FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI

SCHOOL OF ENVIROMENTAL TECHNOLOGY.

DEPARTMENT OF BUILDING TECHNOLOGY

HARMATTAN SEMESTER EXAMINATION 2014/2015 SESSION

Course Title: Structural Mechanics **Course Code: BDT213** **Time: 3Hours**

Instructions: ANSWER ANY FIVE QUESTIONS

1ai) What is a free body diagram and what are the step by step procedure for drawing an excellent free body diagram? (5marks)

1aii) What is a frictional force? Identify the various types of frictional force and differentiate between them. (5marks)

1bi) Calculate the acceleration of a 10Kg block, which experiences a 50N force directed 37° above the horizontal (let g=10m/s^2 and U_k= 0.2) show the free body diagram. (5marks)

1bii) Briefly explain the following terminologies

a. Center of mass
b. Center of gravity
c. Centroid
d. Impulse
e. Momentum (Stating the SI unit mathematical expression where applicable) (5marks)

2a) Tension in cable BC is 725-N; determine the resultant of the three forces exerted at point B of beam AB. In Fig 1

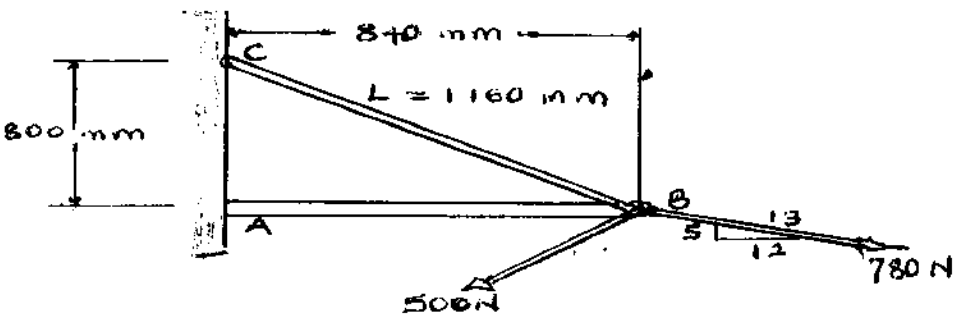


Fig 1 (10marks)

2bi) What is Moment of Inertia? Identify its types stating the SI unit of each identified. (Mathematical expression is required) (5marks)

2bii) State the three (3) Kepler's laws (5marks)

3a) Determine the **x** and **y** scalar components of F1, F2, and F3 acting at point **A** of the bracket in the figure below (Fig 2)

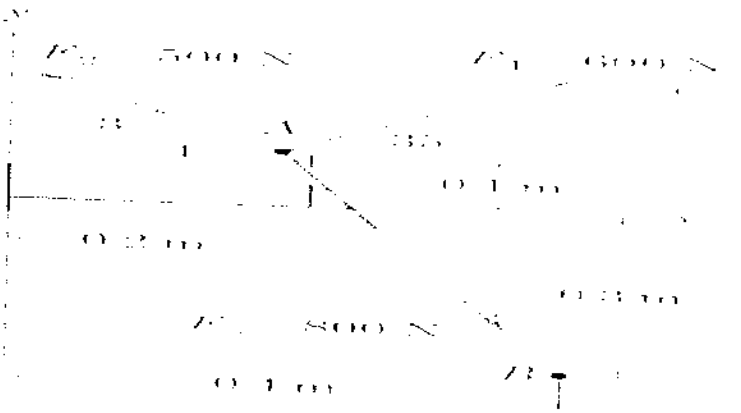


Fig 2

(10marks)

3bi) What is Newton's Law of Gravitation and what are the Newton's laws of motion? (Mathematical expression and SI unit(s) required) (5marks)

3bii) Show the Relationship between '**g**' and '**G**' and what do they represent.(5marks)

4a. Find the centroid of the shape below (Fig 3) :

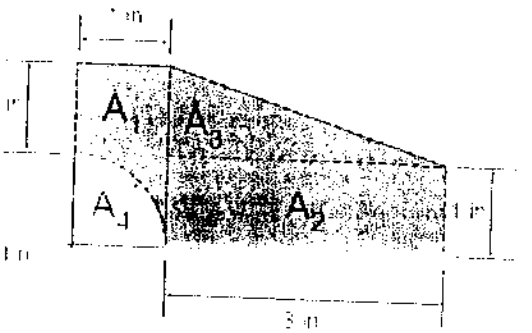
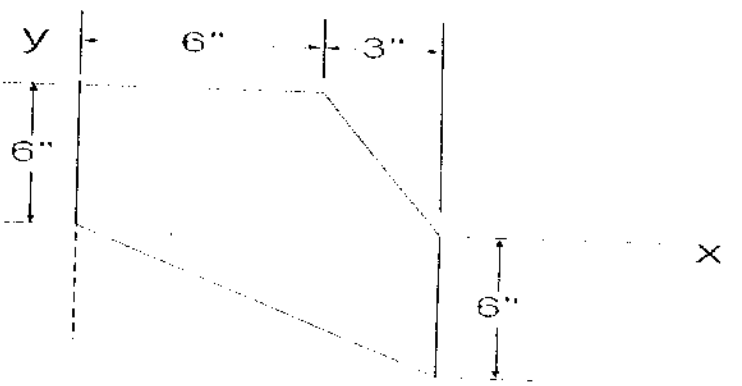


Fig 3

10marks

4b Find the moment of inertia around (y) and (x) axis in the Fig 4 given below

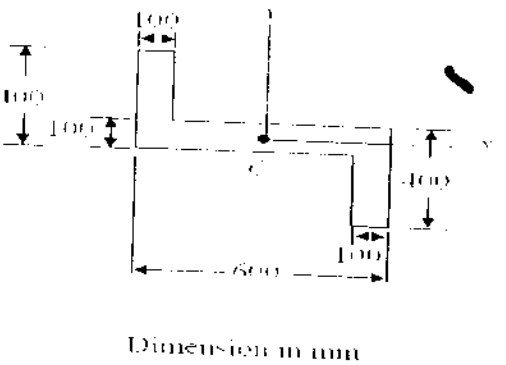


5a) Find the centroid of the Shape Below (Fig 5)

(10marks)

Fig 5

5b Determine the moment of inertia of the beam's cross-sectional area shown about the X and Y centroidal axis in Fig 6 given below



Dimension in mm

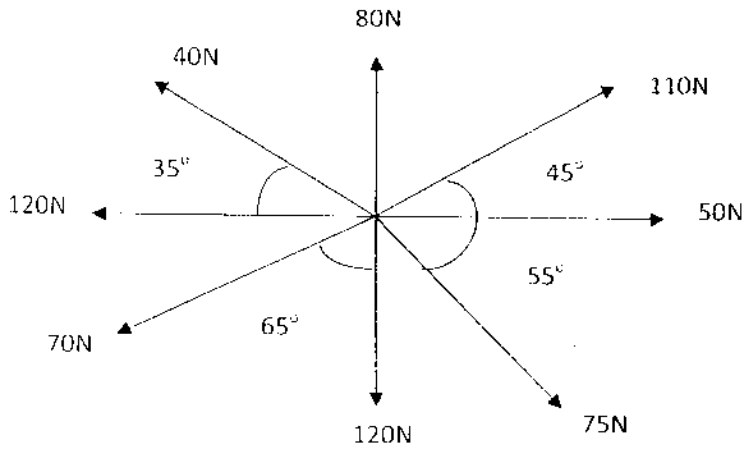
Fig 6

(10marks)

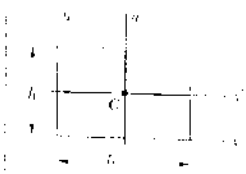
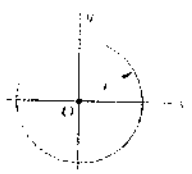
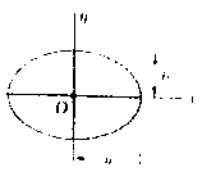
6ai) Differentiate between concurrent force and non-concurrent forces. (5marks)

6aii) List and explain the two types of Moment of Inertia (state their SI units) (5marks)

6b) Find the Resultant of the forces shown below



Standard Table Example

Rectangle		$I_x = \frac{1}{3}bh^3$ $I_{x'} = \frac{1}{12}bh^3$ $I_y = \frac{1}{3}hb^3$ $I_{y'} = \frac{1}{12}hb^3$ $I_o = \frac{1}{12}bh(b^2 + h^2)$	Semicircle		$I_x = I_y = \frac{1}{8}\pi r^4$ $I_o = \frac{1}{4}\pi r^4$
Triangle		$I_x = \frac{1}{12}bh^3$ $I_{x'} = \frac{1}{36}bh^3$	Quarter circle		$I_x = I_y = \frac{1}{16}\pi r^4$ $I_o = \frac{1}{8}\pi r^4$
Circle		$I_x = I_y = \frac{1}{4}\pi r^4$ $I_o = \frac{1}{2}\pi r^4$	Ellipse		$I_x = \frac{1}{4}\pi ab^3$ $I_y = \frac{1}{4}\pi a^3 b$ $I_o = \frac{1}{4}\pi ab(a^2 + b^2)$