

الجامعة التكنولوجية

قسم هندسة البناء والإنشاءات

المرحلة الأولى



العدد : ٢٠٦

التاريخ : ٨ / ٨ / 2017

الى / وحدة الانترنت في القسم

م/ الاجابة النموذجية لمادة ( الميكاتريك الهندسي 2 )

تحية طيبة .....

نرفق لكم طياً نسخة من الأسئلة الخاصة بمادة الميكاتريك الهندسي 2 و للإمتحان النهائي للفصل الدراسي الثاني - الدور الأول و للعلم الدراسي 2016 - 2017 و الذي تم اجراءه بتاريخ 2017/5/28 مع الاجابة النموذجية الخاصة بها.

مع التقدير

أ.م.د. قيس جواد فريج

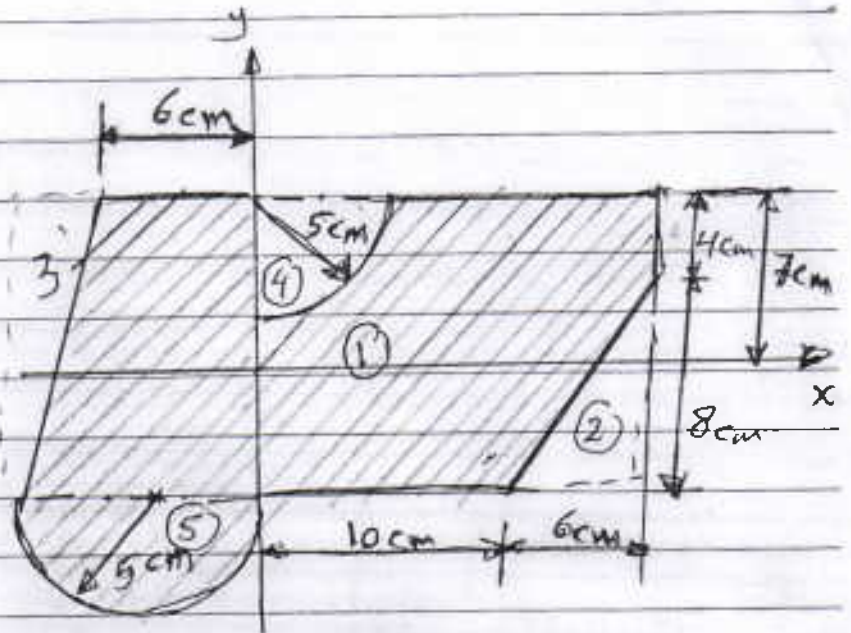
مسؤول المرحلة الأولى

2017 / 6 / 8

نسخة منه الى/

• ملف اللجنة الامتحانية

Q1

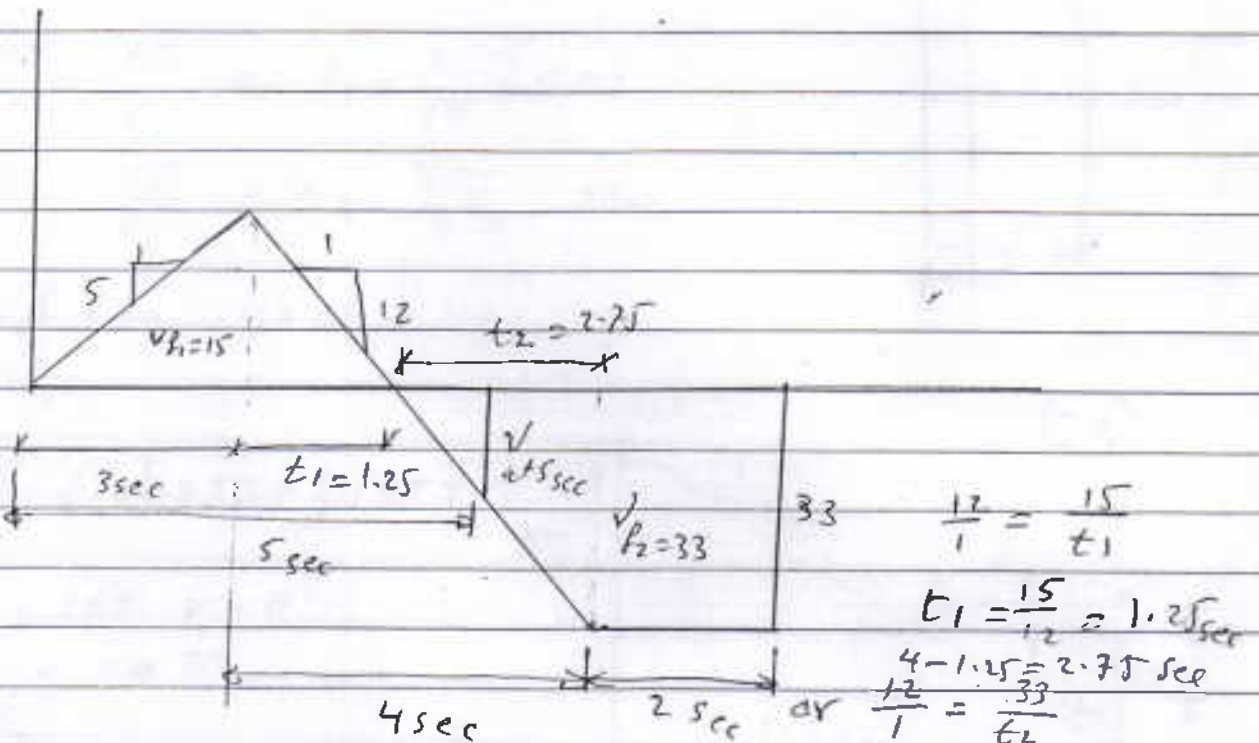


Symbol	Area (cm <sup>2</sup> )	X Coord. (cm)	$M_y$	y Coord. (cm)	$M_x$
1	$26 \times 12 = 312$	3	936	1	312
2	$-\frac{1}{2} \times 8 \times 6 = -24$	14	-336	-2.33	55.92
3	$-\frac{1}{2} \times 4 \times 12 = -24$	-8.67	208.1	3	-72
4	$-\frac{5^2 \pi}{4} = -19.63$	$\frac{4(5)}{3\pi} = 2.12$	-41.62	$7 - \frac{4(5)}{3\pi} = 4.9$	-96.2
5	$\frac{5^2 \pi}{2} = 39.25$	-5	-196.25	$5 + \frac{4(5)}{3\pi} = 7.12$	279.46
Total	283.62		570.23		479.18

$$\bar{x} = \frac{M_{y \text{ total}}}{A_{\text{total}}} = \frac{570.23}{283.62} = 2 \text{ cm}$$

$$\bar{y} = \frac{M_{x \text{ total}}}{A_{\text{total}}} = \frac{479.18}{283.62} = 1.69 \text{ cm}$$

Q-2



$$5 = \frac{v_{f1} - 0}{3} \Rightarrow v_{f1} = 15 \text{ m/sec} \rightarrow$$

$$-12 = \frac{v_{f2} - 15}{4} \Rightarrow v_{f2} = 33 \text{ m/sec} \leftarrow$$

$$\frac{12}{1} = \frac{15}{t_1}$$

$$t_1 = \frac{15}{12} = 1.25 \text{ sec}$$

$$4 - 1.25 = 2.75 \text{ sec}$$

$$\text{or } \frac{12}{1} = \frac{33}{t_2}$$

$$t_2 = \frac{33}{12} = 2.75 \text{ sec}$$

a)  $Q = \frac{1}{2} \times 15 \times 3 + \frac{1}{2} \times 1.25 \times 15 + \frac{1}{2} \times 2.75 \times 33 + 33 \times 2$   
 $Q = 22.5 + 9.375 + 45.375 + 66 = 143.26 \text{ m}$

b)  $Q = 22.5 + 9.375 - 45.375 - 66 = -79.5 \text{ m} \leftarrow$

c)  $\frac{12}{1} = \frac{v \text{ at } 5 \text{ sec}}{2.75} \Rightarrow v \text{ at } 5 \text{ sec} = 9 \text{ m/sec} \leftarrow$

or  $-12 = \frac{v \text{ at } 5 \text{ sec} - 15}{2} \Rightarrow v \text{ at } 5 \text{ sec} = -24 + 15$

$= v \text{ at } 5 \text{ sec} = 9 \text{ m/sec} \leftarrow$

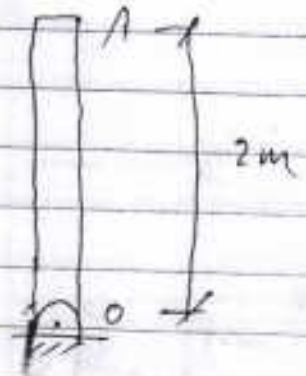


Q.3

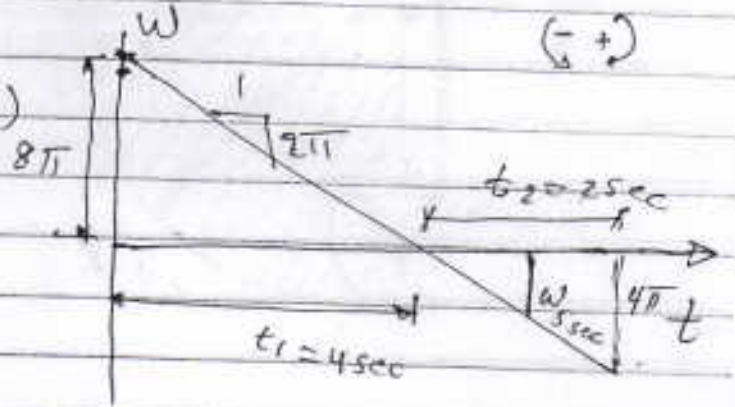
$$a) \frac{2\pi}{1} = \frac{8\pi}{t_1} \Rightarrow t_1 = \frac{8\pi}{2\pi} = 4 \text{ sec}$$

$$\frac{2\pi}{1} = \frac{4\pi}{t_2} \Rightarrow t_2 = \frac{4\pi}{2\pi} = 2 \text{ sec}$$

$$\therefore \text{total time} = 4 + 2 = 6 \text{ sec}$$



$$b) \phi = \frac{1}{2} \times 4 \times 8\pi + \frac{1}{2} (4\pi \times 2)$$
$$= 16\pi + 4\pi$$
$$= 20\pi$$



$$c) a_n = r\omega^2, a_t = r\alpha$$

$$a_t = 2\pi (2) = 4\pi = 12.56 \text{ m/sec}^2$$

$$\frac{-2\pi}{1} = \frac{\omega_{5\text{sec}} - 8\pi}{5} \Rightarrow \omega_{5\text{sec}} = 8\pi - 10\pi$$

$$\omega_{5\text{sec}} = -2\pi \Rightarrow \omega_{5\text{sec}} = 2\pi \text{ rad/sec}$$


$$\text{or } \frac{2\pi}{1} = \frac{\omega_{5\text{sec}}}{1} \Rightarrow \omega_{5\text{sec}} = 2\pi \text{ rad/sec}$$

$$a_n = 2 (2\pi)^2 = 78.9 \text{ m/sec}^2$$

Q.4.


a)

For area (1)



$$I_{x_1} = I_c + Ad^2 = 0.0549(12)^4 + \frac{(12)^2\pi}{4} \left[ -\left(5 + \frac{4(12)}{3\pi}\right) \right]^2$$

$$I_{x_1} = 1138.4 + 113. [-10.1]^2 = 12665.53 \text{ cm}^4$$


For area (2)


$$I_{x_2} = \frac{12(9)^3}{36} + \frac{1}{2}(1)(12)[-2]^2 = 243 + 216 = 459 \text{ cm}^4$$

For area (3)


$$I_{x_3} = 0.11(3)^4 + \frac{3^2\pi}{2} \left[ -\left(5 + \frac{4(3)}{3\pi}\right) \right]^2$$
$$= 8.91 + 14.13 [-6.27]^2 = 564.4 \text{ cm}^4$$

For area (4)


$$I_{x_4} = \frac{\pi(3)^4}{8} + \frac{3^2\pi}{2} [-14]^2$$
$$= 31.79 + 2769.5 = 2801.3 \text{ cm}^4$$

$$I_{x_{\text{total}}} = I_{x_1} + I_{x_2} - I_{x_3} - I_{x_4}$$

$$= 12665.53 + 459 - 564.4 - 2801.3$$

$$I_{x_{\text{total}}} = 9758.8$$

Q.4  
b)

For area ①



$$\begin{aligned} I_{xy_0} &= I_{x'y'} + A x' y' \\ &= -0.0164(12)^4 + \frac{12^2 \pi}{4} \left[ -\frac{4(12)}{3\pi} \right] \left[ -\left(5 + \frac{4(12)}{3\pi}\right) \right] \\ &= -340.67 + 113.04 [-5.1] [-10.1] \end{aligned}$$

$$I_{xy_0} = 6162.8 \text{ cm}^4$$

For area ②



$$\begin{aligned} I_{xy_0} &= \frac{(9^2)(12)^2}{72} + \frac{1}{2}(9)(12)(-4)(-2) \\ &= 162 + 432 = 594 \text{ cm}^4 \end{aligned}$$

For area ③

$$\begin{aligned} I_{xy_0} &= 0 + \frac{3^2 \pi}{2} \left[ -\left(5 + \frac{4(3)}{3\pi}\right) \right] (-9) \\ &= 14.13 (-6.27) (-9) \\ &= 797.4 \text{ cm}^4 \end{aligned}$$

For area ④

$$I_{xy_0} = 0 + \frac{3^2 \pi}{2} \left[ -\frac{4(3)}{\pi} \right] [-14] = 251.23 \text{ cm}^4$$

$$I_{xy_{\text{total}}} = I_{xy_0} + I_{xy_2} - I_{xy_3} - I_{xy_4}$$

$$\begin{aligned} I_{xy_{\text{total}}} &= 6162.8 + 594 - 797.4 - 251.23 \\ &= 5708.2 \text{ cm}^4 \end{aligned}$$



Q.5

$$\begin{aligned} \sum F_x &= m a_x \\ \sum F_y &= m a_y \quad \uparrow 0 \\ a_y &= 0 \end{aligned}$$

$$\begin{aligned} N - W \left( \frac{4}{5} \right) &= 0 \\ \therefore N &= 0.8W \rightarrow \textcircled{1} \end{aligned}$$

$$W \left( \frac{3}{5} \right) - 0.5N = \frac{W}{10} a_x$$

$$0.6W - 0.5(0.8W) = \frac{W}{10} a_x$$

$$\begin{aligned} 0.6W - 0.4W &= \frac{W}{10} a_x \\ 0.2W &= 0.1W a_x \end{aligned}$$

$$a_x = 2 \text{ m/sec}^2 \quad \rightarrow \textcircled{2}$$

$$\frac{2}{1} = \frac{y}{t} \Rightarrow y = 2t$$

$$10 = \left[ \frac{5t + (2t + 5)}{2} \right] t$$

$$20 = 10t + 2t^2$$

$$2t^2 + 10t - 20 = 0$$

$$t = \frac{-10 \pm \sqrt{100 - 4(2)(-20)}}{2 \times 2}$$

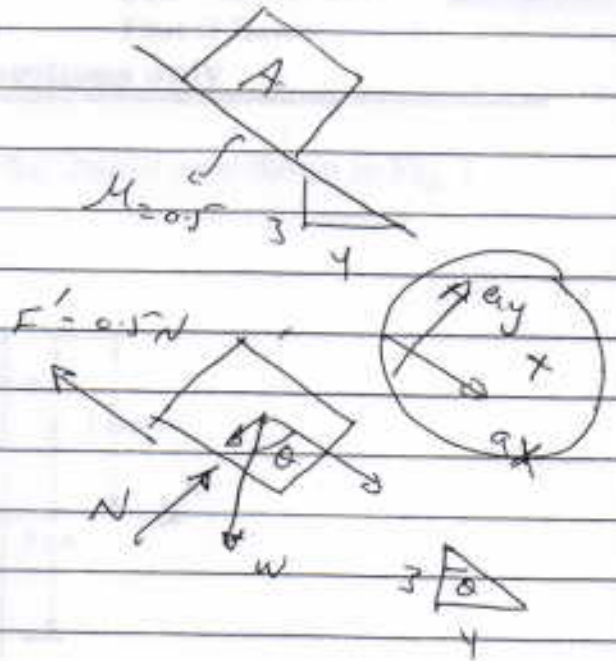
$$t = \frac{-10 \pm \sqrt{100 + 160}}{4} \Rightarrow t = 1.53 \text{ sec}$$

$$\therefore v_f = 5 + 2(1.53) = 8.1 \text{ sec}$$

$$\text{when } F = 20 \text{ N} \Rightarrow F = \mu N \Rightarrow N = 40 \text{ N}$$

Sub in eq. (1)

$$W = \frac{40}{0.8} = 50 \text{ N} \downarrow$$





Subject :Engineering Mechanics  
Class: 1<sup>st</sup>

Date : 28 May 2017  
Time :3 Hours

**Note: Answer FOUR questions only**

**Q1:** Determine the coordinates of the centroid of the shaded area shown in Fig. 1.

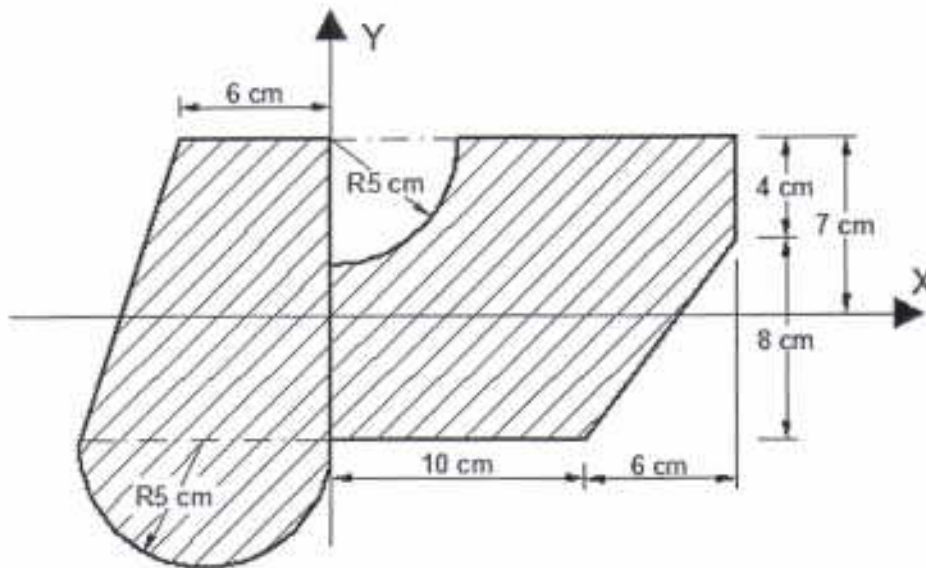


Fig. 1

**Q2:** A particle starts from rest and moves along a straight line for 3 seconds with a constant acceleration of  $5 \text{ m/sec}^2$  to the right. Then the acceleration is change to  $12 \text{ m/sec}^2$  to the left for 4 seconds after which the particle travels with a constant velocity for 2 seconds. Determine:

- The total distance traveled by the particle.
- The linear displacement of the particle from the starting point.
- The velocity of the particle after 5 seconds from the starting point.

**Note: Solve using velocity – time diagram ( $v - t$  diagram).**

**Q3:** The bar OA rotates about an axis through O, when it is in the position shown in Fig. 2 it has an angular velocity of  $8\pi \text{ rad/sec}$  clockwise. The bar rotates with constant angular acceleration of  $2\pi \text{ rad/sec}^2$  counterclockwise. At the end of its rotation time the bar has angular velocity of  $4\pi \text{ rad/sec}$  counterclockwise.

Determine:

- The total time elapsed during the motion of the bar.
- The total angle turned by the bar.
- The components of the acceleration of point A after 5 seconds from its position shown in Fig. 2.

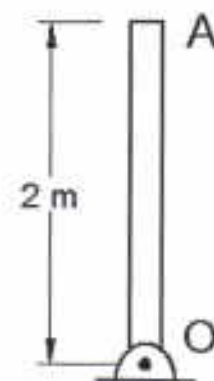


Fig. 2



**Q4:** For the shaded area shown in Fig. 3, determine:

- The moment of inertia with respect to x-axis.
- The product of inertia with respect to axis through the origin.

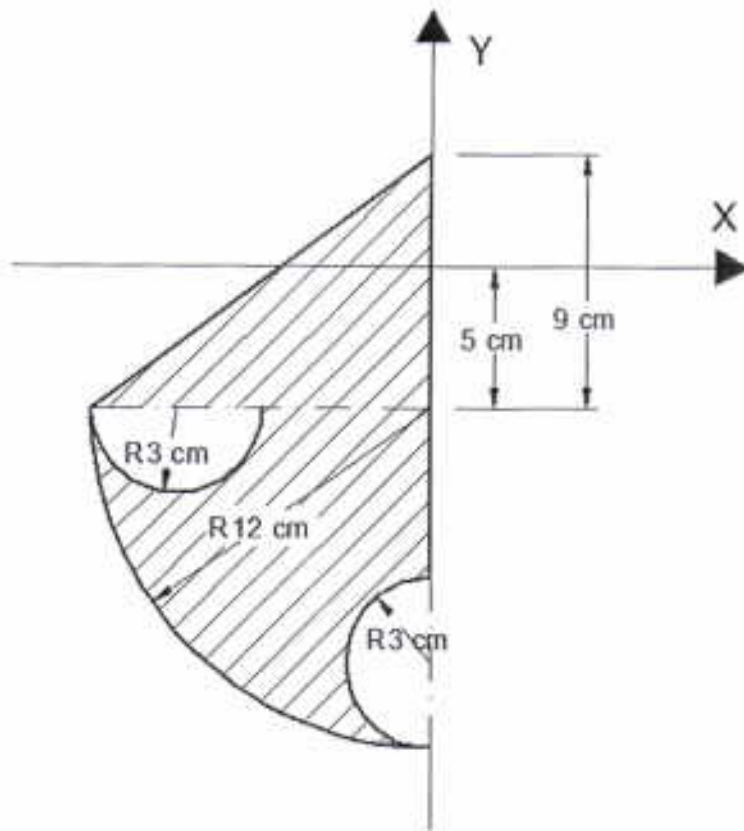


Fig. 3

**Q5:** Block A shown in Fig. 4 has initial velocity of **5 m/sec downwards the plane**. The coefficient of friction between block A and the plane is **0.5**, determine:

- The acceleration of block A.
- The velocity of block A after it moves **10 m**.
- The weight of block A if the frictional force is **20 N**.

**Note:** The gravity acceleration is  $10 \text{ m/sec}^2$ .

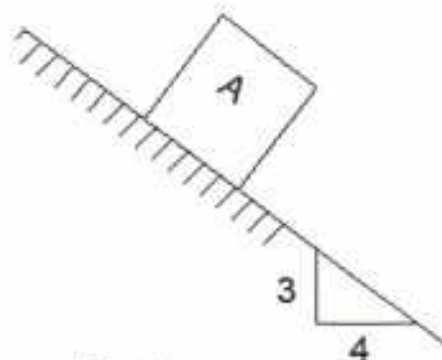


Fig. 4



Subject : Engineering Mechanics  
Class: 1<sup>st</sup>

Date : 28 May 2017  
Time : 3 Hours

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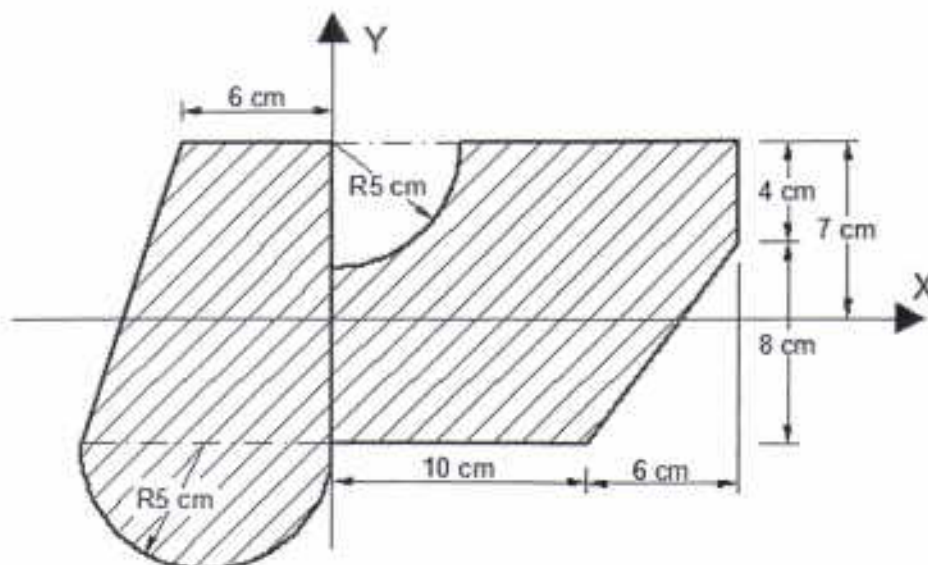


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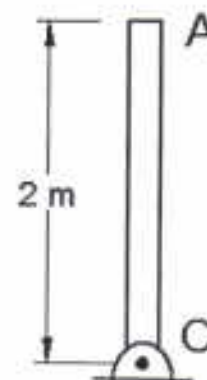


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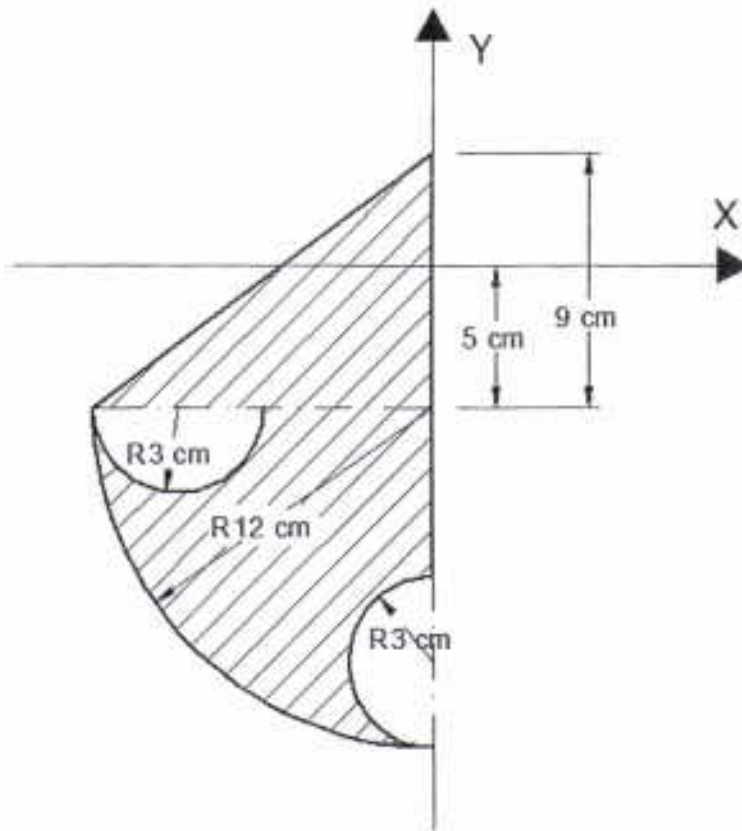


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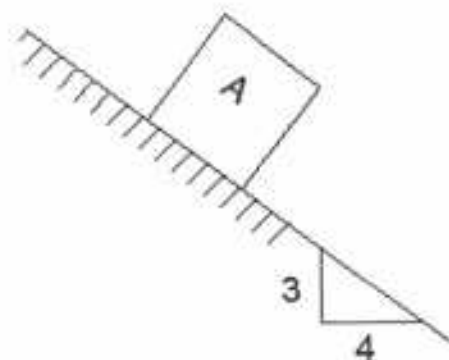


Fig. 4