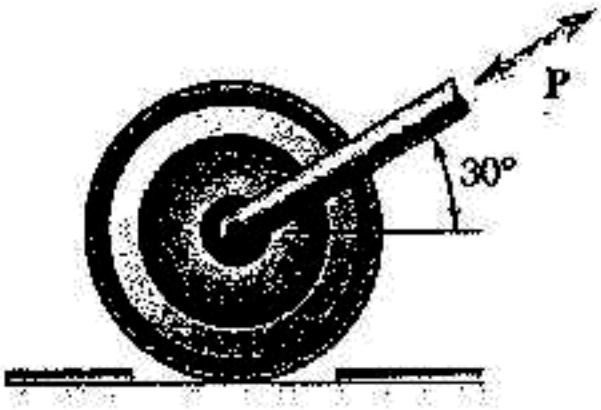
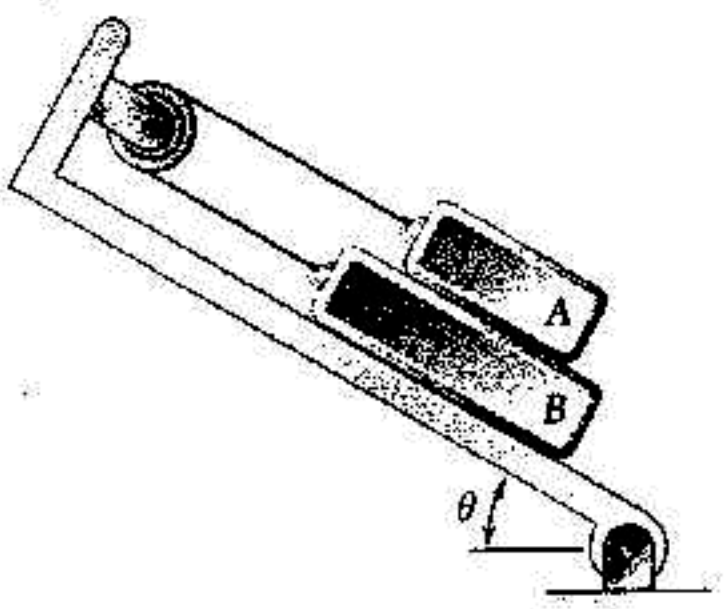
1. Explain the following terminology in detail:(20%)
   (a) Free-body diagram
   (b) Statically indeterminate structure
   (c) Rigid body
   (d) Equation of compatibility
   (e) Section modulus of a beam

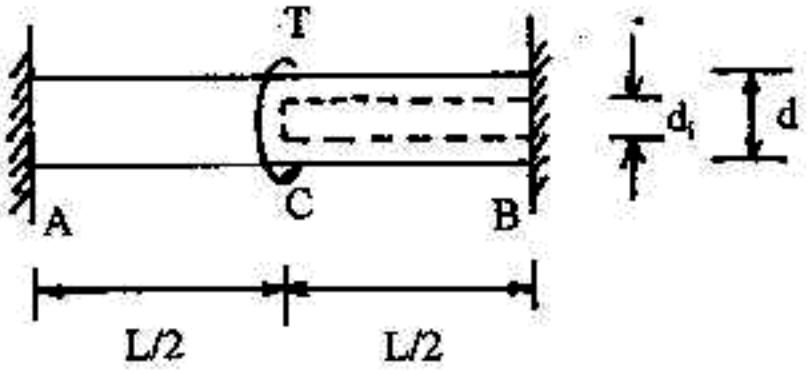
2. A 40-N roller, of diameter 200mm, which is to be used on a tile floor, is resting directly on the subflooring as shown. Knowing that the thickness of each tile is 13.4 mm, determine the force P required to move the roller onto the tiles if the roller is (a) pushed to the left, (b) pulled to the right. (20%) ($\cos 30^0 = 0.886$)



3. The 20-N block A and the 30-N block B are supported by an inclined which is held in the position shown. Knowing that the coefficient of static friction is 0.15 between the two blocks and zero between block B and the incline, determine the value of θ for which motion is impending.(20%)



4. A circular bar AB with fixed ends has a hold extending for half its length. The diameter of the hold $d_i = d/\sqrt{2}$, where d is the outer diameter of the bar. A torque T is applied at the midpoint C of the bar, determine (a) the maximum shear stress in the bar, (b) the angle of twisting at section C. Denote G the shear modulus of bar material.(20%)



5. A cantilever beam AB of length L has a fixed support at A and a spring support at B. If a uniform load of intensity q acts on the beam, determine (a) the displacement δ_B of end B, (b) the maximum displacement of the beam. Denote k the stiffness of spring and EI the flexural rigidity of the beam.(20%)