Physics 21 Problem Set 4

Harry Nelson

due Monday, February 5, In Class

Course Info: The reading this week will be: 1)Review pp. 52-75 (Chapter 2), 2)pp. 23-38 (Chapter 1).

Prof. Nelson's office hours: Friday 2-2:50pm 5103 Broida, 4:10-5:30pm in Phelps 1508. Richard Eager's office hours are Monday 2:00-3:00pm, Tuesday 11:00-12:00noon, and Thursday 11:00-12:00noon in Broida 1019 (The Physics Study Room).

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1. K&K Problem 2.5.
2. K&K Problem 1.12.
3. K&K Problem 1.13.
4. K&K Problem 1.21.
5. Consider again motion in an elliptical path,

$$\mathbf{r}(t) = a\cos(\omega t)\hat{\boldsymbol{\imath}} + b\sin(\omega t)\hat{\boldsymbol{\jmath}}$$

   (a) Compute $\dot{r}$ two different ways, and check to see if you get the same answer:
      i. $\frac{d|\mathbf{r}(t)|}{dt}$
      ii. $\mathbf{v}(t)\cdot\hat{\mathbf{r}}(t)$, where $\hat{\mathbf{r}}$ is the unit vector constructed from $\mathbf{r}(t)$. This manner of calculating $\dot{r}$ is geometric (see the figure on page 33), and uses the first term of problem 1.11 of K&K.

   (b) The other component of the velocity, from the figure on page 33, is $r\dot{\theta}\hat{\theta}$. This component, according to problem 1.11, should also be $(\hat{\mathbf{r}}(t)\times\mathbf{v}(t))\times\hat{\mathbf{r}}(t)$. Evaluate $(\hat{\mathbf{r}}(t)\times\mathbf{v}(t))\times\hat{\mathbf{r}}(t)$, and show from its magnitude that:

$$|\dot{\theta}| = \frac{ab}{a^2\cos^2(\omega t) + b^2\sin^2(\omega t)}|\omega|$$

   . What happens when $a = b$?
