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Subject : Engineering Mechanics

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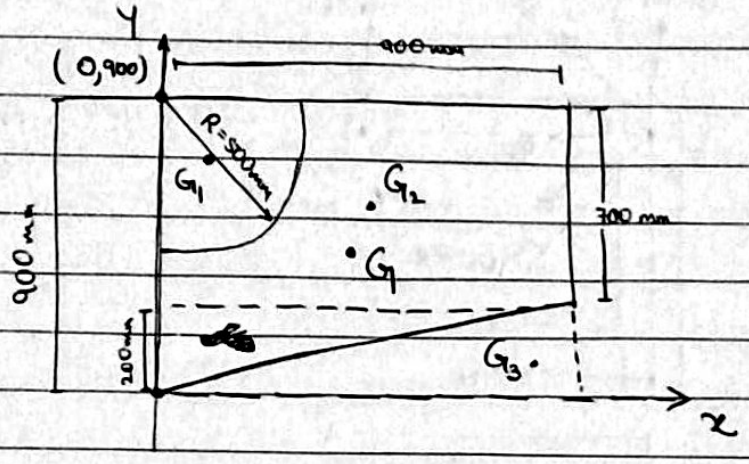
Q2.

A Any 2.

i)

→



	Area	$\bar{x}$	$\bar{y}$
Quarter circle	$\frac{\pi R^2}{4} = -196349.54\ mm^2$	$x_1 = \frac{4R}{3\pi} = 212.20$	$y_1 = 900 - 212.20 = 687.8$
Rectangle	$900 \times 900 = 810000\ mm^2$	$x_2 = 450$	$y_2 = 450$
Triangle	$\frac{1}{2} \times 900 \times 200 = -90000\ mm^2$	$x_3 = 600$	$y_3 = 66.67$.

∴ $A_1x_1 = -41667327.4$ $A_2x_2 = 364500000$ $A_3x_3 = -54000000$

$A_1y_1 = -135049213.6$ $A_2y_2 = 364500000$ $A_3y_3 = -60000$.

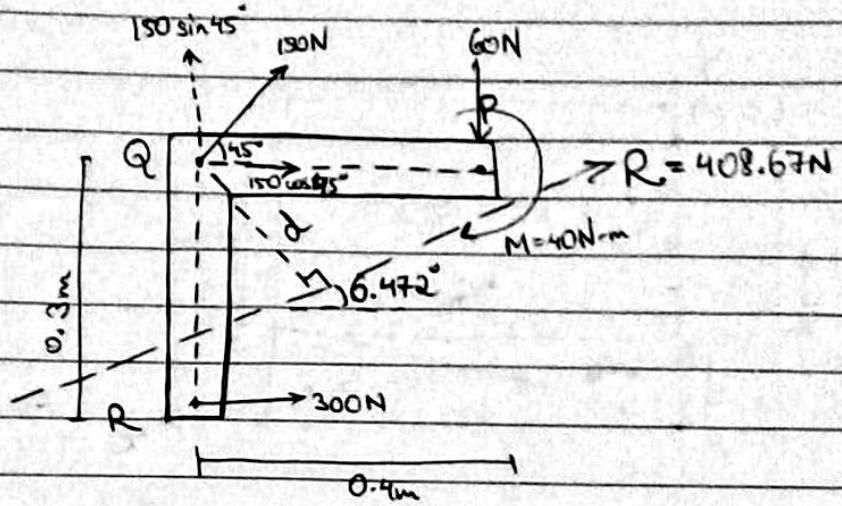
we know, $\Sigma A = 523650.5$. $\Sigma A_i x_i = 268832672.6$

$\Sigma A_i y_i = 223452750$

Centroid $G \equiv (\bar{x}, \bar{y})$ $\bar{x} = \frac{\Sigma A_i x_i}{\Sigma A}$, $\bar{y} = \frac{\Sigma A_i y_i}{\Sigma A}$.

$$G \equiv (513.38, 426.72)\ mm$$

Q2.
A.
i)



This is a system of 3 forces and 1 couple acting on a single body.
Using method of Resolution.

ΣF_x ($\rightarrow$ +ve) $= 150\cos 45° + 300 = 406.067N (\rightarrow)$

ΣF_y ($\uparrow$ +ve) $= 150\sin 45° - 60N = 46.067N (\uparrow)$

Using $R = \sqrt{F_x^2 + F_y^2} = \sqrt{(406.067)^2 + (46.067)^2}$

$\therefore R = 408.67N$ ... (Magnitude of resultant)

also $\tan\theta = \frac{\Sigma F_y}{\Sigma F_x} = \frac{46.067}{406.067}$ $\therefore \theta = 6.472°$ (Direction)

The arrows of ΣF_x and ΣF_y indicate that the Resultant lies in Ist quadrant

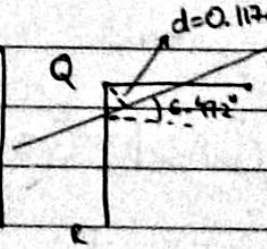
Using Varignon's theorem on point Q,

$\Sigma M_Q^F = M_Q^R$ (↺ +ve).

$-(0.4 \times 60) - 40 + (0.3 \times 300) = 408.67 \times d.$

$\therefore d = 0.117m.$

$\therefore$ The resultant is $R = 408.67N$ ($6.472°$) and the line of action of force of it cuts lines PQ and QR.



Q2.

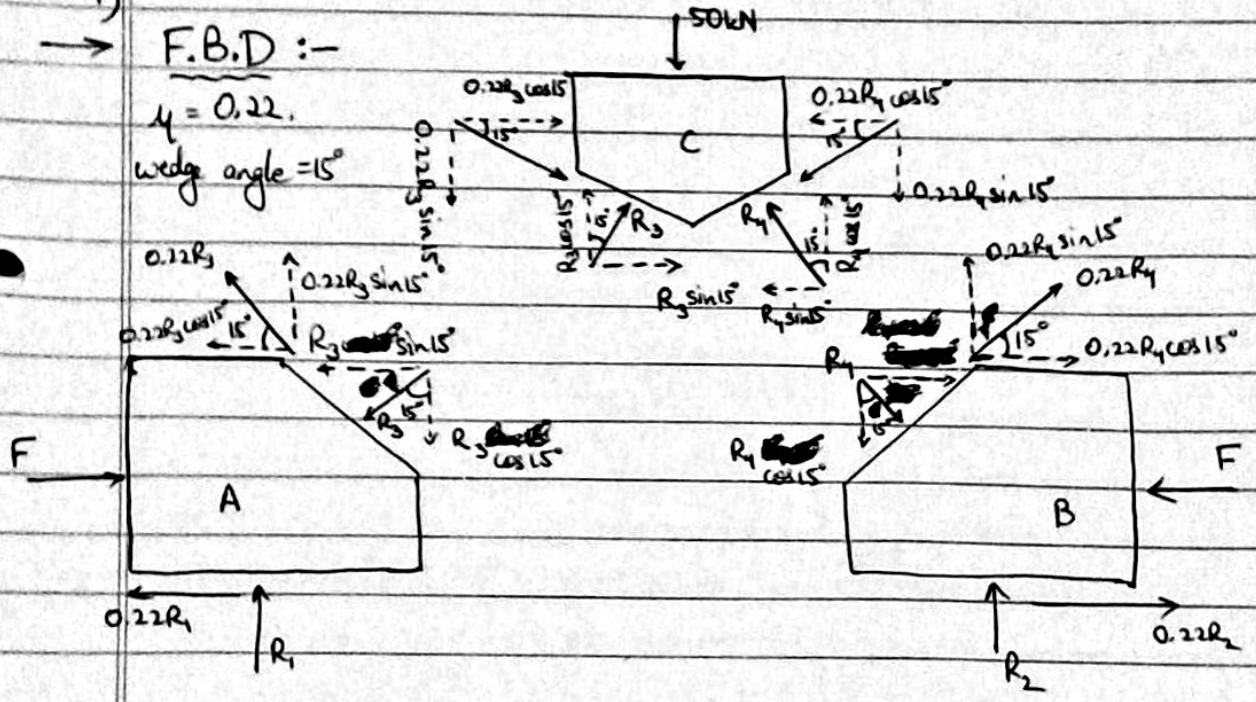
B. Any one.

i)

→ F.B.D :-

$\mu = 0.22$.

wedge angle = 15°



Consider block C:

Applying condition of equilibrium, $\Sigma F_x = 0$, $\Sigma F_y = 0$.

∴ Due to symmetry, $R_3 = R_4$.

$\Sigma F_y = 0$, $R_3\cos15° + R_4\cos15° - 0.22R_3\sin15° - 0.22R_4\sin15° - 50 = 0$.

(↑ +ve)

$$\therefore R_3 = R_4 = 27.51\ kN$$

Consider wedge A:

Applying COE, $\Sigma F_y = 0$. ∴ $0.22R_3\sin15° - R_3\cos15° + R_1 = 0$.

$$\therefore R_1 = 25\ kN$$

$\Sigma F_x = 0$, ∴ $F - 0.22R_3\cos15° - R_3\sin15° - 0.22R_1 = 0$

$$\therefore F = 18.46\ kN$$