Basic of Mechanic (FYSP101), Spring 2013

Exam 1.

1. Explain follwing things shortly. (1 p per item)

   i) Polar coordinates?
   ii) Vector?
   iii) Angular velocity?
   iv) Newton's II law?
   v) Impulse and impulse-momentum theorem?
   vi) Momentum?

2. Relation $x = x_0 + v_0 t + \frac{1}{2}at^2$ describes particle's position x as a function of time t. The unit of x is meter m and the unit of time is second s. Moreover x_0, v_0 and a are constants and time t$\geq$0.

   a) What do x_0, v_0 ja a describe and what are their units? (1 1/2 p)
   b) Lets assume that for now on $x_0 = 2.0$, $v_0 = -1.0$ and $a = 0.5$ (units from a)). Draw a picture of particle's motion diagram, i.e. place-versus-time-graph (1 p).
   c) At what moment t particle is at the point x=2? And what moment t the particle is at point x=5? (1/2 and 1/2 p).
   d) What is particle's instantaneous velocity at point x=2 and at point x=5? (1/2 ja 1/2 p) .
   e) What is particle's average velocity when it moves from position x=2 to position x=5? (1/2 p).
   f) What is particles acceleration during that interval? (1 p).

3. A boy pushes a sledge along horizontal road. His sister is sitting in the sledge. Pushing happens with a force that has 30° angle with the road see figure 1. The sledge and the girl weights together 40 kg. Kinetic friction coefficient between the sledge and the road is μ_k =0.2. How hard (with what force) the boy has to push so that the sledge moves with a constat velocity? (Requirements: coordinaates (1/2 p), draw a free body diagram and vector forces (1 p), equation of motion in vector form (1 p), equation of motion in components [2 dimensions!] (1 p), condition for constat velocity (1 p), solution (1 p), numeric value (1/2 p))
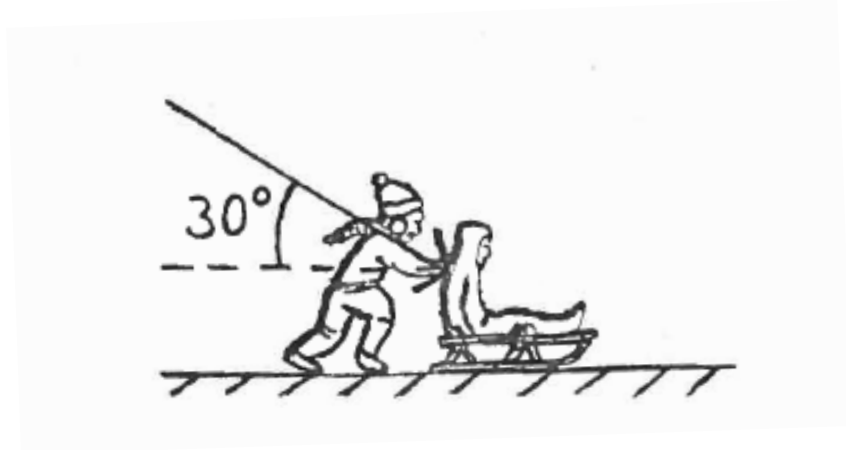
FIGURE 1. Figure for task 3.

4. a) What does it mean if a force or a forcefield is said to be conservative? Give an example of a conservative force. (1 and 1/2 p)

    b) Force $\vec{F}=F\hat{\imath}$, $\left|\vec{F}\right|=200$ N, moves a 10 kg box on a horizontal plane 2 meters along x-axis. How much work that force did? (1 1/2 p)

    c) Use conservation of energy and find out at what speed a 2 kg ball dropped from the tower of Pisa hits the ground, when the height of the tower is 56 m. (conservation law 1 p, solution 1 p)

    d) Draw a motion diagram with velocity vectors from this situation. Draw ball at least in 3 stages. (1 p)