NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

1st SEMESTER EXAMINATION – FEBRUARY 2010

DYNAMICS I– TIE 2106

INSTRUCTIONS TO CANDIDATES
TIME ALLOWED: 3 HOURS
ANSWER ANY FIVE (5) QUESTIONS

QUESTION 1

Two race cars start from rest at the same time. Acceleration of car A is given by

$30e^{-t/5}\ m/s^2$ and that of car B is given by $20e^{-t/5}\ m/s^2$

(a) Determine the distance at which car B overtakes car A . [10]

(b) Also determine their relative velocity at that time. [10]

QUESTION 2

The total linear momentum of a system of three particles at time $t = 5s$ is given by $G_{2.2} = 4i - 6j + 6k$ kg.m/s. At time $t = 8s$, the linear momentum has changed to $G_{2.4} = 3i - .2j + 4k$ kg.m/s. Calculate the magnitude F of the time average of the resultant of the external forces acting on the system during the interval. [20]

QUESTION 3

For the diagram shown in Fig Q3, the 5kg block slides along a horizontal floor and strikes bumper B. The coefficient of friction between the block and the floor is $u_k = 0.3$, and the mass of the bumper is 2kg. If the speed of the block is 10m/s when it is 20 m from the bumper, determine:

(a) the speed v of the block at the instant it strikes the bumper [10]

(b) The maximum deflection of the spring due to the motion of the block. [10]

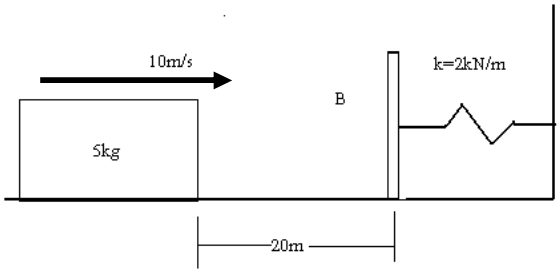

Figure Q3

QUESTION 4

The bars shown in figure Q4 are sliding freely on a horizontal rod. For the conditions specified in table Q4, determine:

(a) The final velocity of both beads. [8]

(b) The percentage of the initial kinetic energy lost as a result of the collision of the two bars. [6]

(c) The average interaction force between the beads if the duration of impact is 0.001s. e is the coefficient of restitution [6]

Table Q4

M_a	V_a	M_b	V_b	e
9kg	3m/s	2kg	Om/s	0.3

Figure Q4

QUESTION 5

(a) Mention the applications of friction where there is need to minimize it and occasions where these effects are essential. [6]

(b) Distinguish between the coefficient of static friction and the coefficient of kinetic friction. [4]

© The uniform pole shown in figure Q5 has a weight of 2kN and a length of 15m. Determine the maximum distance d it can be placed from the smooth wall and not slip. The coefficient of static friction between the floor and the pole is u_s = o.32

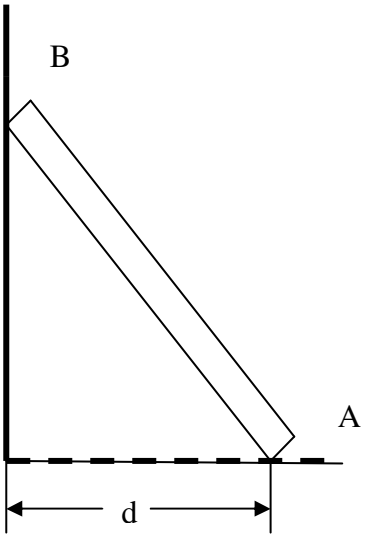

Figure Q5

QUESTION 6

(a) Determine the centroidal coordinates of the trapezoidal area shown in Fig Q6. [10]

(b) Also determine the moment of inertia of the composite body about the X and the Y axis. [10]

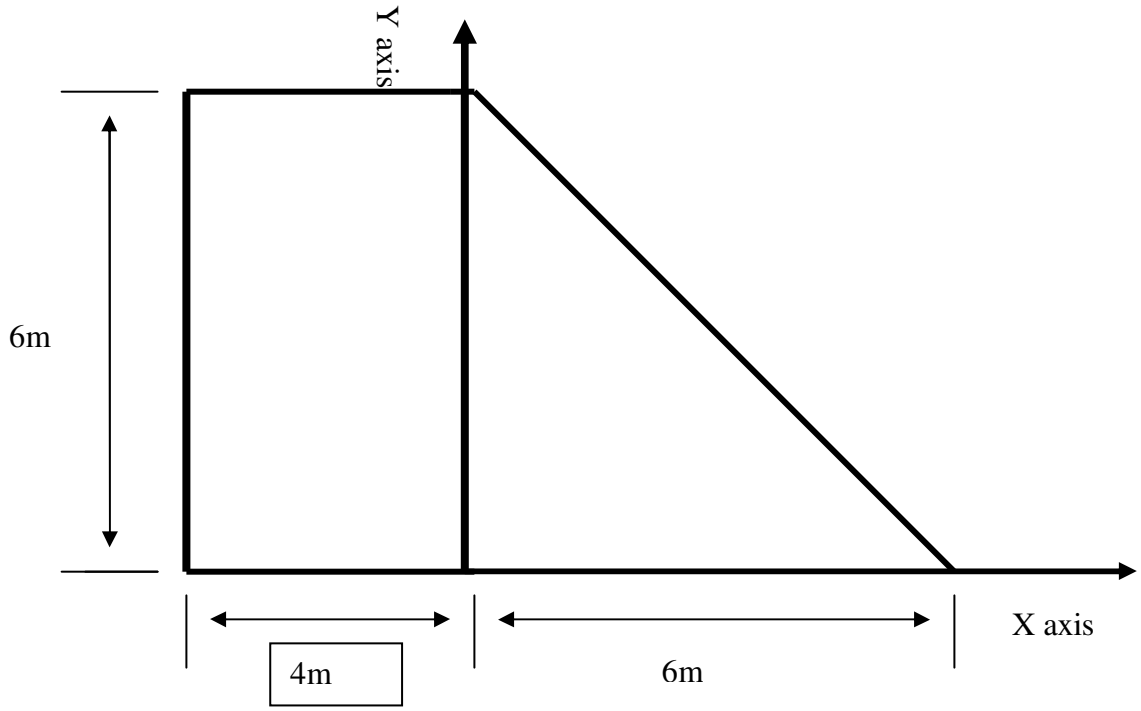

Figure Q6

End of examination