Universität Leipzig, Fakultät für Physik und Geowissenschaften

# Test exam for Experimental Physics 1 (IPSP) (WS 2013/14)

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This test exam ist just for practice, you should answer the questions within 180 min. There is NO homework for the X-mas holidays!

MERRY X-MAS and A HAPPY NEW YEAR!!!

**Exercises:**

1. Name Newton's $3^{rd}$ law!
2. A plane flies at an airspeed of 250 km/h. A wind is blowing at 80 km/h toward the direction $60^{o}$ east of north. (a) In what direction should the plane head in order to fly due north relative to the ground? (b) What is the speed of the plane relative to the ground?
3. An airplane is flying in a horizontal circle at a speed of 480 km/h. The plane is banked for this turn, its wings tilted at an angle of $40^{o}$ from the horizontal (Figure 1). Assume that a lift force acting perpendicular to the wings acts on the aircraft as it moves through the air. What is the radius of the circle in which the plane is flying?

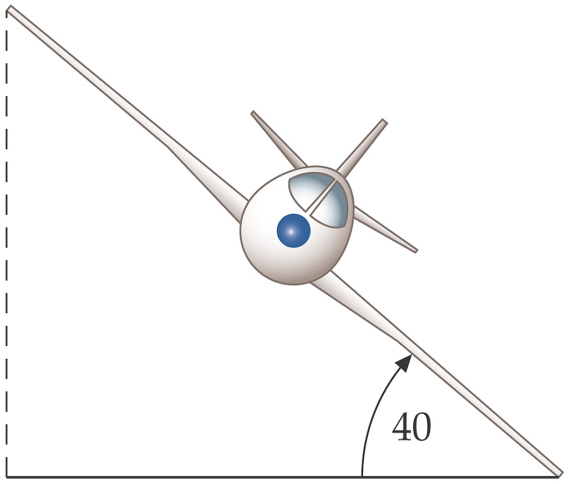


Figure 1: Exercise 3

4. Particle $a$ has mass $m$, is initially located on the positive $x$-axis at $x = x_0$ and is subject to a repulsive force $F_x$ from particle $b$. The location of particle $b$ is fixed at the origin. The force $F_x$ is inversely proportional to the square of the distance $x$ between the particles. That is, $F_x = A/x^2$, where $A$ is a positive constant. Particle $a$ is released from rest and allowed to move under the influence of the force. Find an expression for the work done by the force on $a$ as a function of $x$. Find both the kinetic energy and speed of $a$ as $x$ approaches infinity.

5. A 3.0-kg block slides along a frictionless horizontal surface with a speed of 7.0 m/s (Figure 2). After sliding a distance of 2.0 m, the block makes a smooth transition to a frictionless ramp inclined at an angle of 40° to the horizontal. What distance along the ramp does the block slide before coming momentarily to rest?

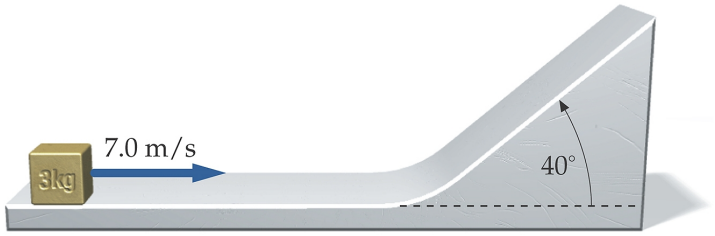


Figure 2: Exercise 5

6. During a pool game, the cue ball, which has an initial speed of 5.0 m/s, makes an elastic collision with the eight ball, which is initially at rest. After the collision, the eight ball moves at an angle of 30º to the right of the original direction of the cue ball. Assume that the balls have equal masses. (a) Find the direction of motion of the cue ball immediately after the collision. (b) Find the speed of each ball immediately after the collision.

7. The tiny Saturnian moon, Atlas, is locked into what is known as an orbital resonance with another moon, Mimas, whose orbit lies outside of Atlas's. The ratio between periods of these orbits is 3:2 – that means, for every 3 orbits of Atlas, Mimas completes 2 orbits. Thus, Atlas, Mimas and Saturn are aligned at intervals equal to two orbital periods of Atlas. If Mimas orbits Saturn at a radius of 186,000 km, what is the radius of Atlas's orbit?

8. Two point masses $m_1$and $m_2$ are separated by a massless rod of length L. (a) Write an expression for the moment of inertia $I$ about an axis perpendicular to the rod and passing through it a distance $x$ from mass $m_1$. (b) Calculate $dI/dx$ and show that $I$ is at a minimum when the axis passes through the center of mass of the system.

9. A steel wire of length 1.50 m and diameter 1.00 mm is joined to an aluminum wire of identical dimensions to make a composite wire of length 3.00 m. Find the resulting change in the length of this composite wire if an object with a mass of 5.00 kg is hung vertically from one of its ends. (Neglect any effects the masses of the two wires have on the changes in their lengths.)