S-104.1310 Additional course in physics 1 (SFT) exam December 21, 2009

1. An object is moving rectilinearly along the x-axis with an acceleration of $a = 6\sqrt[3]{x}$, where $x > 0$. Calculate the position x of the object as a function of time t, when at the time $t = 2$ s $x = 27$ m and $v = 27$ m/s. (You don't have to use units in this problem.)

2. An aeroplane is flying at the latitude of 60° N. What is the velocity (magnitude and direction) of the aeroplane if the centrifugal acceleration caused by the rotation of the earth is exactly compensated by the Coriolis acceleration. The radius of Earth is 6380 km.

3. En electric motor with a mass of m = 50 kg is laying on a flexible platform. The spring constant of the platform is k = 1.1 MN m^{-1}. The motor is oscillating because of a force $F = F_0 \cos(\omega_d t)$ caused by the eccentricity of the motor. a) Write the equation of motion for the motor (you can ignore the weight of the motor and all the damping forces). b) Calculate how large is the amplitude of forced oscillation when $F_0 = 50$ N and ω_d = 150 s^{-1}. c) What is the resonance frequnecy of the system?

4. A particle has a rest energy of mc^2. a) How large must the speed of the particle be for its momentum to be mc? b) Calculate the total energy of the particle in that case.

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