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Menoufiya University **Faculty of Engineering** **Shebin El-Kom** **Final First Semester Examination** **Academic Year: 2013-2014** **Date: 12/1/2014**	*(Minufiya University logo)*	**Dept.: Mechanical Power Eng.** **Year : First** **Subject: Applied Mechanics** **Code : PRE 118** **Time Allowed: 3 hours** **Total Marks : 75 Marks**

Allowed Tables and Charts: None - (take $g_0 = 9.8$ m/s^2)
Examiner: Dr/ Mohamed Hesham Belal

Answer All the Following Questions:

Question (1): [15 Marks]

For the shown loaded beam in Fig.(1): 1)- *Draw* the internal action diagrams, and
2)- *Find* the values and locations of the maximum shearing force and bending moment.

Fig.(1)
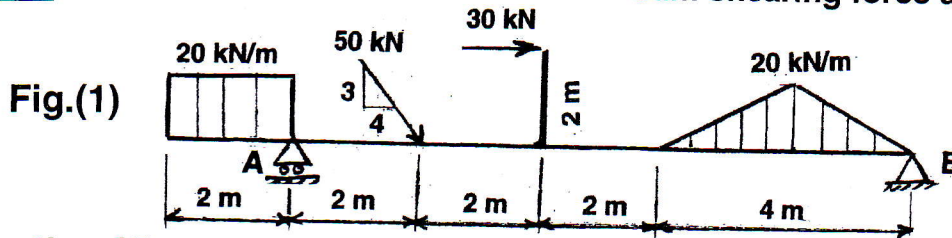
Question (2): [20 Marks]

(a) [8 marks] —The 3000 kg anvil *A* for a drop forge is mounted on a nest of heavy coil springs having a combined stiffness of 2.8 MN/m. The 600 kg hammer *B* falls 500 mm from rest as shown in Fig.(3) and strikes the anvil which suffers a maximum deflection of 24 mm from its equilibrium position. *Determine:* (1)- the height (h) of rebound of the hammer, (2)- the coefficient of restitution (e) which applied, and
(3)- the percentage loss of kinetic energy due to the impact.

(b) [12 marks] — An artificial satellite is launched in a direction parallel to the surface of the earth from a position (*A*) at an altitude h_0. The trajectory of the satellite is elliptical orbit with maximum altitude h_1 at the position (*B*) as shown in Fig.(4). At the position (*B*) set of auxiliary rockets are fired to increase its velocity and set it in a parabolic orbit .

   Given: $h_0 = 1.6 \times 10^6$ m, $h_1 = 25.6 \times 10^6$ m, $R = 6.4 \times 10^6$ m.

Determine: (1)- the eccentricity and the semi latus rectum of the elliptical orbit,
(2)- the periodic time of the elliptical orbit, (3)- the distance from the earth's center and the velocity of the satellite in the elliptical orbit at the position (*C*) , and
(4)- the sudden change in the velocity at the position (*B*).

Question (3): [15 Marks]

(a) [8 marks] — The water flow enters the elbow through the fixed pipe joint at A at the rate of 0.2 m^3 /s and then discharged from the outlet at *B* as shown in Fig.(4). The static gauge pressure at *A* is 100 kPa and the density of water is 1000 kg/m^3. The water-filled elbow has a mass of 20 kg and center of mass at C. The diameter of the inlet pipe at *A* is 0.2 m, and the diameter of the outlet at *B* is 0.1 m.
Determine the horizontal and vertical force reactions and the moment reaction on the fixed pipe joint at *A*.

(b) [7 marks] — A horizontal shaft with a flywheel of mass 32 kg and a radius of gyration of 0.5 m about its mass center starts to rotate under the action of a driving moment $M = M_0 - C\theta$, as shown in Fig.(5), where the constants $M_0 = 1000$ N.m and $C = 8$ N.m/rad. (1)- *Derive* the equation of motion and then the relationship between the angular velocity and angular displacement ($\omega - \theta$ relation),
(2)- *Calculate* the number of revolutions executed by the flywheel before stopping.

Question (4):   [25 Marks]

(a) [13 marks] — The vibratory system shown in Fig.(6) has the natural frequency equal 30 rad/s and the following data: $m_1 = 10$ kg, $m_2 = 16$ kg, $J_0 = 6.4$ kg.m^2, $a = 40$ cm, $b = 80$ cm, $k_1 = 2k_2$. When the system was displaced and released, the amplitude of any cycle decreases to 0.25 of the value of previous cycle.

   (1)- **Find** the values of unknowns C, k_1 and k_2,   (2)- **Find** the periodic time,
   (3)- When the mass m_1 is subjected to a harmonic force: F(t) = 540 sin 60t   N, **write down** the equation of motion, and **determine** the steady state response.

(b) [12 marks] —The thin circular disk of mass m = 2 kg and radius r = 20 cm is mounted on a shaft with length R = 50 cm. The disk rotates about its own z-axis with a constant angular velocity $\omega_2 = 30$ rad/s. Simultaneously, the frame is rotating about the Z-axis at constant angular velocity $\omega_1 = 12$ rad/s with a fixed angle $\theta = 60^0$ as shown in Fig.(7). Axis z has the momentary orientation above Y-axis of the fixed axes X-Y-Z.   **Determine:**   (1)- the angular velocity and angular acceleration of the disk,
(2)-the velocity and acceleration of point A on the rim of the disk,
(3)-the total reaction at the support of the shaft, and
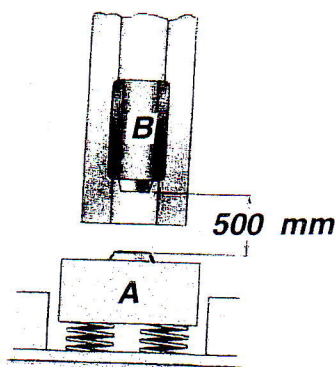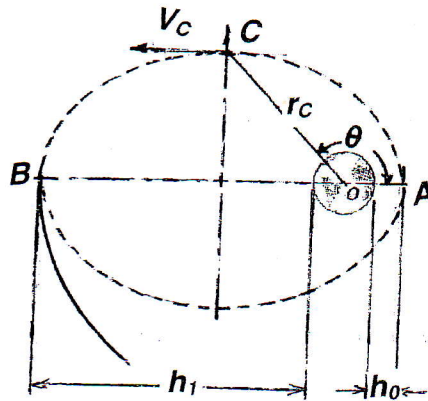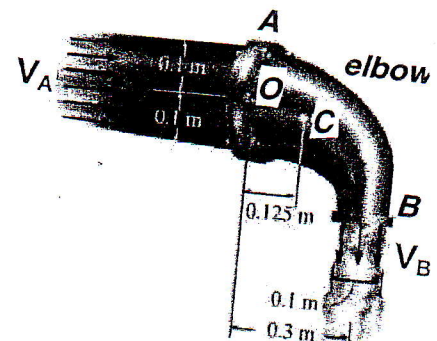(4)- the variation in the dynamic reaction if the neutation angle changed to 90^0.

Fig.(2)

Fig.(3)

Fig.(4)
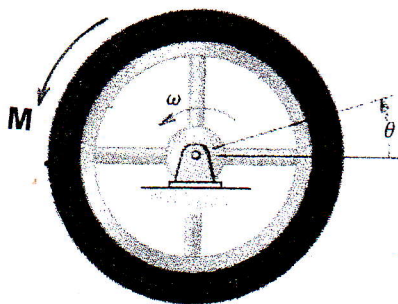
Fig.(5)
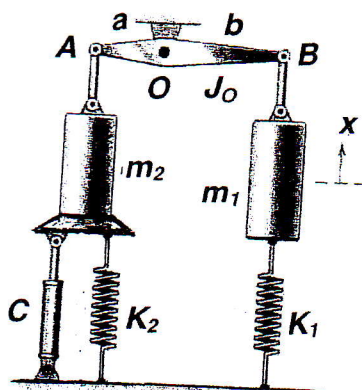
Fig.(6)
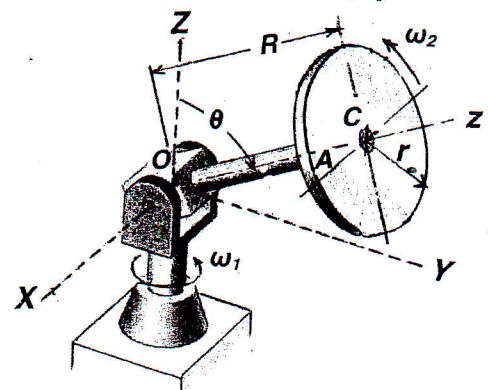
Fig.(7)

With my best wishes

This exam measure the following ILOs											
Question No.	Q1	Q2-a	Q3-b	Q4-b	Q1	Q2-a	Q3-b	Q4-a	Q1	Q2-b	Q3-a	Q4-a
Skills	a-1	a-4	a-1	a-4	b-2	b-7	b-7	b-2	C1	C1	C1	C1
	Knowledge & Understand				Intellectual				Professional			