Physics CS 31 **Fall 2014**

Set #5 - for Wd Nov. 5

Read HR&K	Ch. 3, Ch. 5 - Sects. 5.1, 5.5
Read K&K	Ch. 2, Ch. 3 - Sect. 3.4, 3.5
Read Feynman Vol. 1	Ch. 9

From HR&K:

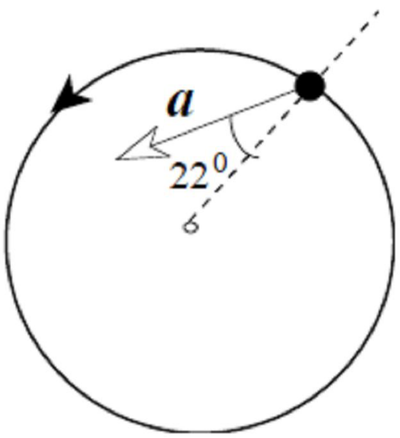
Ch. 3 Exercise 20, Problems 6, 8, 10.
Ch. 5 Problems 1, 20.

From K&K:

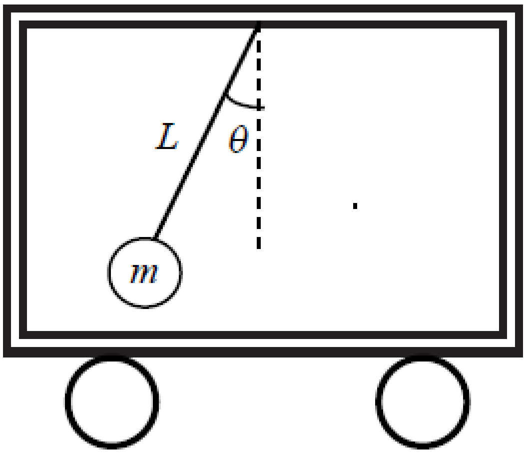
Ch. 1 Problem 1.25
Ch. 2 Problems 2.1, 2.2, 2.3.
Ch. 3 Problem 3.9

1. A particle is traveling in a circular path of radius 3.64 m and counterclockwise. At a certain instant, the particle is moving at 17.4 m/s, and its acceleration is at an angle of 22^o from the direction to the center of the circle as seen from the particle.

a) What is the magnitude of the acceleration?
b) At what rate is the speed of the particle increasing?



2. In Air Force tests designed to investigate the ability of humans to survive large accelerations, a test pilot is launched along a horizontal track in a rocket sled. High speed cameras positioned along the track record the person's response to the motion. In such experiments it is useful to have a record of the instantaneous acceleration, and this can readily be obtained from photographs if a small acceleration meter is mounted on the sled. A simple form of accelerometer consists of a mass m attached to a thread of length L and hung as a simple pendulum. (See Figure below.) When the sled is accelerating, the mass will not hang straight down; the string will be inclined at an angle θ to the vertical. In one experiment it was found that $\theta = 60^{\mathrm{o}}$ for a mass of 50 grams attached to a thread of length 12 cm. What was the acceleration of the sled under these circumstances?



3. Let the scalar f and vectors $\vec{A}$ and $\vec{B}$ be functions of time. Show the following identities:

a) $\frac{d}{dt}(\vec{A} \cdot \vec{B}) = \frac{d\vec{A}}{dt} \cdot \vec{B} + \vec{A} \cdot \frac{d\vec{B}}{dt}$

b) $\frac{d}{dt}(\vec{A} \times \vec{B}) = \frac{d\vec{A}}{dt} \times \vec{B} + \vec{A} \times \frac{d\vec{B}}{dt}$

c) $\frac{d}{dt}[f\vec{A}] = \frac{df}{dt}\vec{A} + f\frac{d\vec{A}}{dt}$