

HW05

MATH 102, WINTER 2018

DUE WEDNESDAY, FEB 14

NAME:

1. The methane molecule CH_4 is arranged as if the carbon atom were at the center of a regular tetrahedron with four hydrogen atoms at the vertices. If vertices are placed at $(0, 0, 0)$, $(1, 1, 0)$, $(1, 0, 1)$, and $(0, 1, 1)$ —note that all six edges have length $\sqrt{2}$, so the tetrahedron is regular—what is the cosine of the angle between the rays going from the center $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ to the vertices? (The bond angle itself is about 109.5° , an old friend of chemists.)
2. What matrix P projects every point in \mathbb{R}^3 onto the line of intersection of the planes $x + y + t = 0$ and $x - t = 0$?
3. If V is the subspace spanned by $(1, 1, 0, 1)$ and $(0, 0, 1, 0)$, find
 - a) a basis for the orthogonal complement V^\perp .
 - b) the projection matrix P onto V .
 - c) the vector in V closest to the vector $\mathbf{b} = (0, 1, 0, -1)$ in V^\perp .
4. Find the best straight-line fit to the following measurements, and sketch your solution:

$$\begin{array}{llll} y = 2 & \text{at} & t = -1, & y = 0 & \text{at} & t = 0, \\ y = -3 & \text{at} & t = 1, & y = -5 & \text{at} & t = 2. \end{array}$$