MTH 2750

Worksheet (9/15/09)

"The Dot Product"

(1) Find the angle between the vectors $\langle \sqrt{3}, 1 \rangle$ and $\langle 0, 5 \rangle$.

(2) A street vendor sells a hamburgers, b hot dogs, and c soft drinks on a given day. He charges \$2 for a hamburger, \$1.50 for a hot dog, and \$1 for a soft drink. If $\mathbf{A} = \langle a, b, c \rangle$ and $\mathbf{P} = \langle 2, 1.5, 1 \rangle$, what is the meaning of the dot product $\mathbf{A} \cdot \mathbf{P}$?

(3) A wagon is pulled a distance of 100 meters along a horizontal path by a constant force of 50 Newtons. The handle of the wagon is held at an angle of 30° above the horizontal. How much work is done on the wagon?

(4) A molecule of methane, CH_4, is structured with the four hydrogen atoms at the vertices of a regular tetrahedron and the carbon atom at the centroid. The *bond angle* is the angle formed by the H-C-H combination; it is the angle between the lines that join the carbon atom to two of the hydrogen atoms. Show that the bond angle is about 109.5°. [Hint: Take the vertices of the tetrahedron to be the points $(1, 0, 0), (0, 1, 0), (0, 0, 1)$ and $(1, 1, 1)$. Then the centroid is the point $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$.]