MA 1111: Linear Algebra I
Homework problems due October 8, 2015

Solutions to this problem sheet are to be handed in after our class at 3pm on Thursday. Please attach a cover sheet with a declaration `http://tcd-ie.libguides.com/plagiarism/declaration` confirming that you know and understand College rules on plagiarism.

Please put your name and student number on each of the sheets you are handing in. (Or, ideally, staple them together).

1. (a) Does the straight line passing through the points $(5, 9)$ and $(8, 14)$ contain the point $(0, 1)$? **(b)** Do the points $(1, 1)$, $(-2, -3)$, and $(9, -5)$ form a right triangle?

2. Given that the points $(1, 1)$, $(-1, -1)$, and $(0, 2)$ are three vertices of a parallelogram, find possible positions of its fourth vertex.

3. (a) Is the function $(\mathbf{u} \cdot \mathbf{v})\mathbf{v}$ multilinear in $\mathbf{u}$ and $\mathbf{v}$? **(b)** Same question for $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{v}$. (*Warning*: the second one is a bit of a trick question.)

In Questions 4–5, we consider the vectors $\mathbf{b} = (2, 1)$, $\mathbf{c} = (3, 1)$, $\mathbf{u} = (1, 2, 2)$, $\mathbf{v} = (2, 3, 5)$, $\mathbf{w} = (3, 0, 1)$ assuming that all the vectors are positioned in such a way that their initial points coincide with the origin of the rectangular coordinate system.

4. Compute the angles between the vectors $\mathbf{b}$ and $\mathbf{c}$, and between the vectors $\mathbf{u}$ and $\mathbf{v}$.

5. (a) Compute the area of the parallelogram determined by the vectors $\mathbf{u}$ and $\mathbf{v}$. **(b)** Compute the volume of the parallelepiped determined by the vectors $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$.

6. Find a vector perpendicular to the plane containing endpoints of $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$. (*Hint*: to find a vector perpendicular to a plane, you can compute the vector product of two vectors in that plane).