

3. The crank  $AB$  is made to rotate with a constant angular velocity of  $Q$  rpm clockwise with no force applied to the face of the piston.
- Determine the velocity of the position  $P$ . (10%)
  - Determine the angular velocity and acceleration of the connecting rod  $BD$ . (10%)
  - If the piston mass is  $m$ , determine the forces exerted on the connecting rod at  $B$  and  $D$ . (Neglect the effect of the weight of the rod). (10%)

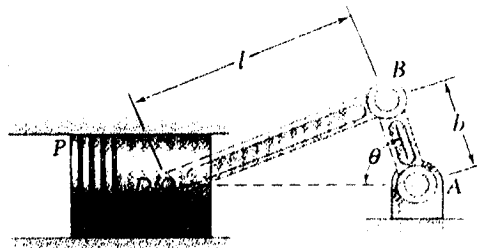


Fig. 3

4. A homogeneous hemisphere of mass  $m$  is released from rest in the position as shown in Fig. 4.
- If it rolls on the horizontal surface, what is its angular velocity when its flat surface is horizontal? (15%)
  - What normal force is exerted on the hemisphere by the horizontal surface at the instant its flat surface is horizontal? (15%)

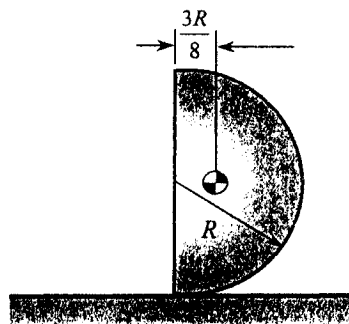


Fig. 4