INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2018**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**EGR1174 : Engineering Statics**
Date of Examination	:	December 12, 2018 (Wednesday)
Time	:	5:00 pm – 7:00 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** and Dennis,Koh Mui Siang
Moderator	:	Ir Gerald Victor Richard Joseph

This paper consists of 7 printed pages, including the cover page.

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR1174 : ENGINEERING STATICS
FINAL EXAMINATION: AUGUST 2018 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 the force **F** shown in Figure Q1(a) as Cartesian vector.

(6 marks)

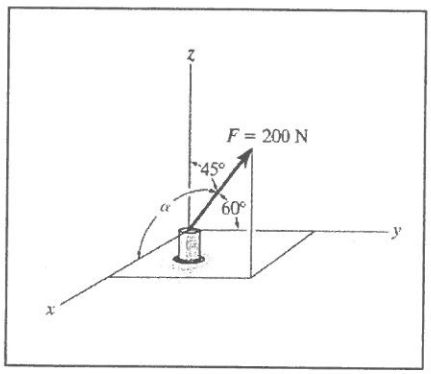


Figure Q1(a)

(b) A particle of mass 4 kg is held in equilibrium on a smooth plane which is inclined at 45° to the horizontal by a horizontal force of magnitude ***P*** N, as shown in the Figure Q1(b). Find the value of ***P*** with simple diagram illustrations.

(7 marks)

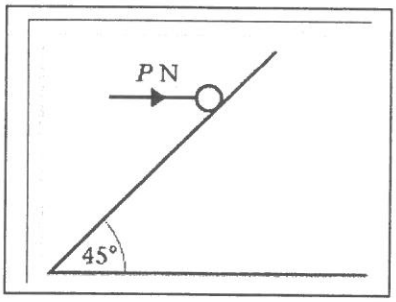


Figure Q1(b)

(c) Determine the magnitude of the resultant force acting on the corbel in Figure Q1(c) and its direction angle measured counter clockwise from the x axis.

(12 marks)

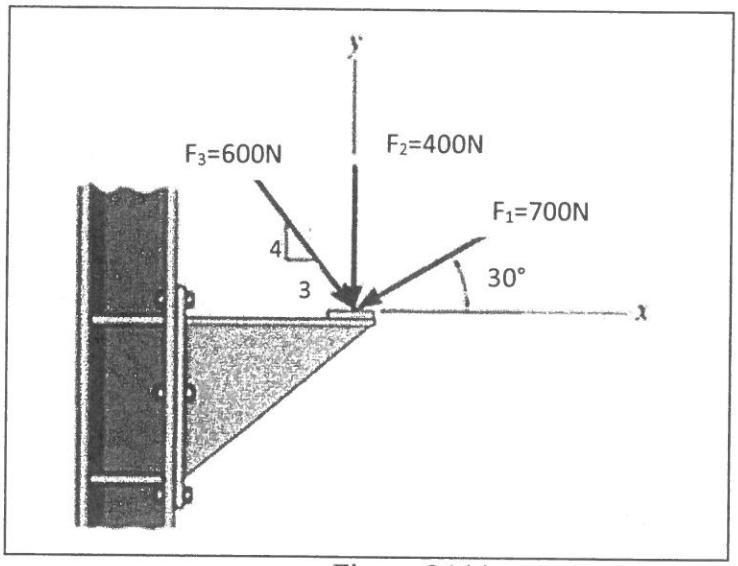


Figure Q1(c)

Question 2

(a) Determine the force P that must be applied perpendicularly to the handle of the flex-headed ratchet wrench in Figure Q2(a) if a torque of 80 Nm is required to loosen the bolt at A.

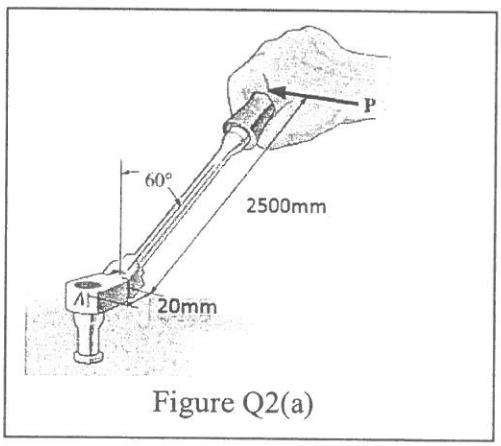


Figure Q2(a)

(20 marks)

(b) Determine by vector analysis, the couple moment acting on the pipe in Figure Q2(b). Segment *AB* is directed 30° below the *x*–*y* plane.

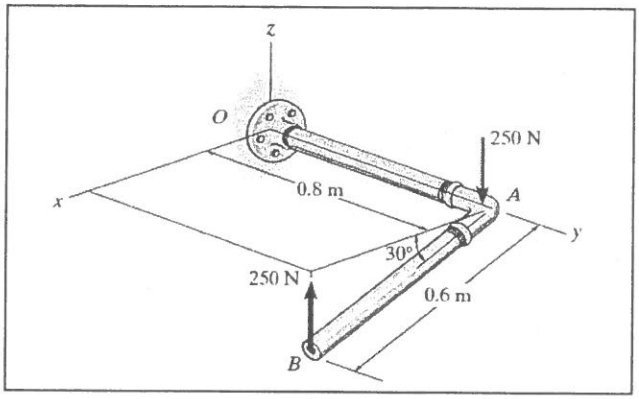


Figure Q2(b)

(5 marks)

Question 3

(a) The Figure Q3(a) shows a non-uniform horizontal beam AB of mass 5 kg and length 3 m is freely hinged to a vertical wall and is supported by a rod CD. Given that the thrust in the rod CD is 35 N, AC = 1 m, and the angle between the rod and the vertical wall is 45°, find the distance of the centre of mass of the beam from A.

(7 marks)

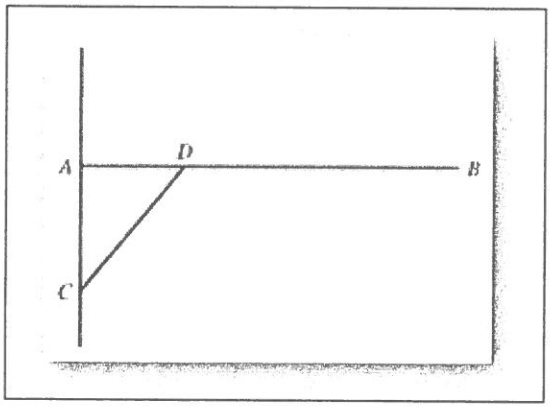


Figure Q3(a)

(b) Determine the components of the support reactions at the fixed support A on the cantilever beam as shown in Figure Q3(b).

(18 marks)

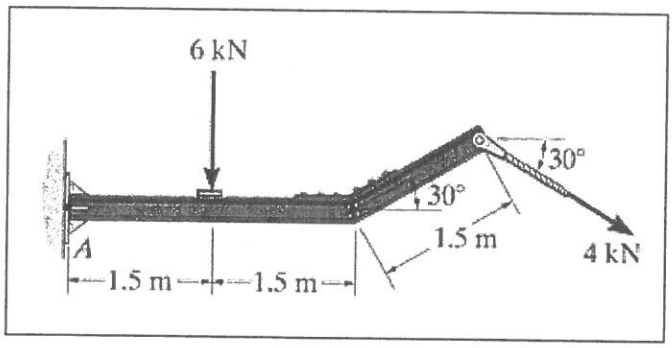


Figure Q3(b)

Question 4

The Howe bridge truss is subjected to the loading as shown in Figure Q4(a). Determine the force in members HD, CD, and GD. Indicate whether the members are in tension or compression. (Members AB, BC, CD and DE are of equal length of 4 m)

(25 marks)

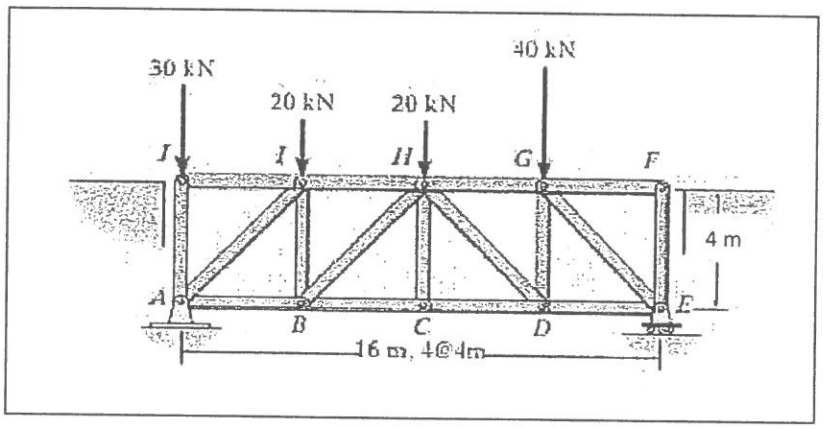


Figure Q4

Question 5

(a) In Figure Q5(a), the support A and B are journal and thrust bearing respectively. Sketch the shear and bending moment diagram for the structure.

(8 marks)

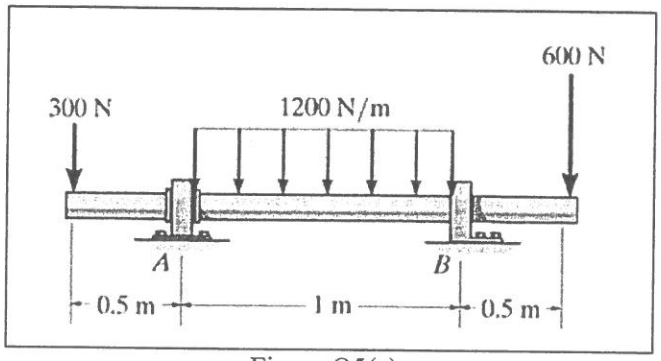


Figure Q5(a)

(b) In Figure Q5(b), if each box weighs 75-kg, determine the least horizontal force P that the man must exert on the top box in order to cause motion. The coefficient of static friction between the boxes is $\mu_s = 0.5$ and between the box and the floor is $\mu_s' = 0.2$.

(17 marks)

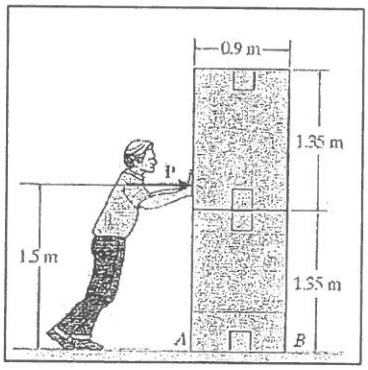


Figure Q5(b)

Question 6

(a) For the beam structure shown in Figure Q6(a), locate the centroid x of the beam's cross sectional area, and then determine the moment of inertia of the area about the centroid y' axis. (the beam has uniform thickness of 10 mm)

(12 marks)

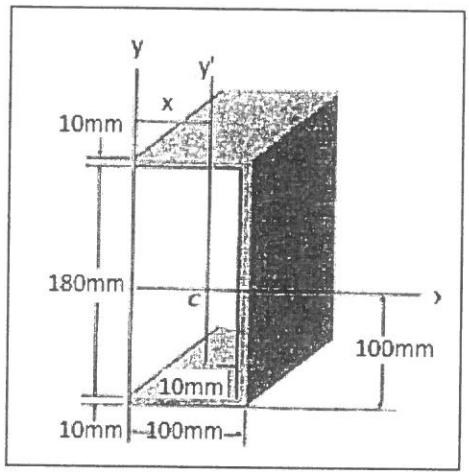


Figure Q6(a)

(b) Determine the moment of inertia of the composite area shown in Figure Q6(b) about the y-axis and x-axis.

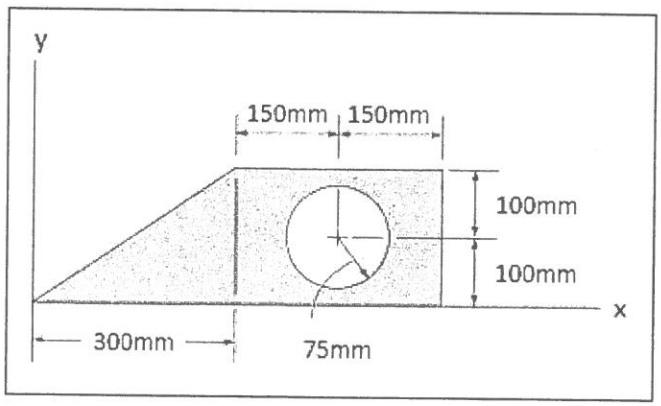
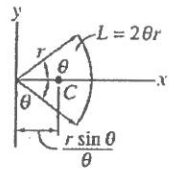
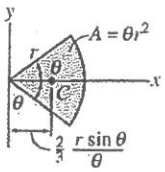
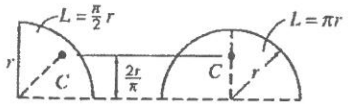
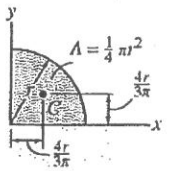
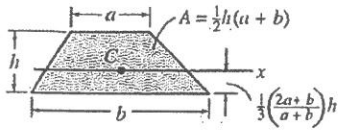
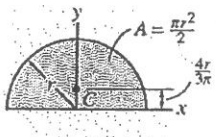
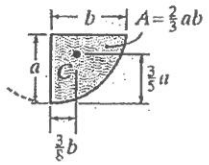
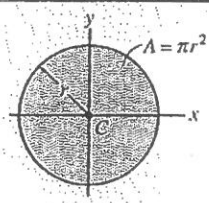
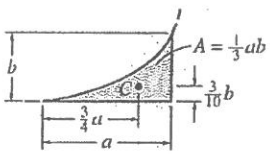
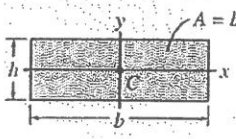
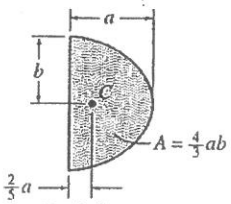
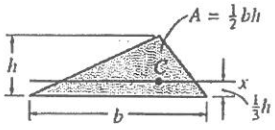


Figure Q6(b)

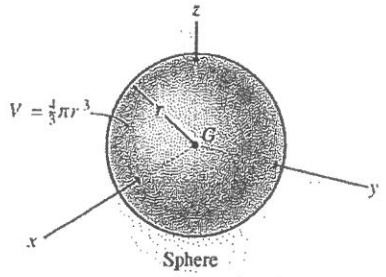
(13 marks)

-THE END-

Geometric Properties of Line and Area Elements

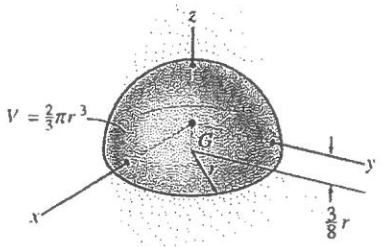
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2)\theta$ $I_y = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2)\theta$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$ $I_y =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



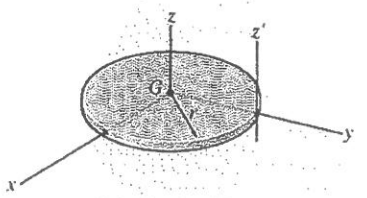
Sphere

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



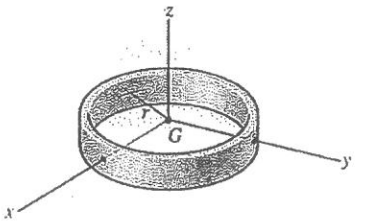
Hemisphere

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



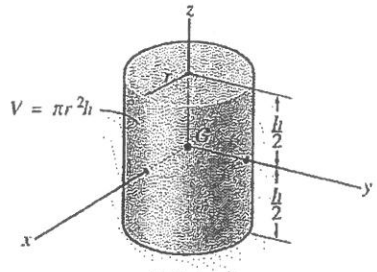
Thin Circular disk

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



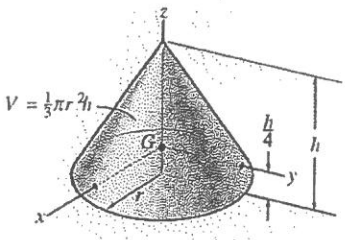
Thin ring

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



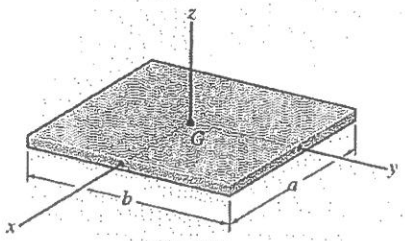
Cylinder

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



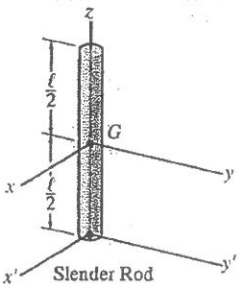
Cone

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



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

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