Universität Leipzig, Fakultät für Physik und Geowissenschaften

# Exercises for Experimental Physics 1 – IPSP

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## Exercise Sheet 7 (WS 2011/12)

Date of Issue: Nov. $18^{th}$ 2011

**Date of Submission: Nov. $25^{th}$ 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. A block of mass m rests on a plane inclined an angle $\theta$ with the horizontal (Figure 1). A spring with force constant $k$ is attached to the block. The coefficient of static friction between the block and plane is $\mu_s$. The spring is pulled upward along the plane very slowly. (a) What is the extension of the spring the instant the block begins to move? (b) The block stops moving just as the extension of the contracting spring reaches zero. Express $\mu_k$ (the kinetic coefficient of friction) in terms of $\mu_s$ and $\theta$. (7 Points)

2. Two ice skaters, whose masses are 55 kg and 85 kg, hold hands and rotate about a vertical axis that passes between them, making one revolution in 2.5 s. Their centers of mass are separated by 1.7 m and their center of mass is stationary. Model each skater as a point particle and find (a) the angular momentum of the system about their center of mass and (b) the total kinetic energy of the system. (5 Points)

3. A 3.0-kg block is traveling in the $-x$ direction at 5.0 m/s, and a 1.0-kg block is traveling in the $+x$ direction at 3.0 m/s. (a) Find the velocity $v_{cm}$ of the center of mass. (b) Subtract $v_{cm}$ from the velocity of each block to find the velocity of each block in the center-of-mass reference frame. (c) After they make a head-on elastic collision, the velocity of each block is reversed (in the center-of-mass frame). Find the velocity of each block in the center-of-mass frame after the collision. (d) Transform back into the original frame by adding $v_{cm}$ to the velocity of each block. (e) Check your result by finding the initial and final kinetic energies of the blocks in the original frame and comparing them. (8 Points)

4. The system shown in Figure 2 consists of a 4.0-kg block resting on a frictionless horizontal ledge. This block is attached to a string that passes over a pulley, and the other end of the string is attached to a hanging 2.0-kg block. The pulley is a uniform disk of radius 8.0 cm and mass 0.60 kg. Find the acceleration of each block and the tension in the string.

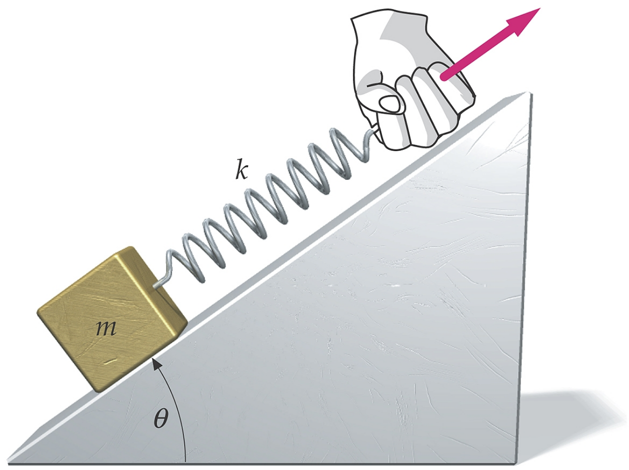


Figure 1: Exercise 1


Figure 2: Exercise 4