Menoufia University
Faculty of Engineering-Shebin Elkom
Prod. Eng. & Mech. Design Department
First Semester Examination-2017/2018
Date of Exam: 3/1/2018

Subject: Applied Mechanics
Code : PRE 113
Year :First Prod.Department
Time Allowed : 3 hours
Total Marks : 120 marks

Answer all the following questions: measures ILOs (a1,a2,a3,b1,b2,b3,c1,c2,c3)

Question No.1 (40 marks) (Marks)

a-Draw the shear force and bending moment diagrams for the beam shown in Fig.(1-a)).(20)

b-Determine the moment of inertia of the section area shown in Fig. (1-b) with respect to the x-axis and y-axis. (10)

c-An anvil consisting of a rectangular prism and two circular cones is shown in Fig.1- c . Determine the mass moment of inertia with respect to x-axis, y-axis and z-axis. (10)
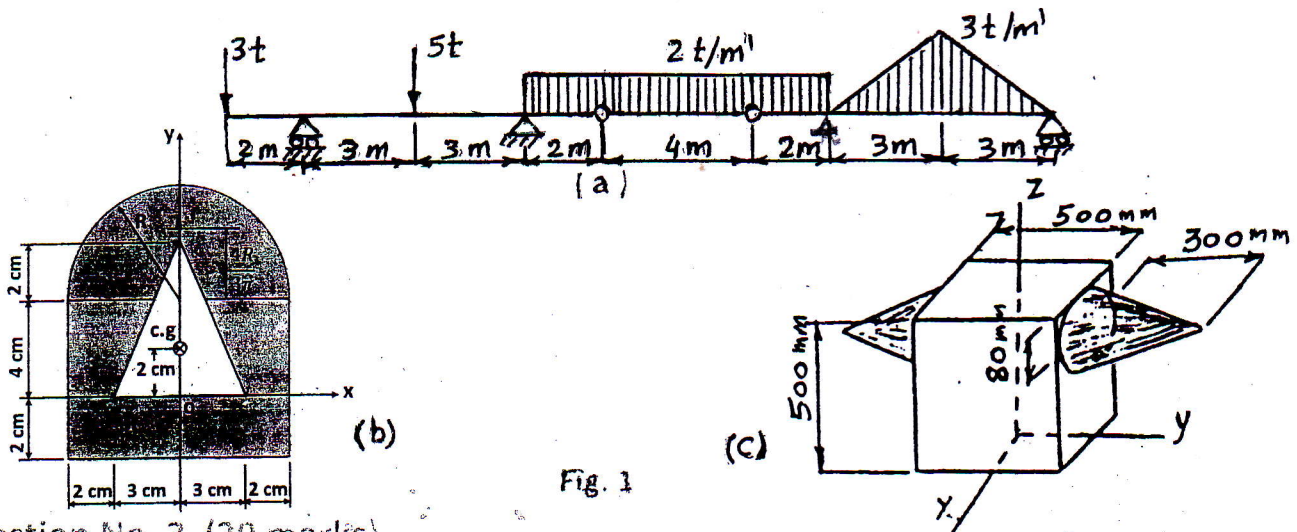

Fig. 1

Question No. 2 (20 marks)

A satellite is describing an elliptical orbit of eccentricity e= 1/5 around the earth with minimum distance from the earth center r_o=10 Mm as shown in Fig.2. Take the mass of the earth m_o= 5.976x10^{24} kg and the universal gravitational constant G= 66.73x10^{-12} m^3/kg.sec^2, calculate :-

a-The maximum and minimum velocities of the satellite v_o and v_1 ,

b-The periodic time τ ,

c- If auxiliary rockets are fired, when the satellite is at point A_o, to increase its velocity to escape velocity v_e , find the work done by the auxiliary rockets.The satellite mass 5 kg.

Question No.3 (15 marks)

Two spheres A and B each have a mass of 10 kg and the initial velocities shown in Fig.3 just before they collide . If the coefficient of restitution e= 0.6 , determine their velocities just after the impact.

Question No. 4 (15 marks)

The pump shown in Fig.4 draws air with a rate of 6 kg/sec through the tube A of diameter D with a velocity v and discharges it at outlet velocity u through two tubes B of diameter d. If v= 10 m/s, D= 0.8 m , d= 0.2 m, α= 45°, determine :-

a - The outlet velocity u, and

b - The force F_x required supporting the pump.

Question No. 5 (15 marks)

Link AOB shown in Fig.5 rotates about the bearing O. A piston C is connected through a link BC which at the instant shown is vertical. Angle AOB is 120° where OA is horizontal. The point A has an upward velocity of 3 m/s and an upward acceleration of 1.5 m/s². Determine the linear velocity and acceleration of the piston C.

Question No. 6 (15 marks)

In Fig.6, a disk of radius R= 50 cm rotates about its axis oz with constant angular velocity ω_1= 40 rad/s. Simultaneously, it is embedded in a frame which rotates about the vertical axis oZ with a constant angular velocity ω_2= 10 rad/s . Determine :-

a-The resultant angular velocity and angular acceleration of the disk ,

b-At the instant when the axis oz coincides with the axis oY, determine the linear velocity and acceleration of the point A on the disk, and

c-The generated gyroscopic moment M_G if the moment of inertia of the disk about the axis oz is I_z= 120 kg·cm²
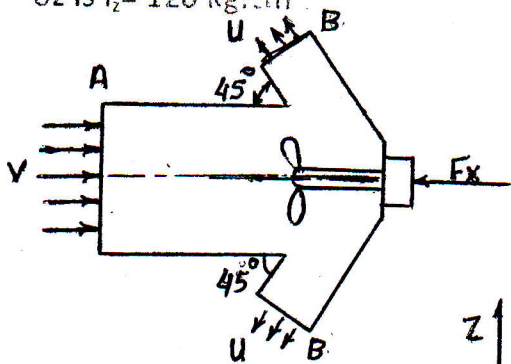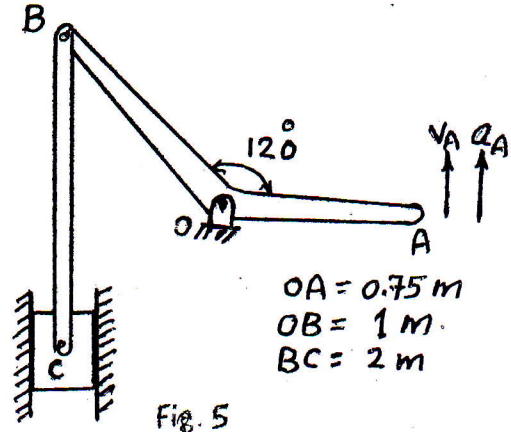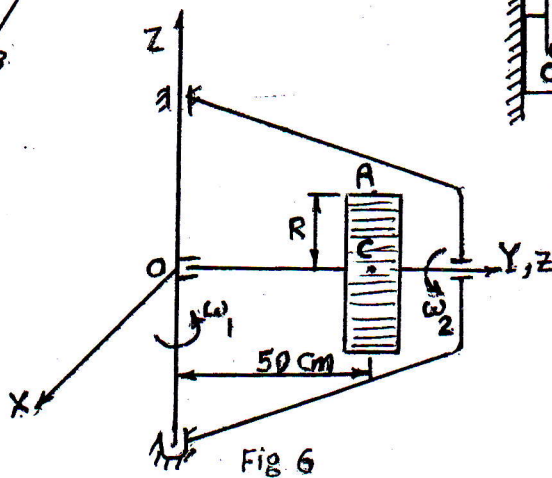

Fig. 4

120°

V_A a_A

OA = 0.75 m
OB = 1 m
BC = 2 m

Fig. 5

50 cm

Fig. 6

GOOD LUCK

With our best wishes