NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEAPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART I SECOND SEMESTER EXAMINATIONS – JUNE 2010
ENGINEERING MECHANICS II: KINEMATICS & DYNAMICS – TCW 1201

INSTRUCTIONS

Answer any five (5) questions

Time: 3 hours
Total Marks: 100

QUESTION I

The velocity of a particle moving along the x-axis is given as a function of time; the position is given at some instant as follows:

$$v(t) = 60t - 20\,{}^{m}\!/_{s}$$

At t=0 , $x(o) = 20m$

(a) Determine the position of the particle as a function of time. **[2 marks]**

(b) Determine the acceleration of the particle as a function of time. **[2 marks]**

© Evaluate the:

(i) position, **[2 marks]**
(ii) velocity, and **[2 marks]**
(iii) acceleration of the particle at $t = 8s$**.** **[2 marks]**

(d) Determine the total distance traveled by the particle between time $t = 8s$ and time $t = 12s$.
[4 marks]

(e) Sketch displacement x(t), the velocity v(t), and the acceleration a(t) for the interval $0 \le t \le 10s$. **[6 marks]**

QUESTION 2

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 marks]**

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

QUESTION 3

(a) Write short notes on the collision of elastic bodies. **[6 marks]**

The bars shown in figure Q3 are sliding freely on a horizontal rod. For the conditions specified in table Q3, determine:

(b) The final velocity of both beads. **[8 marks]**

© The percentage of the initial kinetic energy lost as a result of the collision of the two bars. e is the coefficient of restitution.

[6 marks]

Table Q3

mA	vA	mB	vB	e
10kg	5m/s	6kg	2m/s	0.3

Figure Q3

QUESTION 4

A10kg projectile is fired horizontally with an initial velocity of 100m/s from the top of a hill, which is 100m above the surrounding area.

(a)Determine the range R of the projectile (horizontal distance

traveled). **[10 marks]**

(b) The elapsed time before it strikes the ground. Air resistance is

negligible. **[10 marks]**

QUESTION 5

(a) Mention five characteristics of dry friction. **[5 marks]**

(b) Briefly explain the three types of friction problems **[3 marks]**

(c) Distinguish between the coefficient of static friction and the coefficient of kinetic friction. **[4 marks]**

(d) A 30 kg mass is pulled along a flat surface at a constant speed by a cable tension T at an angle of 40^0 in relation to the horizontal direction as shown in figure Q5 below. The coefficient of kinetic friction between the surface and the mass varies from $\mu_k = 0.20$ to 0.35. Determine the range of values of the magnitude of this tension T. **[8 marks]**

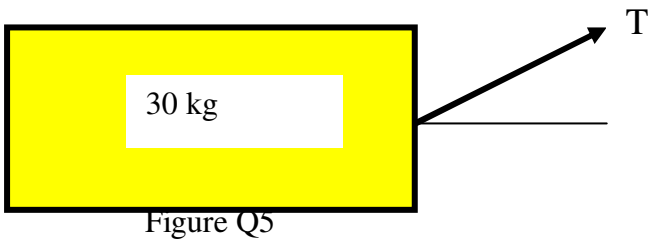

Figure Q5

QUESTION 6

From all the topics covered, explain why engineers should study mechanics with a special emphasis to dynamics. **[20 marks]**

QUESTION 7

(a) Derive an expression for the parallel axis theorem of an area. **[4 marks]**

(b) Determine the centroidal coordinates of the trapezoidal area shown in figure Q7. **[8 marks]**

(c) Also determine the moment of inertia of the composite body about the X and the Y axis.
[8 marks]

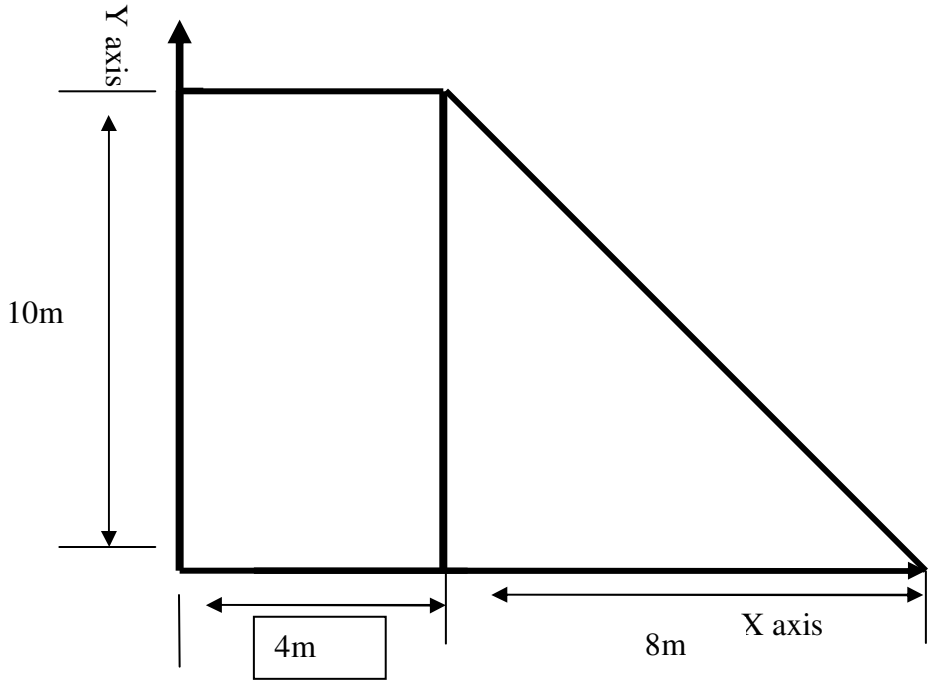

Figure Q7

END OF EXAMINATION!!!