

LB 220, Sections 001 & 002, Fall 2015
Homework 1 (due 9/11)

Instructions: Please write your solutions to the problems below on a clean piece of paper (not this piece of paper). You will not need more than one page (front and back) to write your answers. Show the steps taken to arrive at each answer. Do not include scratch work, doodles, scribbles, crossed out work, etc.; instead, carefully write your solutions after you have figured out the answers and checked them over.

1. Suppose that a force \mathbf{F} of 50 Newtons is applied to an object located at the origin in \mathbb{R}^2 . The direction of \mathbf{F} is such that \mathbf{F} points into the 3rd quadrant (down and to the left) and makes an angle of 30° with the negative x -axis. Suppose that a second force \mathbf{G} is applied to the object. If the resultant \mathbf{R} of these two forces has a magnitude of 50 Newtons and has direction \mathbf{j} , then what is the component form of \mathbf{G} ? Sketch a figure which illustrates this problem, carefully labeling each of \mathbf{F} , \mathbf{G} , and \mathbf{R} .
2. The methane molecule, CH_4 , has the shape of a regular tetrahedron. Determine the bond angles at the carbon atom by carrying out the following steps.
 - (a) Let $(0, 0, 0)$, $(k, k, 0)$, $(k, 0, k)$, and $(0, k, k)$ denote the locations of the hydrogen atoms, where k is a positive real number. Sketch a diagram of this configuration. Find the coordinates of the carbon atom. (Hint: It is the centroid of the four hydrogen atoms.)
 - (b) Verify that the four points corresponding to hydrogen atoms are, in fact, the vertices of a regular tetrahedron.
 - (c) Write two vectors in component form which correspond to two different directed line segments from the carbon atom to one of the hydrogen atoms. What is the length of each of these vectors?
 - (d) Determine the measure of the angle at the carbon atom between the two vectors you determined in part (c). Give an exact answer. Also, give a decimal approximation in degrees.