

LAB A8a: TESTING THE VERTICAL ACCELEROMETER ON PLAYGROUND SWINGS

10/15/03

In this lab, you will determine the centripetal acceleration of a swing at the lowest point in its arc via 2 methods: (1) by measuring the acceleration directly with the vertical accelerometer and (2) by measuring the maximum amplitude (i.e., angle) of the swing motion. You will need a partner to help with the measurements.

- 1) Before making any measurements: Because the path of the swing seat is a circle, the magnitude and the direction of the centripetal acceleration are known. What direction would you expect your acceleration to be at the bottom of the swing's arc?
- 2) Make a large diagram showing the swing when it is at its maximum angle (θ_{\max}) to the vertical. Once you have the swing in motion, you will need to have your partner estimate the maximum angle that the swing makes with the vertical **just before** you attempt to measure the vertical acceleration at the bottom of the swing's arc. The maximum angle (θ_{\max}) should be at least 45 degrees, if possible.

Describe how you will measure the angle θ_{\max} for your partner's swing (and how your partner measured the maximum angle for you). Label the angle on the diagram and record the value of θ_{\max} that your partner measured for you.

- 3) Draw another diagram of the vertical accelerometer which shows
 - a) the bob's position relative to the red-tape markings when the accelerometer at rest and
 - b) the bob's position relative to the red-tape markings at the instant you passed through the bottom of the swing's arc while swinging.

Your accelerometer diagram should show the red tape markings correctly labeled with the corresponding accelerations (both direction and magnitude in g's).

- 4) a) Determine and record the measured vertical acceleration (direction and magnitude) of swing at bottom of arc inferred from your data in (3) above.
 - b) Does the direction of your measured acceleration match your prediction [in (1)] above?
- 5) Later this semester we will show that the centripetal acceleration at the bottom of a swing's arc is

$$a = 2 g (1 - \cos \theta_{\max})$$

where θ_{\max} is the maximum angle that the swing makes with the vertical [measured in (2)].

Using the given formula, calculate the centripetal acceleration from the measured θ_{\max} .

- 6) Compare (% difference) the directly measured and the calculated values of acceleration.