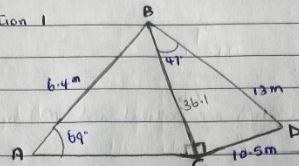


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ACBA 4007 Engineering Mathematics and Structure
Examination 2nd March 2022.
Akeel Jack
Student ID: 2113721

Section A Question 1

a)



Side BC :

Soh Cah Toa

$$\cos BC = \frac{A}{h}$$

$$= \frac{10.5m}{13m}$$

$$\cos BC = 0.808$$

$$BC = \cos^{-1}(0.808)$$

$$BC = 36.099$$

$$BC = 36.1$$

Side AC :

Soh Cah Toa

$$\sin BC = \frac{a}{b}$$

$$\sin BC = \frac{6.4m}{13m}$$

$$\sin BC = 0.492$$

$$BC = \sin^{-1}(0.492)$$

$$BC = 29.5$$

b) Area of ABC : $\frac{1}{2} b \times h$

Q1 - 2

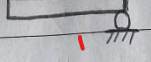
Section B Question 2

a) The three most common types of support are :

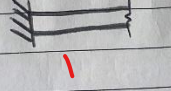
Pin support



Roller support



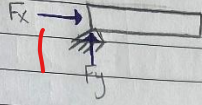
Fixed support



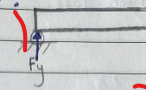
Q2

b) The reaction forces in supports are:

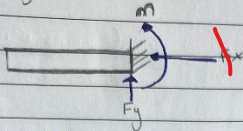
- Pin:



- Roller:



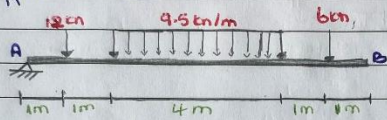
- Fixed:



3

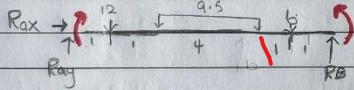
The forces labelled (F_x) are horizontal, (F_y) are vertical and (M) moments.

c) Support Reaction:



$$\sum H = 0$$

$$\sum V = 0$$



$$\sum M_A = R_B \times 8 - 12 \times 1 - 9.5 \times 4 \times (2 + 4/2) - 6 \times 7 = 0$$

$$\sum M_B = R_A \times 8 + 12 \times 7 + 9.5 \times 4 \times (6 + 4/2) + 6 \times 1 = 0$$

$$R_B = 12 \times 1 + 9.5 \times 4 \times (2 + 4/2) + 6 \times 7 / 8 = 0$$

$$12 + 39.8 \times 4 + 42 / 8 = 0$$

$$50 \times 4 + 42 = 0$$

$$206 / 8 = 0 \quad R_B = -25.75 \text{ kN}$$

$$R_A = 12 \times 7 + 9.5 \times 4 \times (6 - 4/2) + 6 \times 1 / 8 = 0$$

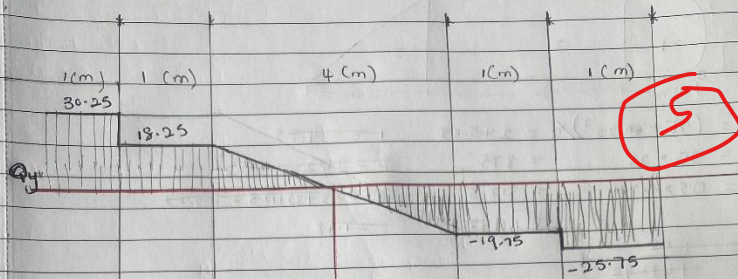
$$84 + 9.5 \times 4 \times 5 + 6 / 8 = 0$$

$$84 + 192 + 6 / 8 = 0$$

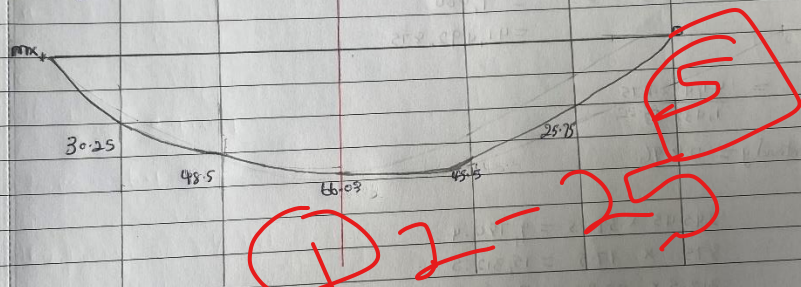
$$242 / 8 = 0 \quad R_A = 30.25 \text{ kN}$$

6

d) Shear force



Bending moments



Question 3

a) Centroid is the geometric centre of a shape whilst center of gravity is the point where the entire weight of a shape is assumed to be concentrated.

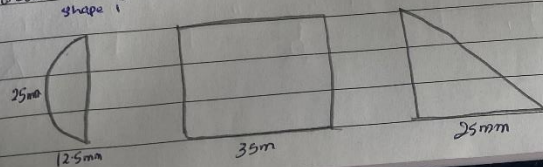
b) $C = G$

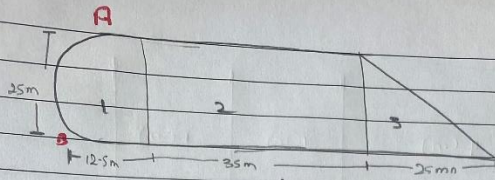
(c)

wood steel

When the object/mass is uniform the centroid and center of gravity will be in the same place, whilst the centroid and center of gravity will be in different places when the object/mass is a combination of two materials.

d)





$$\begin{aligned}
 1 &= (\pi \times 12.5^2) / 4 = 245.43 & 1 &= 39.45 \\
 2 &= 35 \times 25 = 875 & 2 &= 35/2 = 17.5 \\
 3 &= 0.5 \times 25 \times 25 = 312.5 & 3 &= 25/3 + 35 + 12.5 = 23.83 \\
 & & &= 1,432.93 & &= 1.48
 \end{aligned}$$

$$\begin{aligned}
 &= 1.48 \\
 &= 1,432.93
 \end{aligned}$$

$$\begin{aligned}
 &= 245.43 \times 12.5 = 3,067.875 \\
 &875 \times 35 = 30,625 \\
 &312.5 \times 25 = 7,800 \\
 &= 41,492.875
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{41,492.875}{1,432.93} \\
 &= 28.96
 \end{aligned}$$

Centroid $y = 28.96$

$$\begin{aligned}
 245.43 \times 39.45 &= 9,780.4 \\
 875 \times 17.5 &= 15,312.5 \\
 312.5 \times 23.83 &= 7,446.9 \\
 &= 99,561.9
 \end{aligned}$$

$$\begin{aligned}
 &= 99,561.9 \\
 &= 1,432.93
 \end{aligned}$$

Centroid $x = 69.5$

L3-18