UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA

DEPARTEMENT SIVIELE EN BIOSISTEEMINGENIEURSWESE
DEPARTMENT OF CIVIL AND BIOSYSTEMS ENGINEERING

MECHANICS SWK122 – FINAL EXAMINATION
MEGANIKA SWK122 – EINDEKSAMEN

6 November 2007 / *6 November 2007*

Eksaminatore / Examiners: Prof L MAREE; Ms B SSAMULA; Mr R MICHAEL; Mnr F van GRAAN
Eksterne Eksaminator / External Examiner: Prof BWJ VAN RENSBURG

Volpunte / *Full Marks* : **80**
Tyd / *Time* : **2 uur / *hours***

246886

Voorletters en **Van** ***Initials** and **Surname***
Studentenommer ***Student number***
Studierigting [bv Meganies] ***Study discipline** [eg Mining]*
Handtekening ***Signature***

Vraag Question	Punt Mark	
1	12	
2	10	
3	12	
4	10	
5	8	
6	12	
7	16	
Σ =	**80**	

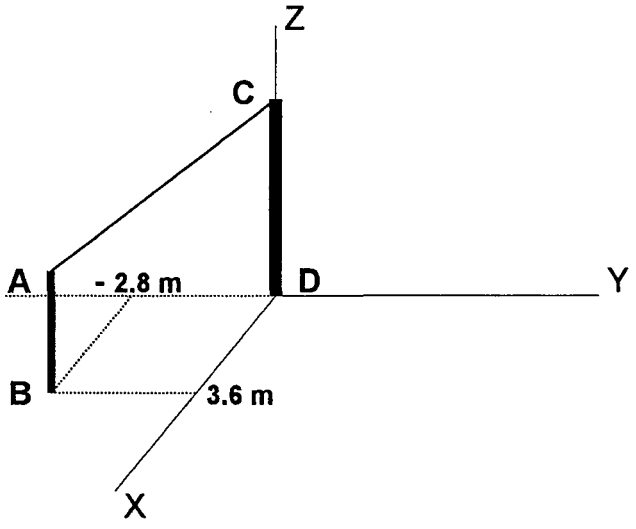
NB ▸ **All answers must be substantiated by the relevant units.**
LW **Alle antwoorde moet deur die nodige eenhede bevestig word.**

▸ **All aspects as described in the EXAMINATION REGULATIONS are applicable.**
Alle aspekte soos vervat in die EKSAMENREGULASIES is van toepassing.

QUESTION 1 / VRAAG 1 **[12]**

An anchor pole **AB** is 4.2 m high, has a mass of 184 kg and anchors an electrical mast **CD** [height 6 metres] by means of anchor cable **AC**.
The force in anchor cable **AC** is 30 kN.

'n Ankerpaal **AB** is 4.2 meter hoog, het 'n massa van 184 kg en anker 'n elektriese mas **CD** [6 meter hoog] deur middel van 'n ankerkabel **AC**. Die krag in ankerkabel **AC** is 30 kN.



1[a] Draw the Free Body Diagram for anchor pole **AB.** **[3]**

Teken die Vryliggaamskets vir ankerpaal **AB.**

1[b] Write the force in the cable in Cartesian format. **[2]**

Skryf die krag in die kabel in Cartesiese vorm.

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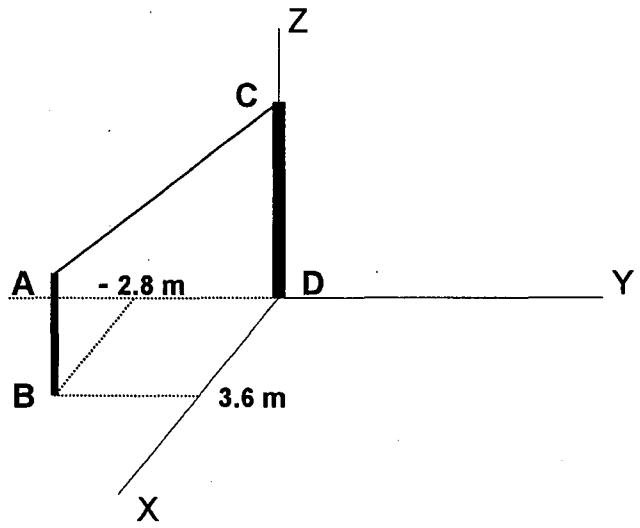

1[c] **Assume** that the force in cable CA is given by (25 ; -19 ; -12) kN. **[3]**
Calculate the moment about B [in Cartersian format] as a result of the force in the cable.

Aanvaar die krag in kabel CA word gegee deur (25 ; -19 ; -12) kN
Bereken die moment [in Cartesiese formaat] wat die krag in die kabel om B veroorsaak.

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1[d] Calculate the magnitude of the component of this moment about BD. **[4]**

Bereken die grootte van die komponent van hierdie moment om BD.

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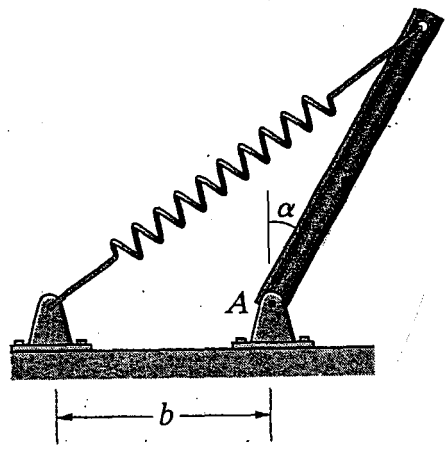
QUESTION 2 / VRAAG 2 **[10]**

The rod is 1 metre long, b = 0.75 m and the angle $\alpha = 30^{\circ}$.
The spring constant = 100 N / m and the spring is unstretched when the rod is vertical.
Determine the mass of the rod as well as the reactions at A for equilibrium in the given position.

Die stang is 1 meter lank, b = 0.75 m en hoek $\alpha = 30^{\circ}$.
Die veerkonstante = 100 N/m en die veer is onuitgerek wanneer die stang vertikaal staan.
Bepaal die massa van die staaf asook die reaksies by A vir ewewig in die getoonde posisie.



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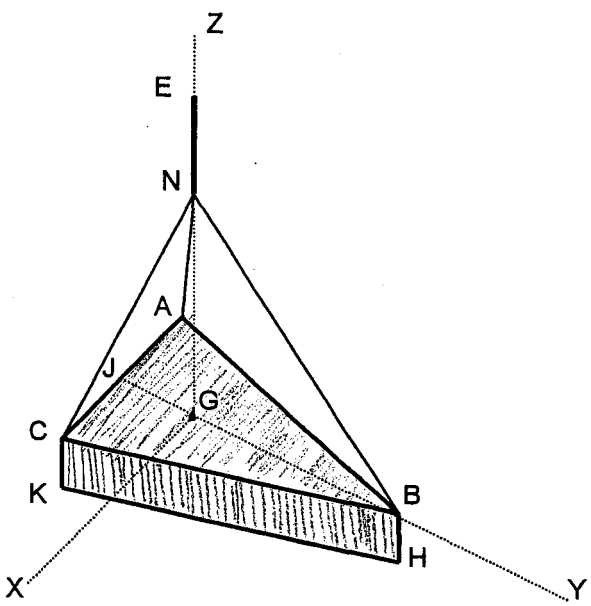
QUESTION 3 / VRAAG 3 **[12]**

The figure shows a triagular concrete slab [CABHK] to be erected at a memorial site. The base of the slab [AC] is 3.4 metres long and the length of the slab [JB] is 8.4 metres.
The slab is supported by three cables NC; NA and NB at it's corners and hangs horisontal.
G is the centroid of triangle CAB, G is also the origin of the axis system and G is 3 metres lower than point N.

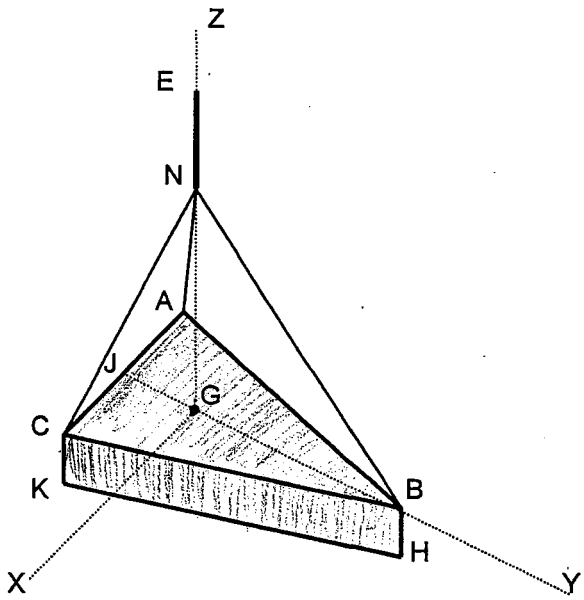
Die figuur toon 'n driehoekige betonblad [CABHK] wat by 'n erfenisterrein opgerig gaan word.
Die basis van die blad [AC] is 3.4 meter lank en die lengte van die blad [JB] is 8.4 meter.
Die blad word ondersteun deur drie kabels NC; NA en NB by die hoeke en die blad hang horisontaal.
G is die sentroïde van driehoek CAB, G is ook die oorsprong van die assestelsel en G is 3 meter laer as punt N.



If the maximum force that can safely be negotiated by any one of the three cables NC; NA or NB is 61.4 kN and if the density of concrete is 2 400 kg/m^3, calculate the thickness of the slab [BH or CK] in mm.

Indien die maksimum krag wat veilig deur enige een van die drie kabels NC; NA of NB hanteer kan word 61.4 kN is en die digtheid van beton 2 400 kg/m^3 is, bereken die bladdikte [BH of CK] in mm.

[Space for calculations on next page
Spasie vir berekeninge op die volgende bladsy]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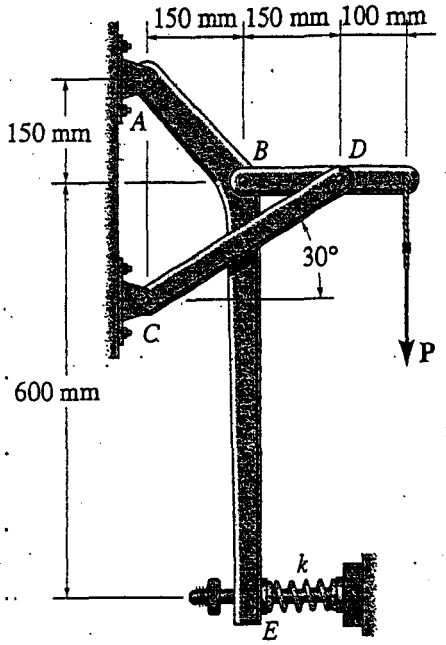
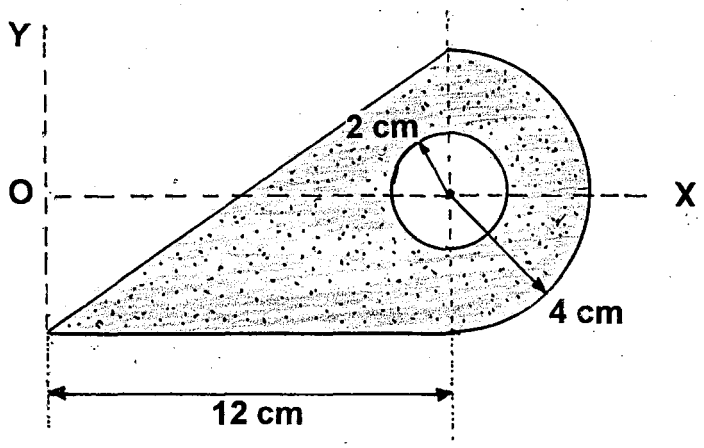
QUESTION 4 / VRAAG 4 **[10]**

A force P = 200 N is applied to the cable.
Determine the compression of the spring at E if the spring stiffness k = 10 kN / m.

'n Trekkrag P = 200 N word op die kabel toegepas.
Bepaal die samedrukking van die veer by E indien die veerstyfheid k = 10 kN/m.



QUESTION 5 / VRAAG 5 **[8]**



5[a] Determine the x-coordinate of the centroid of the given thin flat metal sheet. **[3]**

Bepaal die x-koördinaat van die sentroïde van die gegewe dun metaalplaat.

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5[a] Determine the Moment of Inertia [I_Y] of the given thin flat metal sheet about the y-axis. **[5]**

Bepaal die Traagheidsmoment [I_Y] van die gegewe dun metaalplaat om die y-as.

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QUESTION 6 / VRAAG 6 **[12]**

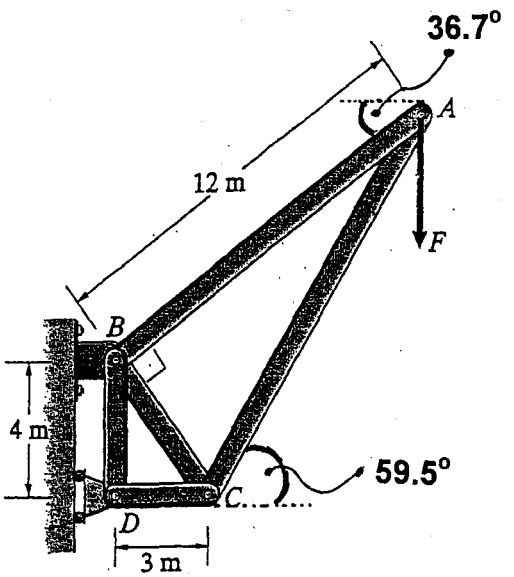

TABLE / TABEL 1

Zero force members Nul-krag stange

TABLE / TABEL 2

Member Stang	Force Krag	Nature [C or T] Aard [C of T]
LM	1.2F	C
AB		
BD		
DC		
BC		
CA		

6[a] Determine the zero force members [if any] in the given truss and note your answer in table 1. **[2]**

Bepaal die nul-krag stange [indien enige] in die gegewe vakwerk en noteer u antwoord in tabel 1.

6[b] Determine the force in terms of **F** as well as the nature [tension (T) or compression (C)] in each member of the given truss and note your answer similar to the example in line 1 of table 2. **[6]**

Bepaal die krag in terme van **F** asook die aard [trek (T) of druk (C)] in elk van die stange van die gegewe vakwerk en gee u antwoord ooreenkomstg die voorbeeld in lyn 1 van tabel 2.

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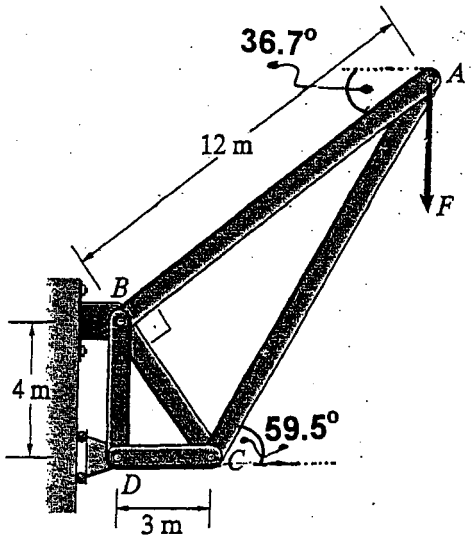
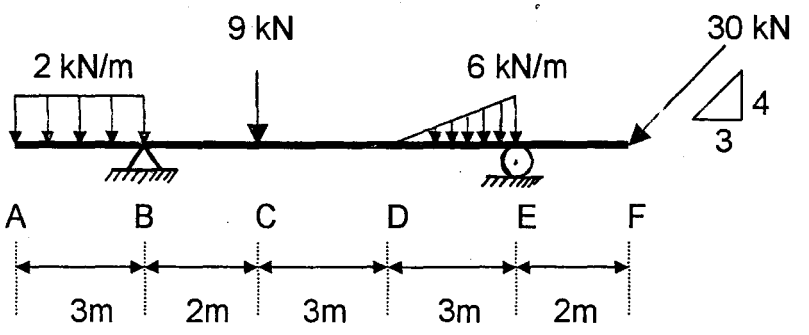


6[c] Calculate the maximum value of **F** if the allowable compression in the members is 20 kN and if the allowable tension in the members is 30 kN. **[4]**

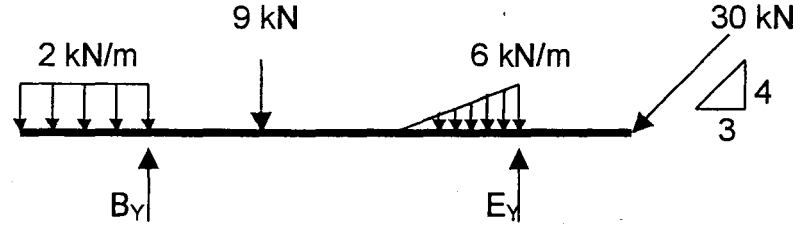
Bepaal die maksimum waarde van **F** indien die toelaatbare drukkrag in die struktuurdele 20 kN is en die toelaatbare trekkrag in die struktuurdele 30 kN is.

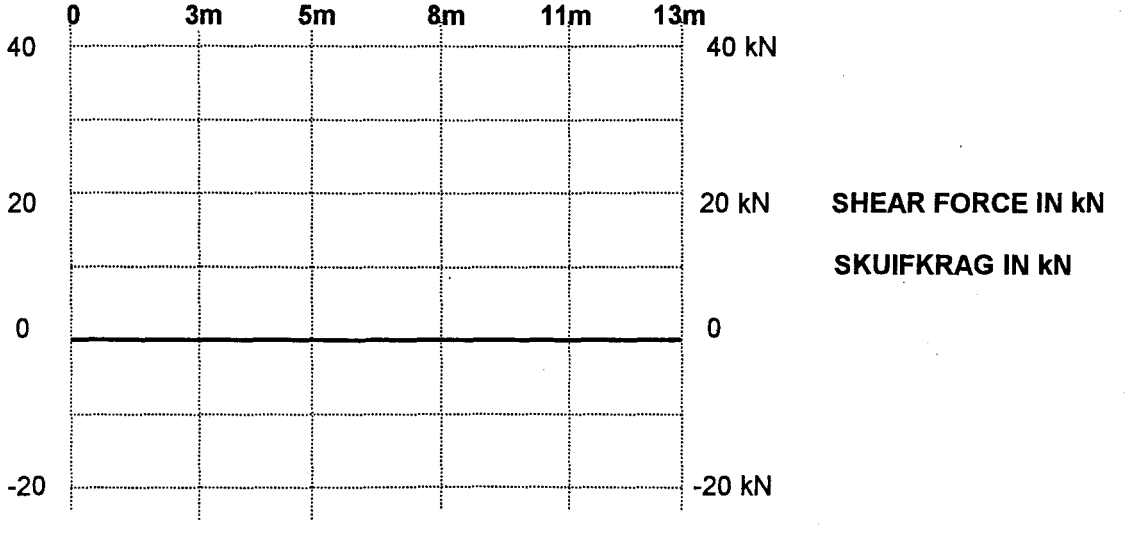
QUESTION 7 / VRAAG 7 [16]

7[a] Calculate the reactions of the given beam
Bereken die reaksies van die getoonde balk. **[2]**



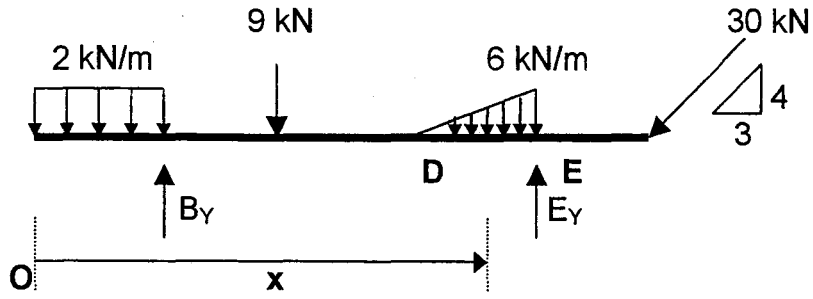
7[b] Draw the shearforce diagram for the given beam. **[4]**
Teken die skuifkragdiagram vir die getoonde balk.





7[c] Develop an equation in [terms of x] that gives the Bending Moment in the region DE of the beam. **[4]**

Ontwikkel 'n vegelyking [in terme van x] wat die Buigmoment in gebied DE weergee.



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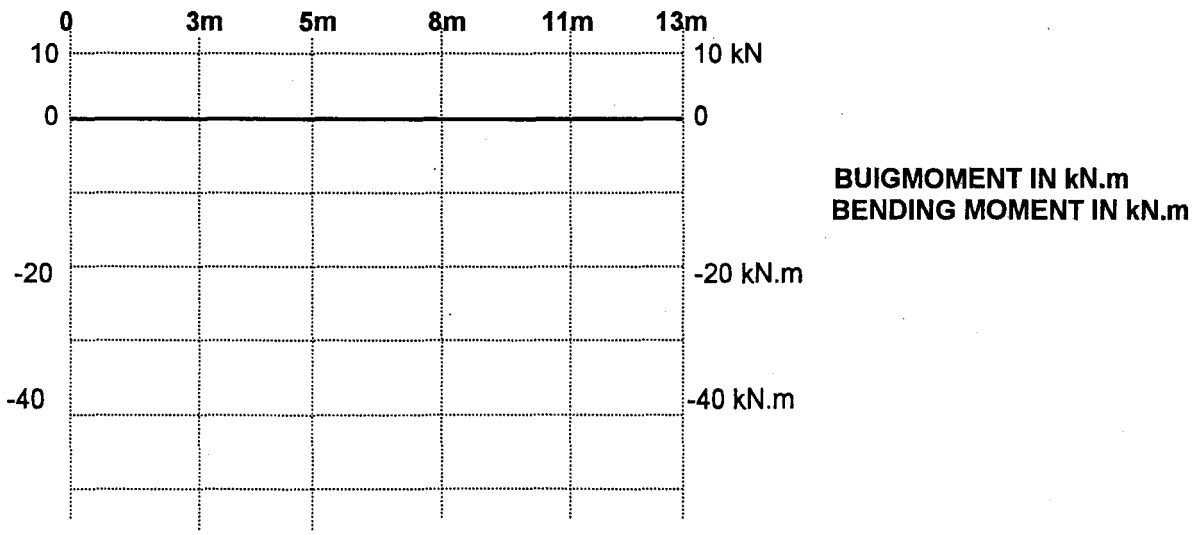
7[d] Draw the bending moment diagram for the given beam. **[6]**

Teken die buigmomentdiagram vir die gegewe balk.



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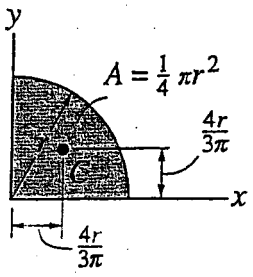
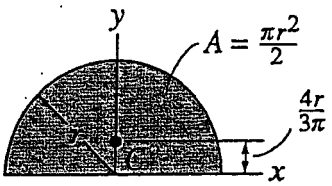


$I_x = \frac{1}{16}\pi r^4$

$I_y = \frac{1}{16}\pi r^4$

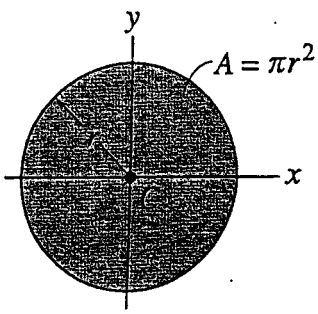
Quarter circle area



$I_x = \frac{1}{8}\pi r^4$

$I_y = \frac{1}{8}\pi r^4$

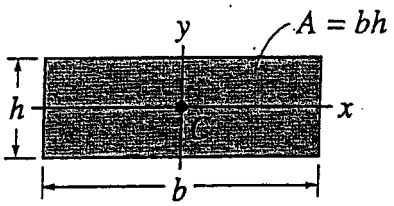
Semicircular area



$I_x = \frac{1}{4}\pi r^4$

$I_y = \frac{1}{4}\pi r^4$

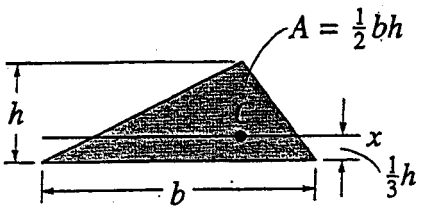
Circular area



$I_x = \frac{1}{12}bh^3$

$I_y = \frac{1}{12}hb^3$

Rectangular area



$I_x = \frac{1}{36}bh^3$

Triangular area