1. (25 pt) A slender rod of mass m and length l is attached to a collar at A and rests on a circular cylinder of radius r. Neglecting the effect of friction and Using the "concept of Potential energy" to determine the ratio of l/r, if the rod is under stable-equilibrium condition at the present position of $\theta = 30°$, as shown in Fig. 1.

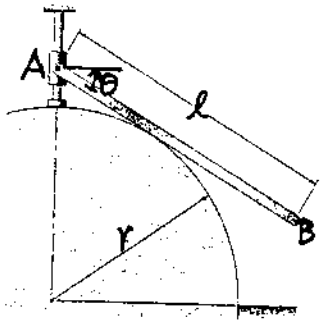


Fig. 1

2. (25 pt) A pipe of diameter 60 mm is gripped by the stillson wrench shown in Fig. 2. Portions AB and DE of the wrench are rigidly attached to each other, and portion CF is connected by a pin at D. If the wrench is to grip the pipe and be self-locking, determine the required minimum coefficients of friction at A and C.

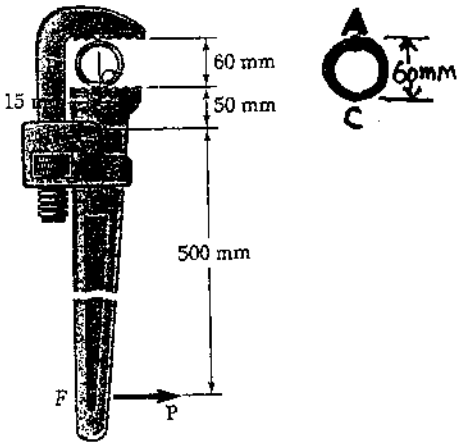
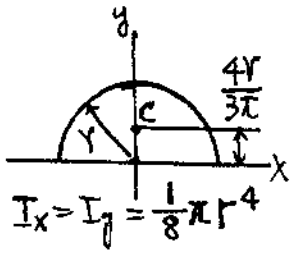


Fig. 2.

(背面仍有題目,請繼續作答)

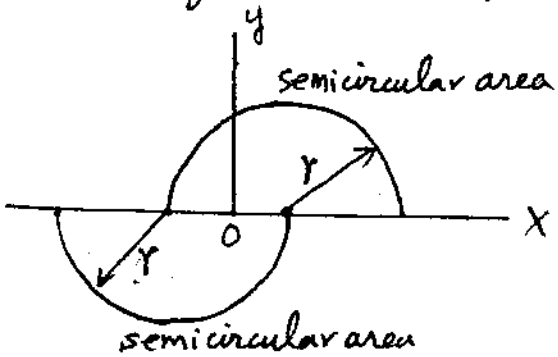
3. For the area as shown in Fig. 3, using the Mohr's circle to determine the orientation of the principal axes at the origin and the corresponding principal values of the moments of inertia. (25 pt)

Note: For semicircular area

① 

$I_x = I_y = \frac{1}{8}\pi r^4$

② Express your results in terms of r.



4. The bracket ABC can be supported in the following different ways as shown in Fig. 4. All connections consist of smooth pins, rollers, or short links. For each case, determine whether (25 pt)

(a) the bracket is completely, partially, or improperly constrained,

(b) the reactions are statically determinate or indeterminate,

(c) the equilibrium of the bracket is maintained in the position shown.

Also, wherever possible, compute the reactions in terms of P.

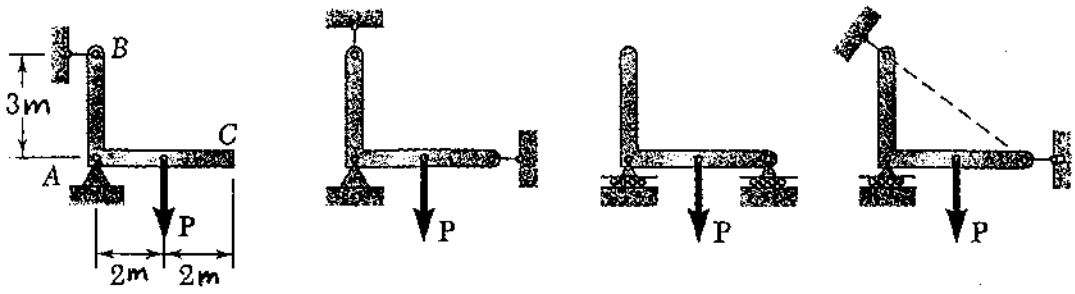


Fig. 4 (1) (2) (3) (4)