INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2017**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGR1174 : Engineering Statics**
Date of Examination	:	December 14, 2017 (Thursday)
Time	:	11:00 am – 1:00 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 :

Calculator

Materials provided :

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

Examiner (s) : **Jaisatia Varthani** & Dennis Koh Mui Siang

Moderator : Ir Gerald Victor Richard Joseph

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

DIPLOMA IN MECHANICAL ENGINEERING POGRAMME (DMEN)
EGR1174 : ENGINEERING STATICS
FINAL EXAMINATION: AUGUST 2017 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) Determine the force in cables AB and AC necessary to support the 12-kg traffic light.
(10 marks)

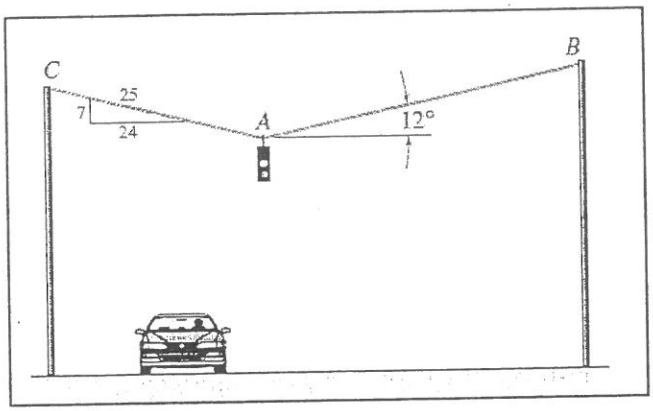


Figure Q1(a)

(b) Determine the magnitude and coordinate direction angles of the resultant force, and sketch this vector on the coordinate system.
(15 marks)

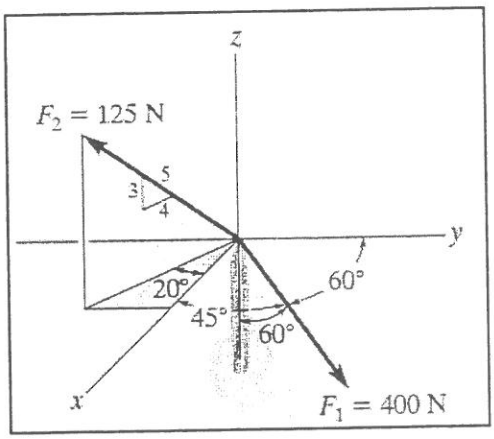


Figure Q1(b)

Question 2

(a) Determine the moment of each of the three forces about point A.

(9 marks)

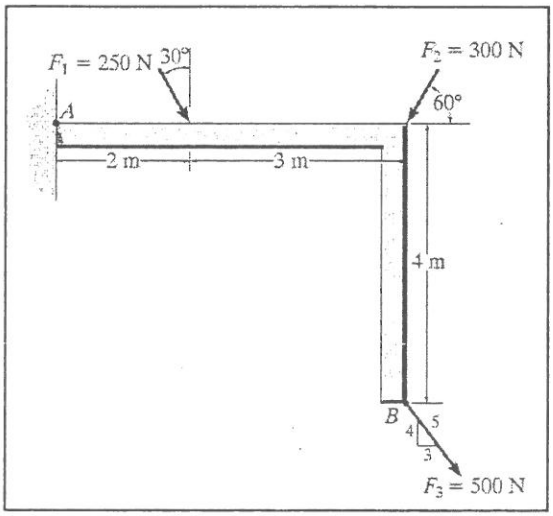


Figure Q2(a)

(b) The boom is intended to support two vertical loads, $\mathbf{F}_1$ and $\mathbf{F}_2$. If the cable CB can sustain a maximum load of 1500 N before it fails, determine the critical loads if $F_1 = 2F_2$. Also, what is the magnitude of the maximum reaction at pin A?

(16 marks)

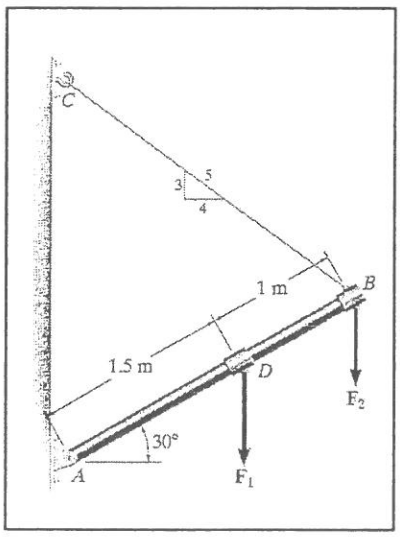


Figure Q2(b)

Question 3

(a) Determine the force in each member of the truss in terms of the external loading and state if the members are in tension or compression. Take P = 2 kN.

(12 marks)

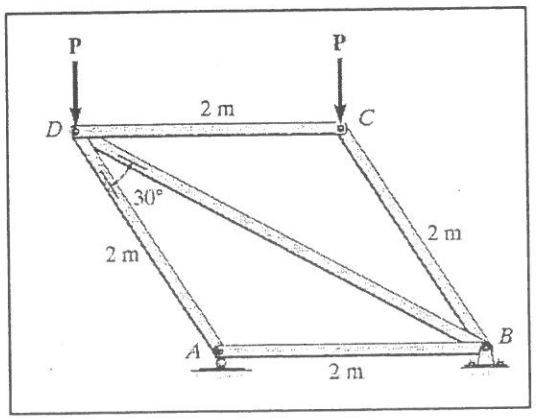


Figure Q3(a)

(b) Determine the force in members JK, CJ, and CD of the truss, and state if the members are in tension or compression.

(13 marks)

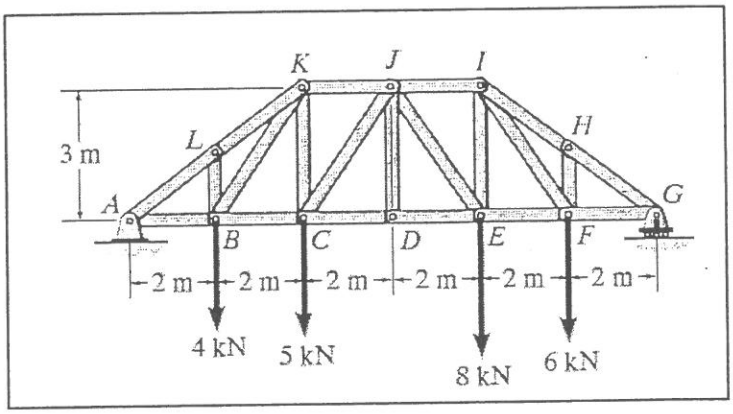


Figure Q3(b)

Question 4

The uniform crate has a mass of 150 kg. If the coefficient of static friction between the crate and the floor is $\mu_s = 0.2$, determine the smallest mass of the man so he can move the crate. The coefficient of static friction between his shoes and the floor is $\mu'_s = 0.45$. Assume the man exerts only a horizontal force on the crate.

(25 marks)

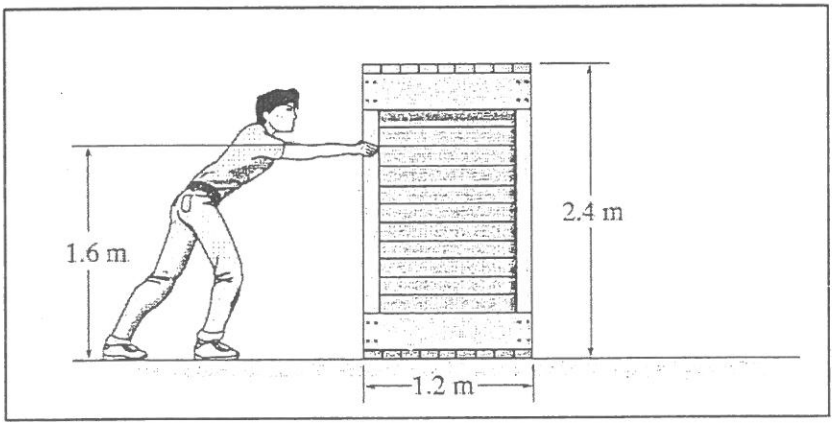


Figure Q4

Question 5

Draw the shear and moment diagrams for the beam.

(25 marks)

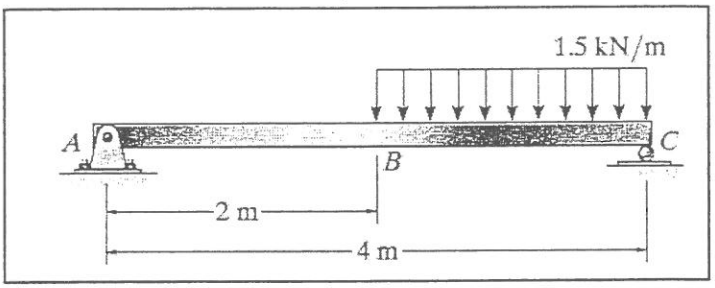


Figure Q5

Question 6

(a) Locate the centroid x of the shaded area.

(6 marks)

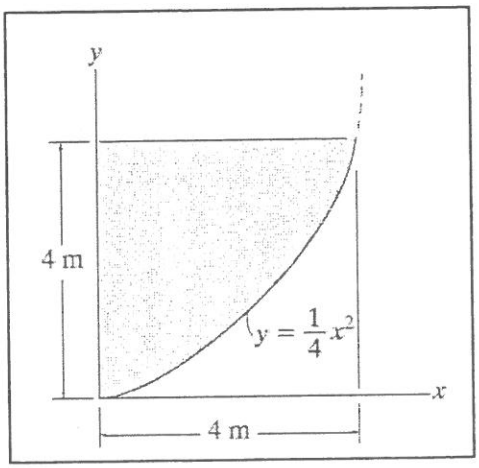


Figure Q6 (a)

(b) Determine $\bar{y}$, which locates the centroidal axis x' for the cross-sectional area of the T-beam, and then find the moments of inertia $I_{x'}$ and $I_{y'}$.

(19 marks)

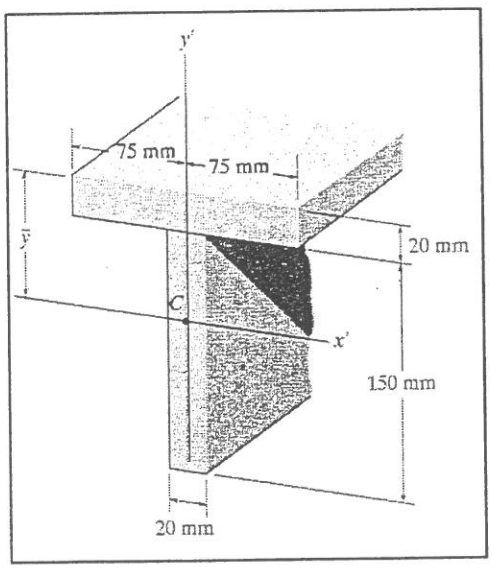
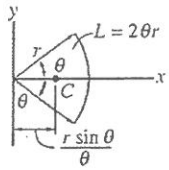
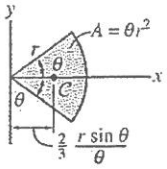
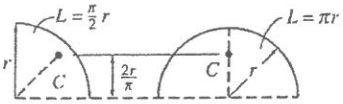
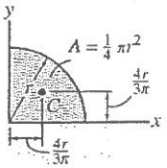
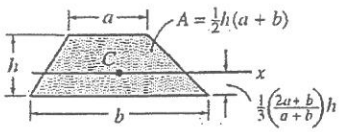
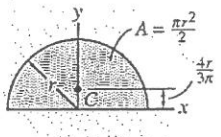
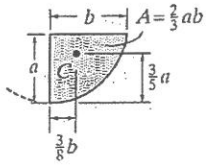
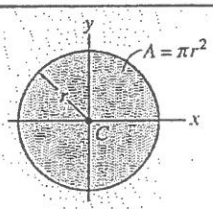
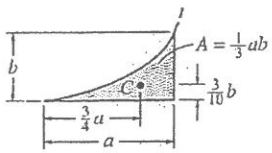
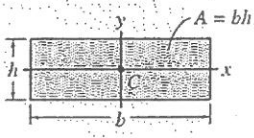
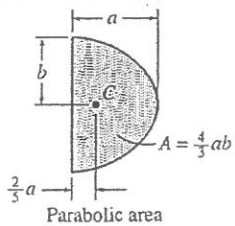
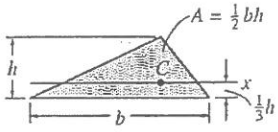


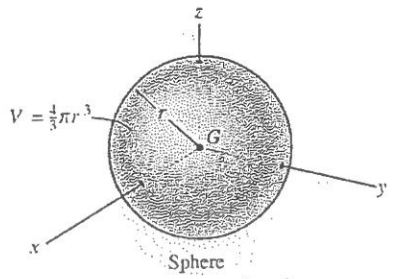
Figure Q6(b)

-THE END-

Geometric Properties of Line and Area Elements

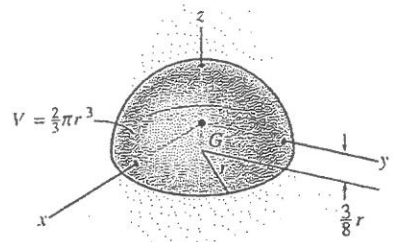
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2)\theta$ $I_y = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2)\theta$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$ $I_y = \frac{1}{16}\pi r^4$
 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



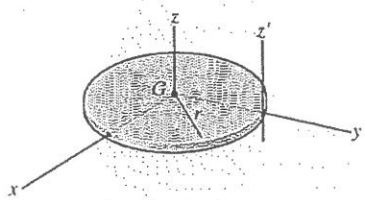
Sphere

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



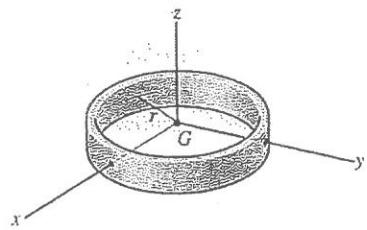
Hemisphere

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



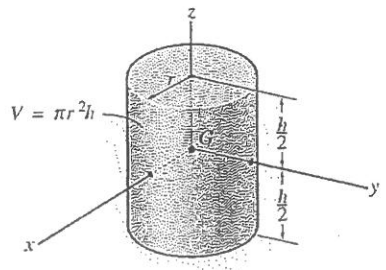
Thin Circular disk

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



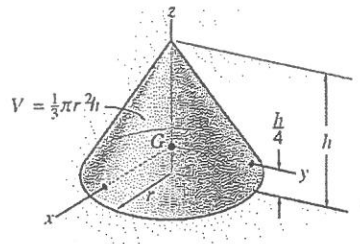
Thin ring

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



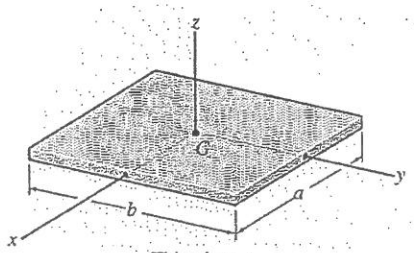
Cylinder

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



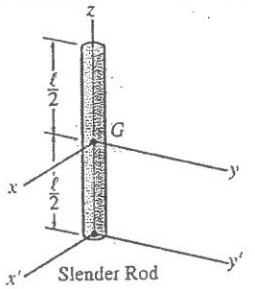
Cone

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



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

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