Assignment 4
Due on 2020-02-26, 20H5: 02.

Problem 1
A particle moves in a straight line with an acceleration given by f(t) = t^2 - 4t + 5. Find the velocity and position functions for the particle, and determine the time(s) at which the particle changes direction.

Problem 2
The position of a particle on a coordinate line is given by s(t) = 2t^3 - 3t^2 + 1, where s is in meters and t is in seconds. Find the velocity and acceleration functions for the particle, and determine the time(s) at which the particle changes direction.

Problem 3
A solid cylinder of mass m and radius r is rolling without slipping on a horizontal surface. Find the angular acceleration of the cylinder as a function of the distance it has rolled from its initial position. Assume that the coefficient of friction between the cylinder and the surface is μ.

Problem 4
A ball is thrown vertically upward with an initial velocity of v0 = 20 m/s. Using the equations of motion, find the maximum height reached by the ball and the total time it takes to return to the ground.

Problem 5
A mass m is attached to a spring with a force constant k. The mass is initially at rest at a distance x0 from the equilibrium position. Find the displacement x(t) of the mass as a function of time.

Problem 6
A simple pendulum of length L and mass m is oscillating with small angles. Find the period of oscillation of the pendulum.

Problem 7
A ball is thrown horizontally from a height of 5 meters with an initial velocity of 20 m/s. Find the time it takes for the ball to hit the ground and the horizontal distance it travels before hitting the ground.

Problem 8
A block of mass m is placed on a frictionless inclined plane of angle θ. Find the normal force and friction force acting on the block, and determine the acceleration of the block.

Problem 9
A spring hangs vertically and is stretched by a mass m. A second mass M is placed on top of the spring-loaded mass. Find the new equilibrium position of the system.