الجامعة التكنولوجية

قسم هندسة البناء والإنشاءات

المرحلة الأولى

العـدد : ـــــ

التاريخ : 07 / 6 / 2015

الى / السيد معاون رئيس القسم

م/ الاجابة النموذجية لمادة (الميكانيك الهندسي 2)

تحية طيبة .....

نرفق لكم طياً نسخة من الأسئلة الخاصة بمادة الميكانيك الهندسي 2 و للإمتحان النهائي للفصل الدراسي الثاني – الدور الأول و للعام الدراسي 2014 – 2015 و الذي تم اجراءه بتاريخ 2015/06/06 مع الاجابة النموذجية الخاصة بها.

مع التقدير

أ.م.د. قيس جواد فريح

مسؤول المرحلة الأولى

07 / 6 / 2015

نسخة منه الى/

- ملف اللجنة الامتحانية

University of Technology
Building and Construction Engineering Department
Final Exam. - First Attempt - 2014-2015

Subject: Engineering Mechanics II **Date: 6 / 6 /2015**
Class: 1st **Time: 3 hrs.**

Note: Answer **FOUR** questions only.

Note: The gravity acceleration is **9.8 m /sec^2**.

Q1/ The **5kN** body **A** shown in Fig. (1) slides on inclined plane. Determine the weight of body **B** if its velocity changes from **1m/sec** downward to **7m/sec** downward while it moves **8m.**

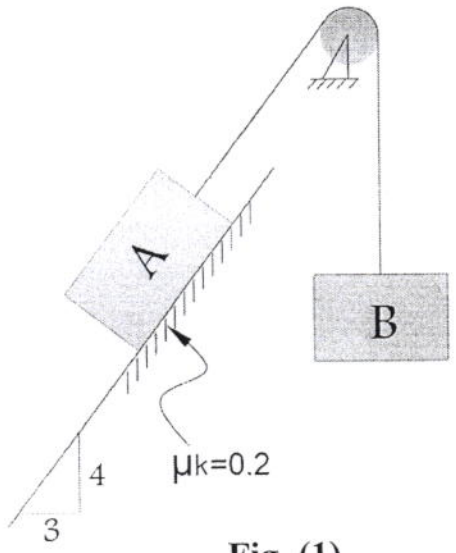


Fig. (1)

Q2/ Starting with a velocity of **6m/sec** to the right, a particle moves along a straight line with an acceleration of **1m/sec^2** to the left for **8 seconds**. The acceleration then becomes **zero** for **2 seconds**, after which the velocity changes uniformly until it become **6m/sec** to the right. The total displacement is **20m** to the right. From **velocity-time diagram**, determine:

1- The total time interval that the particle travels.
2- The velocity after **7 seconds** from starting point.

Q3/ A particle is suspended by a cord **2m** long and swings in a vertical plane. When it is in the position shown in Fig.(2), its speed is **6m/sec** and the tension in the cord is **20N**. Determine:

1- The weight of the particle.
2- The angular acceleration of the cord.

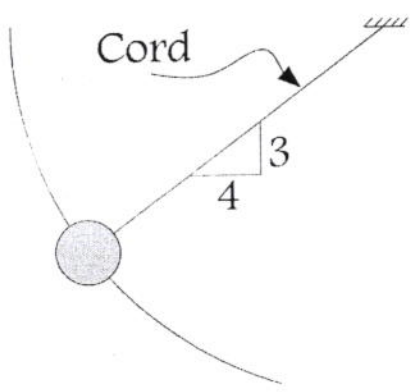


Fig. (2)

Q4/ Determine the coordinates of the centroid of the shaded area shown in Fig.(3).

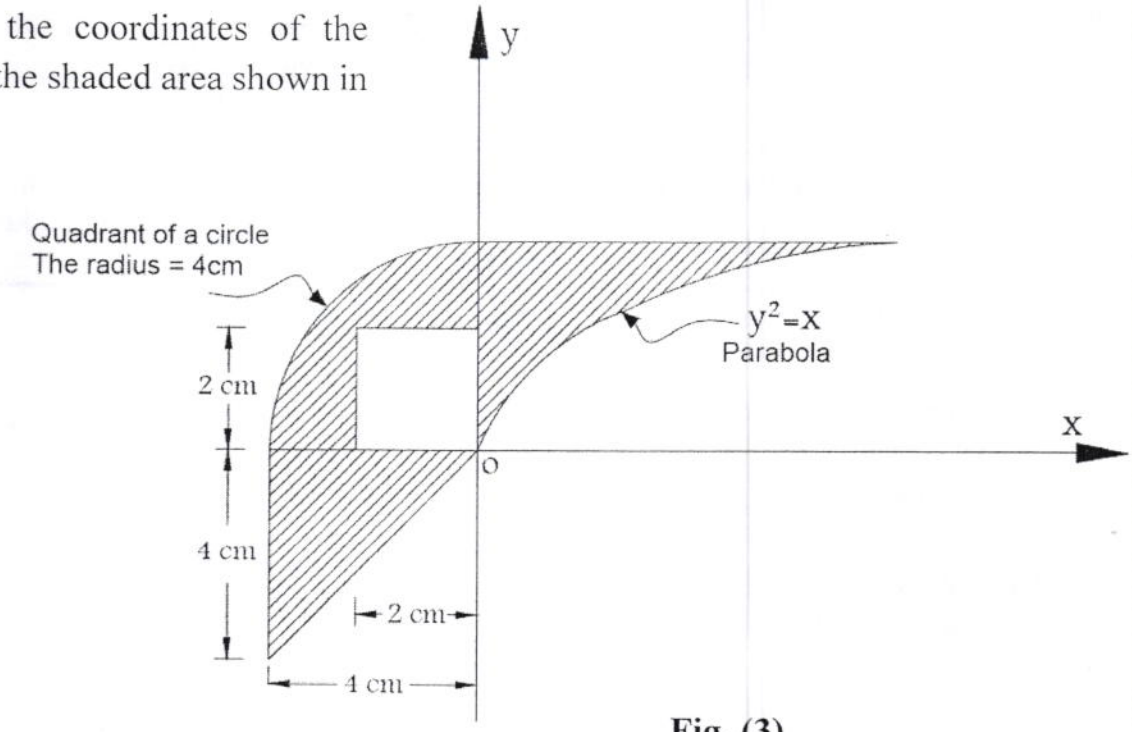


Fig. (3)

Q5/ For the shaded area shown in Fig.(4), determine:

1- The moment of inertia with respect to y- axis.

2- The product of inertia with respect to axes through origin.

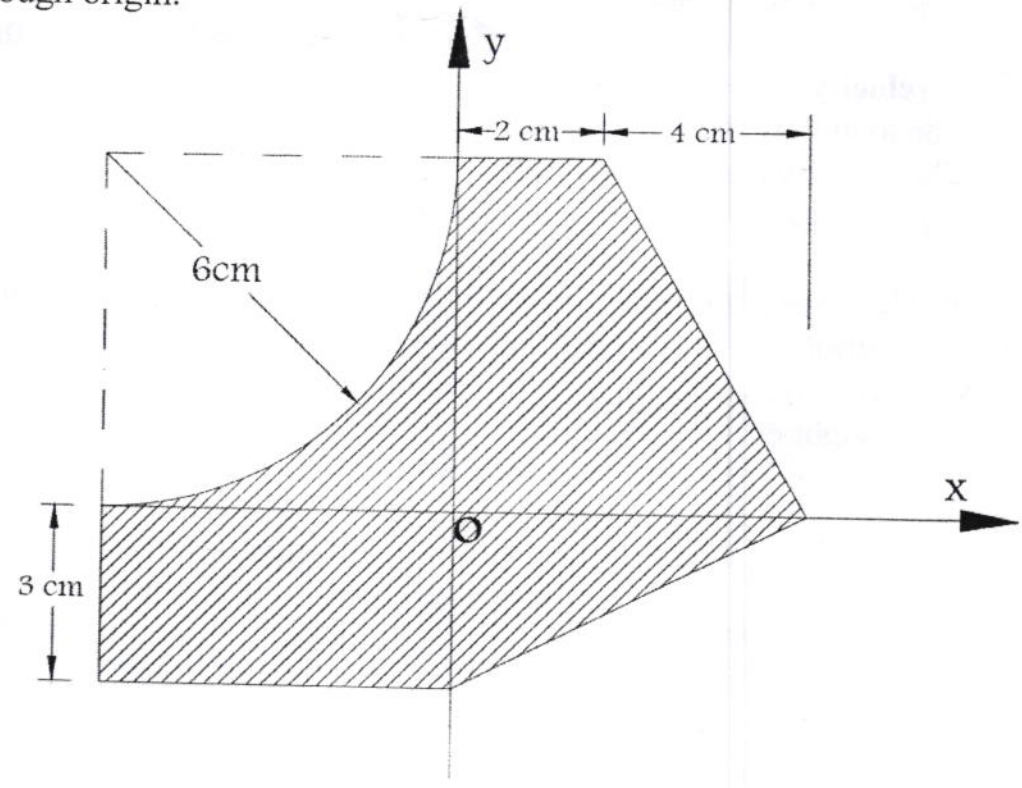
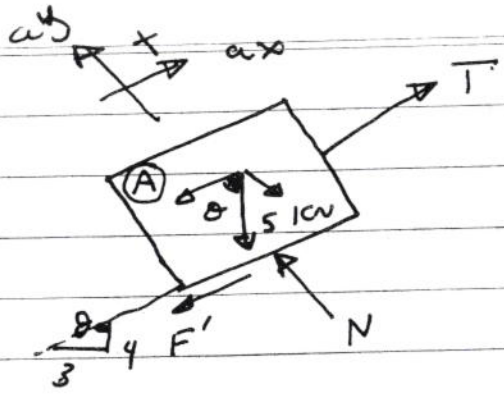


Fig. (4)

الميكانيك الهندسية II

المرحلة الاولى

Q.1



From F.B.D.1

$F' = \mu N = 0.2N$

$\Sigma F_x = ma_x$

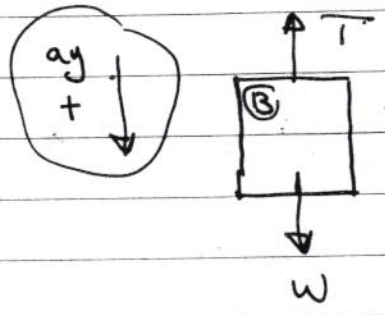
$-0.2N - 5 \times \frac{4}{5} + T = \frac{5}{9.8} a_x$ — ①

$\Sigma F_y = m a_y^{\,0}$

$N - 5 \times \frac{3}{5} = 0$

$N = 3$ KN

F.B.D.1



F.B.D.2

Sub. in Eq. ①

$-0.2(3) - 4 + T = \frac{5}{9.8} a_x$

$T - 4.6 = 0.51\, a_x$ — ②

$a_x = a_y = a$

From F.B.D ②

$\Sigma F_y = m a_y$

$W - T = \frac{W}{9.8} a$ — ③

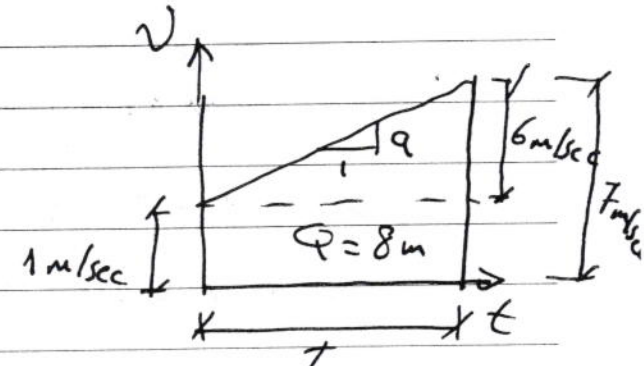
$a = 3\ m/sec^2 \downarrow$ → Sub in Eq. ②

$T - 4.6 = 0.51(3)$

$T = 6.13$ KN

$W - 6.13 = \frac{W}{9.8}(3)$

$W = 8.9$ KN



$8 = \left[\frac{1+7}{2}\right] * t$

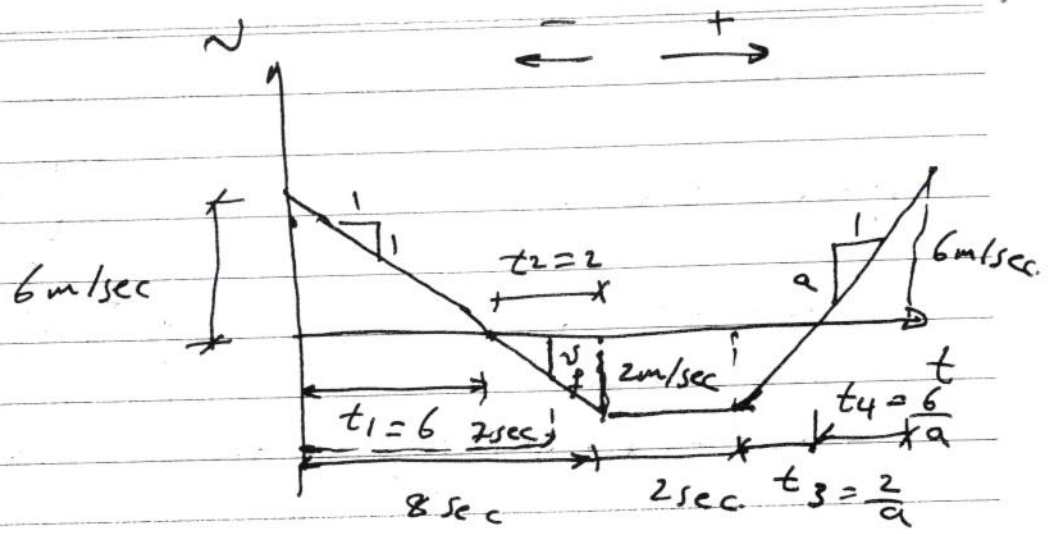
$\therefore t = 2$ sec.

$\frac{a}{1} = \frac{6}{2}$

$a = 3\ m/sec^2 \downarrow$

Q.2

$q = 20\,m \rightarrow$



$a = \frac{v_f - v_i}{\Delta t}$, $-1 = \frac{v_f - 6}{8}$

$v_f = 2\,m/sec \leftarrow$

$\frac{a}{1} = \frac{2}{t_3}$

$t_3 = \frac{2}{a}$.

$\frac{a}{1} = \frac{6}{t_4}$, $t_4 = \frac{6}{a}$

$\frac{1}{1} = \frac{6}{t_1}$, $t_1 = 6\,sec$

$\frac{1}{1} = \frac{2}{t_2}$, $t_2 = 2\,sec$

$$20 = \frac{1}{2} \times 6 \times 6 - \frac{1}{2} \times 2 \times 2 - 2 \times 2 - \frac{1}{2} \times 2\left(\frac{2}{a}\right) + \frac{1}{2} \times 6 \times \frac{6}{a}$$

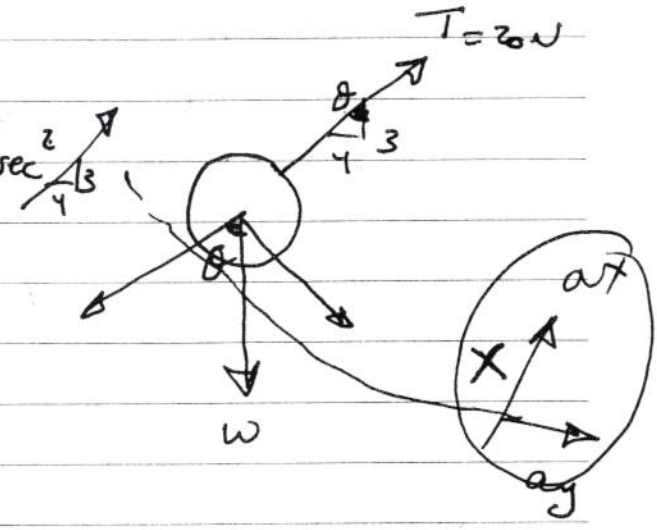
$$20 = 18 - 2 - 4 - \frac{2}{a} + \frac{18}{a}$$

$a = 2\,m/sec^2 \rightarrow$

1) Total time $= 8 + 2 + 1 + 3 = 14\,sec$

2) $-1 = \frac{v_f - 6}{7} \Rightarrow v_f = 1\,m/sec \leftarrow$

Q.3



$a_x = a_n = \frac{v^2}{r} = \frac{(6)^2}{2} = 18 \text{ m/sec}^2$ ←

$\Sigma F_x = m a_x$

$20 - \frac{3}{5}W = \frac{W}{9.8}(18)$

$20 = 2.43W$

$W = 8.23 \text{ N} \downarrow$

$\Sigma F_y = m a_y$

$8.23 \times \frac{4}{5} = \frac{8.23}{9.8}(a_y)$

$a_y = 7.85 \text{ m/sec}^2$ ↗ (4, 3)

$a_y = at = r\alpha$

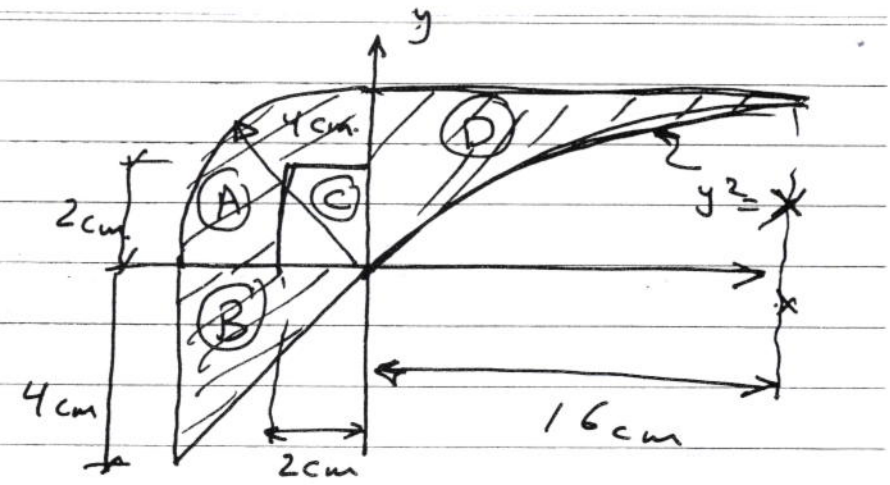
$\therefore \alpha = \frac{7.85}{2} = 3.93 \text{ rad/sec}^2$ ↻

Q.4

$y^2 = x$

at $y = 4$

$x = 16$ cm



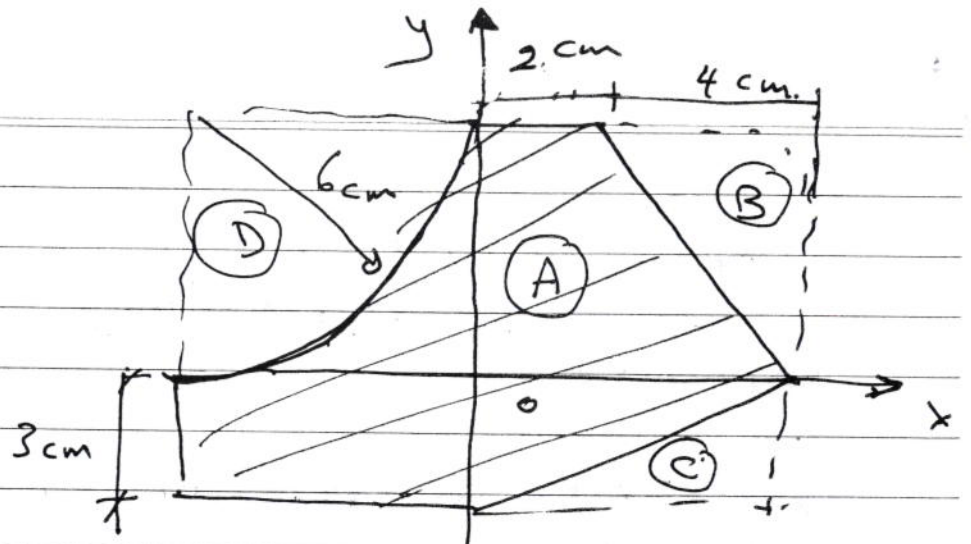
Symbol	Area cm^2	x-coord. cm	M_y cm^3	Y coord. cm	M_x cm^3
A	$\frac{4^2\pi}{4} = 12.57$	$\frac{-4*4}{3\pi} = -1.697$	-21.33	$\frac{4*4}{3\pi} = 1.697$	21.33
B	$\frac{1}{2}*4*4 = 8$	$-\frac{2}{3}*4 = -2.67$	-21.36	$-\frac{1}{3}*4 = -1.33$	-10.64
C	-4	-1	4	1	-4
D	$\frac{16*4}{3} = 21.33$	$\frac{3*16}{10} = 4.8$	102.38	$\frac{3*4}{4} = 3$	63.99
Total	37.9		63.69		70.68

$$\bar{x} = \frac{M_{y\,total}}{A_{total}} = \frac{63.69}{37.9} = 1.68 \text{ cm}$$

$$\bar{y} = \frac{M_{x\,total}}{A_{total}} = \frac{70.68}{37.9} = 1.86 \text{ cm}$$

$(1.68, 1.86)$

Q.5



a-

$$I_{y_A} = I_c + Ad^2 = \frac{9 * 12^3}{12} + (9*12)(0)^2$$

$$I_{yA} = 1296 \text{ cm}^4$$

$$I_{y_B} = \frac{6 \times 4^3}{36} + \frac{1}{2} * 6 * 4 \left(\frac{2}{3} \times 4 + 2\right)^2 \quad (4.7)^2$$

$$I_{y_B} = 10.67 + 265.08 = 275.75 \text{ cm}^4$$

$$I_{y_c} = \frac{3 * 6^3}{36} + \frac{1}{2} * 3 * 6 (4)^2$$

$$I_{y_c} = 18 + 144 = 162 \text{ cm}^4$$

$$I_{y_D} = 0.0549(6)^4 + \frac{6^2\pi}{4}\left(6 - \frac{4*6}{3\pi}\right)^2$$

$$= 71.15 + 337.12 = 408.27 \text{ cm}^4$$

$$I_{y\,total} = I_{y_A} - I_{y_B} - I_{y_c} - I_{y_D}$$

$$I_{y_{total}} = 1296 - 275.75 - 162 - 408.27 = 449.98$$
$$\simeq 450 \text{ cm}^4$$

b)

$$I_{xy_A} = \bar{I}\,\bar{x}'y' + A\,\bar{x}\,\bar{y}$$

$$= 0 + 12 * 9 * (0)(1.5)$$

$$I_{xy_A} = 0$$

$$I_{xy_B} = \frac{-4^2 * 6^2}{72} + \frac{1}{2} * 4 * 6\,(4.7)(4)$$

$$= -8 + 225.6$$

$$I_{xy_B} = 217.6 \text{ cm}^4$$

$$I_{xy_C} = \frac{3^2 * 6^2}{72} + \frac{1}{2} * 3 * 6\,(4)(-2)$$

$$= 4.5 - 72$$

$$I_{xy_C} = -67.5 \text{ cm}^4$$

$$I_{xy_D} = 0.0164\,(6)^4 + \frac{6^2\pi}{4}\left[6 - \frac{4*6}{3\pi}\right]\left[-\left(6 - \frac{4*6}{3\pi}\right)\right]$$

$$= 21.25 + 337.12$$

$$I_{y_D} = 358.37 \text{ cm}^4$$

or

$$I_{xy_D} = \bar{I}_{x'y'} + A\bar{x}\bar{y}$$

$$I_{xy\,Dia} = \bar{I}_{x'y'} + A\bar{x}\bar{y}$$

$$-\frac{(6)^4}{8} = I_{x'y'} + \frac{6^2\pi}{4}\left[\frac{4*6}{3\pi}\right]\left[-\frac{4*6}{3\pi}\right]$$

$$I_{x'y'} = -162 + 183.28 = 21.28 \text{ cm}^4$$

$$I_{xy_D} = 21.28 + \frac{6^2\pi}{4}\left[-\left(6 - \frac{4*6}{3\pi}\right)\right]\left[6 - \frac{4*6}{3\pi}\right]$$

$$= 21.28 + 337.12$$

$$I_{xy_D} = 358.4 \text{ cm}^4$$

$$I_{xy_{total}} = I_{xy_A} - I_{xy_B} - I_{xy_C} - I_{xy_D}$$

$$= -217.6 - 358.37 - 67.5$$

$$I_{xy_{total}} = 613.47 \text{ cm}^4$$