S-104.1310 Additional course in physics 1 (SFT) **exam** **January 15, 2010**

1. A parachutist is at the time t=0 at a position z=0 and moving downwards with a velocity v_0. In addition to the earth's gravity, there is a frictional force of $a_f = -\beta v$ $(\beta > 0)$ acting on the parachutist. Calculate a) the velocity of the parachutist as a function of time (4 p) and b) the terminal velocity, *i.e.*, the velocity attained by the parachutist during a long flight (2 p).

2. An object is moving horizontally on the surface of the Earth with the speed of v. How large is the horizontal component of the Coriolis acceleration, a_H, if the location of the object is at the latitude of λ? Calculate the value of a_H when v = 280 m s^{-1} and $\lambda = 60°$ N.

3. An object having a mass of m is moving along the x-axis. In addition to a sping force $F_1 = -k\,x$ a periodical driving force of $F_2 = -F_0 \sin \omega_d t$ is acting on the object. Assuming that there are no damping forces, write the equation of motion for the object and show by substitution that $x = A \sin \omega_d t$ is a solution to the equation of motion. Calculate the magnitude of the amplitude A.

4. a) A spaceship has a circle (diameter 10 m) painted to its side. If the spaceship is moving past the Earth with a speed of 0,90 c, the circle looks like an ellipse from the Earth. What are the lengths of the major axes as seen from the Earth? b) Assume that the spaceship is now moving with the speed past the Earth, on which an ellipse is marked out. The ellipse has major axis dimensions of 10 m perpendicular to the direction and 22.7 m in the direction of the motion of the spaceship. What are the dimensions of the ellipse as seen from the spaceship?

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