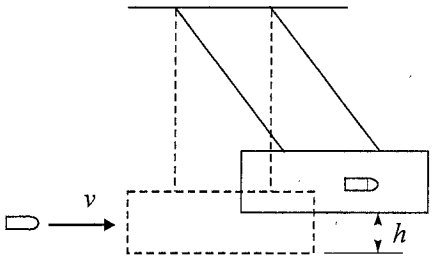
S-104.1010 Physics I (AUT, BIO, EST, TLT) **Exam** **August 27, 2009**

1. The position of an object calculated as a displacement along a circular path follows the equation $s = At^2$, where $A > 0$ when $t \geq 0$. The radius of the circle is R. a) What is the angular velocity of the object, when the object has traveled the distance L along the circle? b) Calculate the tangential and normal components of the acceleration of the object as a function of time.

2. A bullet with a mass of m and a velocity of v, hits a ballistic pendulum having a mass of M. The bullet stops and is stuck with the pendulum. How large must the velocity v be for the pendulum to rise to a height h from the original position?



3. A spacecraft is rotating a planet on a circular orbit with a velocity of 3 550 m s^{-1}. How much additional velocity must the rocket engine of the spacecraft give for the craft to escape the gravitational field of the planet?

4. An object is laying on a horizontal platform, which is oscillating (horizontally) harmonically. The amplitude and the period of the movement of the platform are 0.52 m and 2.0 s, respectively. Calculate how large must the coefficient of static friction be for the object and platform to stay at rest relative to each other (i.e., the object oscillates with the platform).

5. a) Write the differential equation of a longitudinal wave traveling along the x-axis by marking the displacement with y. b) Write the wave function of a sinusoidal wave traveling to the direction of positive x-axis and show that this wave function is a solution to the wave equation. c) Calculate the instantaneous power acting on a point x in a transverse wave motion.

6. Monoatomic ideal gas is expanding adiabatically while temperature is decreasing from the value of T_1 to the value of T_2. The amount of gas is n moles. Calculate the work done by the gas.

Write your name, student number, degree programme, code of the study module, and date of the exam in each paper.