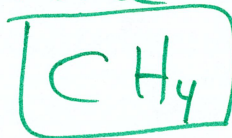


The Methane molecule bond angle.

Carbon at $(0,0,0)$



Hydrogen atoms at $(1,1,1)$, $(1,-1,-1)$,

$(-1,1,-1)$, and $(-1,-1,1)$. (Note that ~~the~~
~~an~~ even number of coordinates (0 or 2) are -1.)

Let $\vec{v}_1 = (1,1,1)$ and $\vec{v}_2 = (-1,-1,1)$.

$$\begin{aligned}\vec{v}_1 \cdot \vec{v}_2 &= (1,1,1) \cdot (-1,-1,1) = -1 - 1 + 1 = -1 \\ &= \|\vec{v}_1\| \|\vec{v}_2\| \cos \theta.\end{aligned}$$

$$\|\vec{v}_1\| = \|\vec{v}_2\| = \sqrt{1^2 + 1^2 + 1^2} = \sqrt{(-1)^2 + (-1)^2 + 1^2} = \sqrt{3}$$

Note:

$$\begin{aligned}\vec{v}_1 \cdot \vec{v}_2 &= \vec{v}_1 \cdot \vec{v}_3 \\ &= \vec{v}_1 \cdot \vec{v}_4 \\ &= \vec{v}_2 \cdot \vec{v}_3 \\ &= \vec{v}_2 \cdot \vec{v}_4 \\ &= \vec{v}_3 \cdot \vec{v}_4 \\ &= -1\end{aligned}$$

$$\text{so } -1 = \sqrt{3} \cdot \sqrt{3} \cdot \cos(\theta)$$

$$-1 = 3 \cos(\theta)$$

$$\cos(\theta) = -\frac{1}{3},$$

$$\boxed{\theta = \arccos\left(-\frac{1}{3}\right)}$$

exact answer.

A calculator (or phone) says

$$\boxed{\theta = 109^\circ}$$

$$\text{or } \boxed{\theta = 1.91}$$

(radians)

The requested answer, in degrees (rounded).

WeBwork uses Radians.