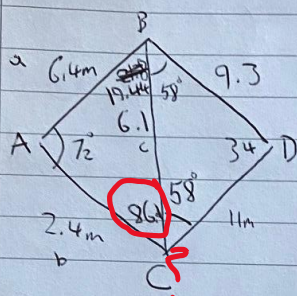


39%

Section A

~~11~~ - 11

1)



$$a^2 = b^2 + c^2 - 2bc \cos A \quad 0.309016$$

$$BC^2 = 6.4^2 + 2.4^2 - 2 \times 6.4 \times 2.4 \cos(72^\circ)$$

$$BC^2 = 37.22699$$

$$BC = 6.101$$

5

$$BD^2 = 6.1^2 + 11^2 - 2 \times 6.1 \times 11 \cos 58^\circ$$

$$BD^2 = 87.09483$$

$$BD = 9.332$$

$$C = \frac{2.4^2 + 6.1^2 - 6.4^2}{2 \times 2.4 \times 6.1} = 0.068$$

$$\cos^{-1}(0) = 86.1$$

3

$$B = 21.899$$

$$CD = \frac{6.1^2 + 11^2 - 9.3^2}{2 \times 6.1 \times 11} = 0.5344 \quad \cos^{-1} = 57.69^\circ$$

$$D = \frac{11^2 + 9.3^2 - 6.1^2}{2 \times 9.3 \times 11} = 0.8322 = 33.66^\circ$$

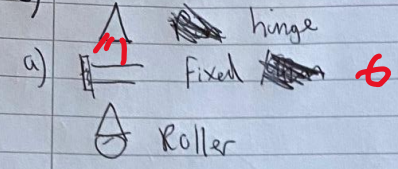
3

$$B = \frac{6.4^2 + 6.1^2 - 2.4^2}{2 \times 6.4 \times 6.1} = 0.942 \quad \cos^{-1} = 19.44^\circ$$

2)

2-18

2)

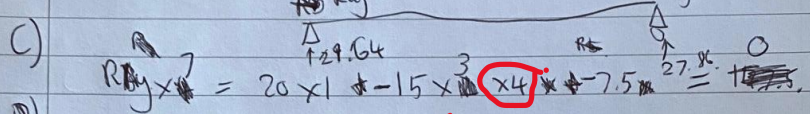


b)

Fixed $\rightarrow \uparrow$

Roller $\uparrow$

hinge $\rightarrow \uparrow$



$\sum F_x = 0$

$R_{Ax} = 0$

$\sum F_y = 0$

$R_{Ay} + R_B - 20 - 30 - 7.5 = 0$

$R_{Ay} + R_B = 57.5$

$R_{Ay} + R_B = 57.5$

$7R_{Ay} - 20 - 180 - 7.5 = 0$

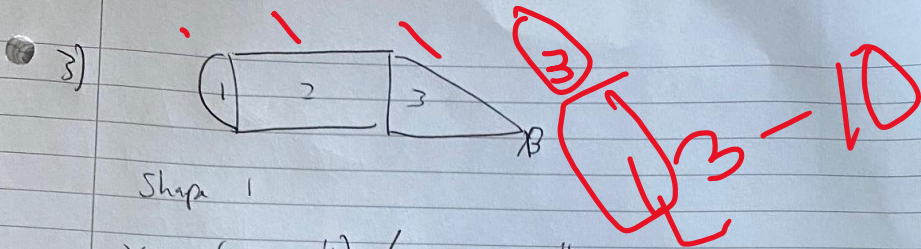
$7R_{Ay} - 207.5 = 0$

$7R_{Ay} = 207.5$

$R_{Ay} = 207.5 \div 7 = 29.64$

	BM
0	0
1	29.64
2	$(29.64 \times 2) - (15 \times 1) \times 4 = 29.64$
3	$(29.64 \times 3) - (15 \times 2) \times 3 = 58.92$
4	78.56
5	
6	
7	

Section	SF (kn)	Bm
A	0 or 29.64	0
1	$29.64 - 20 = 9.64$	$29.64 \times 1 = 29.64$
2	$29.64 - 20 - 15 = -5.63$	$29.64 \times 2 - (15 \times 1) \times 4 = 29.64$
3	$29.64 - 20 - 15 - 15 = -20.36$	$29.64 \times 3 - (15 \times 2) \times 3 = 58.92$
4	-35.36	$29.64 \times 4 - (15 \times 3) \times 3 = 78.56$
5	-50.36	
6	-57.86	
7	-57.86	



Shape 1

$$\begin{aligned}
 Xx &= 1 \left(\pi \times 15^4 \right) / 8 = 19880.3^4 \\
 &2 \left(60 \times 30^3 \right) / 12 = 135000^4 \\
 &3 \left(30 \times 30^3 \right) / 36 = 22500^4 \\
 Xx &= 177380.3^4
 \end{aligned}$$

YY

Shape 1 Same as $Xx = 19880.3^4$

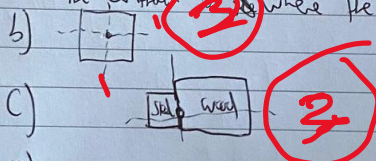
2 $(60^3 \times 30) / 12 = 540000$

3 Same as $Xx = 22500^4$

$YY = 582380.3^4$

Handwritten note: "Handwritten" with a red arrow pointing to the YY calculation.

a) Centroid is the balance point of the shape (centre of gravity).
The centroid is where the mass of the object is.



d) Assume ↑ Shape 1 176 mm
Shape 2 1800 mm
3 450 mm