

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

- [20 %] A non-offset slider-crank mechanism, driven with a constant speed of 2400 rpm, is used within a single cylinder engine, whose crank length is 10 cm, connecting-rod length is 35 cm, and the Bore (or diameter) of the piston is 10 cm. The masses of the crank, connecting-rod and piston are 1 kg, 0 kg, and 0 kg, respectively. The mass center of the crank locates at its middle position. The origin of the reference coordinate system is located on the crank-pin center, the X axis directs to the horizontal right. The gas pressure on the piston is 100 N/m<sup>2</sup>, when the crank is at 15° CCW measured from X axis. Please give (a) the schematic drawing of the mechanism (scale: 1 cm = 5 cm), (b) the free body diagram of each moving link, (c) the coordinates of the pin center between the connecting-rod and piston, (d) the inertia force of the crank, (e) the gas force on the piston, (f) the force on the connecting-rod, (g) the mechanical efficiency of the mechanism.
- [15 %] The cam mechanism as shown in Fig. 1, an eccentric disk is used as the cam whose center is A and the radius is  $\rho_2$ ; the cam is driven with a constant speed of  $\dot{\theta}_2$ , the radius of roller 3 is  $\rho_3$ ; between the cam and roller, it is a rolling joint and their contact point is C. If (PQ) designates the distance between points P and Q,  $V_{PQ}$  designates the relative velocity of point P to point Q,  $\dot{\theta}_i$  and  $\alpha_i$  designate the angular velocity and acceleration, respectively, of link  $i$ , please give the directions and analytical expressions for determining (a) the angular velocity of link 3, (b) the Coriolis and radial components of the acceleration of point B<sub>4</sub> (on link 4) relative to point B<sub>2</sub> (on link 2).

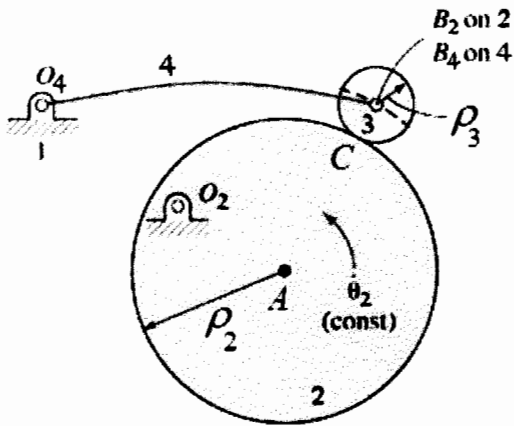


Fig. 1

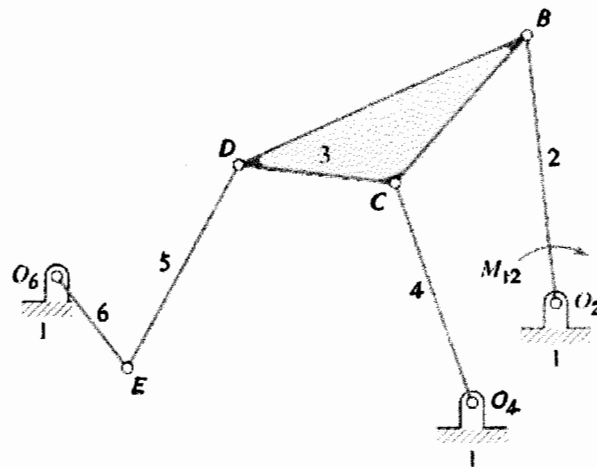
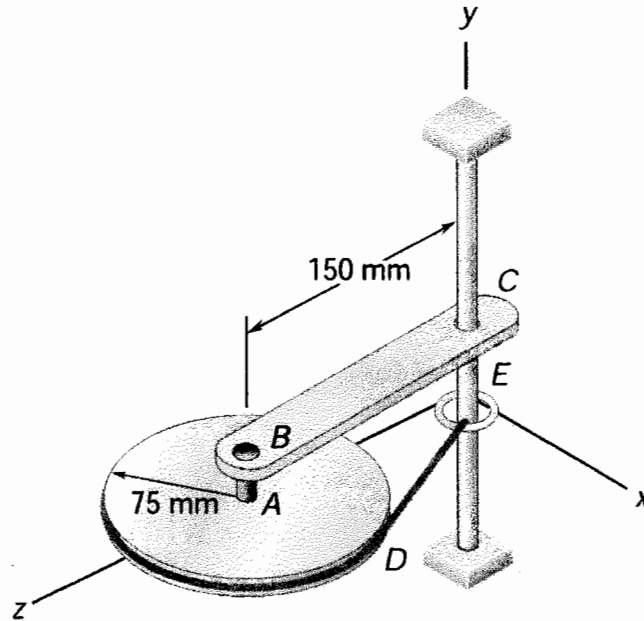


Fig. 2

- [15%] For the mechanism as shown in Fig. 2,  $O_2B = 7$  m,  $O_6E = 3$  m, the driving speed  $\omega_2 = 10$  rpm clockwise (constant), the lengths of other links can be measured on the figure which is given in scale. The input torque  $M_{12} = 20$  N-m clockwise, if there is a load  $M_{16}$  on link 6, please (a) give the assumptions needed to determine the mechanical advantage of the mechanism (with the given information), (b) give the mechanical advantage.

4. (25%) A 5-kg uniform disk is attached to the 3-kg uniform rod  $BC$  by means of a frictionless pin  $AB$ . An elastic cord is wound around the edge of the disk and is attached to a ring at  $E$ . Both ring  $E$  and rod  $BC$  can rotate freely about the vertical shaft. Knowing that the system is released from rest when the tension in the elastic cord is 15 N, determine (a) the angular acceleration of the disk, (b) the angular acceleration of the rod, and (c) the acceleration of the center of the disk.



5. (25%) The uniform rectangular block shown is moving along a frictionless surface with a velocity  $v_1$  when it strikes a small obstruction at  $B$ . Assuming that the impact between corner  $A$  and obstruction  $B$  is perfectly plastic, the maximum angle  $\theta$  through which the block will rotate is  $30^\circ$ . Determine (a) the angular velocity of the block immediately after impact and (b) the magnitude of the velocity  $v_1$ .

