Fundamentals of Physics: Problem Set #2

Vectors and Systems of Particles

$$\vec{u} = u_x\hat{x} + u_y\hat{y} + u_z\hat{z} = \begin{pmatrix} u_x \\ u_y \\ u_z \end{pmatrix} \quad ; \quad u = |\vec{u}| = \sqrt{u_x^2 + u_y^2 + u_z^2} \quad ; \quad \vec{u} + \vec{w} = \begin{pmatrix} u_x + w_x \\ u_y + w_y \\ u_z + w_z \end{pmatrix}$$

$$\vec{r}_{CM} = \frac{1}{M_{total}}\left(m_1\vec{r}_1 + m_2\vec{r}_2 + \cdots + m_N\vec{r}_N\right) \quad ; \quad \vec{p}_{total} = m_1\vec{v}_1 + m_2\vec{v}_2 + \cdots + m_N\vec{v}_N = M_{total}\vec{v}_{CM}$$

Due: Friday Sept. 6 in class

Notes: 1) No Class on Monday (9/2).
2) If you would like to learn something about my research, I will be giving a talk in the library on Wed. (9/4) at 4:15.

Reading assignment: for Wednesday, C4 (Systems and Frames)
for Friday, C5 (Conservation of Momentum)

Problem assignment:
(WARNING - The problem numbering scheme in the text can be a bit confusing, so ALWAYS double check the problem numbers to make sure you don't work the wrong problems!)

C3-B.3 & B.6 (vector manipulations)
C3-B.7 (displacement vector between two people)
C3-M.6 (underground orienteering ... no GPS signal!!)
C3-R.2 (airplane displacement vector)

C4-B.3 (Center of mass of the sun-Jupiter system)
C4-M.3 (Designing a modern sculpture)
C4-R.3 (Walking in a canoe)

Bonus: (CM location of a toy top)
A child's toy top consists of a uniform wooden sphere of radius R glued to a wooden rod of length R and diameter R/2. Determine the top's center of mass location relative to the center of the sphere. Give your result in terms of R. [Answer: 6R/67 below sphere center]