I: Momentum

(a) Go back over the steps in Taylor section 1.5, on "Multiparticle systems" (p. 20 and 21), which proves conservation of momentum, for the specific case $N = 3$ (*i.e.*, there are particles labeled 1, 2, and 3 making up the system). Write out all the summations in Eq 1.27 explicitly (*i.e.*, no "summation" symbols, really show what is being added up!) to make sure you understand the somewhat mathematically formal manipulations going on.

(b) Look at Taylor Example 3.1 (p. 84 and 85). Suppose in that figure, $\vec{v}_1 = (+1\,\mathrm{m/s})\hat{x} + (+1\,\mathrm{m/s})\hat{y}$, and $\vec{v}_2 = (+1\,\mathrm{m/s})\hat{x} + (-2\,\mathrm{m/s})\hat{y}$. Suppose further that $m_1 = 2m_2$. What is the angle between the final velocity of the final "blob" ($\vec{v}$), and the velocity labeled $\vec{v}_1$?

II: Center of Mass

(a) Look at Taylor's Example 3.2 (p. 89). Explain in your own words why Taylor says "For any given z, the integral over x and y runs over a circle of radius $r = Rz/h$". (Specifically, we're curious where that Rz/h came from!) ALSO, explain in your own words how we know $Y(\textit{center of mass}) = 0$ (Please don't just say "by symmetry" – be a little more explicit!).

III: Angular Momentum

(a) Taylor (on p. 91) argues that $\vec{r}\times\vec{F}=0$ for the case of a planet orbiting the sun. He then uses that to claim that the planet's orbit "is confined to a single plane containing the sun", and the problem of orbits is thus 2-D, not 3-D. Explain in your own words how you draw that conclusion from "$\vec{r}\times\vec{F}=0$".

IV: Taylor Series Expansion

(a) In your own words (not just a formula) what does it mean to write a Taylor series expansion around the point a?