FINAL

ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2020**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGR1174 : Engineering Statics**
Date of Examination	:	August 6, 2020 (Thursday)
Time	:	8:00 am – 10:15 am Reading Time : Nil
Duration	:	2 hour 15 mins

Special Instructions :

Answer **ALL FOUR (4)** questions.

Material 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** & Nur Hafizah Habidden
Chief Moderator	:	Mr Teow Hsien Loong

This paper consists of ***5*** *printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR1174: ENGINEERING STATICS
FINAL ALTERNATIVE ASSESSMENT: APRIL 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Question 1

Determine the force in each member of the truss and state if the members are in tension or compression. Set P_1 = 10 kN, P_2 = 8 kN.

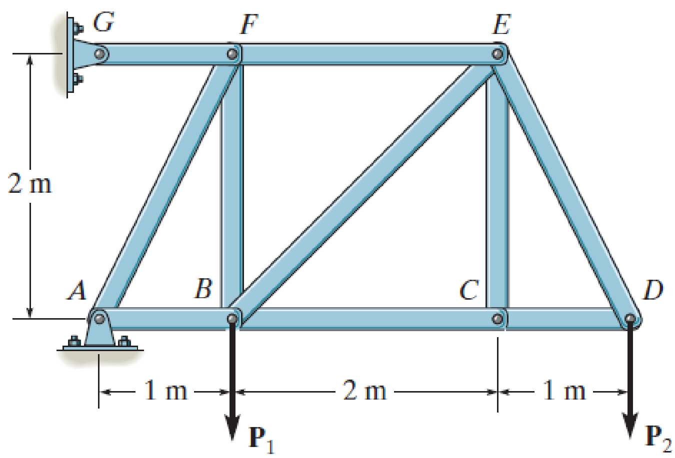

Figure Q1

(25 marks)

Question 2

(a) The automobile has a mass of 2 Mg and center of mass at *G*. Determine the towing force **F** required to move the car. Both the front and rear brakes are locked. Take μ_s = 0.3.

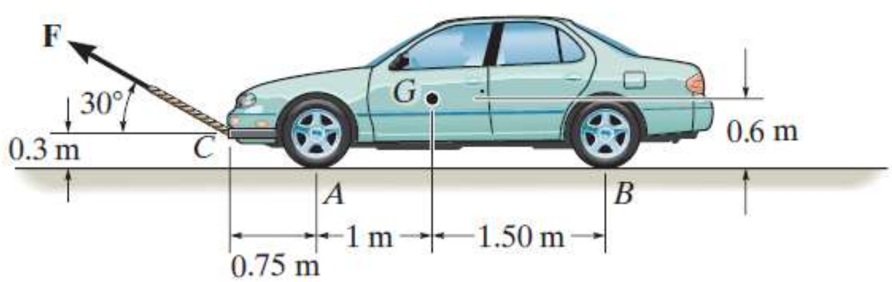

Figure Q2a

(12 marks)

(b) Determine the minimum applied force **P** required to move wedge *A* to the right. The spring is compressed a distance of 175 mm. Neglect the weight of *A* and *B*. The coefficient of static friction for all contacting surfaces is $\mu_s = 0.35$. Neglect friction at the rollers.

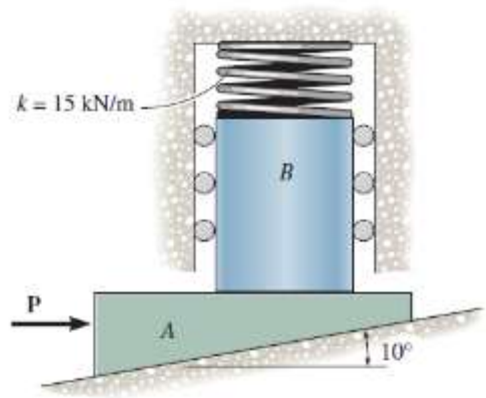

Figure Q2b

(13 marks)

Question 3

(a) Determine the internal normal force, shear force, and moment at points *D* in the beam.

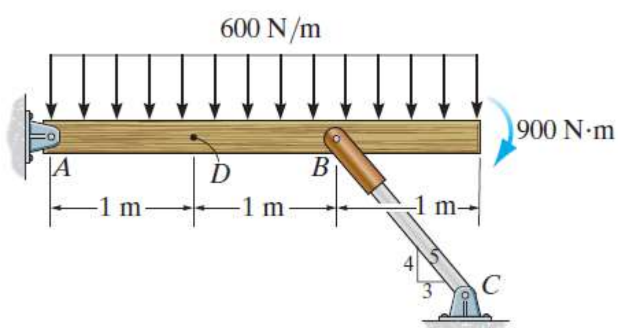

Figure Q3a

(15 marks)

(b) Draw the shear and moment diagrams for the beam.

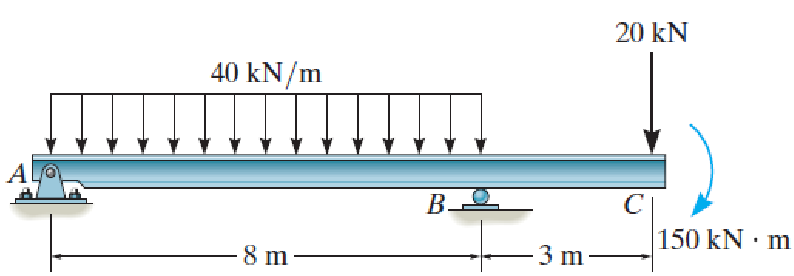

Figure Q3b

(10 marks)

Question 4

(a) Determine the location $\bar{y}$, of the centroidal axis $\bar{x} - \bar{x}$ of the beam's cross-sectional area. Neglect the size of the corner welds at A and B for the calculation.

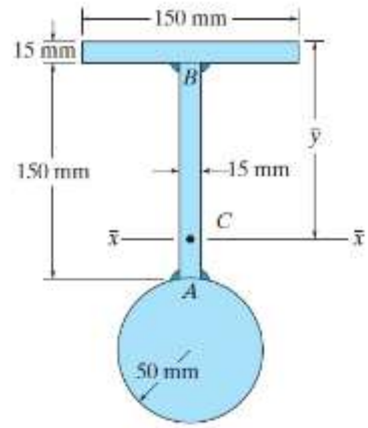

Figure Q4a

(9 marks)

(b) Determine the location $\bar{y}$, of the centroid of the channel's cross-sectional area and then calculate the moment of inertia of the area about this axis.

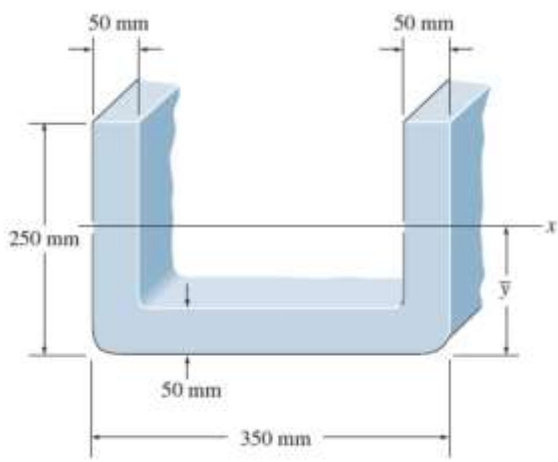

Figure Q4b

(16 marks)

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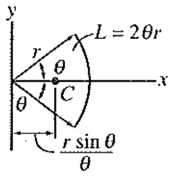
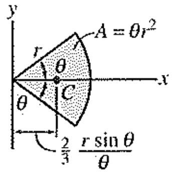
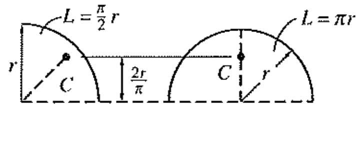
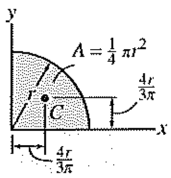
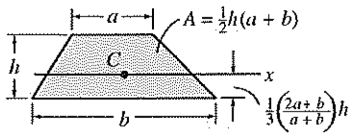
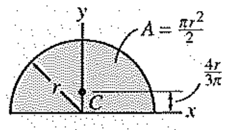
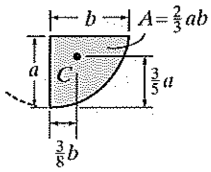
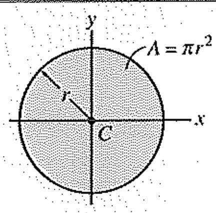
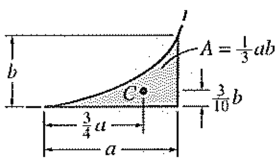
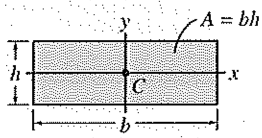
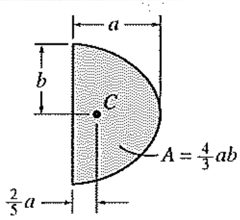
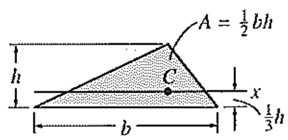
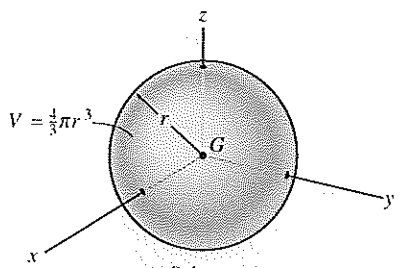
Geometric Properties of Line and Area Elements

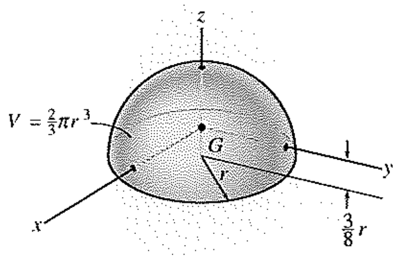
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4} r^4 (\theta - \frac{1}{2} \sin 2\theta)$ $I_y = \frac{1}{4} r^4 (\theta + \frac{1}{2} \sin 2\theta)$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$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



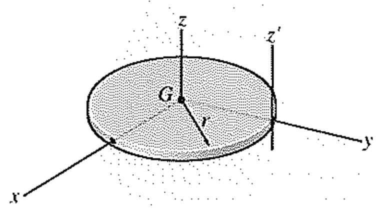
Sphere

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



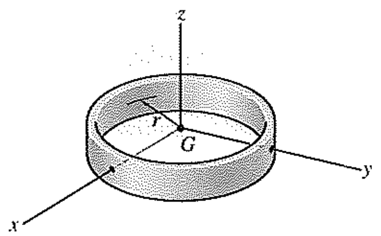
Hemisphere

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



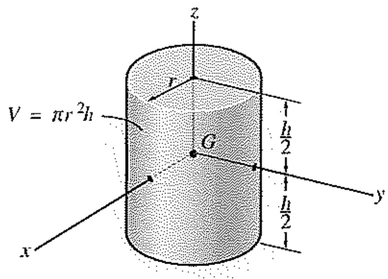
Thin Circular disk

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



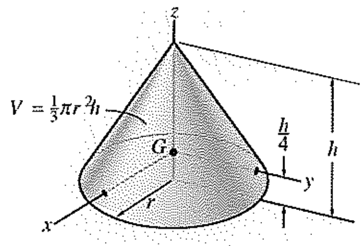
Thin ring

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



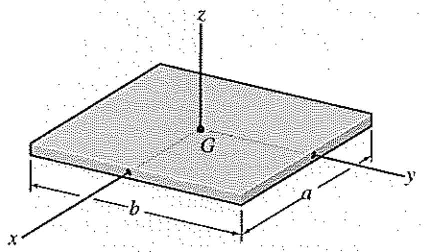
Cylinder

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



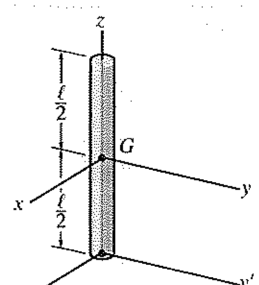
Cone

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



Thin plate

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



Slender Rod

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