Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 1 – IPSP

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Exercise Sheet 6 (WS 2011/12)

Date of Issue: Nov. 11th 2011

Date of Submission: Nov. 18th 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. When we calculate escape speeds, we usually do so with the assumption that the body from which we are calculating escape speed is isolated. This is, of course, generally not true in the Solar system. Show that the escape speed at a point near a system that consists of two massive spherical bodies is equal to the square root of the sum of the squares of the escape speeds from each of the two bodies considered individually. (6 Points)

2. The potential energy of an object constrained to the x axis is given by $U(x) = 3x^2 - 2x^3$, where U is in joules and x is in meters. (a) Determine the force F_x associated with this potential energy function. (b) Assuming no other forces act on the object, at what positions is this object in equilibrium? (c) Which of these equilibrium positions are stable and which are unstable? (7 Points)

3. A 0.20-kg point mass moving on a frictionless horizontal surface is attached to a rubber band whose other end is fixed at point P. The rubber band exerts a force whose magnitude is $F = bx$, where x is the length of the rubber band and b is an unknown constant. The rubber band force points inward towards P. The mass moves along the dotted line in Figure 1. When it passes point A, its velocity is 4.0 m/s, directed as shown. The distance AP is 0.60 m and BP is 1.0 m. (a) Find the speed of the mass at points B and C. (b) Find b. (7 Points)

4. Mars orbits the Sun at a mean orbital radius of 228 Gm (1 Gm = 10^9 m) and has an orbital period of 687 d. Earth orbits the Sun at a mean orbital radius of 149.6 Gm. (a) The Earth-Sun line sweeps out an angle of 360° during one Earth year. Approximately what angle is swept out by the Mars-Sun line during one Earth-year? (b) How frequently are Mars and the Sun in opposition (on diametrically opposite sides of Earth)?

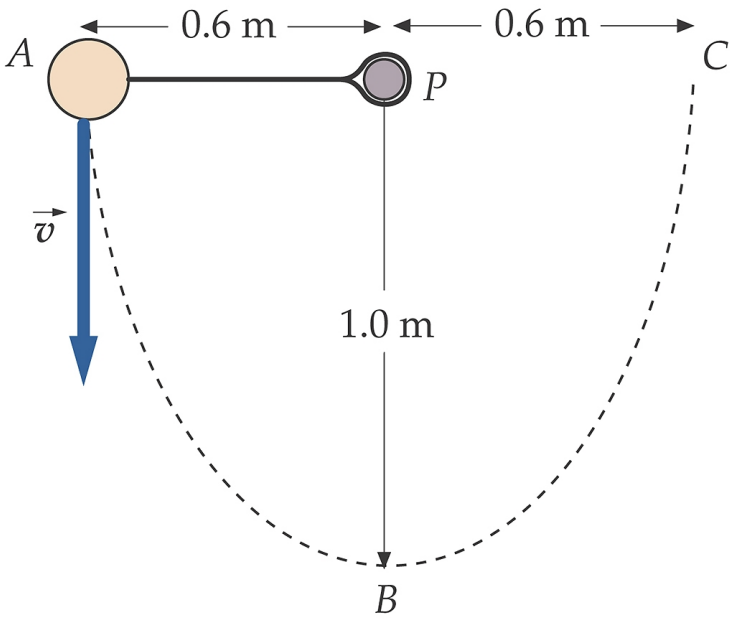

Figure 1: Exercise 3