

# Phys-109 Homework 1

Due: 1 October 2013

In The Lord of the Rings, Frodo Baggins starts his journey from The Shire (Bagend) and he has got a ring. Later, he will learn that The Ring is the power ring and it should be thrown to the Mount Doom. While his journey, he come by Rivendell, Moria, Lorien, Rohan, Minas Trith. You have a map, and this map has grid lines, and assume the grid distance as  $1cm$ . Accept the left upper corner as the origin, then necessary points can be given as: Bagend(10.8,8.5), Rivendell(17.9,8.1), Moria(18.4,11.7), Lorien(20.0,12.0), Rohan(19.4,16.8), Minas Trith(24.6,20.6), Mount Doom(28.5,19.8)

The numbers in the parenthesis represent position of the places in the map and the first (second) number corresponds to the horizontal (vertical) one ,x-axis (y-axis). (Previous sentence can be read as two sentences; first one without parenthesis, second one without the words in front of the parenthesis and with the words in the parenthesis.) One can write the position vector for Bagend as  $\vec{r}_{Bagend} = 10.8\hat{x} + 8.5\hat{y}$ .

1) Use the  $\hat{x}$ - $\hat{y}$  representation to show all vectors for necessary points. Draw them on the map. (eg  $\vec{r}_{Bagend} = 10.8\hat{x} + 8.5\hat{y}$ )

2) Calculate the vectors, which represent from departures to the next arrivals. (ie. Bagend to Rivendell) Draw them on the map.

3) Add all vectors algebraically found in second question. Calculate the vector from Bagend to the Mount Doom, let us show this vector by  $\vec{r}_{BD}$  considering  $B(D)$  represents Bagend (Mount Doom). Compare these two results. If there is a difference, what can be the reason?

4) Calculate the distance between the Bagend and the Mount Doom by using points, given in the introducing text. Calculate the dot product of the vector,  $\vec{r}_{BD}$ , by itself ( $\vec{r}_{BD} \cdot \vec{r}_{BD}$ ). What is the relation between these two?

5) Use dot product to find the projection of journey from Bagend to Rivendell to  $\vec{r}_{BD}$ .

6) In the Hobbit story, Bilbo Baggins and his friends pass through Mirkwood Forest. To find its area, we can approximate this forest by a triangle with corners at (21.2,4.6),(24.9,13.8) and (27.5,8.3). Find the area of this forest by using cross product. Use of your sense of proportion to calculate its area from the map. Compare these two.(With a better approximation its area is  $40cm^2$ .) Can you find a normal vector to this area? What is its direction?

7) Find a way to find the scale of the map. (You should find! Try to be creative.)



*Middle Earth*  
*Map of the Ring*  
*The Lord of the Rings*