INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2019**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGR1174 : Engineering Statics**
Date of Examination	:	December 12, 2019 (Thursday)
Time	:	2:00 pm - 4:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non Programmable Calculator

Materials provided :

Geometric Properties of Line and Area Elements
Center of Gravity and Mass Moment of Inertia of Homogeneous Solids

Examiner (s)	:	**Koh Mui Siang** and Nur Hafizah Habideen
Moderator	:	Ir Gerald Victor Richard Joseph

*This paper consists of **8** printed pages, including the cover page.*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR1174: ENGINEERING STATICS
FINAL EXAMINATION: AUGUST 2019 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Express each of three forces acting on the support in Cartesian vector form and determine the magnitude of the resultant force and its direction, measured clockwise from positive x axis.

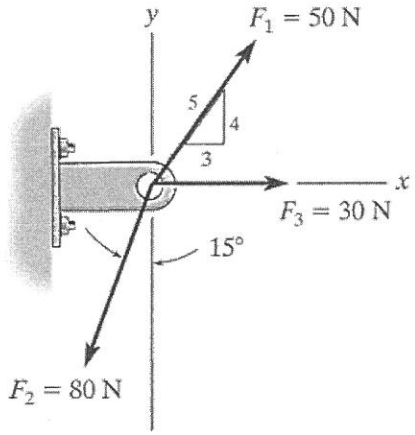

Figure Q1(a)

(13 marks)

(b) The lift sling is used to hoist a container having a mass of 500 kg. Determine the force in each of the cables AB and AC as a function of θ. If the maximum tension allowed in each cable is 5 kN, determine the shortest length of cables AB and AC that can be used for the lift. The center of gravity of the container is located at G.

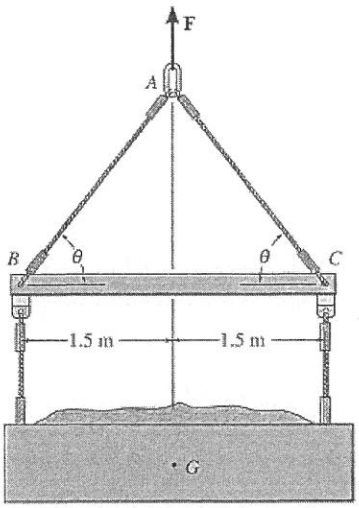

Figure Q1(b)

(12 marks)

Question 2

(a) The 20 N horizontal force acts on the handle of the socket wrench. Determine the moment of this force about point O. specify the coordination angles α, β, γ of the moment axis.

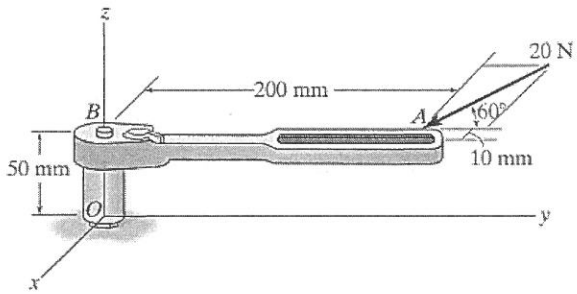

Figure Q2 (a)

(15 marks)

(b) Determine the moment of force F about point O. The force has a magnitude of 800 N and coordinate direction angles of $\alpha = 60°$, $\beta = 120°$, $\gamma = 45°$. Express the result as a Cartesian vector.

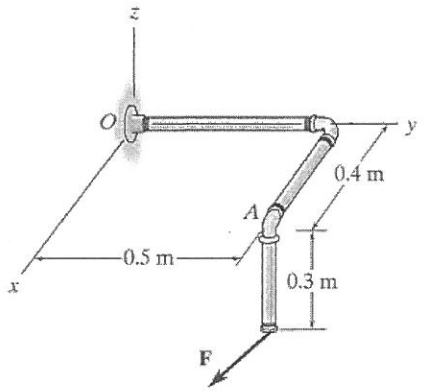

Figure Q2(b)

(10 marks)

Question 3

(a) Determine the reactions at the pin A and the tension in cord BC. Set F = 40 kN. Neglect the thickness of the beam.

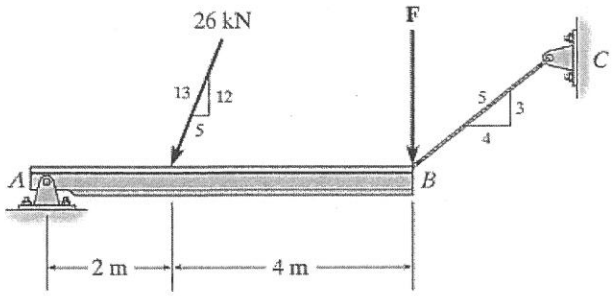

Figure Q3 (a)

(8 marks)

(b) Determine the force in each member of the truss and state if the members are in tension or compression. Set $P_1 = 6$ kN, $P_2 = 9$ kN.

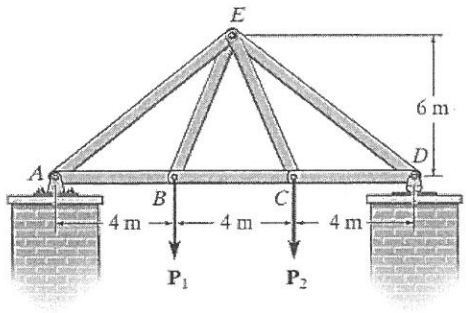

Figure Q3 (b)

(17 marks)

Question 4

Determine the internal normal force, shear force and the moment at points C and D.

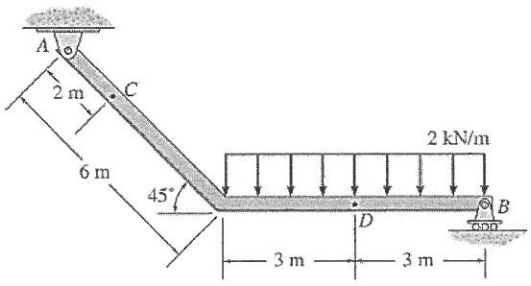

Figure Q4

(25 marks)

Question 5

Blocks *A* and *B* have a mass of 3 kg and 9 kg respectively, and are connected to the weightless links shown below. Determine the largest vertical force **P** that can be applied at the pin C without causing any movement. The coefficient of static friction between the blocks and the contacting surfaces is $\mu_s = 0.3$.

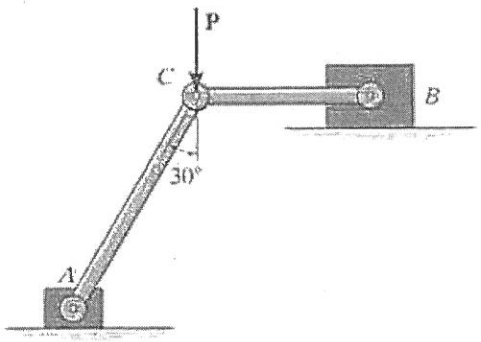

Figure Q5

(25 marks)

Question 6

(a) Determine the location of the centroidal axis of the beam's cross-sectional area as shown below. Neglect the size of the corner welds at *A* and *B* for the calculation.

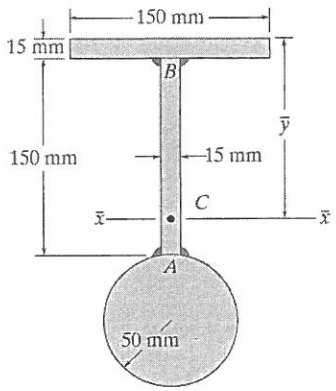

Figure Q6 (a)

(9 marks)

(b) Determine the moments of inertia for the cross-sectional area of the member below about the x and y centroidal axes.

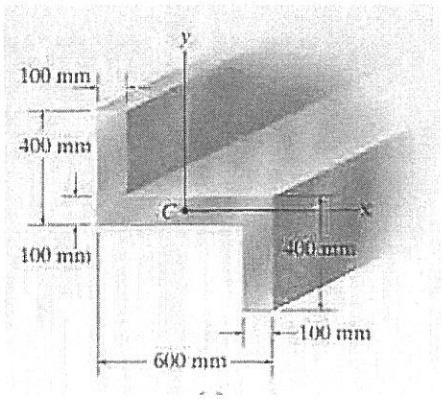

Figure Q6 (b)

(16 marks)

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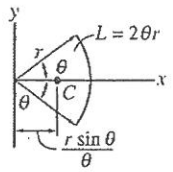
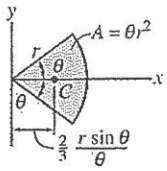
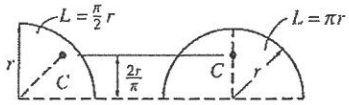
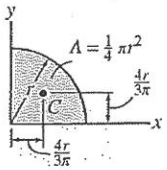
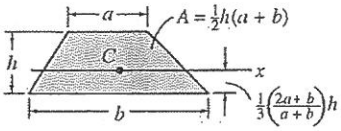
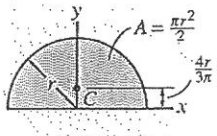
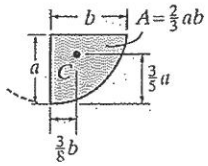
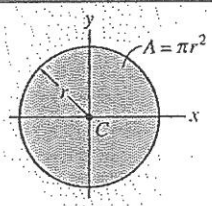
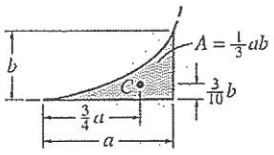
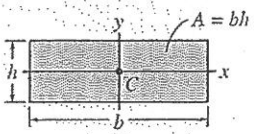
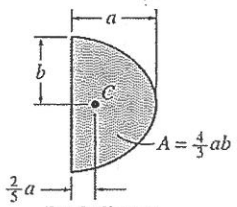
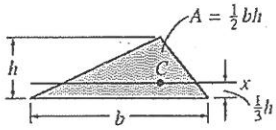
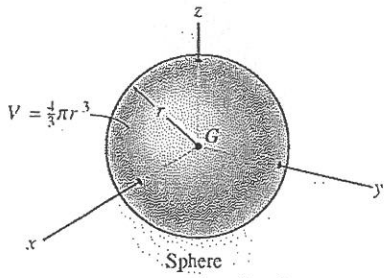
Geometric Properties of Line and Area Elements

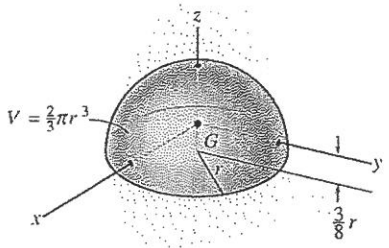
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2)\theta$ $I_y = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2)\theta$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$ $I_y = \frac{1}{16}\pi r^4$
 Trapezoidal area	 Semicircular area	$I_x = \frac{1}{8}\pi r^4$ $I_y = \frac{1}{8}\pi r^4$
 Semiparabolic area	 Circular area	$I_x = \frac{1}{4}\pi r^4$ $I_y = \frac{1}{4}\pi r^4$
 Exparabolic area	 Rectangular area	$I_x = \frac{1}{12}bh^3$ $I_y = \frac{1}{12}hb^3$
 Parabolic area	 Triangular area	$I_x = \frac{1}{36}bh^3$

Center of Gravity and Mass Moment of Inertia of Homogeneous Solids



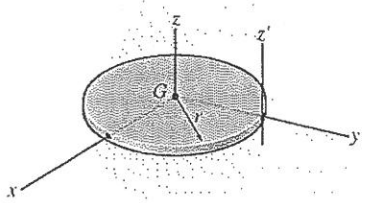
Sphere

$I_{xx} = I_{yy} = I_{zz} = \frac{2}{5}mr^2$



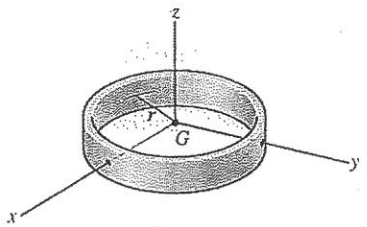
Hemisphere

$I_{xx} = I_{yy} = 0.259mr^2 \quad I_{zz} = \frac{2}{5}mr^2$



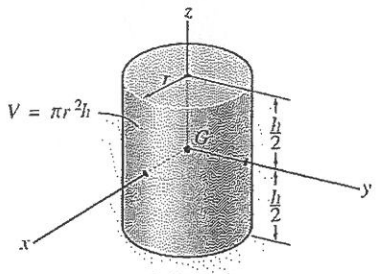
Thin Circular disk

$I_{xx} = I_{yy} = \frac{1}{4}mr^2 \quad I_{zz} = \frac{1}{2}mr^2 \quad I_{z'z'} = \frac{3}{2}mr^2$



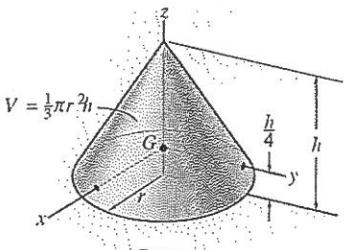
Thin ring

$I_{xx} = I_{yy} = \frac{1}{2}mr^2 \quad I_{zz} = mr^2$



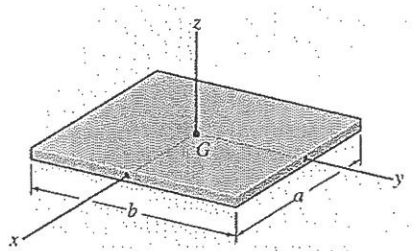
Cylinder

$I_{xx} = I_{yy} = \frac{1}{12}m(3r^2 + h^2) \quad I_{zz} = \frac{1}{2}mr^2$



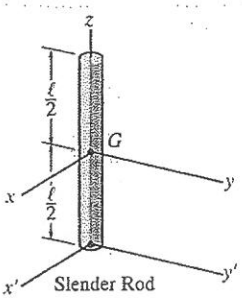
Cone

$I_{xx} = I_{yy} = \frac{3}{80}m(4r^2 + h^2) \quad I_{zz} = \frac{3}{10}mr^2$



Thin plate

$I_{xx} = \frac{1}{12}mb^2 \quad I_{yy} = \frac{1}{12}ma^2 \quad I_{zz} = \frac{1}{12}m(a^2 + b^2)$



Slender Rod

$I_{xx} = I_{yy} = \frac{1}{12}m\ell^2 \quad I_{x'x'} = I_{y'y'} = \frac{1}{3}m\ell^2 \quad I_{z'z'} = 0$