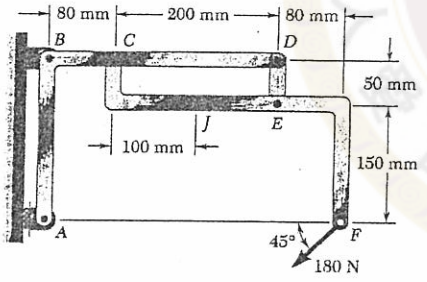
A. Define and describe the following terms: (4 points each, 20 points total)

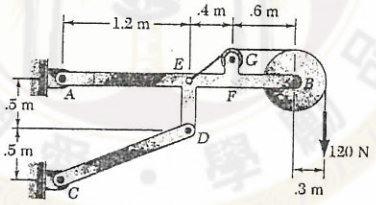
1. Equilibrium
2. Free-body diagram
3. Polar moment of inertia
4. Conservative force
5. Kinematics of rigid bodies

B. Calculation problems (refer to the figures on bottom for the corresponding problems)

6. For the frame and loading shown, determine the components of all forces acting on member ABCD. (15 points)
7. Neglecting the size of the pulley at G, (a) draw the shear and bending-moment diagrams for the beam AB, (b) determine the maximum absolute values of the shear and bending moment. (15 points)
8. A car of mass m is traveling at a slow velocity v_0. If it is subjected to the drag resistance of the wind, which is proportional to its velocity, i.e., $FD = kv$. Determine the distance and the time the car will travel before its velocity becomes $0.5\ v_0$. Assume no other frictional forces act on the car. (15 points)
9. A small particle having a mass m is placed inside the semicircular tube. The particle is placed at the position shown and released. Apply the principle of angular momentum about point O ($\Sigma M_O = \dot{H}_O$), and show that the motion of the particle is governed by the differential equation $\ddot{\theta} + (g/R)\sin\theta = 0$. (15 points)
10. Rod AB rotates counterclockwise with a constant angular velocity $\omega = 3$ rad/s. Determine the velocity and acceleration of point C located on the double collar when $\theta = 45°$. The collar consists of two pin-connected slider blocks which are constrained to move along the circular path and the rod AB. (20 points)



Problem 6



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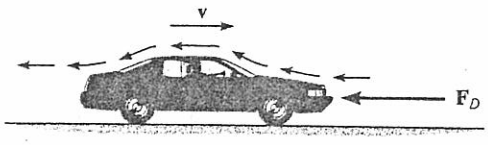
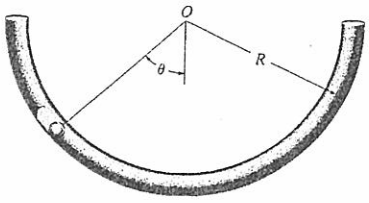
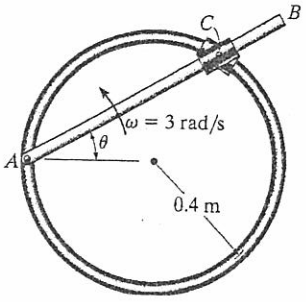


Problem 8



Problem 9



Problem 10