



Al-Mustaqbal University
College of Engineering and Technologies
Prosthetics and Orthotics Engineering



MECHANICS-DYNAMIC
TUTORIAL
Moment of Inertia
Lec.2

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Moment of Inertia - Tutorial



Example ⑤; Find I_x for the shaded area.

* نعوّض ببجزيات المباحث المركبة
الى مستطيل مضرب ومثلث
مضرب و دائرة فارغة

$$I_{x_1} = \frac{bh^3}{3} = \frac{100 \times 40^3}{3}$$

$$\Rightarrow I_{x_1} = 2133333 \text{ mm}^4 \text{ للمضرب}$$

$$[I_{x_2} = I_{xc_2} + A_2 d_2^2]$$

$$I_{xc_2} = \frac{bh^3}{36} = \frac{100 \times 40^3}{36}$$

$$\Rightarrow I_{xc_2} = 177777 \text{ mm}^4$$

$$d_2 = \bar{y}_2 = \frac{40}{3} + 40 = 53.33 \text{ mm}$$

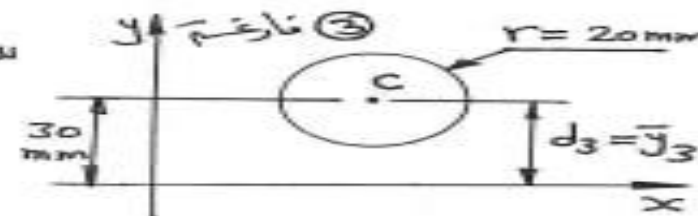
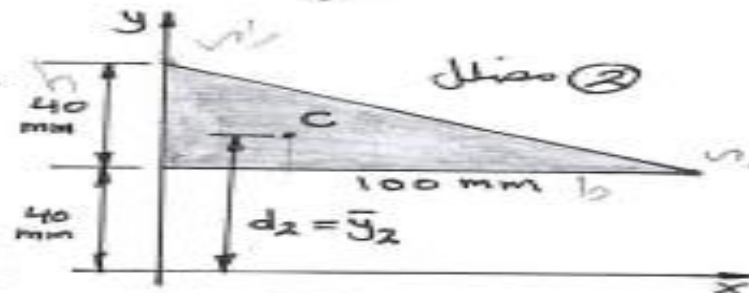
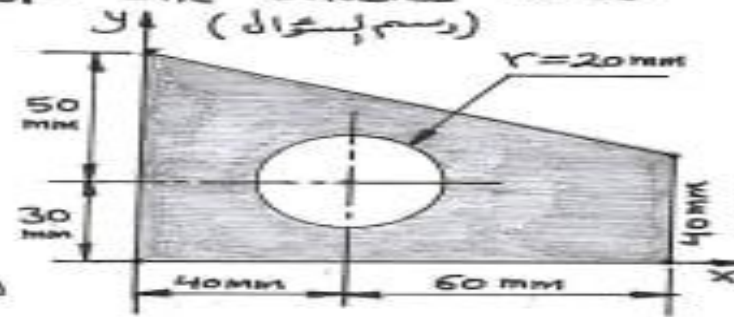
$$A_2 = \frac{bh}{2} = \frac{100 \times 40}{2}$$

$$\Rightarrow A_2 = 2000 \text{ mm}^2$$

$$\therefore I_{x_2} = 177777 + 2000 \times (53.33)^2$$

$$\Rightarrow I_{x_2} = 5866594 \text{ mm}^4 \text{ للمثلث}$$

$$[I_{x_3} = I_{xc_3} + A_3 d_3^2]$$





Moment of Inertia - Tutorial



$$I_{xc_3} = \frac{-\pi r^4}{4} = \frac{-\pi * 20^4}{4} = -125600 \text{ mm}^4.$$

$$A_3 = -\pi r^2 = -\pi * 20^2 = -1256 \text{ mm}^2.$$

$$d_3 = \bar{y}_3 = 30 \text{ mm}.$$

$$\therefore I_{x_3} = -125600 - 1256 * 30^2 = -1256000 \text{ mm}^4.$$

للمناخنة

$$\therefore I_x = I_{x_1} + I_{x_2} + I_{x_3} \Rightarrow$$

$$I_x = 2133333 + 5866594 - 1256000.$$

$$\Rightarrow I_x = 6743927 \text{ mm}^4.$$



Moment of Inertia - Tutorial



Example ⑥, Find I_x for the shaded area.
(رسم إسئوال)

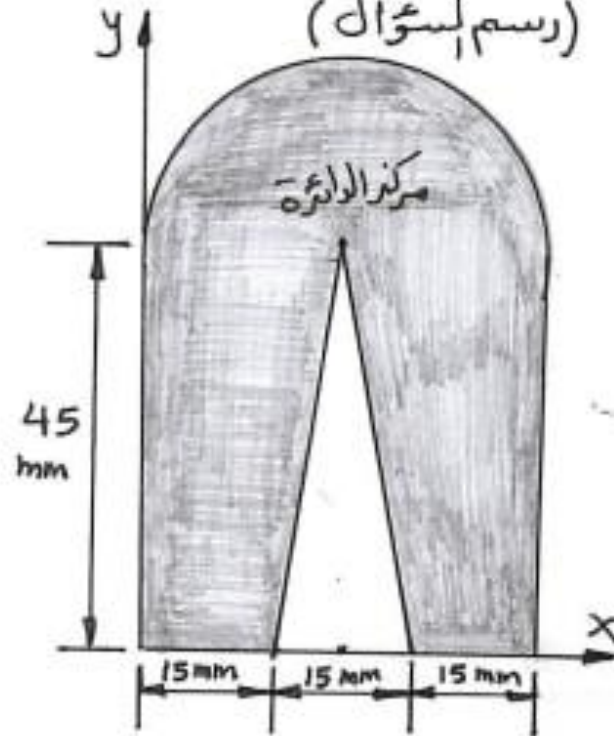
* نَعْم بِنَجْرَم الماحم المركب
الى مسطيل مضلل ونصف دائرة
مضلل ومثلث مساوي الاضلاع فارغ

$$I_{x_1} = \frac{bh^3}{3} = \frac{45 \times 45^3}{3}$$

$$\Rightarrow I_{x_1} = 1366875 \text{ mm}^4 \text{ للمسكيل}$$

$$[I_{x_2} = I_{xc_2} + A_2 d_2^2] \text{ للنصف دائرة}$$

$$I_{xc_2} = 0.11r^4 = 0.11 \times (22.5)^4 = 28192 \text{ mm}^4$$



$$\phi \text{ قطر الدائرة} = 15 + 15 + 15 = 45 \text{ mm}$$

$$r \text{ نصف قطر الدائرة} = \frac{45}{2} = 22.5 \text{ mm}$$



Moment of Inertia - Tutorial



$$A_2 = \frac{\pi r^2}{2} = \frac{3.14 \times 22.5^2}{2} = 227$$

$$\Rightarrow A_2 = 794.8 \text{ mm}^2$$

$$d_2 = \bar{y}_2 = \frac{4r}{3\pi} + 45 \Rightarrow$$

$$d_2 = \frac{4 \times 22.5}{3 \times 3.14} + 45 = 54.5 \text{ mm}$$

$$\therefore I_{x_2} = 28192 + 794.8 \times (54.5)^2$$

$$\Rightarrow I_{x_2} = 2388946 \text{ mm}^4$$

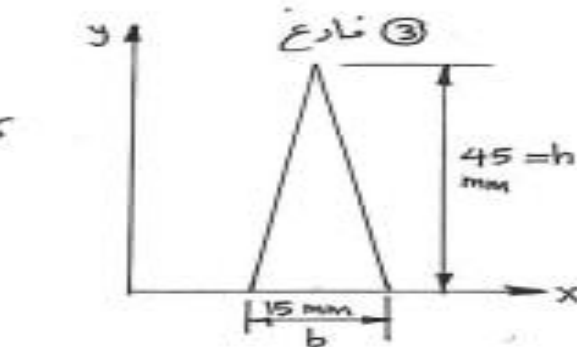
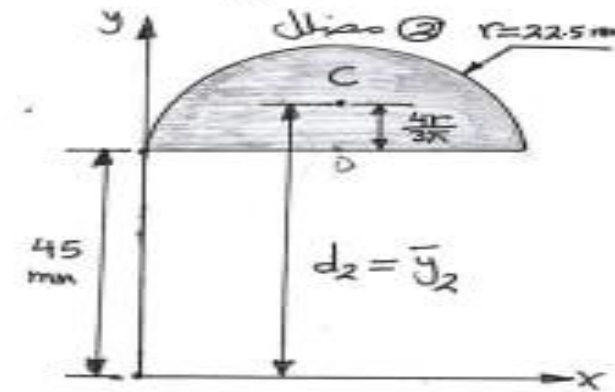
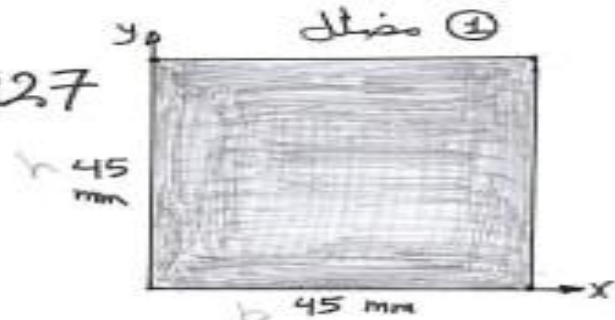
$$I_{x_3} = -\frac{bh^3}{12} = -\frac{15 \times 45^3}{12}$$

$$\Rightarrow I_{x_3} = -113906 \text{ mm}^4$$

$$\therefore I_x = I_{x_1} + I_{x_2} + I_{x_3}$$

$$I_x = 1366875 + 2388946 - 113906$$

$$\Rightarrow I_x = 3641915 \text{ mm}^4$$





Thanks

