ENGRD 202 : Homework #6 Comments

Comments on HW 6 - 9 by graders. Nov 3, 2002

Questions on Center of Mass

The key to solving such questions is to UNDERSTAND and APPLY the following 2 equations :

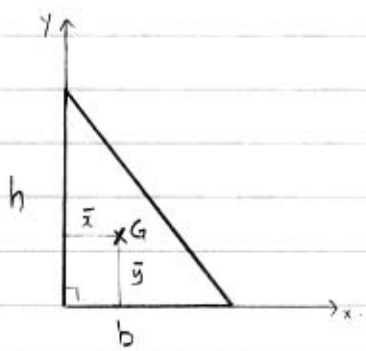
$$\bar{x} = \frac{\sum A_i x_i}{A} \quad ; \quad \bar{y} = \frac{\sum A_i y_i}{A}$$

You should also learn how to break up complex geometrical shapes into simple components such that you are able to find their C.M.s easily.

(refer to Q5.51 please).

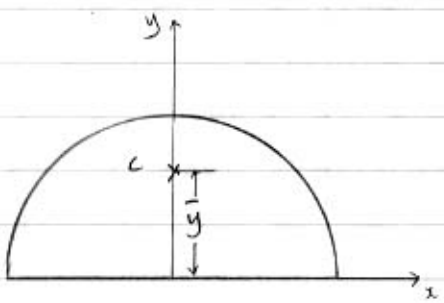
Do NOT solve such questions by integration unless it is absolutely necessary ! For most questions, the solutions are straight forward and do not require any integration at all.

It is good for you to memorise and know the center of mass location for common shapes , such as right-angled triangles and semi-circles.



$\bar{x} = \frac{1}{3}b$

$\bar{y} = \frac{1}{3}h$



$\bar{x} = 0$

$\bar{y} = \frac{4r}{3\pi}$

Note that you need to specify a co-ordinate system from which $\bar{x}$ & $\bar{y}$ are measured.

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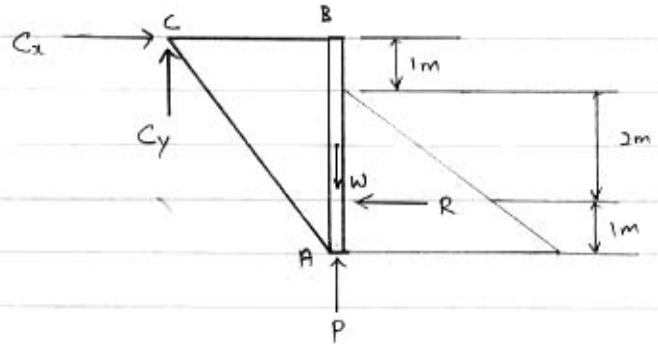
Q 1.565

PLEASE DRAW A FREE BODY DIAGRAM !!!

Remember that each time you use summation of forces (or moments), you MUST draw the relevant FBD for that equation.

Q 5.211

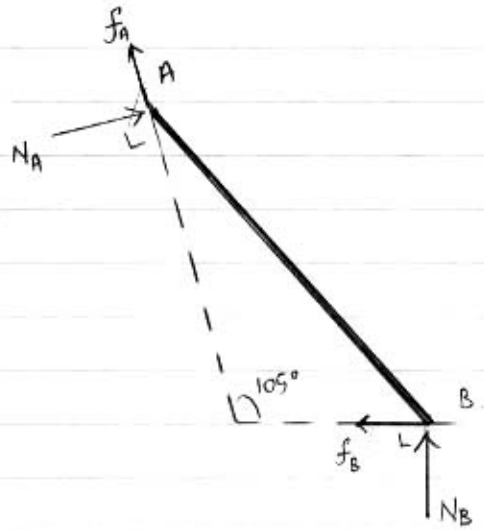


Do not leave out the reaction forces (C_x & C_y) at the hinged joint !

Make it a good habit, please, to include all distances, so that you are absolutely clear where each force is acting.

You should understand that PRESSURE in the water varies LINEARLY with the WATER DEPTH. This is why you should model the pressure distribution with a right-angled triangle.

Q 6.13



You should understand that :

① Frictional force acts ALONG the wall

② Normal reaction force acts PERPENDICULAR to the wall

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Q3.108

You must NEVER assume that the angles are of certain values without doing any calculations at all. Do not simply look at the diagram and conclude that the angles are 60° or that is a tetrahedral or isosceles triangle etc[3] ...

You should DRAW DIAGRAMS and perform the relevent calculations to confirm the value of all angles before proceeding with the rest of the question.

Q 6.131

Please understand exactly where each force should be acting on and their directions !
You should know that frictional force is always along the surface on which the body is slipping, and acts at the point of contact, in the opposite sense as the body's motion.

You need to understand that :

Before slipping, $f < \mu_s N$
At point of slippage, $f = \mu_s N$

Please distinguish between these 2 situations !!!

Also, for all purposes of this course, the kinematic coefficient of friction, μ_k, is irrelevant.

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Q 1.5 - 3

You should understand and be able to apply the following formulas :

$$\nu = -\frac{\text{lateral strain}}{\text{axial strain}} = -\frac{\varepsilon'}{\varepsilon}$$

$$\sigma = \frac{P}{A}$$

$$E = \frac{\text{stress}}{\text{strain}} = \frac{\sigma}{\varepsilon}$$

Please note that :

① $\nu = -\frac{\varepsilon'}{\varepsilon}$

Do not omit the negative sign !

The negative sign means that a lateral compression must be accompanied by an axial expansion.

② $E = \frac{\sigma}{\varepsilon}$

This relationship is only valid for $\sigma \leq$ yield strength, i.e. elastic limit is not exceeded.

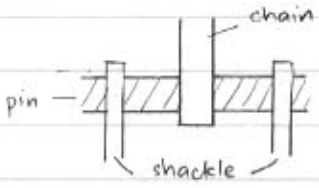
Q 1.6 - 11

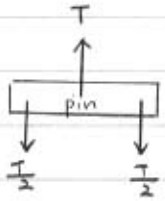
You need to draw a FBD for

① the buoy

② the pin

You should recognise that the pin is under double shear, and that hence, average shear force is HALF the tension in the chain.





It is essential for you to fully understand these equations :

① Average shear stress, $\tau_{ave} = \frac{V}{A}$

where V is the shear force

A is the area over which V acts

(which is πr^2 in this case)

② Bearing area , $\sigma_b = \frac{F}{A_b}$

where F is the bearing force

A_b is the bearing area

Note the difference between A and A_b !!!

→ A is in a plane parallel to shear force V

→ A_b is in a plane normal to bearing force F.

Q 1.7 - 14

You should be able to recognize that the tension in the string is constant due to absence of friction. Then, by applying $\Sigma F_x = 0$, you should see that AC and BC make the same angle to the horizontal.

Know that : $\text{Load}_{\text{allowable}} = \frac{\text{Strength}}{\text{Safety Factor}}$

Draw a free body diagram of the system !!!