I. Answer the following questions:

1. What is the plane of motion for a rigid body in a plane motion? Meanwhile, try to determine the associate instantaneous center for the above plane motion, and then illustrate what are the corresponding body and space centrodes and the relation between them? (10%)

2. Continuing on the Question 1, taking a rolling wheel without slipping on a plane in x-direction as an example, can you try to do all things as requested above ?(10%).

3. For a two particles collision in x-y plane, what is the coefficient of restitution involved? Why does it need for impact analysis? (8%)

4. Regards to the kinetics of particles, some approaches involve for the analysis. Which is it most appropriate for two-particle collision? Please to tell me why? (8%)

5. When the x-y plane of a rectangular Cartesian frame system is rotating about z axis with angular speed ω in a plane curve. Try to determine the time derivatives of two unit vectors in x- and y-axes (7%).

6. when a rigid body is being in general plane motion, try to prove its kinetic energy can be expressed as the sum of two separate parts as:

$$T = \frac{1}{2}m\bar{v}^2 + \frac{1}{2}I_G\omega^2$$ Where m is the total mass, $\bar{v}$ is the velocity of the center of mass, I_G is the mass moment of inertia of rigid body about its center of mass and ω is its associated angular speed (7%)

II. as shown in the figure, the 6-lb slider is released from rest at position 1 and slides with negligible friction in a vertical plane along the circular rod. The attached spring has a stiffness of 2lb/in. and has an un-stretched length of 24 in. (13%).
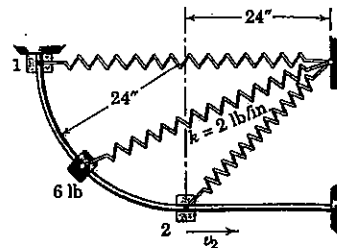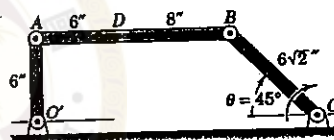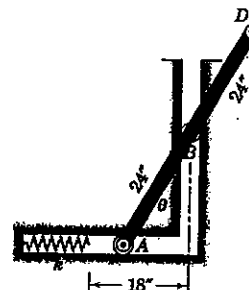

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III. For a steady mass flow as shown in the figure, try to write out all possible equations involved for the dynamical analysis (12%).
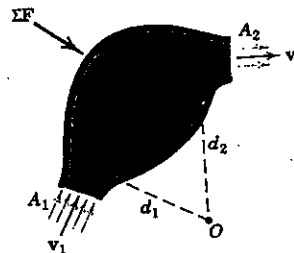
IV. A shown in the figure, arm OB of the linkage has a clockwise angular velocity of 10 rad / sec in the position shown where $\theta = 45°$. Determine the velocity of A, the velocity of D, and the angular velocity of link AB for the position shown (12%).

V. as shown in the figure, the 4-ft slender bar weighs 40lb with mass center at B and is released from rest in the position for which θ is essentially zero. Point B is confined to move in the smooth vertical guide, while end A moves in the smooth horizontal guide and compressed the spring as the bar falls. Determine (a) the angular velocity of the bar as the position $\theta = 30°$ is passed and (b) the velocity with which B strikes the horizontal surface if the stiffness of the spring is 30lb/in. (13%).

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