

### Homework 1

Due January 22nd at the beginning of class, or by 12:30 pm in MATH 602. Justify your answers. Please let me know if you have a question or find a mistake.

- Let  $v = (1, 2)$  and  $w = (3, -1)$ .
  - Find  $v + w$ ,  $v - w$ , and  $w - v$ .
  - Sketch a triangle, as accurately as possible, with oriented sides  $v$ ,  $w$ , and  $v + w$ .
  - Sketch a triangle with oriented sides  $v$ ,  $w$ , and  $v - w$ .
  - Sketch a triangle with oriented sides  $v$ ,  $w$ , and  $w - v$ .
- Two particles have positions given by

$$P_1(t) = (2, 3, 4) + t(1, 2, 3), \quad \text{and} \quad P_2(t) = (1, 0, -1) + t(-2, 3, 1).$$

At what time  $t$  are they at the same height? (The  $z$ -coordinate is the height.)

- Let  $u = (2.386, 4\sqrt{5}, -e - \pi)$ . Let  $v = 3u$  and let  $w = -2u/\|u\|^2$ . Evaluate  $v \cdot w$ .  
*Hint:* Using algebra you can avoid finding  $v$  and  $w$  individually.
- Let  $P$  be the plane parallel to  $x + 2y + 3z = 4$  which passes through  $(1, 1, 1)$ . Where does  $P$  intersect the  $y$  axis?
- We say that a vector  $(a, b)$  makes angle  $\theta$  with the positive  $x$  axis if  $a = r \cos \theta$  and  $b = r \sin \theta$  for some  $r > 0$ . You are given that  $(a, b)$  makes angle  $\theta$  with the positive  $x$  axis and  $(c, d)$  makes angle  $\varphi$  with the positive  $x$  axis. In each of the following cases, sketch the vectors and say whether  $\det \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  is positive, negative, or zero.
  - $\theta = -\pi/5$  and  $\varphi = 2\pi/3$ ,
  - $\theta = 7$  and  $\varphi = 3$ ,
  - $\theta = \pi/4$  and  $\varphi = -3\pi/4$ .
- Find an equation for the plane containing the points  $(1, 2, 3)$  and  $(1, 2, 4)$  and  $(0, 3, 4)$ .
- Find all vectors perpendicular to both  $(2, -1, 0)$  and  $(-2, 3, 1)$ .

## Extra review

None of this is to be handed in, but if you would like to brush up on algebra or calculus, I recommend looking at some practice problems from <http://tutorial.math.lamar.edu/>, especially from

- <http://tutorial.math.lamar.edu/Problems/CalcI/TrigFcns.aspx>
- <http://tutorial.math.lamar.edu/Problems/CalcI/CommonGraphs.aspx>
- <http://tutorial.math.lamar.edu/Problems/CalcI/ChainRule.aspx>

There is a lot of material here, more than we will need, and at a first pass I recommend making sure you can do at least a few of the easiest problems in each section. The main functions for us will be combinations of polynomials, rational functions, exponentials, logarithms, sine and cosine. We will make only limited use of trig functions other than sine and cosine.