Mansoura University | **Mechanical Power Eng. Department**
Faculty of Engineering | **Second year**
Final Exam. 2008/2009 | **Exam. Time: 3 Hours**

THEORY OF MACHINES

Question 1:

The sun gear 1, of the planetary gear train, has 26 external gear teeth, the planet gear 2 has 22 external gear teeth, the planet gear 2' has 30 external gear teeth, the sun gear 4 has 20 external gear teeth, the planet gear 5 has 18 external gear teeth, and the ring gears 3, 6 are internally teethed.

The gears 2 and 2' are fixed on the same shaft. The gear 1 rotates with input angular speed 100 rpm, in clockwise (CW) direction, and *the ring gear 3 is fixed (not rotate)*. All the gears have the same module. ***Find:***

a) The number of teeth of ring gears 3, 6.

b) The angular velocity and direction of rotation (CW or CCW) of each gear.

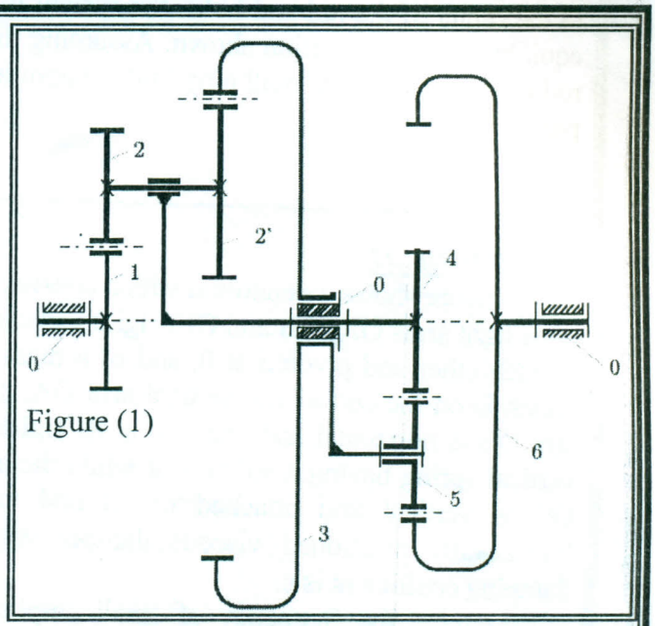


Figure (1)

Question 1:

Figure (2) shows a mechanism in which **O** and Q are the fixed centres. Determine the velocity and acceleration of the slider S, and the angular velocity and angular acceleration of the link BQ for the given configuration.

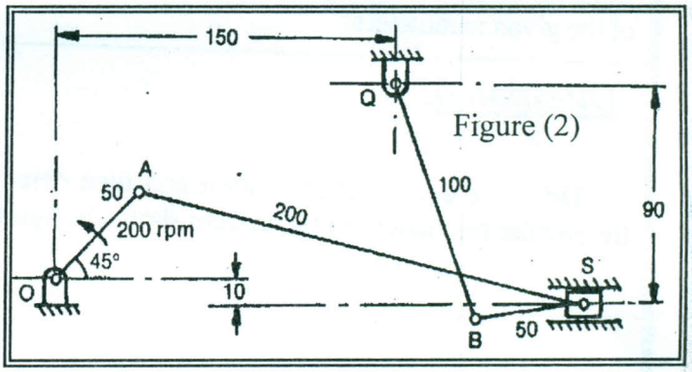


Figure (2)

Question 3:

Figure (3) shows a schematic diagram of an eight-link mechanism. The link lengths are ;

AB = 450	$OF = FC = 250$
$AC = 300$	$CG = 150$
$BD = 400$	$HG = 600$
$BE = 200$	$QH = 300$

Determine the required shaft torque on link 8 for static equilibrium against an applied load of 400 N on the link 3

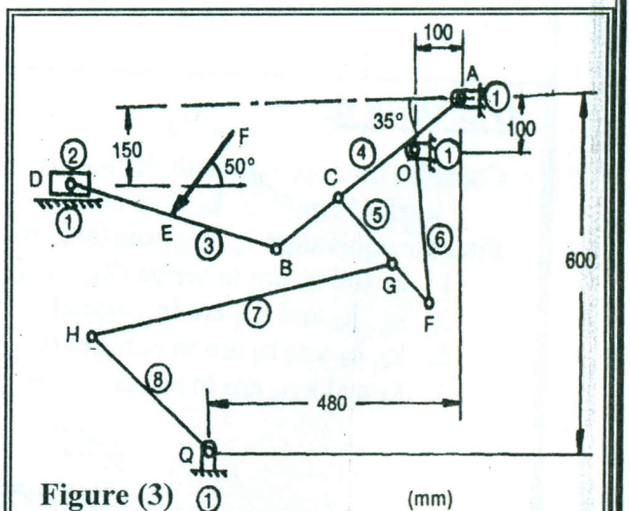
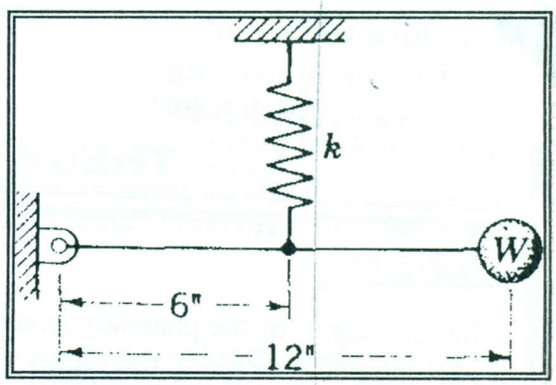


Figure (3)

Question 4:

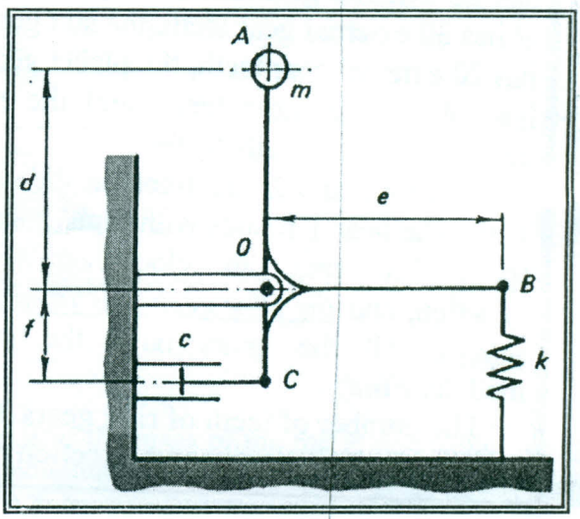
The figure shows a weight W = 15 Ib connected to a pivoted rod which is assumed to be weightless and very rigid. A spring having k = 60 Ib/in is connected to the center of the rod and holds the system in static equilibrium at the position shown. Assuming that the rod can vibrate with a small amplitude. determine the period of the motion.



Question 5:

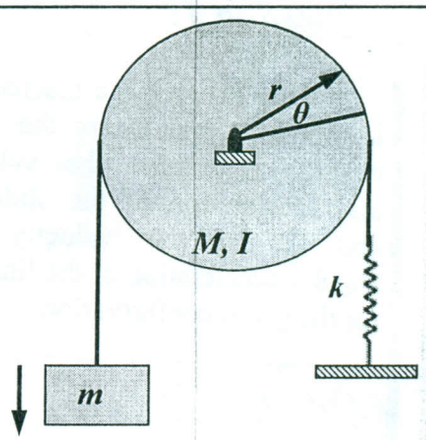
The figure shows a pendulum which consists of three light arms OA, OB and OC, rigidly attached to each other and pivoted at 0, and of a mass rn which is on the end of the vertical arm OA. The arm OB is horizontal and attached at its end to a vertical spring having a stiffness k while the arm OC is vertical and attached at its end to a horizontally positioned viscous damper whose damping coefficient is c.

Determine the frequency of small amplitude undamped oscillations of the pendulum about O and find the critical damping coefficient in terms of the given parameters.



Question 6:

Drive the equations of motion and then determine the angular frequency for the system shown in figure



Question 6:

Consider four springs with the spring constants :

k_1=50 N/m, k_2=100 N/m, k_3=200 N/m, k_4=300 N/m.

Find the equivalent spring constants for the following combinations :

1. k_3 and k_4 are in series (k_{eq}= k_{34})
2. k_1 , k_2 and k_{34} are in parallel
3. k_2, k_3 and k_4 are in parallel (k_{eq}= k_{234})
4. k_1 and k_{234} are in series

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