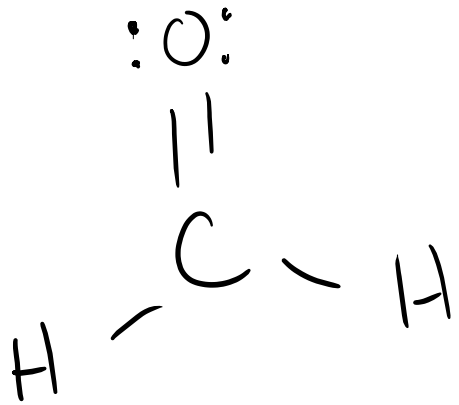
TL;DR for hybridization

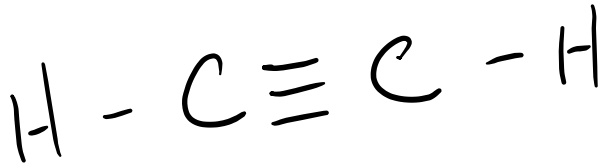
- Count the number of **electron groups** around an atom
  a double or triple bond only counts as **<u>one</u> group**
  each lone pair counts as **one group**

- Number of groups = the total number of *letters* in the hybridization label.

Examples:







Poll

MCAT Question

Identify the hybridization of the carbon atom and the oxygen atom indicated by the arrows.

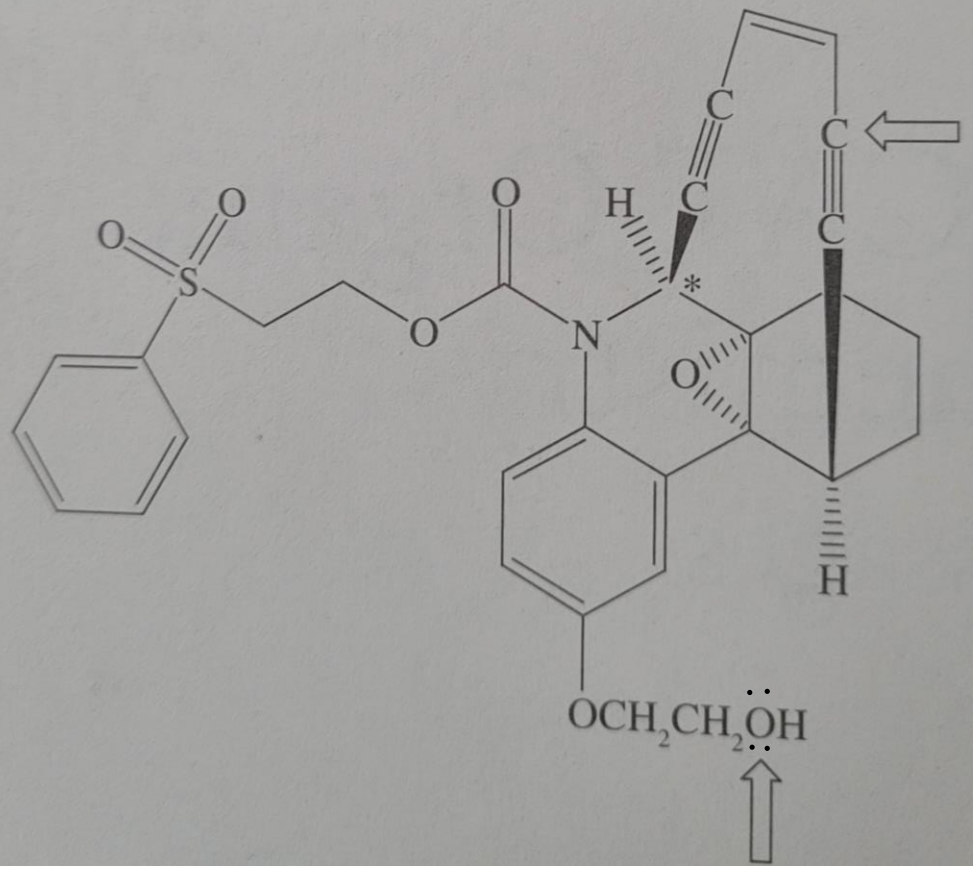
A. C: *sp*, O: sp^2

B. C: *sp*, O: sp^3

C. C: sp^2, O: sp^3

D. C: sp^3, O: sp^3

Recent research has demonstrated that there is a class of DNA-cleaving molecules that are referred to as *enediynes*. These compounds are known as enediynes because they contain a continuous six-carbon unit in which there is one double bond and two triple bonds. These DNA-cleaving molecules appear to be quite potent and, most importantly, selective in regards to anticancer activity. The following molecule has proven to be one of the more potent of these enediyne molecules:



pollev.com/timcook653 or text timcook653 to 22333 or use android/iphone app

Poll

MCAT Question

How many π-bonds does this molecule have?

A. 12

B. 13

C. 14

D. 15

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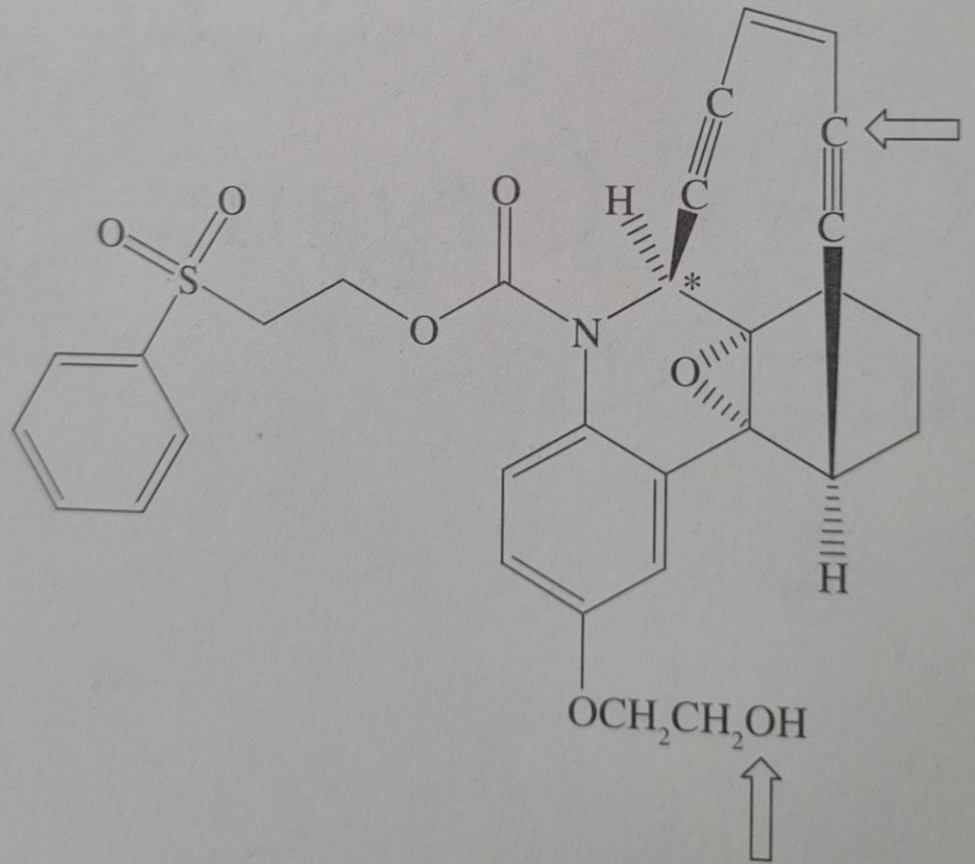

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Molecular vs electron geometry

Molecular geometry – describes shape formed by the atoms

Electron geometry – describes shape formed by the electron groups (including the lone pairs!)

Molecule polarity

A molecule is polar if it has a *net dipole moment* – or exhibits permanent, partial charges on atoms due to polar bonds.

A molecule can have polar bonds, but be nonpolar overall!