1. The smooth 0.5-kg double-collar in figure can freely slide on arm AB and the circular guide rod. If the arm rotates with a constant angular velocity of $\omega = 3 \text{ rad/s}$, determine the force the arm exerts on the collar at the instant $\Theta = 45^\circ$. Motion is in the horizontal plane.

2. A 60-kg satellite travels in free flight along an elliptical orbit such that at A, where $r_A = 20 \text{ Mm}$, it has a speed $V_A = 40 \text{ Mm/h}$. What is the speed of the satellite when it reaches point B, where $r_B = 80 \text{ Mm}$? $M_e = 5.976(10^{24}) \text{ kg}$ and $G = 66.73(10^{-12}) \text{ m}^3/(\text{kg} \cdot \text{s}^2)$.

3. At the instant $r = 1.5 \text{ m}$, the 5-kg disk is given a speed of $v = 5 \text{ m/s}$, perpendicular to the elastic cord. Determine the speed of the disk and the rate of shortening of the elastic cord at the instant $r = 1.2 \text{ m}$. The disk slides on the smooth horizontal plane. Neglect its size. The cord has an unstretched length of 0.5 m.

4. Crank AB rotates with a constant angular velocity of 5 rad/s. Determine the velocity of block C and the angular velocity of link BC at the instant $\theta = 30^\circ$. 
5. Block D shown in figure moves with a speed of 3 m/s. Determine the angular velocities of links BD and AB, at the instant shown.

6. The 5 kg slender rod shown in figure is pinned at O and is initially at rest. If a 4-g bullet is fired into the rod with a velocity of 400 m/s, as shown in the figure, determine the angular velocity of the rod just after the bullet becomes embedded in it.

7. The block has a mass of 50 kg and rests on the surface of the cart having a mass of 70 kg. If the spring is initially compressed 0.2 m, determine the speed of the block with respect to the cart after the spring becomes undeformed. Neglect the mass of the cart’s wheels and the spring in calculations. Also neglect the friction. Take k=300 N/m

8. The 5 kg block of negligible size rests on the smooth horizontal plane. It is attached at A to slender rod of negligible mass. The rod is attached to a ball-and-socket joint at B. If a moment M=(3t) Nm, where t is in seconds, is applied to the rod and a horizontal force P=10 N is applied to the block, determine the speed of the block in 4 s starting from rest.