King Fahd University of Petroleum & Minerals

Department of Civil and Environmental Engineering

CE 201 – Statics

Semester: 141

Examination: Final

Date (Day): January 10, 2015 (Saturday)

Time: 08:00 – 11:00 a.m.

Section	1 & 2	3	4	5	6	8	9	10
Instructor	Al-Malack	Vohra	Al-Attas	Essa	Al-Senan	Alghamdi	Chowdhury	Al-Osta
Time	07:00 & 08:00	09:00	09:00	10:00	11:00	11:00	10:00	08:00
Tick								

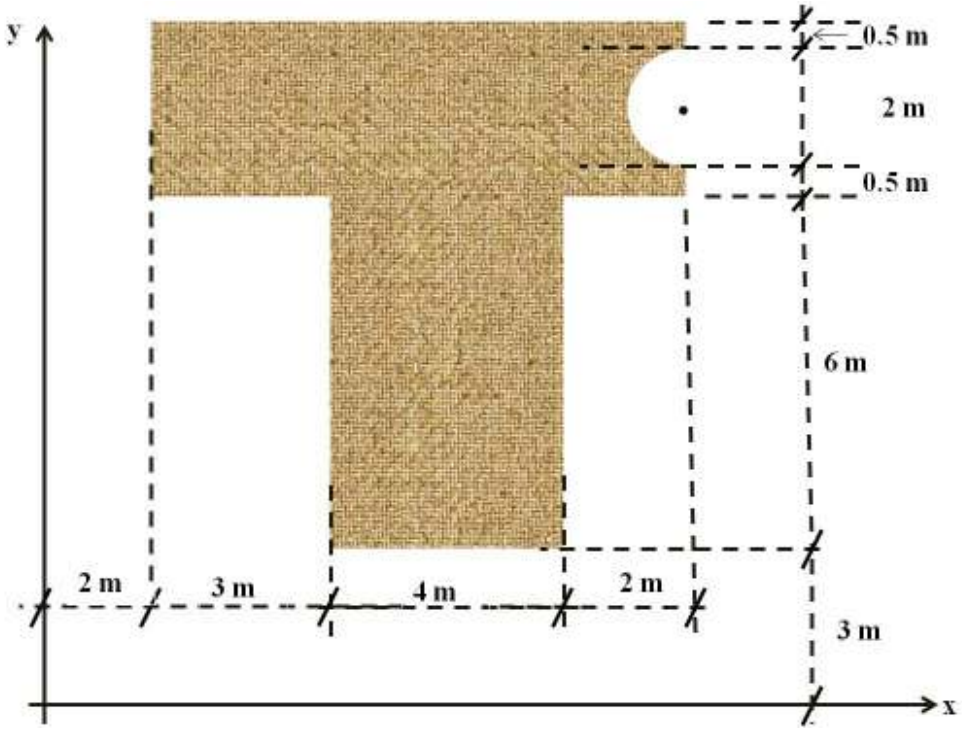
Student's Name :	
Student's ID :	

Problem	Assigned Grade	Earned Grade
1	15 (Points)	
2	25 (Points)	
3	20 (Points)	
4	15 (Points)	
5	25 (Points)	
Total	100 (Points)	

Good Luck

Problem 1 (15 Points)

Locate the centroid (x, y) of the shaded area shown below. **Use the specified axes shown and the provided table in your solution**.



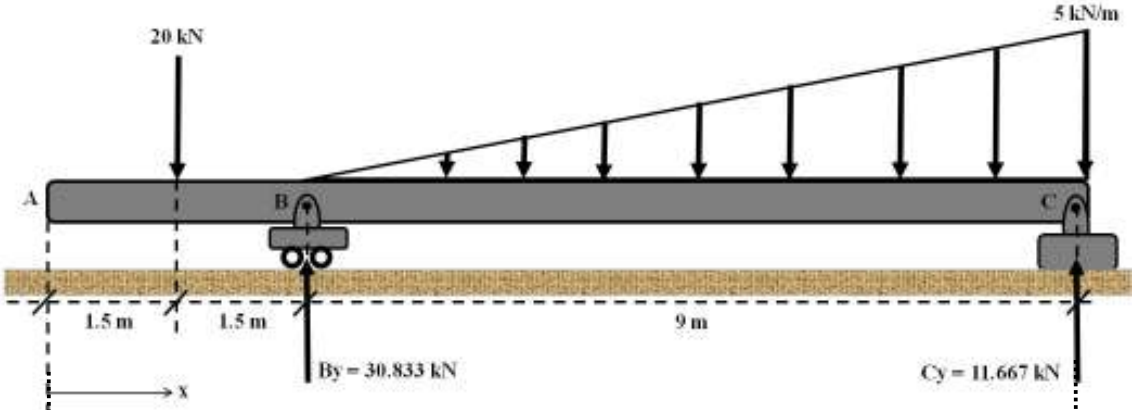
Problem 2 (25)

For the beam shown below:

(15 Points) (1) Determine the shear and moment as a function of x.

(10 Points) (2) Draw the shear force and bending moment diagrams.

The reactions at the supports B and C (B_y and C_y) are given. Develop the equations on **page 4** and draw the diagrams on **this page**. **Show all solution steps.**

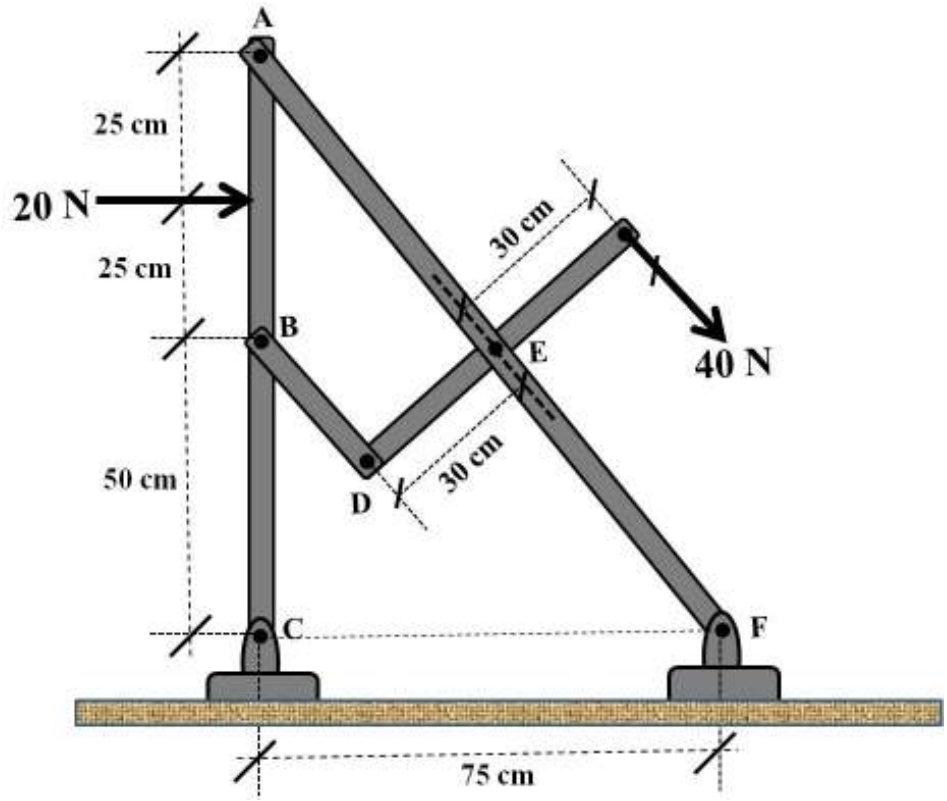


Problem 3 (20 Points):

For the frame shown below, determine the horizontal and vertical components of reactions at pins A, B, C, D, E and F.

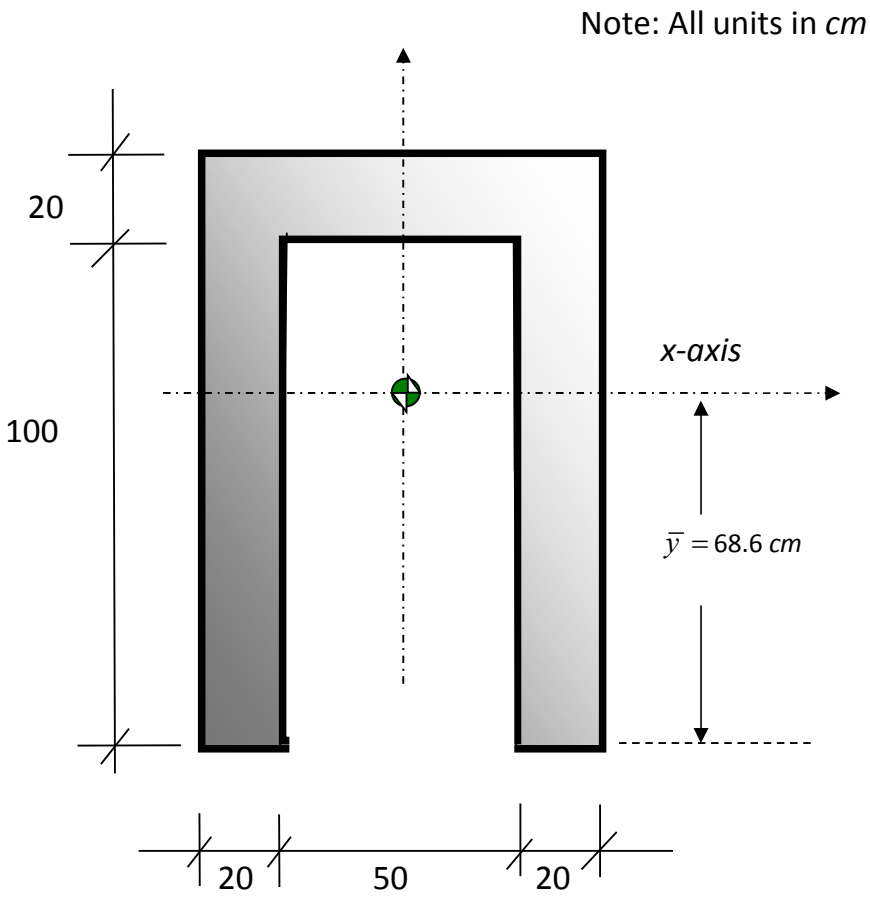
Note:

member BD is perpendicular to member DE, member DE is perpendicular to member AF and the 40 N force is perpendicular to member DE



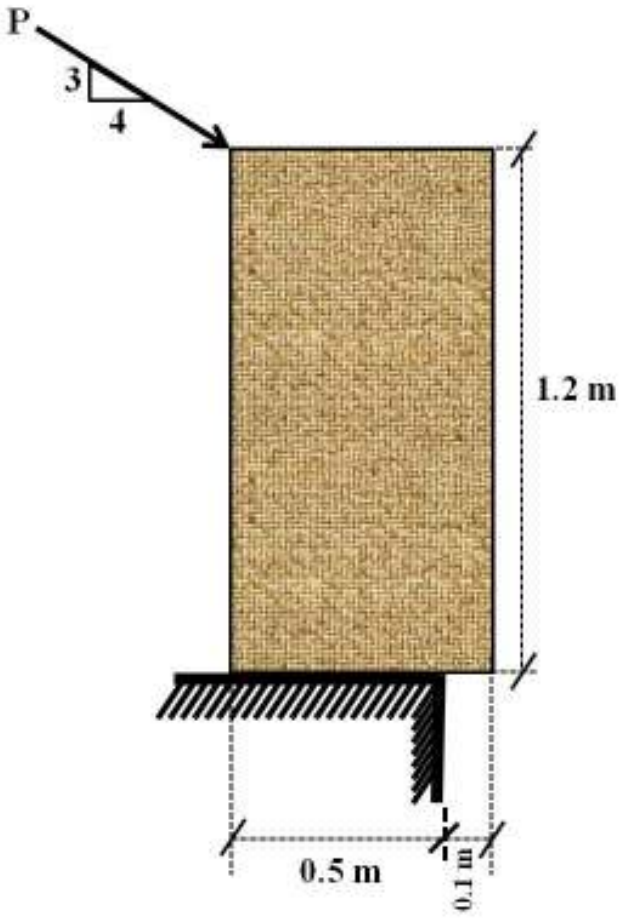
Problem 4 (15 Points)

The inverted U-shaped section (*shown below*) is the cross-section for a given beam-structure. For this cross-section, determine the moment of inertia about the x-axis (I_{xx}).

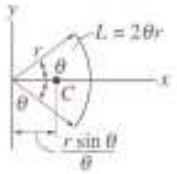
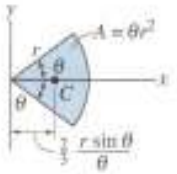
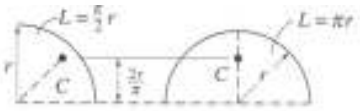
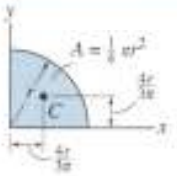
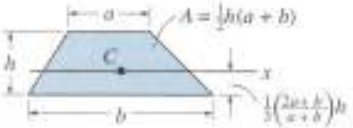
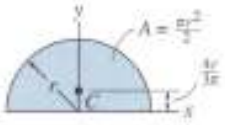
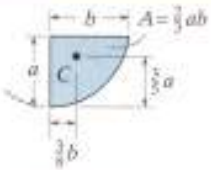
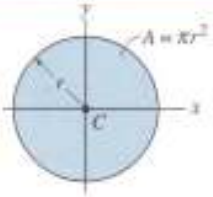
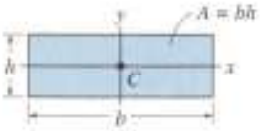
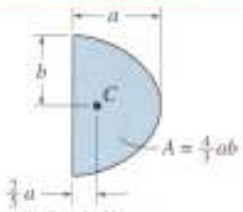
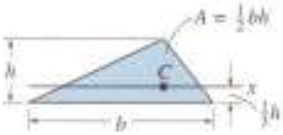


Problem 5 (25 Points)

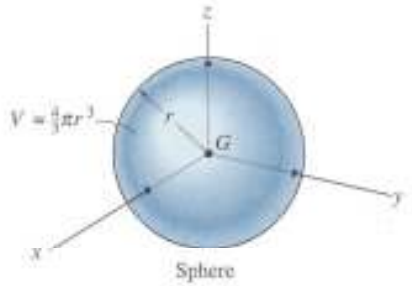
A box has a mass of **100 kg** and rests on the floor for which the coefficient of static friction μ_s is **0.25**. Determine the smallest magnitude of the force (**P**) that will cause impending motion of the box.



Geometric Properties of Line and Area Elements

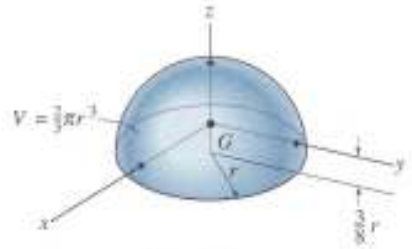
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2\theta)$ $I_y = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2\theta)$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$ $I_y =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



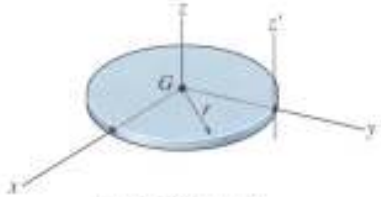
Sphere

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



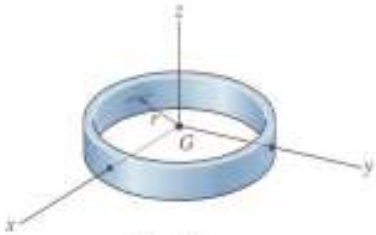
Hemisphere

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



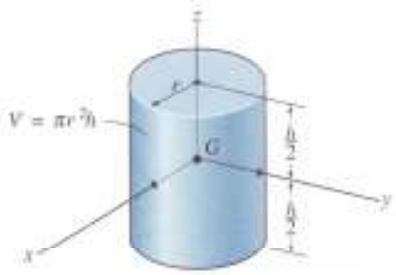
Thin Circular disk

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



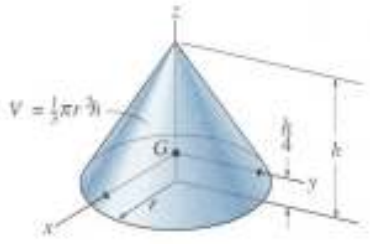
Thin ring

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



Cylinder

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

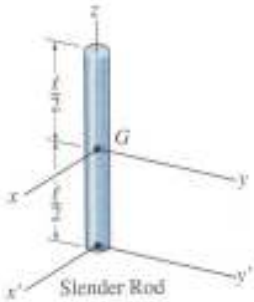


Cone

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

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

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