Universität Leipzig, Fakultät für Physik und Geowissenschaften

# Exercises for Experimental Physics 1 – IPSP

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## Exercise Sheet 9 (WS 2011/12)

Date of Issue: Dec. $2^{nd}$ 2011

**Date of Submission: Dec. $9^{th}$ 2011**

**Submission Place:** Marked mailbox next to room 302 (Linnestr. 5)
**Submission Time:** 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

**Exercises:**

1. In the center-of-mass reference frame a particle with mass $m_1$ and momentum $p_1$ makes an elastic head-on collision with a second particle of mass $m_2$ and momentum $p_2 = -p_1$. After the collision its momentum is $p_1'$. Write the total kinetic energy in terms of $m_1$, $m_2$, and $p_1$ and the total final energy in terms of $m_1$, $m_2$, and $p_1'$, and show that $p_1' = \pm p_1$. If $p_1' = -p_1$, the particle is merely turned around by the collision and leaves with the speed it had initially. What is the situation for the $p_1' = +p_1$ solution? (6 Points)

2. William Tell shoots an apple from his son's head. The speed of the 125-g arrow just before it strikes the apple is 25.0 m/s, and at the time of impact it is traveling horizontally. If the arrow sticks in the apple and the arrow/apple combination strikes the ground 8.50 m behind the son's feet, how massive was the apple? Assume the son is 1.85 m tall. (7 Points)

3. A spherical 0.34-kg orange, 2.0 cm in radius, is dropped from the top of a 35 m-tall building. After striking the pavement, the shape of the orange is a 0.50 cm thick pancake. Neglect air resistance and assume that the collision is completely inelastic. (a) How much time did the orange take to completely "squish" to a stop? (b) What average force did the pavement exert on the orange during the collision? (7 Points)

4. A wedge of mass $M$, as shown in Figure 1, is placed on a frictionless, horizontal surface, and a block of mass $m$ is placed on the wedge, whose surface is also frictionless. The center of mass of the block moves downward a distance $h$, as the block slides from its initial position to the horizontal floor. (a) What are the speeds of the block and of the wedge, as they separate from each other and each go their own way? (b) Check your calculation plausibility by considering the limiting case when $M >> m$.

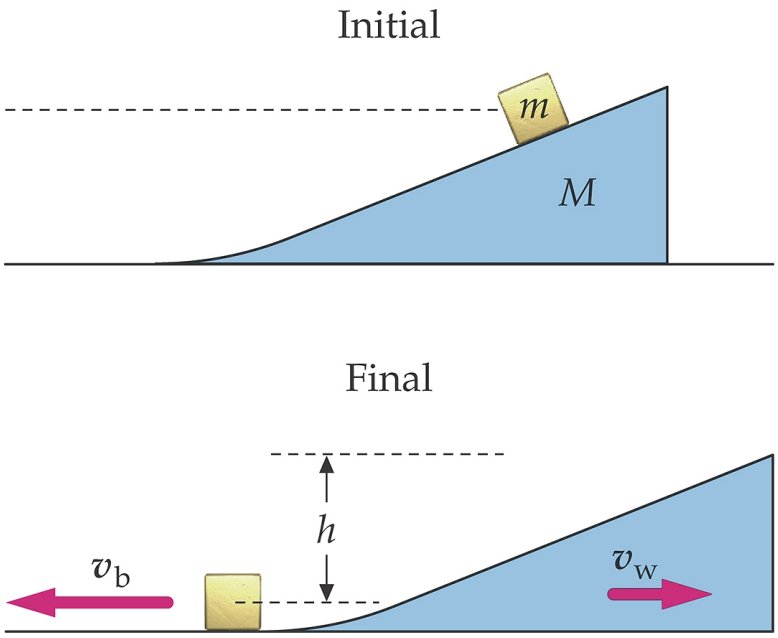


Figure 1: Exercise 4