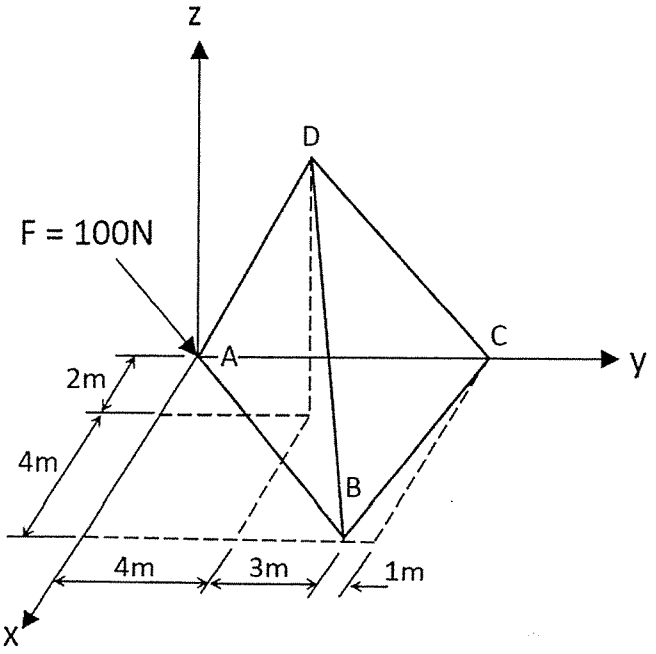
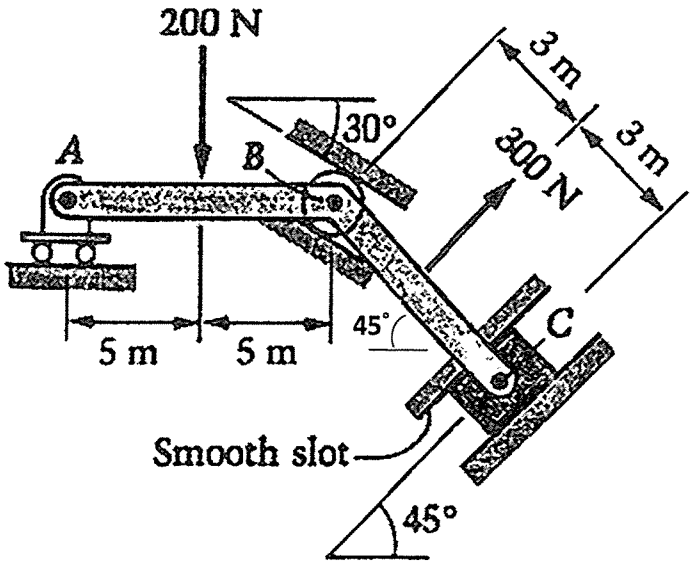
1. (15%) A 100N force acts along line AB. Please determine the moment of this force about the line CD. Write the moment as a *Cartesian vector*. (Point D is 6m above the x-y plane.)



2. (15%) Find the reaction forces at positions A, B, and C necessary for ABC to be in equilibrium.



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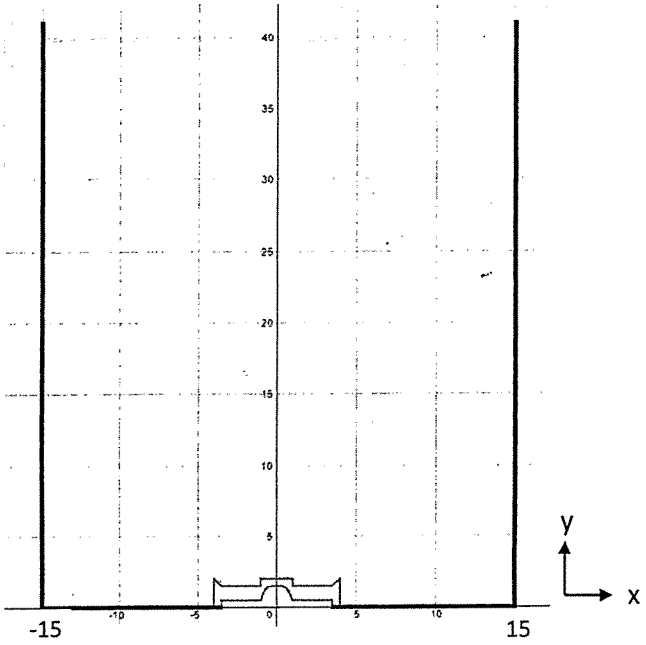
3. (25%) There is a rectangular tank. It has a level of 40 cm from the bottom of the tank when filled with water. Now we want to design a Water-blocking device. The design parameters and the sections of the Water-blocking device are given below.

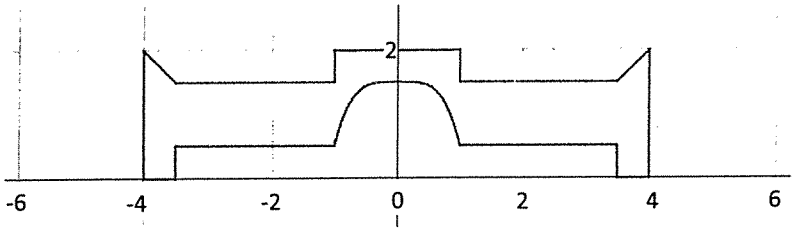
$y = -x^4 + 1.5$ {1>x> -1}
y = 2 {1>x>-1}
x = 1 {2>y>1.5}
x = -1 {2> y>1.5 }
y = 0.5 {1<x<3.5,-1>x>-3.5}
y = 1.5 {1 <x<3.5,-1>x>-3.5}
x = 4 {2>y>0}
x = -4 {2> y>0}
y = 0 {3.5<x<4,-3.5>x>-4}
x = 3.5 {0<y<0.5}
x = -3.5 {0<y<0.5}
y = x-2 {3.5<x<4}
y = -x-2 {-3.5>x>-4}

(cm)

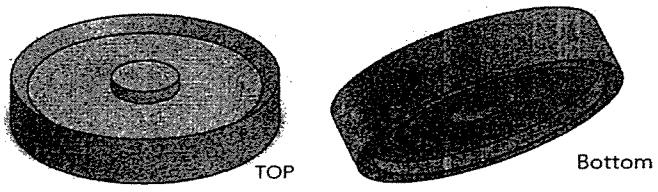
$D_{water} = 1000\ kg/m^3$



a. Show the **distributed force diagram of water pressure** on the Water-blocking device. Only show the force in **y direction**. (You can show it in 2-D.)



b. What is the **total force of water pressure** in **y direction** on the Water-blocking device?



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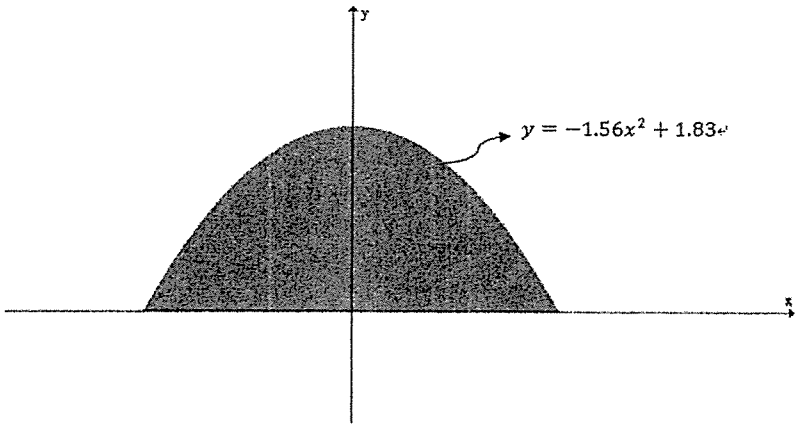
c. Now we have some material parameters. What is the best choice?

Hint : When the tank is empty, start adding water from the tank wall. It has to make sure that the blocker will not open. **(無計算過程不予計分)**

Material name	density
Taiwon#1	800 kg/m^3
Jepen#6	1000 kg/m^3
Korae#19	1200 kg/m^3
Chine#99	1400 kg/m^3
" Do not get influenced by the names of the material! "	

4. (10%) Determine the moment of inertia of the area about the y axis. Solve the problem in two ways, using rectangular differential elements.
   a. having a thickness of dx.
   b. having a thickness of dy.

   (必須將所選區塊畫出否則不予計分)



單位: mm

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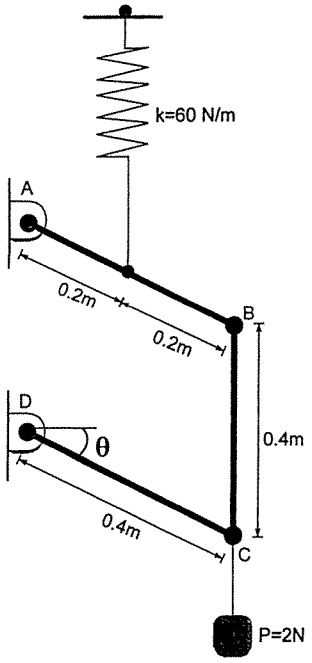
5.

a) (10%) Consider the structure as shown below with a spring attached at the center of rod AB. Neglect the weight of all links and assume a frictionless pin connection among all links. The angle θ is zero at equivalent without the external force P. Determine the value of angle θ after P=2N is applied directly downward.

b) If friction force exists in all pin connections, please use engineering judgments with verifications to describe

1. (5%) The friction effects on the angle θ .
2. (10%) The friction effects on the equivalent spring constants of the entire structure at point C.



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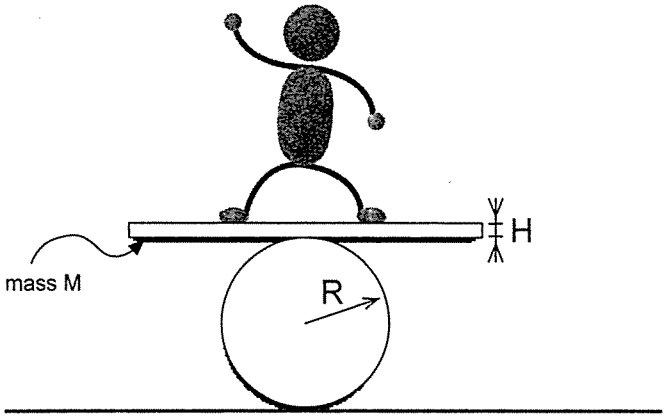
國立臺灣大學 105 學年度碩士班招生考試試題

6. (10%) An athlete performs an acrobatic act on a plate with square cross section on the top of a ball with radius R, as shown below. Agility and complete focus are required to ensure a balanced result. Ignore all effects due to the athlete (assume a man with no weight), please show that the plate-ball system can only be stable if H is small enough compared with R.



試題隨卷繳回