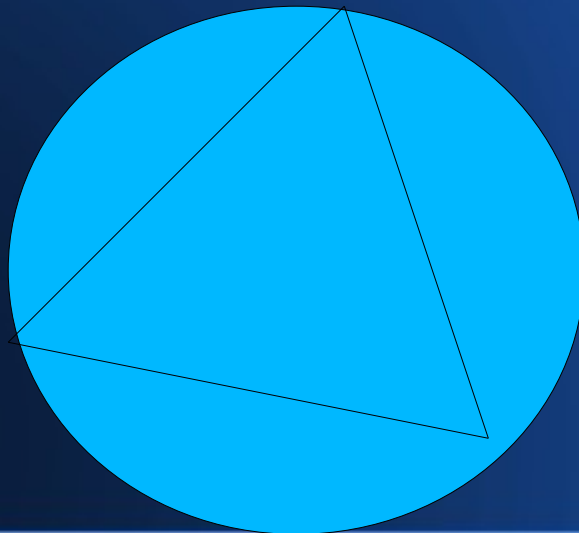


Calculating SP³ bond angles using spherical trig

IPFW Chemistry

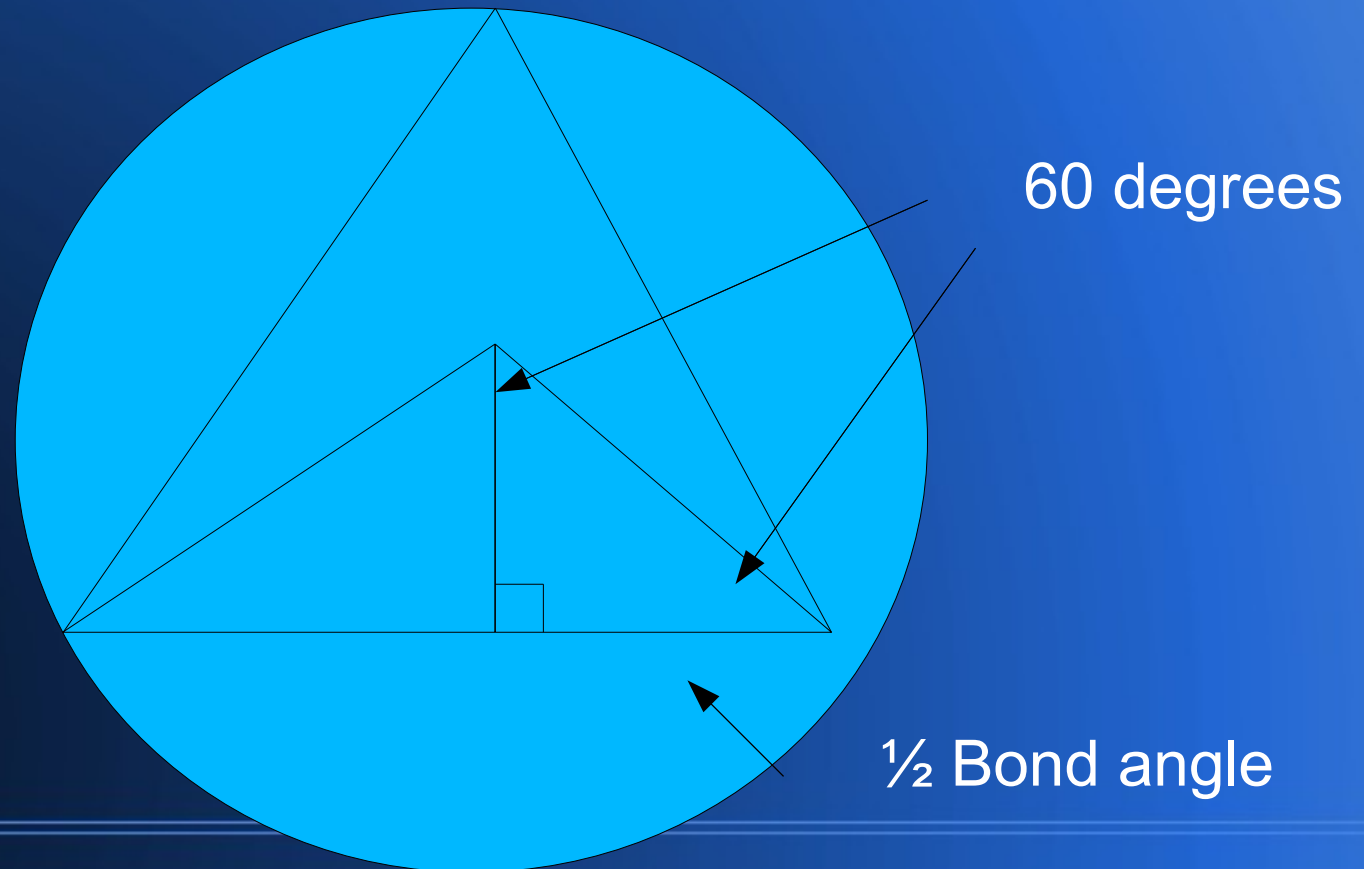
Step 1. Draw triangles on sphere to form pyramid on outside of sphere

- Angles at corners of triangles are each 120 degrees at each corner. Draw the four triangles on a globe to confirm this for yourself.
- Half angle is 60 degrees



Step 2.-Find middle of triangle and drop a perpendicular

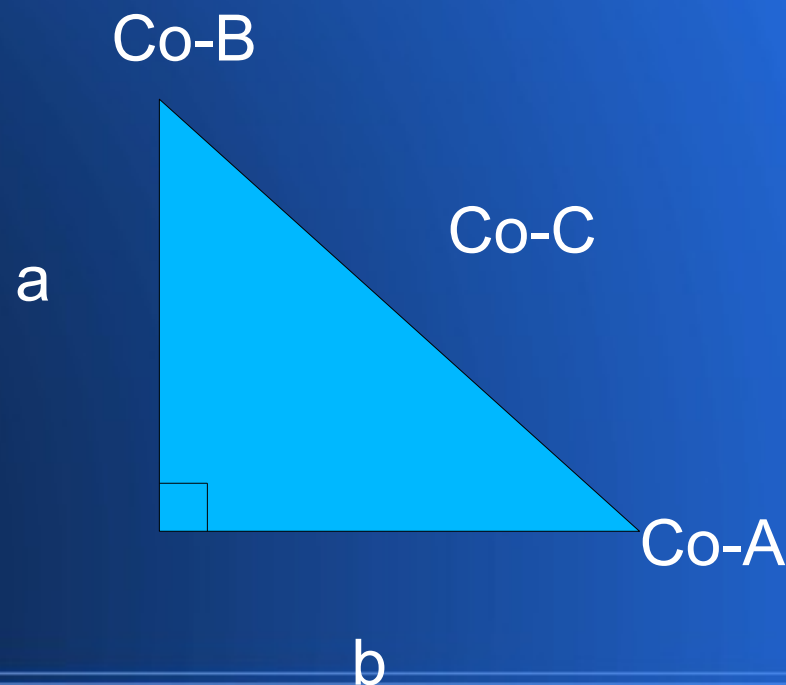
- Identify known angles



Step 3.-Write out Napier's rules for a spherical right triangle

- IOWA -Sine of any middle part is equal to the product of the cosine of the two opposite parts or the product of the tangent of the adjacent parts.

$$\text{Co-B} = 90 - B$$



Step 4.-Identify the known and desired angles and a rule to connect them

- $b = 1/2$ the bond angle
- $A = 60$, $Co-A = 30$ degrees
- $B = 60$ degrees, $Co-B = 30$ degrees
- Sine of any middle part is equal to the cosine of the opposite parts
- $\sin(30) = \cos(b) * \cos(30)$
- $\sin(30)/\cos(30) = \cos(b)$ or $\cos(b) = \tan(30)$

Step 5.- Solve

- $b=54.7$ degrees
- But b is half the bond angle therefore
- Bond angle equals 109.5 degrees!

Observation and Warning

- This is an average angle and actual angle can be slightly squashed due to differences caused by hybridization of different energy levels between s and p orbitals