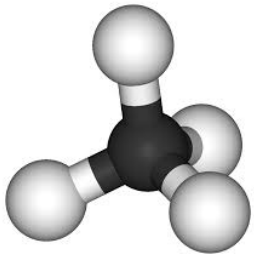
1. A methane molecule has a single carbon atom surrounded by four hydrogen atoms, like so:



   The angles formed by the carbon-hydrogen bonds are all equal. Determine this common angle size.

2. A 100 lb weight is suspended from the ceiling by two ropes: one is a 3 ft rope which makes an angle α with the ceiling, the second a 4 ft rope which makes an angle β with the ceiling. The rope attachment points are 5 ft apart on the ceiling. Determine the angles α and β as well as the tension forces in the two ropes.

3. Give a parametrization of the line segment joining $P(1,2,0)$ and $Q(1,3,-1)$.

4. What angle does the line of intersection of the planes $2x+y-z=0$ and $x+y+2z=0$ make with the positive x-axis?

5. Let
$$f(x) = \begin{cases} \dfrac{\sin(x-y)}{|x|+|y|} & \text{if } |x|+|y| \neq 0 \\ 0 & \text{if } (x,y)=(0,0) \end{cases}.$$
   Is f continuous at the origin?

6. Find parametric equations for the tangent line to the curve of intersection of the surfaces $x^2+2y+2z=4$ and $y=1$ at the point $(1,1,1/2)$.

7. Find the plane
$$\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$$
   that passes through the point $(2,1,2)$ and cuts off the least volume from the first octant.

8. Compute $\displaystyle\int_0^8 \int_{\sqrt[3]{x}}^2 \frac{1}{1+y^4}\,dy\,dx$

9. Draw the region in the xy-plane that lies inside the cardioid $r=1+\cos(\theta)$ but outside the circle $r=1$. This region is the base of a cylinder which has top defined by the plane $z=7-x$. Express the volume of the resulting solid as a triple integral in cylindrical coordinates.