S-104.1310 Additional course in physics 1 (SFT) **exam** **January 10, 2007**

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. A rectilinear, constant force F is acting on a particle originally at rest for so long that the speed of the particle is approaching the speed of light. Calculate the speed of the particle as a function of time. Use the following to calculate the integral:

$$\frac{d}{dx}\left(\frac{x}{(1-x^2)^{1/2}}\right) = \frac{1}{(1-x^2)^{3/2}}.$$

4. Let there be a steady flow (the flow pattern does not change with time) of liquid with a viscosity of η in a horizontal pipe (length L) having a circular cross section (radius R). Let there be a pressure difference of Δp between the ends of the pipe. Let us denote the distance from the central axis of the pipe with r. Using the expression for the flow speed of the liquid

$$v_y(r) = \frac{1}{4\eta}(r^2 - R^2)\frac{\Delta p}{L}$$

calculate the total flow of the liquid through the cross section of the pipe.

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