Physics 5A, Fall 2017
Homework Set 1

Problems dealing with math:

KK: 1.4, 1.10, 1.13, 1.15, 1.19

Problems dealing particles under constant acceleration:

KK: 1.16, 1.20, 1.26, 1.27

Supplemental problem:

S 1.1 You are given three time dependent orthogonal unit vectors (orthonormal vectors) $\widehat{e}_1(t), \widehat{e}_2(t), \widehat{e}_3(t)$ where

$$\begin{aligned} &\widehat{e}_1(t)\cdot\widehat{e}_1(t) = 1 \quad , \qquad \widehat{e}_2(t)\cdot\widehat{e}_2(t) = 1, \qquad \widehat{e}_3(t)\cdot\widehat{e}_3(t) = 1, \\ &\widehat{e}_1(t)\cdot\widehat{e}_2(t) = 0 \quad , \qquad \widehat{e}_2(t)\cdot\widehat{e}_3(t) = 0, \qquad \widehat{e}_3(t)\cdot\widehat{e}_1(t) = 0. \end{aligned} \tag{1}$$

(a) Show that there exists functions $\omega_{12}, \omega_{13}, \omega_{21}, \omega_{23}, \omega_{31}, \omega_{32}$ such that

$$\begin{aligned} \frac{d\widehat{e}_1}{dt} &= \omega_{12}\widehat{e}_2 + \omega_{13}\widehat{e}_3, \\ \frac{d\widehat{e}_2}{dt} &= \omega_{21}\widehat{e}_1 + \omega_{23}\widehat{e}_3, \\ \frac{d\widehat{e}_3}{dt} &= \omega_{31}\widehat{e}_1 + \omega_{32}\widehat{e}_2, \end{aligned} \tag{2}$$

(b) Show that $\omega_{12} = -\omega_{21}$, $\omega_{13} = -\omega_{31}$, and $\omega_{23} = -\omega_{32}$, so that out of the six possible functions, only three are unique.

(c) Verify that these relations reproduce Eq. (1.3) and (1.4) in the special case of the polar coordinate system.

Comments

The answer to 1.10 is not unique.

While 1.20 gives numbers for distances and accelerations, I would strongly suggest that you solve this problem using variables.

Remember that *showing* that an equation is true is different from *verifying* that it is true. In the first, you show that it is true using mathematical identities and concepts that we developed in the book or in class. In the second, you assume that the equation is true, and then check to see if it works (or more accurately, that it is consistent). Often, the first is harder than the second.

For all the problems dealing with partiles under constant acceleration, remember that the vector $\vec{r}(t)$ gives the *position* of the object (where it is) at time t.

For 1.26, the *range* is defined as the distance the rock travels *along the ground*.