

**2.004: MODELING, DYNAMICS, & CONTROL II**  
Spring Term 2003

PLEASE ALSO NOTE THAT ALL PRELAB EXERCISE ARE DUE AT THE START (WITHIN 10 MINUTE) OF THE LAB SESSION, NO LATE WORK IS ACCEPTED.

**Pre-Lab Exercise for Experiment 2**

We will consider the dynamics of a bouncing ball, with mass  $m$  under gravity  $g$ .

(1) Quantitatively describe the trajectory  $z(t)$  of a ball in between bounces. You may assume the maximum height that it reaches is  $h$ . What is the functional form of the trajectory?

(2) Quantitatively describe the time dependence of the velocity,  $v(t)$ , and  $a(t)$  of the ball using result from (1).

(3) Consider a collision event, assume the coefficient of restitution is  $e$  and the ball reaches a maximum height,  $h$ , before impact. Calculate  $v(t)$  and  $a(t)$  before and after impact.

(4) What is the momentum transfer resulted from the impact?

(5) Can you define impulse and force during impact? What information do you need to deduce the force generated at impact?