NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART I SUPPLIMENTARY EXAMINATION - AUGUST 2014
TCW 1201: ENGINEERING MECHANICS – KINEMATICS AND DYNAMICS

INSTRUCTIONS
Answer any FOUR questions. Each question carries 25 marks.

Time: 3 Hours
Total Marks: 100

QUESTION 1

a) Kinematics of a particle is characterized by specifying, at any given instant, the particle's position, velocity and acceleration. From first principles derive an expression that relates these three parameters. [10]

b) The velocity of a particle traveling along a straight line is $v = v_0 - ks$, where k is constant. If $s = 0$ when $t = 0$, determine the position and acceleration of the particle as a function of time. [15]

QUESTION 2

A boy throws a ball at O in the air with a speed v_0 at an angle θ_1 . If he then throws another ball with the same speed v_0 at an angle $\theta_2 < \theta_1$, determine the time between the throws so that the balls collide in mid air at *B*. [25]

QUESTION 3

The 800-kg car at *B* is connected to the 350-kg car at *A* by a spring coupling as shown in Figure 3.1. Determine the stretch in the spring if:

(a) The wheels of both cars are free to roll and
(b) The brakes are applied to all four wheels of car *B*, causing the wheels to skid.

Take $(\mu_k)_B = 0.4$. Neglect the mass of the wheels. [25]

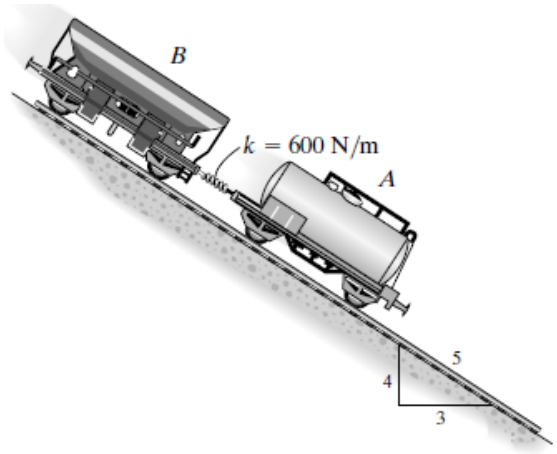

Figure 3.1

QUESTION 4

a) Marbles having a mass of 5 g fall from rest at *A* through the glass tube and accumulate in the can at *C* as illustrated in Figure 4.1. Determine the placement *R* of the can from the end of the tube and the speed at which the marbles fall into the can. Neglect the size of the can. [15]

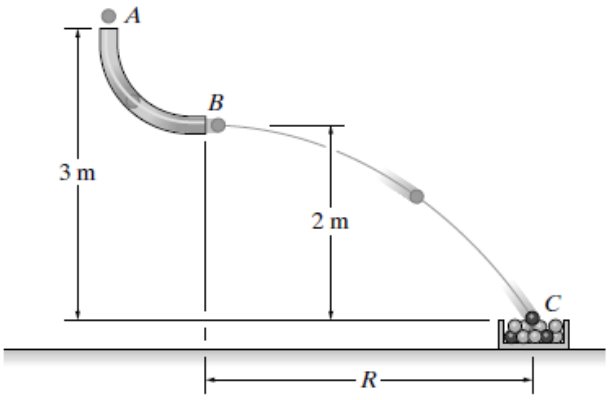

Figure 4.1

b) The ball has a mass of 0.5 kg and is suspended from a rubber band having an unstretched length of 1 m and a stiffness $k = 50$ N/m as shown in Figure 4.2. If the support at *A* to which the rubber band is attached is 2 m from the floor, determine the greatest speed the ball can have at *A* so that it does not touch the floor when it reaches its lowest point *B*. Neglect the size of the ball and the mass of the rubber band. [10]

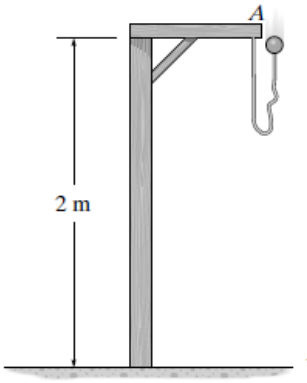

Figure 4.2

QUESTION 5

If the shaft and plate rotate with a constant angular velocity of $\omega = 14$ rad/s, determine the velocity and acceleration of point C located on the corner of the plate at the instant shown. Express the result in Cartesian vector form. [25]

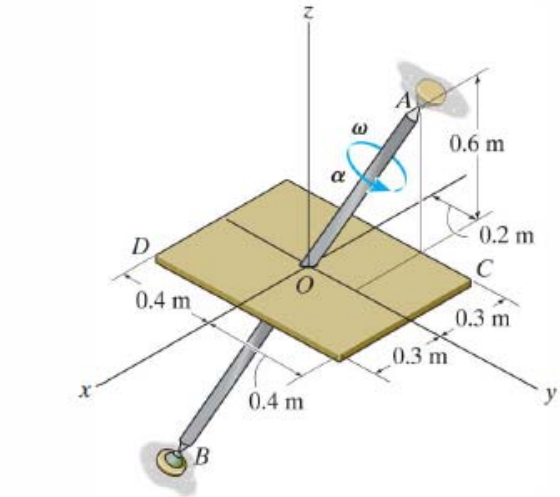

Figure 5.1