UNIVERSITY OF GHANA

B.Sc (ENGINGEERING) SECOND SEMESTER EXAMINATIONS: 2013/2014

FAEN 104: BASIC MECHANICS II (3 credits)

INSTRUCTION:

ANSWER ALL QUESTIONS

TIME ALLOWED: *TWO AND HALF* $(2\frac{1}{2})$ *HOURS*

1. a.) Define the term "impact" and explain the following:
   - i. Central impact.
   - ii. Eccentric impact.
   - iii. Direct central impact.
   - iv. Restitution period.

(8 marks)

b.) Two cylinders move along a rod in a frictionless manner (figure 1). Cylinder *A* has a mass of 10 kg and moves to the right at a speed of 3m/sec, while cylinder *B* has a mass of 5 kg and moves to the left at a speed of 2.5 m/sec. The velocities before impact are 1.38 m/s and 1.22 m/s for collars A and B respectively.

Determine:
- i. The speed of cylinder *B* after impact for a coefficient of restitution of 0.8.
- ii. The energy loss during impact.

(12 marks)

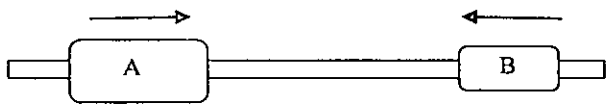

Figure 1

2. a) Block A is attached to a rope that is wrapped around a drum of radius 2 m (figure 2). The drum's initial angular velocity is 10 rad/s clockwise and is increasing at a rate of $(t^2 + 2)$ rad/s^2. Determine the velocity and acceleration of block A at $t = 3$ s.

(10 marks)

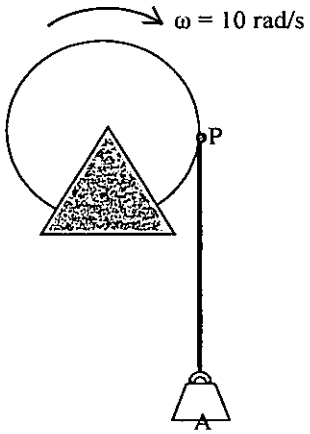

Figure 2

b) A rigid, slender bar is rotating about its pin-connected support (O) with an angular speed of 5 rad/s clockwise (figure 3). At the position shown, the angular speed of the bar is increasing at the rate of 3 rad/s^2. Determine the velocity and acceleration of the tip A of the bar at the given position.

(10 marks)

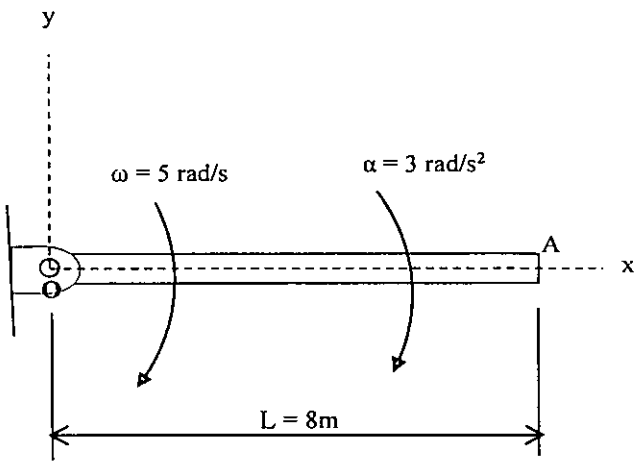

Figure 3

3. a) Define the following terms related to rectilinear motion of a particle:

i. Displacement
ii. Instantaneous velocity
iii. Instantaneous acceleration

(6 marks)

b) A particle at position (3, 4, 6) m at time $t_o = 1$ sec is given a constant acceleration having the value $6\boldsymbol{i} + 3\boldsymbol{j}$ m/sec^2. If the velocity at the time t_o is $16\boldsymbol{i} + 20\boldsymbol{j} + 5\mathbf{k}$ m/sec^2, what is the velocity of the particle 20 sec later? Also give the position of the particle.

(24 marks)