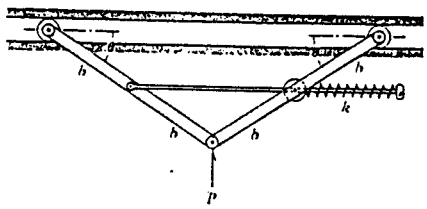
M.S. Entrance Examination

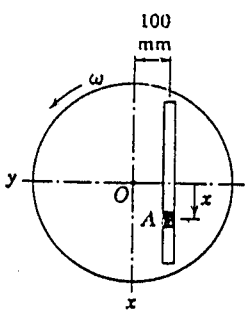
(1) (25%) Answer the following questions carefully:

(a) explain "statically indeterminate";
(b) draw the shear and moment diagrams for the cantilever beam (with a length of L) subjected to a static loading P applied on the tip of the beam (please also explain how you get these diagrams)
(c) explain "virtual work";
(d) explain "principal of virtual work";
(e) explain "stability";

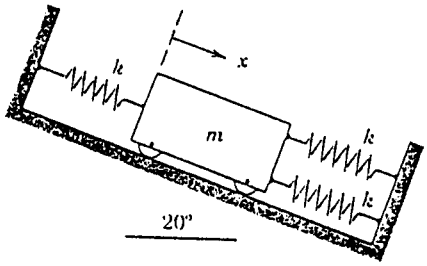
(2) (15%) Determine the angle θ for equilibrium of the spring-loaded linkage in the vertical plane in terms of the applied force P. Each of the uniform links has a mass m, and the force in the spring of stiffness k is zero when $\theta = 90°$.



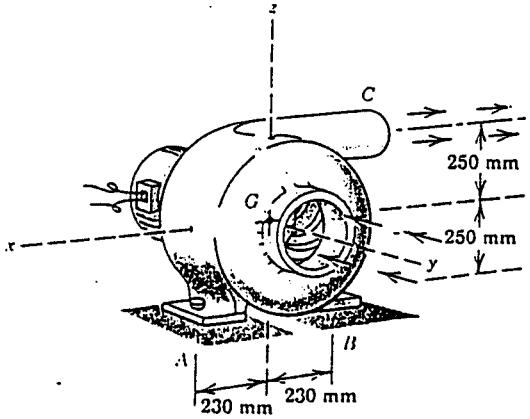
(3) (10%) The slider A moves in the slot at the same time that the disk rotates about its center O with an angular speed ω positive in the counterclockwise sense. Determine the x-and y-components of the absolute acceleration of A if, at the instant represented, $\omega = 5$ rad/s, $\dot{\omega} = -10$ rad/s^2, $x = 100$ mm, $\dot{x}$=150 mm/s, and $\ddot{x}$=500 mm/s^2.



(4) (15%) The three springs of equal moduli are unstretched when the cart is released from rest in the position $x = 0$. If $k = 120$ N/m and $m = 10$ kg, determine (a) the speed v of the cart when $x = 50$ mm, (b) the maximum displacement x_{max} of the cart, and (c) the steady-state displacement x_{ss} that would exist after all oscillations cease.



(5) (17%) The blower is run by an attached electric motor that turns the impeller at 3450 rev/min and blows air from the 150-mm-diameter outlet at C at the rate of 24 m^3/min. Air enters the unit in the negative y-direction with a density of 1.206 kg/m^3. The entire unit has a mass of 30 kg, with center of mass at G directly above the midpoint between the hold-down bolts A and B. Calculate the net vertical force exerted on the blower supports at A and B.



(6) (18%) A metal hoop with a radius $r = 150$ mm is released from rest on the 20° incline. If the coefficients of static and kinetic friction are μ_s=0.15 and μ_k=0.12, determine the angular acceleration α of the hoop and the time t for the hoop to move a distance of 3 m down the incline.